DETERMINANTS OF INVESTMENT PATTERN IN INDIAN MANUFACTURING INDUSTRIES
A PANEL DATA STUDY

MANJAPPA. D. HOSAMANE AND NIRANJAN, R.
University of Mysore

Abstract
Understanding of the behaviour of investment provides an important insight into the process of economic development. The economic growth critically depends on capital accumulation and it stems from investment. The economy’s productive capacity can be expanded by investment as a dynamic variable, on long life capital goods which embody technical advance. This paper using the neoclassical theory of investment, explores the investment determinants, using fifteen years (1991-2005) panel data set comprising of ten manufacturing industries at an aggregate level. The study makes use of panel estimation models along with the recently developed IPS panel unit root test [Im, Pesaran and Shin, 2003]. The results of the random effects model indicates that output, change in output (with one year lag) and profits, along with capital stock, change in capital stock (with one year lag) and cost of capital are important variables in determining investment behaviour of Indian manufacturing sector.

Keywords: Private Investment, Financing Constraints, Manufacturing

JEL Classification: C22; D21; O14

INTRODUCTION
Industrial sector in India has been undergoing significant changes both in its structure and pattern owing to the policy changes. Since the early 1950s up until the early 1980s the evolution of manufacturing sector was guided by protected industrial and trade policies, which restricted the growth of the economy in general and manufacturing sector, in particular. Under old industrial and trade policy regime, manufacturing sector was characterized by extensive public sector participation, regulation of the private sector firms, restrictions on foreign investment, high tariff and non-tariff restrictions on imports, which held up the growth of the manufacturing sector in India. This has been replaced by a more liberal industrial and trade policy regime, through the inception of new economic policy in 1991. The major focus of these policies had been to dismantle the complex web of controls that severely constrained the emergence and operation of the private entrepreneurs. Investment performance has been a key emphasis in the policy debate following the reforms (Athukorala and Sen 1998). It is observed that new
policies have made tremendous effects on the industrial sector, in terms of conducive business environment and future growth process of industries.

Understanding of the behaviour of investment provides an important insight into the process of economic development. The economic growth critically depends on capital accumulation and it stems from investment. The economy’s productive capacity can be expanded by investment spending as a dynamic variable, on long life capital goods which embody technical advance. However, recent theoretical and empirical studies on the determinants of investment focused on the role of government policy and tried to derive an explicit relationship between the principal policy instruments and private investment (Blejer and Khan 1984, Greene and villaneuva 1991). More importantly, as evidenced in many research works, it is the private investment that plays a greater role than public investment in determining economic growth in developing countries.

Investment refers to increase in the total assets of a corporation, where new investment consists of addition to its assets, which enables it to produce more output. The growth in industrial output is primarily associated with new investment in plant and machinery. If firms are confident that demand will remain buoyant, they invest more in new plant and machinery which generate even more demand. The escalating domestic demand and growing export orientation has brought an upsurge in the Indian manufacturing sector. Phenomenal growth is registered in automobile sector, iron and steel, machinery and equipment, including transport and basic chemicals sector in recent years. Emphasizing the role of private investment in determining economic growth in a developing economy, a short run analysis of investment determinants becomes crucial for understanding year to year changes in industrial performance.

In this paper, we made an attempt to assess the determinants of investment patterns of Indian Manufacturing sector over the years, at an aggregate level of major industry groups. The aim of this paper is to examine the role of accelerators and financial variables affecting on investment. The broad objective is to investigate, the significance of internal funds as a source of finance and the role of external funding (debt and equity) for industries in determining investment, which are usually channeled towards growing and profitable industries.

It is observed that an extensive volume of research works have emerged, both at the theoretical and empirical levels, to counter the above issues. Theoretically, in modeling the determinants of investment behaviour of a firm, five broad approaches are considered; which include the simple accelerator model, the liquidity theory, the expected profits theory and the neo classical theory of investment. One of the first theories of investment and the base for other approaches was the simple accelerator model, (Clarke, 1917) which maintains expected future sales as the main determinant of investment. This acceleration concept hypothesized a direct functional relationship between a rate of change in a flow and additions to a stock, (Meyer. J and Edwin Kuh, 1955). Specifically, additions to the stock of physical capital were considered, as a simple function of the rate of change in output. This model was soon transformed into the flexible accelerator model of investment behaviour (Chenery, 1952 and Koyock, 1954), which states that, the adjustment of capital stock to the desired level is not instantaneous because of delivery lags and delayed responses to changes in the level of demand. They
incorporated financial variables along with future sales as the determinant for investment decisions, where they assumed the level of desired capital to be proportional to output. There are other theories, which are propounded as alternatives to the rigid accelerator theory i.e. Liquidity theory and Expected Profits theory. In the liquidity theory of investment behaviour, desired capital is proportional to liquidity (Jorgenson and Calvin D. Siebert 1968), whereas in expected profits theory desired capital is proportional to profit. The Profits theory holds that the amount of investment spending depends on the amount of profits that firms and industries are making i.e. profit expectations determine investment behaviour. As, against the above investment theories, the neo classical investment path, based on firm profit optimization, has been most dominant in applied research (Robert. S. Chirinko 1993). There are two major variants of this approach; one is the user cost of capital model, pioneered by Dale Jorgenson (1963), which postulates that output levels and user cost of capital are the two key determinants of investment. The theory of a profit maximizing firm, subject to a production function through which a technical relationship between inputs and outputs get defined is central in the neo classical model. The model assumes flexible accelerator prices and capital markets. The other variant of the optimizing approach is the $q^2$ theory pioneered by Tobin (1969), which incorporates Keynes’s analysis of share (stock) price instability into fixed investment volatility. According to Tobin, firm investment opportunities are summarized by the market value of its capital stock. In particular, firm investment expenditure is positively related to average $q$ (also known as Tobin’s $q$) defined as the ratio of the market value of the firm to the replacement cost value of its assets. The use of $q$ is based on the idea that investment opportunities can be captured by equity market.

On the other hand, a vast literature suggests that in addition to real sales growth and the user cost of capital, financial factors are also imperative in explaining short-run fluctuations in investment. However, firms first utilize internal funds for investment purposes so as to maintain their control. But, the external finance is also sought for financing their investment plans if the desired rate of growth is higher than that permitted by the internal finance. According to financing hierarchy hypothesis, i.e. Myers (1984) “pecking order” theory of financing, the firm’s capital structure will be driven by the desire to finance new investments, first internally, then with low-risk debt, and finally with equity only as a last resort. In contrast, transaction costs / or information asymmetries induce a cost premium that makes external finance an imperfect substitute for internal finance. Therefore, in a world of heterogeneous firms, financing constraints would clearly influence the investment decisions of firms. In particular, investment may depend on financial factors, such as availability of internal finance, access to new debt or equity finance, or the functioning of particular credit markets.

In the following empirical works where we found the contradictory views regarding investment determinants. The studies, like Dhrymes, P. J., and M. Kurz (1967), Sachs, Reynolds and Albert. G. Hart (1968), investigated the determinants of fixed investment in a broader way, where they determined the structure underlying the dividend – investment – external finance triad of decision making process and found external finance activity of firms to be strongly affected by their investment policies. They indicated the considerable relevance of accelerator and profit theories in explaining the empirical
behaviour of investment. Krishnamurthy. K and Sastry (1971, 1975), Bhattacharya.S (2008), also argued along similar lines, found the positive effects of accelerator, retained earnings and flow of external finance in determining investment behaviour of Indian manufacturing sector. These studies claim a significant support for the investment – accelerator relationship. Similarly, Bilsborrow E. Richard (1977) analyzed the determinants of investment of manufacturing firms with different institution and cultural context of a developing country study of aggregate Colombian firms, where along with the accelerator and financial variables he appraised the importance of foreign exchange as a significant influence on annual variation in investment. Recent empirical works⁵, revealed the dependence of investment on financial factors. Hubbard. G, (1998) emphasized on the contemporary models of capital market imperfection and the implications of these models in firm’s investment process. The study considers the applications of these models to a range of investment activities including research on inventory investment, research and development, employment, business formation, survival, pricing and corporate risk management. However, identifying a specific channel (debt covenants) and the corresponding mechanism (transfer of control rights) through which financing frictions impact corporate investment, Chava. S and Michael. R. Roberts, (2008), show that capital investment declines sharply following a financial covenant violation, when creditors use the threat of accelerating the loan to intervene in management.

Further, the reduction in investment is concentrated in situations in which agency and information problems are relatively more sever, highlighting how the state-contingent allocation of control rights can help mitigate investment distortions arising from financing frictions. On the other hand, Cava La, Gianni (2005), Bond. S and Costas Meghir (1994), explored the impact of financial factors on corporate investment, and indicated the severity of financing constraints of firms. The study on innovation is that they distinguish financially distressed firms from financially constrained firms. The presence of financially distressed firms appears to bias downwards the sensitivity of investment to cash flow. The paper also explores the effects of cash flow on investment, where the availability of internal funding could significantly affect the investment of financially constrained firms. Real sales and the user cost of capital, which incorporates both debt and equity financing costs, also appears to be an important determinant. Their views have been contradicted to some other studies which argue for the government intervention in the allocation of investment finance⁶. Emphasizing on the implications of the recent structural adjustment policy reforms of 1990s, for investment behavior Athukorala and Sen (1996) examined the determinants of private corporate investment in India. The results of their econometric analysis suggest that the net impact of the reforms on corporate investment has been salutary. The decline in real public sector investment brought about by the fiscal squeeze carried out as part of the reforms seems to have had a significant adverse impact on corporate investment. However, this adverse impact was outweighed by the salutary effects of the reform process on investment operating through the decline in real rental cost of capital and favourable changes in investor perception in the aftermaths of the reforms. Finally, they indicated the strong complimentary relationship of public investment with private corporate investment in India.
The previous empirical studies focused on investment determinants, on the manufacturing sector as a whole for the pre and post reform period, with the variables such as level of output, expected future earnings, cost of capital, profits, and bank credit. However, we feel that equity finance, lag of capital stock and lag of accelerator variables are important explanatory variables in determining investment patterns in Indian manufacturing sector. Thus an attempt has made to assess the determinants of investment in select manufacturing sectors of India at an aggregate level by including these variables in this study.

**METHODOLOGY AND DATA MEASUREMENT**

In order to encompass sound theoretical underpinnings on the determinants of investment, we make use of neo classical model for empirical specification. The neo classical model pioneered by Jorgenson, (1963, 1967) postulated that output levels and user cost of capital are the two key determinants of investment. The demand for capital is assumed to positively related to expected output (Y) and inversely related to the expected rental cost of capital (C).

Assuming a conventional neoclassical model where a profit maximizing firm is subject to constant returns to scale and a constant elasticity of substitution production function, the functional optimal capital stock ($K^*$) can be expressed as:

$$K^*_t = \alpha Y_t C_t^{-\delta}$$  \hspace{1cm} (1)

Where, $K^*_t$ is the desired capital stock, $Y_t$ is the expected level of output in period $t$, $C_t$ is expected cost of capital, in period $t$.

If expectations are static, so that future changes in output are unanticipated, net investment can be represented as a distributed lag on past changes in desired capital stock.

$$I^*_t = \alpha \beta_j \sum_{j=0}^{N} \Delta K^*_{t-j}$$  \hspace{1cm} (2)

Assuming, that capital depreciates at a constant rate, the replacement investment ($I_r^*$) is given as:

$$I^*_r = \delta K^*_{t-1}$$  \hspace{1cm} (3)

By combining both net and replacement investment and adding a stochastic error term ($u_t$) we obtain the neo-classical investment model as:

$$I_t = \delta K^*_{t-1} + \sum_{j=0}^{N} \alpha \beta_j \Delta(Y^*_{t-j} C^*_{t-j}) + u_t$$  \hspace{1cm} (4)

For empirically estimating investment function we approximate $K^*$ linearly on the assumption that expectations of the output and rental cost terms are based on extrapolations of past values. Thus with inclusion of additional variables such as borrowings ($BR_{it}$), equity ($EQ_{it}$) and operating profit ($OP_{it}$), the model can be written as:

$$I_{it} = C + \alpha K_{it} + \delta K^*_{it} + \Sigma \Phi_{ij} Y_{it} + \Sigma \Phi_{ij} \Delta Y_{it-j} - \Sigma \Phi_{ij} C_{it} + \Phi_4 OP_{it} + \Phi_5 BR_{it} + \Phi_6 EQ_{it} + u_{it}$$  \hspace{1cm} (5)
Where the distributed lag co-efficients are an amalgam of the delivery lag, expectations and production parameters.

Since, we have Panel data for our analysis, the study make use of the panel estimation models, where the fixed effects model as well as the random effects model, employed to identify the determinants of investment of manufacturing sector in India. The fixed effects model takes into account the firm specific effects where as the random effects model considers the time effect.

The fixed effects model is expressed as:

$$ I_{it} = \alpha_i + \beta X_{it} + u_{it} \quad i = 1 \ldots N; \quad t = 1 \ldots T $$

where, $I_{it}$ is investment variable of $i^{th}$ industry in $t^{th}$ period, $X_{it}$ is vector of k explanatory variables of $i^{th}$ industry in $t^{th}$ period, $\beta$ is parameters to be estimated and $u_{it}$ is error term and assumed $\sim N(0, \sigma^2)$. $\alpha_i, 1\ldots N$ are constant coefficients, specific to each industry. Fixed effect model assumes that differences across the considered industries appear by means of differences in the intercept term. These individual coefficients are estimated together with vector of parameters $\beta$.

The random effects model is defined as:

$$ I_{it} = \alpha_i + \beta X_{it} + u_{it} \quad i = 1 \ldots N; \quad t = 1\ldots T $$

In the random effects model, the $\alpha_i$ are treated as random variables rather than fixed constants. The $\alpha_i$ are assumed to be independent of the errors $u_{it}$, i.e., $\alpha_i \sim N(0, \sigma^2_{\alpha})$ and $u_{it} \sim N(0, \sigma^2_{u})$. The $I_{it}, \beta, X_{it}$ are defined as prior. Since $\alpha_i$ are random, the errors now are $w_{it} = \alpha_i + u_{it}$. The presence of $\alpha_i$ produces a correlation among the errors of the same cross section unit, though the errors from the different cross-section units are independent. In random-effects (error component) models when the variances of the individual-specific effect and error term are unknown, generalized least squares method (GLS) is the standard way for estimation of parameters (Baltagi, 2005). Finally, to select an appropriate model from fixed effects and random effects model, the study employed Hausman test. The null hypothesis indicates that the individual effects are uncorrelated with the regressors. This shows that the estimations of the fixed effects panel model are not statistically different from the estimate of the panel model with random effects. The null hypothesis is not rejected, so it is sensible to conclude that the individual effects are not correlated with exploratory variables in the model.

**DATA MEASUREMENT**

The data for our investment analysis is drawn from the Industry Financial Aggregates and Ratios information compiled by the Centre for Monitoring Indian Economy (CMIE). A balanced panel is used for this exercise for the period 1991-92 to 2005-06. Investment ($I_t$), sales ($Y_t$), sales lag ($Y_{t-1}$), borrowing ($BR_t$), operating profit ($OP_t$), equity capital ($EQ_t$), net asset ($K_t$), net asset lag ($K_{t-1}$) and user cost of capital ($C_t$) are used as exogenous variables selected for the analysis, where the controlled variable is the fixed investment of the industries. We are examining the investment patterns of ten industries covering, Food & Beverages, Textiles, Chemicals, Drugs and Pharmaceuticals, Gems & Jewellery, Metals & Metal products, Machinery, Electronics, Automobile and Leather products are ten aggregate industries selected for the study. These ten manufacturing industries
are selected based on their share in the total output of the manufacturing sector, annual growth rate in the investment level and as well as considering each industry export intensity level.

On the other hand the variable user cost of capital (Hebbel and Muller, 1992), is equal to $C_t = PK (r (1-t) + \delta - \pi) / P$. Where, $PK =$ price of capital goods, $r =$ bank lending rate, $t =$ corporate tax, $\delta =$ depreciation rate, $\pi =$ expected rate of change in capital goods price (inflation), and $P =$ the general price level.

EMPIRICAL RESULTS & DISCUSSION

Panel Unit Root Test

Since, we make use of panel time series data; the unit root test has applied to ascertain the stationarity of the data series. A variety of procedures for the analysis of unit roots in a panel context have been developed. Here we make use of IPS test developed by Im, Pesaran and Shin (2003). IPS, using the likelihood framework, suggested a new more flexible and computationally simple unit root testing procedure for panels (which is referred as t-bar statistic), that allows for simultaneous stationary and non-stationary series (Barbieri, Laura 2006).

In this test the null hypothesis is that of a unit root. The IPS is based on averaging individual Dickey-Fuller unit root tests computed for each cross-section unit in the panel when the error term $u_t$ of the model is serially correlated, possibly with different serial correlation patterns across cross-sectional units when $T$ and $N$ are sufficiently large. The IPS test results presented in table: 1 shows that all variables are non stationary, and they are only stationary at first difference, hence we have taken first difference of all the variables for estimation.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Level</th>
<th>First difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Statistic</td>
<td>Probability</td>
</tr>
<tr>
<td>$I_t$</td>
<td>4.29307</td>
<td>1.0000</td>
</tr>
<tr>
<td>$Y_t$</td>
<td>5.35571</td>
<td>1.0000</td>
</tr>
<tr>
<td>$BR_t$</td>
<td>2.24306</td>
<td>0.9876</td>
</tr>
<tr>
<td>$OP_t$</td>
<td>5.43106</td>
<td>1.0000</td>
</tr>
<tr>
<td>$EQ_t$</td>
<td>-4.92354</td>
<td>0.4000</td>
</tr>
<tr>
<td>$C_t$</td>
<td>-3.78265</td>
<td>0.7401</td>
</tr>
<tr>
<td>$K_t$</td>
<td>3.26892</td>
<td>0.9995</td>
</tr>
<tr>
<td>$K_{t-1}$</td>
<td>2.22536</td>
<td>0.9870</td>
</tr>
<tr>
<td>$Y_{t-1 lag}$</td>
<td>6.65954</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

* Significant at 1 %, **Significant at 5 % and *** Significant at 10 %.
Null Hypothesis: Unit root (individual unit root process)

On the result of the above unit root test we have estimated the parameters by using panel models both types of models, Random effect model and fixed effects model.
select the appropriate model we employed Hausman test, where in order to distinguish between the two models the Hausman statistic is used to test the null hypothesis that the regressors and individual effects are not correlated. Failure to reject the null hypothesis implies that the random effects model will be preferred. If the null hypothesis is rejected, the fixed effects model will be appropriate. The Hausman test statistic 9.87 ($p$ value 0.2740) shows that the null hypothesis is not rejected, which indicates that industry specific effects are uncorrelated with the regressors. This suggests that the random effects model is appropriate, and the fixed effects estimates are not consistent. Since the random effects model is the appropriate one, interpretation of the results will focus on the random effects model only.

Table 2

Estimation Results of Panel Models

<table>
<thead>
<tr>
<th>Variable</th>
<th>Random Effects (GLS) Regression</th>
<th></th>
<th>Fixed Effects (within) Regression</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>$P$ value</td>
<td>Coefficient</td>
<td>$P$ value</td>
</tr>
<tr>
<td>Constant</td>
<td>818.2231</td>
<td>0.041**</td>
<td>-558.0341</td>
<td>0.565</td>
</tr>
<tr>
<td>($399.64$)</td>
<td>($967.88$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$Y_{it}$</td>
<td>-0.0535317</td>
<td>0.014**</td>
<td>-0.0587172</td>
<td>0.008*</td>
</tr>
<tr>
<td>($0.02186$)</td>
<td>($0.02163$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$Y_{t-1}$</td>
<td>0.1286147</td>
<td>0.000*</td>
<td>0.145752</td>
<td>0.000*</td>
</tr>
<tr>
<td>($0.02628$)</td>
<td>($0.02744$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$BR_{t}$</td>
<td>-0.0150731</td>
<td>0.688</td>
<td>-0.1357231</td>
<td>0.026**</td>
</tr>
<tr>
<td>($0.03757$)</td>
<td>($0.06042$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$OP_{t}$</td>
<td>0.2537212</td>
<td>0.000*</td>
<td>0.1931821</td>
<td>0.002*</td>
</tr>
<tr>
<td>($0.05947$)</td>
<td>($0.06098$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$EQ_{t}$</td>
<td>-0.0188381</td>
<td>0.839</td>
<td>0.2842271</td>
<td>0.119</td>
</tr>
<tr>
<td>($0.09250$)</td>
<td>($0.18090$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$K_{t}$</td>
<td>-0.0975896</td>
<td>0.042**</td>
<td>-0.0142789</td>
<td>0.804</td>
</tr>
<tr>
<td>($0.04810$)</td>
<td>($0.05747$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$K_{t-1}$</td>
<td>0.0809913</td>
<td>0.049**</td>
<td>0.0325715</td>
<td>0.421</td>
</tr>
<tr>
<td>($0.0411$)</td>
<td>($0.04038$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$C_{t}$</td>
<td>-0.3246374</td>
<td>0.026**</td>
<td>0.2374582</td>
<td>0.096***</td>
</tr>
<tr>
<td>($0.14562$)</td>
<td>($0.14168$)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hausman test ($p$ value) 9.87 (0.2740)

Wald chi$^{2}$ 2079.16 —

F-test — 3.40**

$R^2$ within 0.8917 0.8992

$R^2$-between 0.9859 0.9260

$R^2$-overall 0.9412 0.9134

* Significant at 1%, **Significant at 5% and *** Significant at 10%.

Standard errors are in parenthesis.
Table 2 presents the results from the panel of 10 manufacturing industries, where we estimated the relationship between investment and its determinants over the period 1990-2005. We have reported both the random effects and fixed effects model results side by side; as mentioned earlier, random effects model is considered for analysis. For convenience of estimation, we consider a one-year lag period for changes in the level of output and for capital stock. We have seen that all the regressors except borrowing and equity capital are significant at various levels. An interesting result that emerges from this study is that sales affect net investment only with a lag. These are consistent with theoretical expectation. The coefficient of the lagged accelerator is greater than the coefficient of the current accelerator.

This implies that the effect of the lagged accelerator on investment is stronger than that of the current accelerator. Results indicate that the standard accelerator mechanism is vital in explaining investment behaviour. On the other hand lagged net assets of the industries is positive and significant variable in determining investment of the industries. The coefficient of current net asset is negative, implying inverse relationship between current net asset and investment. Consistent with empirical works (Bhattacharyya, Surjit 2008) the results reveal that operating profit as one of the major determinants of investment, thereby indicating imperfection in the Indian capital market. Operating profit is significant at 1% level (i.e. highly significant). The coefficient of operating profit is positive and statistically significant in both models. On the other hand we also explore firms’ accessibility to external capital and its relation to investment activities. The results shows that external sources (both borrowings from bank and also from stock market i.e. equity capital) are not statistically significant; they are not determining investment in a larger way. This finding supports, (Nayak, K. T. and Praveen K. 2007), where borrowings is found to be statistically insignificant variable, signifying that its impact on investment is not considerable. Simultaneously the results show that cost of capital had a positive and statistically significant impact on investment.

CONCLUSION
The paper examines patterns and determinants of investment behaviour in Indian manufacturing sector. In Indian context most of the empirical literature, by using time series data, focused on manufacturing sector as a whole and there are just a few cross industry studies that with a small sample of industries. Further, attempting to partially fill this gap, we examined the determinants of investment using a panel of ten manufacturing industries over a 15 year period. The functional form of the private investment is based on the neoclassical investment theory, in which output growth, cost of capital, availability of capital funds and profits, etc are incorporated. For empirically estimating investment function we employed panel estimation models and based on Hausman test statistic we used random effects model for estimation. On the other hand, we make use of a relatively new method, namely Im, Pesaran and Shin (IPS 2003) test to address the issue of unit root faced in panel time series. The results of our study show that the responsiveness of investment is more with output and profit than the other variables. Both accelerator hypothesis as well as profit theory has been found to be important in explaining investment. Numerous studies have established a positive relationship of investment with accelerator and profit theories, although in all
cases the results were not robust. However, contradicting with earlier works an interesting result that emerges from this study is that sales and net assets affecting investment with a lag. The fact that accelerator and profit theory functioned well as an explanation of investment for Indian industries lends additional support to it being considered a crucial determinant of long-run investment. On the other hand, factors such as bank borrowings and equity capital have not been found to play a significant role in determining investment. Thus it may be concluded from the above findings that even after more than a decade of reforms, financial constraints have an adverse impact on investment. The user cost of capital, also appears to be an important determinant. Neoclassical investment theory postulates that private investment is strongly related to the cost of capital; consistent with the theory this study has indicated a strong and significant link between the two variables. Thus we conclude that output, change in output (with one year lag) and profits, along with capital stock, change in capital stock (with one year lag) and cost of capital are important variables in determining investment behaviour of Indian manufacturing sector.

**Acknowledgement**

Authors like to thank Dr. Mahesh, Reader of Economics, University of Mysore, for his thoughtful comments and suggestions.

**Notes**

2. Tobin’s q – defined as the ratio of the financial value of the firm (Vt) to the replacement cost of its existing capital stock, Qt A= Vt / pt Kt, where pt is the relative price of investment goods to the price of output and Kt is the capital stock at time t.
4. see Myers and Majluf (1984).
7. The composite error term wit consists of two components, ái, which is the cross-section, or individual-specific, error component, and uit, which is the combined time series and cross-section error component. The term error components model derives its name because of the composite error term wit which consists of two (or more) error components.
8. There are different types of panel unit root tests. One of the first unit root tests to be developed for panel data is that of Levin, Lin and Chu (2002) and the second is that of Hadri (2000). Both test assume that the autoregressive parameters are common across cross section units, while Levin, Lin and Chu (2002) uses a null hypothesis of a unit root, while that of Hadri (2000) uses a null of no unit root. Unlike Levin, Lin and Chu test Hadri test is applicable to small–T, large–N panels. A third test is referred to as the IPS test developed by Im, Pesaran and Shin (2003). In this test the null hypothesis is that of a unit root, where this test is applicable to sufficiently large T and N.

**References**

Athukorala, Prema-chandra and Kunal Sen (1998), ‘Reforms and Investment in India’, Department of Economics and Australia South Asia Research Centre, Research School of Pacific and Asian Studies, the Australian National University.

Determinants of Investment Pattern in Indian Manufacturing Industries...


Cava La, Gianni (2005), ‘Financial Constraints, the User Cost of Capital and Corporate Investment in Australia, Research Discussion Paper 2005-12, Reserve Bank of Australia.


