"Investment Decision of Manufacturing Firm in INDIA"

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Abstract: -

This study looks into what influences companies in India when they decide to invest in research and development (R&D). It checks data from financial statements of public companies or over-the-counter (OTC) manufacturing companies listed in the Indian stock exchange, taken from the Prowess database. The study focuses on seven key factors that affect these investment decisions, and it sees R&D investment as linked to internal resources like money and assets. Its main goals are to understand how India invests in R&D, to look closely at specific resources that drive companies' R&D choices, and to figure out if the magnitude of the corporation and its non-physical assets (like patents and skilled employees) are big factors in these decisions. The study's results could be really beneficial for both scholarly investigation and for companies aiming for long-term success.

Introduction: -

This research looks at how manufacturing companies in India decide where to put their money, especially when it comes to spending on research and development (R&D). They gathered information from different parts of these companies' financial records over 21 years, like how much money they have, how much they owe, and what they spend money on. Then, they used special techniques to analyze this data, like fixed, random, and pooled OLS regression, to see how R&D spending is connected to things like how much profit the company makes, how big it is, how it manages its money, and if it does business in other countries. The researchers made some guesses, called hypotheses, about what might affect R&D spending. For example, they thought that companies with more money of their own and bigger companies might spend more on R&D. They also looked at things like what stuff the company owns, how good its employees are, and if it does business internationally to see if these

affect R&D spending decisions. They looked at numbers like return on assets (how much money the company makes compared to what it owns), how much debt the company has, and how much it spends on R&D to get an idea of what's going on. Then, they used special models to see how these numbers are connected. It helps us understand how manufacturing companies in India decide to spend their money on R&D. Knowing this helps government people and business leaders make better decisions about new ideas and technology in the industry.

Literature Review: -

This study looks at how manufacturing companies in India decide to spend money on research and development (R&D). They gather data from different parts of companies' financial records over 21 years, like how much they own, how much they sell, and how much they spend on R&D. The goal is to figure out what factors affect their decisions about R&D spending. They have a few ideas, like how much money the company makes, how big it is, and how good their employees are. The results show that when companies make more money, they tend to spend less on R&D. Also, bigger companies and those with lots of valuable stuff tend to spend more on R&D. Companies with smart employees and those selling things internationally also tend to invest more in R&D. By using fancy math techniques, they find that one specific method, called the fixed effect model, works best for understanding these decisions. These findings help policymakers and companies understand how to balance making money now with investing in new ideas for the future.

Data & Methodology: -

In this research project we have taken the list of listed manufacturing firms in India and have taken variables from different portions of balance sheet like Total Asset, Total Liabilities, Sales, Amortization, Employee expenses, Foreign earning, R&D etc. This data is collected over the period of 21 years. We will be using panel data analysis in the model by modelling fixed, random and pooled OLS regression. After running the regression, we will run some test on the data like Hausman test, fixed time effect test.

This paper analyses the Investment decision of manufacturing firms in India. Our analysis of panel data is based on the result of Hausman test, according to which fixed effect model regression approach has been used to analyse empirically the relationship between the Research and development and the Return on assets taken by manufacturing firms.

The panel data fixed effect regression can be stated as:

$$FP_{it} = \alpha_i + \sum_{k=1}^{n} \beta_i X_{it} + \varepsilon_{it}$$

FP = Firm performance parameters as dependent variable.
α = Constant
X = Institutional Investors as an independent variable.
B = Coefficient of institutional investors.
U = Error term
n = No of Cross-Sectional

Model:

Research and development are taken as a proxy of foreign investment decision is taken as dependent variable and other variables like date ratio return on assets size of firm fixed asset turnover personal expense ratio and foreign earned income are treated as independent variable.

$$R\&D_{it} = \beta_1 Debt\ ratio_{i,t} + \beta_2 Return\ on\ asset_{i,t} + \beta_3 Size_{i,t} + \beta_4 Fixed\ asset\ turnover_{i,t} + \beta_5 Personal\ expense\ ratio_{i,t} + \beta_6 Foreing\ earned\ income_{i,t} + d_t + \alpha_i + \vartheta_{i,t}$$

Research Hypothesis: -

This study suggests the following hypothesis:

H1. Increased independence in corporate finances will be more successful in stimulating investment in research and development endeavours.

Investing in Research and Development (R&D) is influenced by internal factors such as profitability. Given the inherent risk and uncertainty associated with R&D, enterprises typically need substantial capital and long-term financial backing. Companies that effectively fund R&D from their profits are willing to undertake the financial risks associated with it. Hence, the hypothesis posits that successful R&D investment relies on utilizing company profits to support it, thereby embracing the associated financial risks.

H2. Greater enterprise revenue or profitability will result in increased engagement in research and development investment endeavours.

Big companies, which have a lot of money and good management, usually invest more in Research and Development (R&D). Other researchers agree that bigger companies are more likely to do R&D. Studies also show that when companies sell more and hire more people, they tend to spend more on R&D. So, this study suggests the following idea.

H3. Bigger corporations demonstrate a greater inclination to invest in activities associated with research and development.

Researchers have also found that a company's financial structure can influence its spending on Research and Development (R&D). When a company's tangible resources are more valuable, it tends to invest more in technological innovations. In examining a company's tangible resources, it's important to consider not only its size but also its reliance on physical assets such as buildings and investments. Therefore, this study puts forward the following hypothesis.

H4. Increased depreciation of a company's capital structure will result in a greater inclination to invest in activities related to research and development.

An organization's intangible assets, such as patents, goodwill, and brands, play a significant role. Studies show that there's a positive relationship between R&D investment and profitable patents. Likewise, higher innovation levels are associated with better brand performance. Therefore, an organization's goodwill and patents are closely tied to its investments in R&D. Hence, this study presents the following hypothesis.

H5. Enhanced corporate reputation and a greater number of accumulated patents can result in increased engagement in research and development activities.

When a company values its employees highly, it can use this to improve its understanding of technology and absorb information better during R&D. Research shows that having technical staff who know about relevant technology can help integrate knowledge for R&D activities. Having skilled employees means combining skills and knowledge within the company, which can boost its R&D efforts. Therefore, this study suggests that companies with valued employees will likely have better R&D outcomes.

H6. Enhanced human resources within the enterprise can lead to increased involvement in research and development activities.

Competition is fiercer in international markets than in domestic ones. Companies that engage in Research and Development (R&D) tend to export more than those that don't, according to Wakelin (1998). Studies also indicate a positive relationship between a company's export activities and its investment in R&D. Therefore, it is suggested that companies involved in R&D are likely to have higher export levels.

H7. The engagement of an enterprise in export activities will have a positive influence on the amount of investment directed towards the enterprise's research and development endeavours.

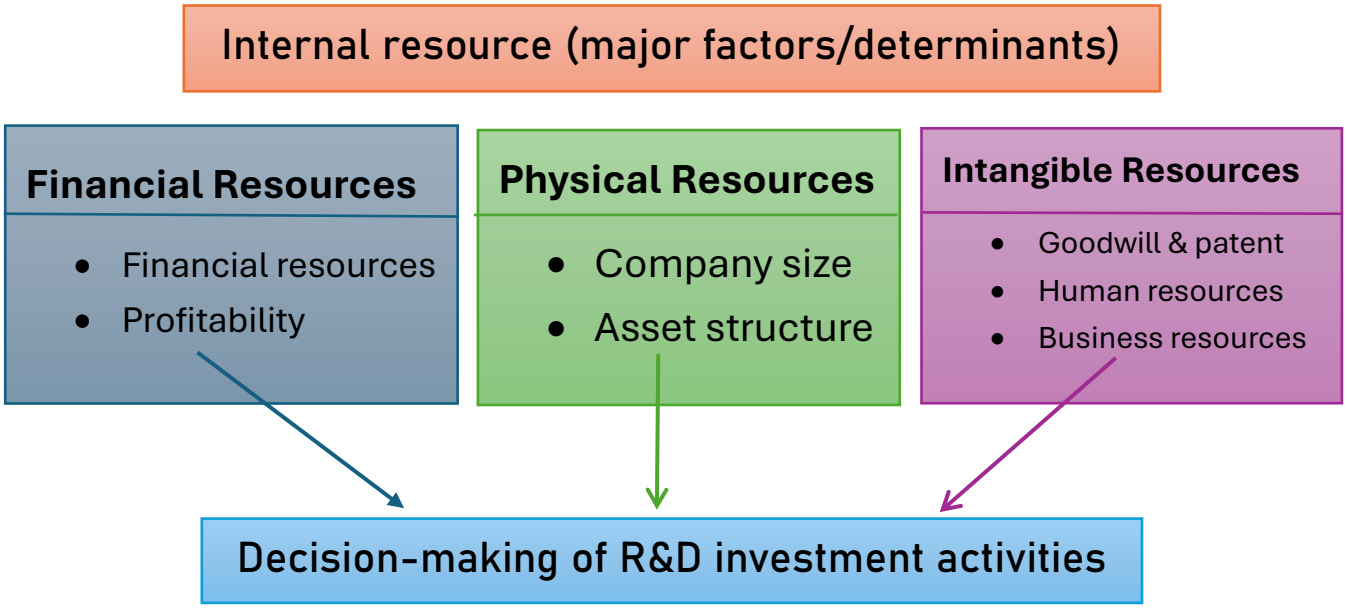


Fig. 1. Research Framework

Empirical Analysis: -

This section explores our data's summary statistics for the characteristic of different indicators of firm, offering fundamental understandings of the nature of ROA and their possible relationship to firm's investment decision, we are understanding this distribution to set further investigation into the impact of firm's profitability and returns on investment decision of firms

This section explores our data's summary statistics for the characteristic of different indicators of firm, offering fundamental understandings of the investment decision of firm.

	R&D	Debt ratio	Return on assets	Size	Fixed asset turnover ratio	Personnel expenses ratio	Foreign earned income
Mean	0.004564	0.8925	0.05316	7.351	0.01201	0.0964	0.182
Median	0.000000	1.0000	0.04900	9.003	0.00000	0.0590	0.019
Min.	0.000000	0.0000	-51.60000	-2.303	0.00000	-0.4910	-0.935
Max.	1.550000	1.0000	1.11600	16.070	6.00000	0.8940	96.963
Quantile 1	0.000000	1.0000	0.01000	4.961	0.00000	0.0270	0.000
Quantile 3	0.002000	1.0000	0.10600	10.384	0.00000	0.1120	0.175

This above table represent the characteristics of the indicators of manufacturing firms.

R&D: This column likely represents research and development expenses as a proportion of total revenue or some other measure. The mean, median, minimum,

maximum, and quartiles provide information about the distribution and central tendency of R&D expenditure across the companies in the sample.

Debt ratio: This column shows the debt-to-equity ratio or some other measure of leverage. It indicates the proportion of a company's financing that comes from debt. Again, the statistics provide insights into the distribution of leverage among the companies.

Return on assets: This column presents the return on assets (ROA), which measures a company's profitability relative to its total assets. The mean, median, and quartiles reveal the typical level and variability of ROA among the companies.

Size: This likely represents the size of the companies in the sample, possibly measured by total assets or market capitalization. The statistics describe the distribution of company sizes in the sample.

Fixed asset turnover ratio: This ratio indicates how efficiently a company is using its fixed assets to generate revenue. The statistics describe the efficiency of fixed asset utilization across the companies.

Personnel expenses ratio: This column shows personnel expenses as a proportion of total revenue or some other measure. It provides insights into how much companies are spending on employee salaries and benefits relative to their revenue.

Foreign earned income: This represents the proportion of a company's income derived from foreign operations. The statistics describe the extent of international revenue generation among the companies.

Random Effect Model

In the random effects model, R&D expenditure (R&D) is modeled as a function of several independent variables including the debt ratio, return on assets, fixed asset turnover, personnel expenses ratio, and foreign earned income. The model is represented by the equation:

$$R\&D_{it} = \beta_1 Debt\ ratio_{i,t} + \beta_2 Return\ on\ asset_{i,t} + \beta_3 Size_{i,t} + \beta_4 Fixed\ asset\ turnover_{i,t} + \beta_5 Personal\ expense\ ratio_{i,t} + \beta_6 Foreing\ earned\ income_{i,t} + \varepsilon_{i,t}$$

The coefficients represent the expected change in R&D expenditure for a one-unit change in each independent variable, holding other variables constant. The estimated coefficients obtained from the random effects model are as follows: the debt ratio has no significant effect on R&D expenditure, while a one-unit increase in return on assets is associated with a decrease in R&D expenditure by

approximately 0.0141553 units. Fixed asset turnover, personnel expenses ratio, and foreign earned income do not have statistically significant effects on R&D expenditure. The intercept, representing the baseline R&D expenditure when all independent variables are zero, is statistically significant. Overall, the model explains approximately 0.6% of the variation in R&D expenditure.

Fixed Effect Model

In the fixed effects model, R&D expenditure is modeled as a function of several independent variables including the debt ratio, return on assets, fixed asset turnover, personnel expenses ratio, and foreign earned income. The model is represented by the equation:

$$R\&D_{it} = \beta_1 Debt\ ratio_{i,t} + \beta_2 Return\ on\ asset_{i,t} + \beta_3 Size_{i,t} + \beta_4 Fixed\ asset\ turnover_{i,t} + \beta_5 Personal\ expense\ ratio_{i,t} + \beta_6 Foreing\ earned\ income_{i,t} + \alpha_{i,t} + \varepsilon_{i,t}$$

The coefficients represent the expected change in R&D expenditure for a one-unit change in each independent variable, while holding other variables constant and accounting for individual-specific effects. In the provided results, return on assets is the only variable with a statistically significant negative effect on R&D expenditure, suggesting that higher returns are associated with lower R&D spending. Other variables do not have statistically significant effects on R&D expenditure.

Empirical finding			
Dependent variable- Research and development (R&D)			
Variables	Random effect model Coefficient	Fixed effect model Coefficient	Pooled OLS model Coefficient
Debt ratio	0	0	0.005 (0.036)
Return on asset	-.0141553 (-7.23)	-.0135042 (-6.88)	-0.001 (-2.962)**
Fixed asset turnover	.0002179 (0.04)	.0003291 (0.06)	-0.009 (-0.396)
Personnel expenses ratio	-.0043296 (-0.95)	-.0070015 (-1.46)	0.015 (5.247)***
Foreign earned ratio	-.000781 (-0.47)	-.0000876 (-.53)	.0004 (1.454)
Constant	.0074053 (3.82)	.00763348 (13.32)	0.00 (0.000)
Total panel observation	8577	8577	8577
R^2	0.60	0.61	0.6653
F-statistic	53.30	12.36	12.27
Prob (F- statistic)	0.0000	0.0000	0.0000
Hausman test	39.77		

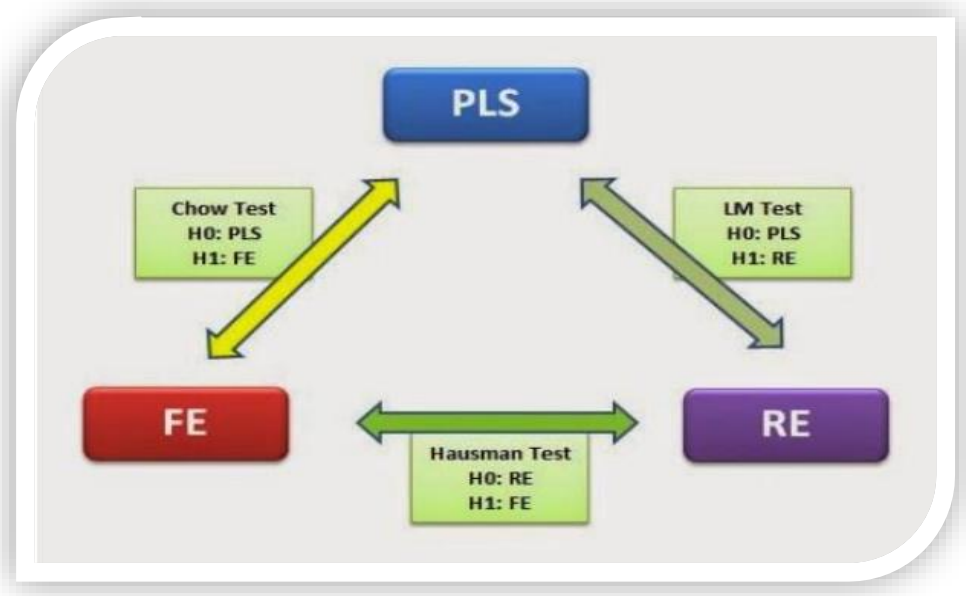
The value of R^2 is 60% in case of REM 61% in case of FEM shows the combined effect of the above model in in explaining the relevant correlation between the dependent and independent variable, and the value of R^2 is 66% tells us the proportion of ROA explained by the independent variable this suggest that a very small portion of ROA is explained by these independent variables.

Now we need to verify that out of all these models which model will be appropriate for my panel dataset for this we will be running Hausman test to check which model will be the best fit model for my dataset.

Hausman Test

The Hausman test statistic tells us which model is best fit for our panel data that is fixed effects (FE) and random effects (RE) models. Hausman test takes the following hypothesis while testing the model;

- Null hypothesis (H_0) = cov (X_{it} , α_i) = 0 { Random effect model}
- Alternative hypothesis (H_1) = cov ($X_{it,}$ α_i) ≠ 0 {Fixed effect model}



Formula for calculating Hausman test is

$$H = \frac{(\beta_{FE} - \beta_{RE})}{\{Var\ (\beta_{FE}) - Var(\beta_{RE})} \sim \chi 2_{(1)}\ dist.$$

Where, β_{FE} = beta value of fixed effect

B_{RE} = Beta value of random effect

Model	Chi square value of Hausman test
Model 1 (Research & development)	39.77

Conclusion: -

The analysis of investment decisions among manufacturing firms in India, particularly in research and development (R&D) expenditure, yields significant insights. The empirical findings reveal a noteworthy negative relationship between R&D spending and return on assets (ROA) across all models examined. This implies that companies with higher profitability, as measured by ROA, tend to allocate fewer resources towards R&D activities. However, factors such as the debt ratio, fixed asset turnover, personnel expenses ratio, and foreign earned income do not demonstrate significant influences on R&D expenditure. Among the models tested, the Fixed Effect Model (FEM) emerges as the most suitable for the panel dataset, according to the Hausman test. This suggests that there are specific firm-level factors influencing R&D spending, and incorporating these factors enhances the model's accuracy in explaining the data. Additionally, the FEM accounts for approximately 61% of the variability in R&D expenditure, highlighting its effectiveness in capturing the dynamics of R&D investment decisions among the sampled firms. These findings provide crucial insights into the determinants of R&D investment behavior within India's manufacturing sector. The negative correlation between profitability and R&D spending underscores the delicate balance firms must strike between investing in innovation and maximizing short-term profits. Moreover, the preference for the Fixed Effect Model underscores the importance of firm-specific characteristics in shaping R&D investment strategies, emphasizing the need for a nuanced understanding of individual firm dynamics for informed policy-making and strategic planning in innovation and technology development.

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