Abstract
This paper brings forth the relative importance of R&D intensity of a company on a sample of S&P BSE-500 companies. The independent variables studied included proportion of inside directors of a company and ownership concentration in a company. A positive relationship was found between proportion of inside directors and R&D intensity of a company. The results suggest no significant relationship emerges between ownership concentration variables and R&D intensity of a company.

Keywords

I. Introduction
With the globalization and liberalization of the Indian economy, technological innovation has taken a strong foothold in the economy. The up-gradation of technology occurs in very short spans of time worldwide, which has helped make the Indian economy highly competitive. Companies are striving to achieve the best in production both, qualitatively and quantitatively. Today, one of the major factors contributing to the company’s ability to carve a niche in the markets is the research and development (R&D) expenditure incurred by companies. Also, India is becoming a favoured destination for investments in R&D and the global distribution of R&D is being re-shaped.

R&D investments are typical in nature requiring employment of specialists and long term investment (Holmstrom, 1989, Dosi, 1989; Nelson and Nelson, 2002), and this can have a negative impact on short term performance. Even though investing in R&D can contribute to value maximization (Johnson and Pazderka, 1993; Lev and Sougiannis, 1996; Cho, 1988 and Chan et al., 2001) and financial performance (Hill and Snell, 1988; Lau, 1998), such investments may be perilous, and these require, on average, three to six years of continuing efforts and expenses before benefit could be arrived at from these investments. Holmstrom (1989) explains that agency costs associated with innovative activity are likely to be high because such projects are risky, labour-intensive, distinctive, and their profitability, if any, can only been assessed in the long run. Studies that have analyzed the relationship between ownership concentration and R&D investments highlight that when corporate ownership is widely-held, ownership concentration has a positive effect on R&D investments (Hill and Snell, 1988; Cho, 1998; Baysinger et al., 1991; Gompers et al., 2004), and R&D outcomes (Francis and Smith, 1995). However at higher levels of concentration, agency problems related with entrenchment seem to reverse the effect of ownership concentration on R&D, and it becomes significantly negative (Cho, 1998; Gompers et al., 2004). This is where corporate governance comes into the picture, and control mechanisms have to be implemented. Corporate governance mechanisms need to protect all the parties with interests from trivial or ineffectual use of resources. In terms of R&D activities, sufficient execution of governance practices is required to lessen agency costs at different levels of the firm (directors, managers, R&D employees), but also to reduce the high costs of sharing, integrating and creating knowledge (Lacetera, 2001; Foss, 2007).

A. Research Focus And Objectives of The Study
The main focus of the study has been to examine the effect of ownership and board composition on R&D spending of companies. In specific the objectives of the study are:
1. To study the effect of ownership structure and board on R&D spending of companies
2. To identify and to give suggestions as to the type of ownership structure that may be suitable to promote innovation activities in a company

B. Review of Literature
Hill and Snell (1988) probed into the idea that a divergence of interest between stockholders and managers had a serious impact for the corporate strategy of a firm and ultimately lead to an impact on its profitability. The scope of the study was 94 Fortune 500 companies and the results were along the line hypothesized earlier. In a nutshell, the study concluded that large stakeholders led to increased investment in R&D. Baysinger and Hoskisson (1989) in their study have provided empirical evidence on the diversification strategy being adopted by large multiproduct firms affecting the R&D intensity. The study had examined 971 firms from 1980-82. The results showed that R&D intensity in dominant-business firms which had an emphasis on strategic controls was found to be significantly higher than in related- and unrelated-business. Hansen and Hill (1991) in their research study examined 129 firms for a ten year period for four industries. The results suggested that higher levels of institutional ownership were associated with greater R&D expenditures. Baysinger et al. (1991) investigated as to how the company’s R&D strategy was effected by the percentage of inside directors on the company’s board and its equity ownership structure. Also the roles of individual and institutional stockholders with regard to the company R&D spending were analyzed. The study had a scope of 176 Fortune 500 companies. The research concluded that higher number of insider representation and an increased concentration of institutional investor equity had a definite positive impact of R&D spending. With an examination of these studies, various aspects of corporate governance and R&D have been highlighted.

On the basis of review of the literature (Hill and Snell, 1988; Baysinger and Hoskisson, 1989; Hansen and Hill, 1991; Baysinger, 1991) examining the effect of ownership and board composition on R&D expenditure the following hypotheses (stated in alternative form) would be tested:
Hypothesis 1a There is a significant effect of the proportion of inside directors on corporate R&D spending

II. Methodology

Section A

1. Hypotheses
2. Empirical research design
3. Data and method

Section B

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2. Research Design
3. Hypothesis testing strategy

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3. Limitations

Section E

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1. Research Focus and Objectives of the Study
2. Review of Literature
3. Methodology
4. Results and Discussion
5. Conclusion

Appendix

1. Data Source
2. Research Design
3. Hypothesis testing strategy
4. Data Analysis
5. Empirical Results
6. Conclusion

References


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Hypothesis 1b There is a significant effect of the ownership concentration of major shareholders on corporate R&D spending
Hypothesis 1c There is a significant effect of the proportion of institutional shareholding on corporate R&D spending
Hypothesis 1d There is a significant effect of the proportion of individual shareholding on corporate R&D spending

C. Population and Sample Selection
In order to study the first objective effect of ownership and board composition on the R&D spending of a company, two samples were formed from the S&P BSE-500 listed companies. A sample of the S&P BSE-500 listed companies as on 31, March 2009 for five years was taken. Table 1 presents a summary of sample selection procedure (on basis of employees) for effects of ownership and board composition on R&D spending of companies. The following criteria have been used for selecting the final sample. First of all companies which were not reporting any R&D expenditure, which were 1395 observations in total were deleted. Next, 210 observations of companies for five years reporting a different year ending than march 2005-2009 were deleted. In the next stage, companies having no segment sales have been deleted, which resulted in 205 observations for five years from 2005-09. After that, 175 observations of companies in five years from 2005-09 with missing employee numbers were deleted. Then companies with missing R&D expenditure, employee figures and segment sales in individual years were deleted. The remaining companies were deleted due to consolidated segment sales, change in National Industrial Classification (NIC), missing shareholding patterns, missing director information and single year segment sales.

Table 1: Summary of Sample Selection Procedure (on basis of employees) for Effects of Ownership and Board Composition on R&D Spending of Companies

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Observations to be deleted</th>
<th>Final Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>S&amp;P BSE-500 companies as on 31 March, 2009</td>
<td></td>
<td>2,500</td>
</tr>
<tr>
<td>(-) Companies without R&amp;D expenditure (including financial sector companies and banks) deleted</td>
<td>(1,395)</td>
<td></td>
</tr>
<tr>
<td>Companies with year ending different than March</td>
<td>(210)</td>
<td></td>
</tr>
<tr>
<td>Companies with no segment sales</td>
<td>(205)</td>
<td></td>
</tr>
<tr>
<td>Companies with missing employee figures</td>
<td>(175)</td>
<td></td>
</tr>
<tr>
<td>Companies with missing R&amp;D expenditure, employee figures and segment sales in individual years</td>
<td>(165)</td>
<td></td>
</tr>
<tr>
<td>Companies having consolidated segment sales</td>
<td>(36)</td>
<td></td>
</tr>
<tr>
<td>Companies with change in NIC classification</td>
<td>(13)</td>
<td></td>
</tr>
<tr>
<td>Companies with missing shareholding patterns</td>
<td>(03)</td>
<td></td>
</tr>
<tr>
<td>Companies with missing director information</td>
<td>(04)</td>
<td></td>
</tr>
<tr>
<td>Companies with single year segment sales</td>
<td>(30)</td>
<td></td>
</tr>
<tr>
<td>Final sample</td>
<td></td>
<td>2236/264</td>
</tr>
</tbody>
</table>
D. Data Sources and Period of Study
A sample of the S&P BSE-500 listed companies as on 31, March, 2009 was taken. Data regarding the variables such as R&D expenditure, sales, segment sales, ownership pattern and inside director details of companies was taken from the PROWESS database of the Centre for Monitoring Indian Economy (CMIE). This was also supplemented by the annual reports and corporate governance reports from the websites of companies as well as from the EDIFAR database (which was there previously) of SEBI. The data relating to sharing patterns was collected from the website of BSE (http://www.bse.com). The time period of the study was from the year 2005-2009.

Information on the National Industrial Classification (NIC) was obtained from the website of Central Statistical Organization, Ministry of Statistics and Programme Implementation, New Delhi as well as from the Prowess database. The study used two-digit and four digit classification of industry groups provided by the NIC.

E. Models Proposed to be used in the Study
1. To study the effect of ownership and board composition on R&D expenditure of companies the following models as proposed by Baysinger et al. (1991) will be tested. Descriptive statistics (mean, standard deviation and quartiles) and correlation matrix will be found. Multiple Regression analysis will be applied in all the Models (1, 2 and 3).

Model 1:
\[ \text{R&D \_INT} = \beta_0 + \beta_1 \text{IND\_R&D} + \beta_2 \text{SALES} + \beta_3 \text{REL\_DIV} + \beta_4 \text{UNREL\_DIV} + \beta_5 \text{P\_ID} + \beta_6 \text{OC\_CUM} + \epsilon \]  

Model 2:
\[ \text{R&D\_INT} = \beta_0 + \beta_1 \text{IND\_R&D} + \beta_2 \text{SALES} + \beta_3 \text{REL\_DIV} + \beta_4 \text{UNREL\_DIV} + \beta_5 \text{P\_ID} + \beta_6 \text{OC\_HI} + \epsilon \]  

Model 3:
\[ \text{R&D\_INT} = \beta_0 + \beta_1 \text{IND\_R&D} + \beta_2 \text{SALES} + \beta_3 \text{REL\_DIV} + \beta_4 \text{UNREL\_DIV} + \beta_5 \text{P\_ID} + \beta_6 \text{OC\_INSTT} + \beta_7 \text{OC\_IND} + \epsilon \]  

Where
- R&D\_INT = Research and development intensity which is research and development expenditure divided by no. of employees (averaged over the time period 2005-2009)
- IND\_R&D = Industry research and development spending
- SALES = Natural logarithm of sales
- REL\_DIV = Related diversification
- UNREL\_DIV = Unrelated diversification
- P\_ID = Percentage of inside directors
- OC\_CUM = Cumulative ownership of equity with shareholders owning more than 1% equity share capital
- OC\_HI = Herfindahl index calculated for the cumulative measure
- OC\_IND = Shareholders under the head individuals (both on the promoter and non-promoter side) having equity holding in excess of 1 percent
- OC\_INSTT = Shareholders under the head institutions (on the non-promoter side) having equity holding in excess of 1 percent
- \( \epsilon \) = Error term

F. Details of Variables
The following section provides detailed information about the variables used in the study. The variables have been divided into three categories- dependent, independent and control variables, which are as follows.

1. Dependent Variables and Independent Variables
In order to study the effect of ownership and board structure on R&D expenditure of companies the following dependent, independent and control variables were used.

(i). R & D Spending Per Employee
The total R&D expenditure divided by number of employees, averaged over the period 2005-2009. Graves (1988), Hill and Snell (1988) and Baysinger et al. (1991) have used R&D spending per employee as the dependent variable. The effects of business cycles, accounting manipulations, and asset sales on R&D spending per employee were found to be less and the measure was considered to be more reliable than R&D spending as a proportion of sales (Scherer, 1984).

(ii). Percentage of Inside Directors
In accordance with the past research, Sarkar and Sarkar (2009) have classified directors into inside (termed as executive directors in the CG report) and outside (termed as non-executive directors in the CG report). Inside directors are full-time employees of the company vested with responsibility of administering the business while outside directors are nonemployee, part-time directors brought in as advisors.

(iii). Ownership Concentration
It refers to the percentage of company shares owned by the controlling shareholder (i.e., the largest shareholder) of the listed company. In the present study ownership concentration is measured as the cumulative percentage of equity held by shareholders owning more than 1 percent.

(iv). Herfindahl Index
It has been calculated for the above, i.e. companies in which shareholders own more than 1 percent of the shares. The following formula is used to calculate the Herfindahl index

\[ \ln \sum_{i=1}^{n} S_i^2 \]

Where \( S_i \) is the percentage of equity owned by the ith shareholder and \( n \) is the number of shareholders who owned more than 1 percent of the company. The weight given by the cumulative concentration measure is equal for all shareholders. On the other hand, the herfindahl measure gives very large ownership positions more weight than smaller positions (Hay and Morris, 1979).

(v). Ownership Concentration (Individuals)
Ownership concentration was also measured for individual (both on the promoter and non-promoter side) shareholders as those shareholders who held more than 1 percent equity shares of the company.

(vi). Ownership Concentration (Institutions)
Ownership concentration for the institutional shareholders has been calculated for all the institutional shareholders (mainly on the non-promoter side) holding more than 1 percent equity shares of the company.
2. Control Variables

The following section gives the control variables used in the study. They are industry R&D spending, related and unrelated diversification and sales.

(i). Industry R&D Spending

This variable has been calculated from the following formula:

\[ \sum_{j=1}^{n} P_{ij}/RD_j \]

Where \( RD_j \) is R&D spending relative to the sales of industry \( j \), \( P_i \) is the percentage of firm \( i \)'s total sales in industry \( j \), and \( n \) is the number of different industries in which firm \( i \) operates. Industries are defined by standard number (NIC classification) of different industries in which firm \( i \) operates.

(ii). Related Diversification and Unrelated Diversification

Previous research suggests that the diversification strategy of the firm may impact its investment in long-term projects. By employing the entropy measure the effects of diversification were controlled (Jacquemin and Berry, 1979; Palepu, 1985). The two components of this measure, measuring related diversification and unrelated diversification, were used.

Entropy measure of diversification = \( \sum \ln (1/P_i) \)

where \( P_i \) is the rupee value of sales attributed to segment I and \( \ln (1/P_i) \) is the logarithm of the inverse of sales.

Entropy measure of diversification is calculated separately for related and unrelated diversification. All four digit NIC industry segments are examined in single two digit NIC classification for related diversification and between industry groups for the latter.

(iii). Sales

For developing new products generally large firms have the impetus and capability to do so (Scherer, 1984). Natural logarithm of sales (net) has been calculated for March 2005-2009 period to control for the size effect.

G. Results and Analysis of the Effect of Ownership and Board Composition on the R&D Spending of Companies

R&D investment has been receiving a lot of attention from policy makers and researchers in different fields, especially fields of economics and strategic management as empirical evidence suggests that investment in R&D has a significant positive effect on economic growth. Lucas (1988) and Romer (1990) regarded as the advocates of new growth theory concluded that R&D was an important factor in improving the economic growth of the country. India is likely to be the third largest economy with a GDP size of USD 15 trillion by 2030, says Standard Chartered’s Super Cycle Report. Therefore, in addition to other sectors where growth regimes would be seen, India is seen as one of the attractive destinations for R&D investments, both overseas and within the country. The five year plan outlines certain measures for boosting R&D activity in the country. This can be seen as a positive for all the sectors of the economy, as trade will be boosted which necessitates the need for a company to increase its R&D spending. Therefore, it makes it important to study the impact of R&D spending of Indian companies on various aspects of a company’s operation.

Although R&D investments are considered to be significant for a company, firms into innovative activities suffer from high degree of information asymmetry, which leads them to confront external financing constraints and agency conflicts, both of which distort investment efficiency of firm innovation.


The empirical results relating to the effect of ownership and board composition on the R&D spending of companies for a sample of 264 observations (basis of employees) for a period of five years from 2004-05 to 2008-09 have been analysed. The study used descriptive statistics (e.g. mean, standard deviation median and quartiles) to examine the basic features of the sample. Pearson’s correlation has been employed to determine the degree of relationship between the variables. In order to determine the effect of ownership and board composition on the R&D spending of companies, the study used multiple linear regression has been used.

1. The Effect of Ownership and Board Composition on the R&D Spending of Companies (on the basis of number of employees)

This section studies the effect of ownership and board composition on the R&D spending of companies on the basis of number of employees. The section has been divided into following sub-sections: the sub-section G.2 presents the descriptive statistics of the sample, sub-section G.3 correlation matrix of the key variables and sub-section G.4 results of the multiple linear regression analysis.

2. Descriptive Statistics

Table 1.2 presents the descriptive statistics for the variables studied to know the effects of ownership and board composition on R&D spending of companies. The average and standard deviation values for R&D intensity (R&D_IN) are 0.005 and 0.017. The first quartile and median for R&D intensity (R&D_IN) are 0.001 and third quartile value is 0.004. The mean and third quartile for industry R&D spending (IND_R&D) is 0.001. The mean and standard deviation calculated for sales (SALES) is 7.761 and 1.512 respectively. The values for sales (SALES) for first quartile, median and third quartile are 6.662, 7.569 and 8.605.

Related diversification (REL_DIV) shows mean value of 0.437 and standard deviation value as 0.399. The first quartile, median, and third quartile for related diversification (REL_DIV) are 0.141, 0.397, and 0.678. Further the mean and standard deviation values for unrelated diversification (UNREL_DIV) are 0.193 and 0.321. The table shows the third quartile unrelated diversification (UNREL_DIV) as 0.380. The descriptive statistics table indicates the average values for the percentage of inside directors (P_ID) as 0.299 and standard deviation values as 0.166. The first quartile, median, and third quartile for the percentage of inside directors (P_ID) are 0.143, 0.286 and 0.409 respectively.
The cumulative ownership concentration measure suggests that there are concentration so certain groups can influence the decision making process. As the ownership structures are concentrated so different participants of the ownership structure like Individuals and Hindu undivided family, corporate bodies, institutional investors and individuals maybe having a say in the R&D investment decisions in a company when cumulative ownership concentration measure was used. When ownership concentration was measured by the Herfindahl index, though the measure gives larger shareholders more weightage, average values were around -2 showing a negative relationship with R&D spending. This shows that even shareholders with a larger stake in the ownership structure of a company are not favouring R&D investment decisions. The average values for ownership concentration when measured for institutions was about 16 percent and as for individuals section when ownership concentration was measured, the average values were about 5 percent, which doesn’t suggest a dominant say in R&D investment decisions for both these shareholders.

### 3. Correlation Matrix

Table 3 presents the results of the effects of ownership and board composition on R&D spending of companies for a sample of 264 observations of companies. The correlations are low. R&D intensity (R&D_IN) shows a positive correlation with industry R&D (IND_R&D) spending. Sales (SALES) is significantly (at 1 percent level of significance) positively correlated with R&D intensity (R&D_IN). The results show that industry R&D (IND_R&D) spending is negatively correlated with ownership concentration, the cumulative ownership concentration when measured by the Herfindahl index (OC_CUM) shows a negative relationship with R&D spending. This shows that companies maybe engaging in related diversification activities and even spending R&D on finding new areas for specialization but not in unrelated diversification. The average inside directors figures suggest companies to be having lesser inside directors, therefore lesser specialization and lesser investment in R&D. The cumulative ownership concentration measure suggests that the structures are concentrated so certain groups can influence the decision making process.

#### Table 2: Descriptive Statistics

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>First Quartile</th>
<th>Median</th>
<th>Third Quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D_IN</td>
<td>0.005</td>
<td>0.017</td>
<td>0.001</td>
<td>0.001</td>
<td>0.004</td>
</tr>
<tr>
<td>IND_R&amp;D</td>
<td>0.001</td>
<td>0.005</td>
<td>0.000</td>
<td>0.000</td>
<td>0.001</td>
</tr>
<tr>
<td>SALES</td>
<td>7.761</td>
<td>1.512</td>
<td>6.662</td>
<td>7.569</td>
<td>8.605</td>
</tr>
<tr>
<td>REL_DIV</td>
<td>0.437</td>
<td>0.399</td>
<td>0.014</td>
<td>0.397</td>
<td>0.678</td>
</tr>
<tr>
<td>UNREL_DIV</td>
<td>0.193</td>
<td>0.321</td>
<td>0.000</td>
<td>0.000</td>
<td>0.380</td>
</tr>
<tr>
<td>P_ID</td>
<td>0.299</td>
<td>0.166</td>
<td>0.143</td>
<td>0.286</td>
<td>0.409</td>
</tr>
<tr>
<td>OC_CUM</td>
<td>0.698</td>
<td>0.164</td>
<td>0.590</td>
<td>0.707</td>
<td>0.836</td>
</tr>
<tr>
<td>OC_HI</td>
<td>-2.031</td>
<td>1.324</td>
<td>-2.972</td>
<td>-2.042</td>
<td>-1.168</td>
</tr>
<tr>
<td>OC_INSTT</td>
<td>0.161</td>
<td>0.125</td>
<td>0.634</td>
<td>0.151</td>
<td>0.224</td>
</tr>
<tr>
<td>OC_IND</td>
<td>0.054</td>
<td>0.125</td>
<td>0.000</td>
<td>0.000</td>
<td>0.028</td>
</tr>
</tbody>
</table>

Note: N=264

For the cumulative ownership concentration (OC_CUM) measures the mean and standard deviation values are as follows 0.698 and 0.164 respectively. The table 4.1 shows the mean and standard deviation values for ownership concentration, as measured by the Herfindahl index (OC_HI) as -2.031 and 1.324 respectively. The results show the mean and standard deviation values for ownership concentration when measured for institutions (OC_INSTT) 0.161 and 0.125 and ownership concentration, as measured by individuals (OC_IND) is 0.054 and 0.125 respectively. The first quartile, median, and third quartile for ownership concentration measures is, cumulative ownership concentration (OC_CUM) are 0.590, 0.707 and 0.836 respectively. The results show when ownership concentration, as measured by the Herfindahl index (OC_HI) first quartile, median and third quartile are -2.972, -2.042, and -1.168. The first quartile, median and third quartile ownership concentration when measured for institutions (OC_INSTT) are 0.634, 0.151, and 0.224 and ownership concentration, as measured by individuals (OC_IND) 0.000, 0.000 and 0.280 respectively. From the above discussion the following conclusions can be drawn.

#### 3. Correlation Matrix

Table 3 presents the results of the effects of ownership and board composition on R&D spending of companies for a sample of 264 observations of companies. The correlations are low. R&D intensity (R&D_IN) shows a positive correlation with industry R&D (IND_R&D) spending. Sales (SALES) is significantly (at 1 percent level of significance) positively correlated with R&D intensity (R&D_IN). The results show that industry R&D (IND_R&D) spending is negatively correlated with ownership concentration, the cumulative ownership concentration when measured, the average values for ownership concentration when measured for institutions was about 16 percent and as for individuals section when ownership concentration was measured, the average values were about 5 percent, which doesn’t suggest a dominant say in R&D investment decisions for both these shareholders.
positively correlated with ownership concentration, when measured by cumulative measure (OC_CUM) and ownership concentration, as measured by individuals (OC_IND). Cumulative ownership concentration (OC_CUM) is found to be significantly correlated with ownership concentration, as measured by the Herfindahl index (OC_HI). Cumulative ownership concentration (OC_CUM) is positively correlated with ownership concentration when measured for institutions (OC_INSTT). Further it is found that ownership concentration, as measured by the Herfindahl index (OC_HI) is significantly (at 1 percent level of significance) negatively correlated with ownership concentration when measured for institutions (OC_INSTT) and ownership concentration, as measured by individuals (OC_IND) respectively.

The variables show correlation with the dependent variable as well as amongst the independent variables. R&D intensity is showing a negative significant relationship with Sales (SALES). Other significant relationships emerge between related and unrelated diversification variables and ownership concentration variables. Baysinger et al. (1991) recorded similar results for correlation. From the above it can be predicted that some suggestions as to the R&D expenditures incurred with the other variables can be put forth by applying multiple regression analysis.

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1.8.4 Multiple Regression Analysis

Table 1.4 presents the multiple linear regression results of the effects of ownership and board composition on R&D spending of companies. The constant is significant at 1 percent level of significance. Industry R&D (IND_R&D) spending shows a positive relation with R&D intensity (R&D_IN). Sales (SALES) is significantly but negatively related to R&D intensity (R&D_IN). Related diversification (REL_DIV) is negatively related to R&D intensity. The results show that unrelated diversification (UNREL_DIV) is negatively related to R&D intensity (R&D_IN). The coefficients for beta and t-values for the percentage of inside directors (P_ID) is 0.081 and 1.234 in model 1. A positive relationship is found between percentage of inside directors (P_ID) and R&D intensity (R&D_IN). Cumulative ownership concentration (OC_CUM) results in Model 1 show coefficient values for beta and t-values as -0.024 and -0.375 which expresses a negative relationship between cumulative ownership concentration and R&D intensity (R&D_IN). The adjusted R2 is 7.5 percent in Model 1. The overall model is significant.

Table 4: Results of Linear Regression Analysis of the Effects of Ownership and Board Composition on R&D Expenditure of Companies (Basis of Employees)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beta coefficient</td>
<td>t-statistic</td>
<td>Beta coefficient</td>
</tr>
<tr>
<td>R&amp;D IN</td>
<td>0.000</td>
<td>3.564*</td>
<td>0.000</td>
</tr>
<tr>
<td>IND R&amp;D</td>
<td>0.097</td>
<td>1.571</td>
<td>0.095</td>
</tr>
<tr>
<td>SALES</td>
<td>-0.228</td>
<td>-3.649*</td>
<td>-0.224</td>
</tr>
<tr>
<td>REL_DIV</td>
<td>-0.075</td>
<td>-1.064</td>
<td>-0.074</td>
</tr>
<tr>
<td>UNREL_DIV</td>
<td>-0.117</td>
<td>-1.664</td>
<td>-0.117</td>
</tr>
<tr>
<td>P_ID</td>
<td>0.081</td>
<td>1.234</td>
<td>0.080</td>
</tr>
<tr>
<td>OC_CUM</td>
<td>-0.024</td>
<td>-0.375</td>
<td>-0.045</td>
</tr>
<tr>
<td>OC_HI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OC_INSTT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OC_IND</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R2</td>
<td>0.075</td>
<td></td>
<td>0.077</td>
</tr>
<tr>
<td>Adjusted R2</td>
<td>0.054</td>
<td></td>
<td>0.055</td>
</tr>
<tr>
<td>F change</td>
<td>3.489</td>
<td>0.002</td>
<td>3.559</td>
</tr>
</tbody>
</table>

Note:* Significant at the 0.01 level (2-tailed).
** Significant at the 0.05 level (2-tailed)
***Significant at the 0.05 level (2-tailed)
Column 2 of table 1.3 shows the results for model 2 presents the multiple linear regression results of the effects of ownership and board composition on R&D spending of companies when ownership concentration is measured with the Herfindahl index. Industry R&D spending shows a positive relationship with R&D intensity (R&D_IN). Sales is significantly but negatively related to R&D intensity (R&D_IN). Related diversification (REL_DIV) is negatively related to R&D intensity. Unrelated diversification (UNREL_DIV) results show it is negatively related to R&D intensity (R&D_IN). A positive relationship is found between percentage of inside directors (P_ID) and R&D intensity (R&D_IN). In model 2 with the Herfindahl measure also a negative relationship emerges with R&D intensity (R&D_IN). The adjusted R2 is 7.7 percent. The model is significant at 5 percent level of significance.

The multiple linear regression results of the effects of ownership and board composition on R&D spending of companies when ownership concentration is measured for institutions and individuals separately in Model 3. Industry R&D spending shows a positive relationship with R&D intensity (R&D_IN) in Model 3. Sales is negatively and significantly related to R&D intensity (R&D_IN). Related diversification (REL_DIV) is negatively associated with R&D intensity. The results show that unrelated diversification (UNREL_DIV) is negatively related to R&D intensity (R&D_IN). A positive relationship is found between percentage of inside directors (P_ID) and R&D intensity (R&D_IN) with a coefficient of 0.075. In Model 3 the ownership concentration among institutional as well as ownership concentration (OC_IND) among individual shareholders negatively affected R&D Intensity (R&D_IN) relationship. The adjusted R2 is 7.8 percent. The overall model is significant.

Overall, the results suggest a negative relationship of sales with R&D intensity meaning that maybe the company had cash constraints forcing them to reduce R&D (Jalilvand and Harris 1984). Diversification (related and unrelated) are showing negative relationship with R&D intensity as companies might be investing in diversification rather than R&D. Boards play a crucial role in the company decision making, which is supported by the positive relationship between R&D intensity and percentage of inside directors. Ownership concentration measures show a negative relationship with R&D intensity meaning thereby, they are not supportive of R&D investments in an organization.

The above discussion on the effects of ownership and board composition on the R&D spending of companies brought to light a number of issues. Companies basically incur R&D expenditure in order to develop new products and processes i.e. innovation or to improve the old ones, to increase the productivity in an organization. The control variables show industry R&D spending, sales, related diversification and unrelated diversification give a mixed response. Industry R&D spending is significantly and positively related to R&D intensity. Sales are negatively related to R&D intensity in the all the models (Model 1, 2 and 3) Firstly, size as measured by sales in this case proxies for the amount of information available about the firm (Wiedman, 1996). Larger (smaller) firms have richer (poorer) information environments that should reduce (increase) opportunities for successful earnings management with R&D. Secondly, size proxies for the likelihood the firm faces cash constraints (Jalilvand and Harris, 1984). Smaller firms are more likely to suffer cash flow shortages that force them to reduce R&D.

Related diversification is also positively related to R&D intensity. The results show that unrelated diversification is negatively related to R&D intensity. Baysinger et al. (1991) had not found a significant relationship between diversification and R&D spending. A positive relationship is found between percentage of inside directors and R&D intensity in all the Models (Model 1, 2 and 3). Boards have been considered by economists have viewed the as a pertinent element in the governance structure of the large corporation (Fama and Jensen, 1983). However, Hill and Snell (1988) found that a high level of inside directors positively affected corporate R&D spending.

Cumulative ownership concentration results in Model 1 express a negative relationship between cumulative ownership concentration and R&D intensity in the case In Model 2 ownership concentration with the Herfindahl measure also resulted in a negative relationship. In Model 3 also the concentration of equity among institutional negatively affected R&D intensity. Demetz and Lehn (1985) found no significant relationship between ownership concentration and accounting profit rate, and especially no significant positive relationship, casting a doubt on the Berle-Means thesis. According to another aspect, Graves (1988) illustrated the alleged adverse effect of institutional stock ownership on corporate R&D spending, lending support to the myopic viewpoint. According to the myopic viewpoint, institutional investors value short-term benefits over long-term gains. These investors may lack access to firm-specific information, and therefore find it difficult to evaluate the long-term value of a firm (Porter, 1992). On the other hand, they may focus on short term performance measures which are measurable. The relationship of R&D intensity with individual shareholders is also a negative one in Model 3. In certain cases where there is more amount of heterogeneity among individual shareholders (disagreement effect), decision making on R&D projects becomes difficult to achieve. If there are risk and investment involved in a project, conflict is likely to be present (Hoskisson et al., 2002). This maybe cited as the reason for the negative relationship between individuals and R&D intensity.

From the above it will be very difficult to decipher the role of various types shareholders in the Indian context as it is in negative direction. As the results for cumulative ownership concentration for major shareholders, when measured by the Herfindahl index and when measured for institutions and individuals mainly suggest a negative role in relation to R&D investments. The results makes the role of various types of shareholders is R&D decision making process questionable. This offers a chance that different categories of shareholders can be supportive and taking part in the R&D investment decisions. In order to fulfill the second objective it becomes imperative that the various constituents of the ownership structure would give encouragement to the R&D investments made by an organization.

References


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