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THE DETERMINANTS OF INVESTOR VALUATION OF R&D EXPENDITURE: A STUDY OF IT INDUSTRIES IN INDIA

Shailendra Kumar
Trade Economic Intern, Ministry of Commerce and Industry,
Udyog Bhavan,
New- Delhi-110001, India.
shail.du7@gmail.com

Dinesh Kumar Choudhury
Assistant Professor, Dept of Economics, Sri Sathya Sai Institute of Higher Learning
Prashanti Nilayam, Andhra Pradesh- 515134, India
dineshkumarchoudhury@sssihl.edu.in

Abstract

This paper empirically investigates the impact of R&D expenditure on four key market valuation variables – labor intensity, market share, age and H- index - in Indian IT firms. However, the results of the regression analyses partially support that the R&D intensity is positively influence the firm's market value (RDR), as measure by H- index. The results extend the understanding of the role of firm size in the R&D intensity, and on the firm's financial performance. The empirical tests use an extensive database containing product level information of software firms between 1997 and 2011, along with accounting and stock price data of the same period. The test results, consistent with our hypotheses, show that R&D spending is more valuable for firms with larger market shares, higher percentage of Labor intensity, and those that have diversified into different product categories.

***Keywords:** Investor, R&D, Software Industry, India*

I. INTRODUCTION

For a business to experience future growth research and development is very vital as it helps in developing new products or processes to improve and expand their operations. Innovation is one of the major engines of growth and the most important way of gaining competitive advantage over competitors in today's new economic environment. Investor Valuation is used in finance to compute the current value of an asset based on statistical inputs for cash flow expectations. Its main purpose is to find investment opportunities such that the internal profitability rate must be above a company's cost of capital in future. Research and Development (R&D) is a key factor of innovation and has become an integral part of many companies, especially those in the high-tech industries. Research is generally defined as the primary search for scientific and technical improvement. Development is defined as the translation

of such improvements into product/service or process innovation and technology imports complement or substitute in house R&D efforts. R&D-intensive companies compete on the basis of a new innovation that allows them to retain their existing customers and capture new markets with a substantial amount of growth in sales and earnings. However, given the strategic significance of R&D, how does R&D spending relate to a firm's financial performance? Although many studies found that there is a link between R&D expenditure and firm value, this relationship changes over time and differs greatly from industry to industry and from firm to firm. In most cases, however, financial benefits become apparent only when the specific R&D activities lead to patent issuance. In today's knowledge-based economy, R&D plays a vital role and acts as strategic weapon to thrive in global market. The firm can reap benefits from the investment of R&D if the innovation can be marketed on a larger scale. It is found that the level of a firm's R&D spending positively affects the firm's financial performance. Another factor firms invest in R&D is the firm size. Firm size has a positive impact on the probability that a firm will engage in innovative activities. R&D expenditure in software industry has revolutionized the way business is being done. With these motivations we would like to focus on IT firms in India. The major research question of this study is to know, whether there is any relationship exists between R&D Structure and to investor decision? R&D investments should be reflected into financial investors' valuations and stock market prices. It is well known that R&D investments affect firm performance, expected profits, and cash flows. Since in efficient financial markets investors evaluate a firm based on its expected cash flows (i. e., firm's market value should be equal to the present value of all the expected cash flows produced in the future), R&D investments should also be reflected in market values. Moreover, stock prices should embed all the information currently available on the firm's R&D investments and should react to any new information arrival about those investments for these reasons, a number of researchers have turned to stock market value as an indicator of the firm's expected economic results from investing in R&D. Indian IT has a large software services export industry with an exceedingly fast growth rate. R&D collaborations between R&D units, network with IT firms. It is important to find out the nature and characteristics of units that network and the consequences of networking to the units and foreign collaboration. India: Software services remain the dominant output, accounting for more than 90% of the industry's sales revenue, rather than packaged software products. Beyond the impact of R&D expenditure on a firm's market value, it has a significant influence on the firm's financial performance. We will review the impact of R&D expenditure on a firm's revenue and profitability.

This paper will focus on the statistical evidence of R&D spending on a firm's financial performance. It also examines the effects of other firm characteristics. R&D activities may also influence firm's revenue growth, short-term profitability, and long-term economic performance. The rest of the paper is organized as follows:

section 2 gives literature review, section 3 gives data and methodology; in section 4 we present the empirical results with discussions and finally section 5 provide concluding remarks.

II. LITERATURE REVIEW

According to the study by Dutta and Rao(1999) , the factors like marketings, R&D and operation capabilities are important determinants of financial performance in high technology industries. The study of Lau(1998) suggest that the difference of ROA between hogh and low R&D intensity firms is marginally significant, he also conclude that high R&D intensity do not imply higher ROA. But according to the study by Chen *et al*. (2005) , there exist a positive relationship among R&D intensity and both the profitability measure – Return on Assets (ROA) and Return on Equity (ROE) which implies that for firm's future growth and profit, R&D investment is very important. Quo *et al*. (2004) argued that R&D intensity has a significant negative impact on profitability and firm size has a significant influence on R&D expenditure and firm's performance. Ho *et al*. (2005) found significant negative relationship between firm size and R&D intensity and also found positive relationship between firm size and market to book value ratio. This indicate bigger firms have higher market value than smaller firms, but smaller firms are more innovative if their R&D intensity is higher compared to bigger firms. Moving on to the studies based on relationship between firm's size and profitability, the study by Kotabe *et al*. (2002) suggest a strong positive significant relationship between firm size and ROA, which indicate that bigger firms are more profitable and manages their assets to increase their profit. In contrast Lin *et al.* (2006) found significant negative relationship between firm size and Tobin's Q indicating bigger firms have lower growth potential compared to smaller firms. Quo *et al.* (2004) found that firm size has a positive impact on productivity and no significant influence on profitability. The reason behind the positive impact of firm size on productivity is due to the economies of scale of large firms. The relationship among R&D intensity, firm size, profitability measures remains ambiguous as many studies have found both positive and negative relationship among them.

III. DATA AND METHODOLOGY

The data for the empirical analysis is derived from the Center for Monitoring Indian Economy (CMIE) PROWESS Data base for the 154 software firms in IT industry of Indian Economy. We have downloaded data from 1992 to 2011. Sample size and

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period are based on the availability of data. We will use pooled data for the empirical analysis. The list of variables used in this study, are as follows:

Table No. 1: Definition of the Variables

Sl. No.	Variable	Variable	Definition of the Variable
1	Stock Excess Return	R	Annual common stock excess return per share cumulated beginning nine months before to three months after the fiscal year end for firm i
2	Earnings Per Share	EPS	A financial measure that represents a per share assessment of the minimum value of a company's equity.
3	Research & Development Intensity	RDI	R&D intensity is the ratio of R&D expenditure and net total assets at fiscal year end and is denoted here by R&D INT.
4	Change in earning per share	DEPS	changes in earnings per share before R&D for firm i
5	Interaction 1	DRDI	Interaction between RDI and Change in earning per share
6	Size	Size	Firm size is defined as the natural logarithm of a firm's Sales at fiscal year end and is denoted here as SIZE.
7	Book to market value	BMV	A ratio used to find the value of a company by comparing the book value of a firm to its market value.
8	H- Index	H	A commonly accepted measure of market concentration. It is calculated by squaring the market share of each firm competing in a market
9	Age of the firm	Age	Year of study minus year of incorporation
10	Aggregate Market Share	AM	Aggregate market share of a firm is the firm's total sales divided by total industry sales.
11	Labour Intensity	LI	Labor intensity is the relative proportion of labor (compared to capital) used in a process. Its inverse is capital intensity
12	Multinational Affiliation	MNE	MNE are organizations that own or control production or services facilities in one or more countries other than the home country, in this case a value takes 1 for the MNE affiliate and 0 otherwise

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3.1 Hypotheses

The hypotheses of the study are as follows:

1. The market valuation of R&D spending is a positive function of expected R&D productivity as depicted by labour intensity.
2. The market valuation of R&D spending is positively related to a firm's product market share.
3. Market valuation of R&D expenditures is a function of the firm's average product age.
4. The market valuation of R&D is higher for firms that diversify into different product categories (within the same industry) than those who do not diversify.

3.2 Control variables

A sizable literature exists on the effect of firm size on market valuation. In general, large firms have smaller earnings response coefficients than small firms. In the R&D context, Holthausen, Larcker and Sloan (1995) argue that centralization is necessary for large firms to control employee managers, and that a more centralized firm tends to inhibit innovation due to its more bureaucratic control mechanisms. To the extent that firm size proxies for centralization, firm size could show a negative correlation with the market valuation of R&D spending. However, firm size is also related to the availability of financial resources. If the availability of financial resources can facilitate innovation efficiency, firm size will be positively correlated with the market valuation of R&D. Since the size effect on the market valuation of R&D investment is ambiguous but the effect of size in firm valuation is well documented, firm size only is used as a control variable in the study. In addition to Firm Size, we adopted multinational affiliation of firms as other control variable.

3.3 Methodology

To evaluate the four hypotheses presented above, we use the returns model presented by Easton and Harris (1991), Easton and Zmijewski (1989), Collins *et* al. (1994). This model depicts returns as a function of earnings and the change in earnings. The basic empirical model estimated can be presented as follows:

$$R_i = \alpha_1 + \beta_1 + \beta_1(RDI)_i + \beta_2(DRDI)_i + \beta_3(EPS)_i + \beta_4(EPSD)_i + \beta_5(DPES)_i + \beta_6(SIZE)_i + \beta_7(BMV)_i + \beta_7(MNE)_i + u_i \quad (3.1)$$

All variables except the R, and SIZE are scaled by the market value at the beginning of the year.

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IV. EMPIRICAL RESULTS

Table 2 presents descriptive statistics of the variables that we use in our analysis. The average of the variable research and development intensity (RDI) and price to book value (PBV) is pretty low around 0.07 and 0.05 respectively. Mean is low for labor intensity (LI). It is very high for total Asset and Net Income. The variability of research and development intensity (RDI), price to book value (PBV) and labor intensity (LI) variable is low. It is high in case of variable RDI and total Asset.

Table 2. Summary Statistics of the sample firms For the Years 1997–2011.

Variables	Mean	Standard Deviation	Minimum	Maximum	25%	75 %
Net Income	28464.13	65175.52	33.1	299311.2	388.8	11998.7
Research and Development Expenses	497.22	1444.84	0.1	10480	15.5	282
Total Asset	30583.36	66280.13	26.2	344350	735	16260
Price to Book Value	0.05	0.077	0.001	0.499	0.009	0.063
R&D Intensity	0.07	0.13	0.0004	0.882	0.006	0.057
Labour Intensity	0.83	0.55	0.04	1.889	0.297	1.354

Table 3. Sample statistics of product market structure variables sample period: 1997–2011

Variables	Mean	Median	Standard Deviation	Minimum	Maximum
Age of the sample firm's average product on the market	18.603	17	11.312	3	66
Herfindahl Index	0.533	0.604	0.283	0.025	0.934
Aggregate market share	10.810	1.097	17.032	0.006	74.771
Weighted average market share	-0.001	-0.011	12.314	-35.51	61.016
Market value of common equity	3776.33	441.344	11382.77	5.202	60653.5

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Table 3 presents descriptive statistics of the variables that we use in our analysis. The average of the variable Herfindahl Index (HI) and Weighted average market share (WAMS) is low around 0.53 and negative - 0.001 respectively. Mean is very high for Age of the sample firm's average product on the market, Aggregate market Share (AMS) and Market value (MV). The variability of HI variable is very low. It is high in variable Age , AMS and WAMS and very high in case of variable MV.

Table-4 Correlations among the variables of interest

A. Spearman correlation of product market structure variables of the main sample					
Variables	Average Product Age	Herfindahl Index	Weighted Average Market Share	Firm Size	Labour Intensity
Average Product Age	1				
Herfindahl Index	-0.187	1			
Weighted Average Market Share	-0.020	-0.035	1		
Firm Size	0.036	-0.009	0.091	1	
Labour Intensity	0.016	0.074	0.065	0.276	1

B. Spearman correlation of percentage of labor intensity with cost structure variables				
Variables	R&D to Revenue	Cost to Revenue	PI	Cost Excluding R&D to Revenue
Labour Intensity	0.229	0.286	0.286	0.248

From table 4 we can observe that Herfindahl Index (H) is negatively correlated to Average Product Age. Weighted Average Market Share (WAMS) is negative correlated to both Average Product Age and Herfindahl Index (HI). Firm Size is weakly correlated to Average Product Age or WAMS and negatively correlated to HI. Labour Intensity (LI) is 27% correlated to Firm Size. LI variable has positively correlated to all variable i.e AGE, SIZE, HI, WAMS, and LI.
Labour Intensity is 28% correlated to Cost to Revenue and PI . Labour intensity is low correlated to R&D to Revenue and Cost Excluding R&D to Revenue.

4.1. Test of Hypothesis H1

Panel-A of Table 5 presents the results of evaluating Hypothesis H1 in the sample. Hypothesis H1 predicts that R&D spending is more valuable for firms which exhibit higher future R&D productivity as measured by the labour intensity. In Panel-A; RDI is the variable which is turning out to be significant at 1% level of significant. DEPS is significant at 10% level of significant. R- Square is 0.50 by using OLS model. One unit increase in DEPS will lead to 0.1% increase in RDR. The regression analyses support Hypothesis 1.

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4.2. Test of Hypothesis H2

Because the market structure information used in this study is compiled based on CMIE data, the regression results reported here are weighted by percentage of sales derived from net sales. However, to ensure a minimum representation, a ten percent weight is imposed on firms that derive less than that proportion of sales from retail markets. The results reported here are not affected when the regressions are weighted by imposing a minimum of one percent weight, when three different weights are assigned to three levels of net sales, or when non-weighted regressions are run. Regarding market competition, Hypothesis H2 predicts that the market valuation of R&D is positively related to market share. Panel B of Table 4 shows the results on the market competition hypothesis. In Panel-B; RDI, DRDI, SIZE and BMV is the variable which is turning out to be significant at 10% level of significant. R-Square is 0.75 by using OLS model. One unit increase in SIZE will lead to 1% decrease in RDR and same as 1 unit increase in BMV will lead to 11% decrease in RDR. An increase in R&D spending is apparently viewed by investors as beneficial to a firm only if the firm has a large market share. Without factoring in the market competition environment, a study may mistakenly conclude that incremental R&D is always priced positively by the market. The analysis using weighted average market share, although not reported, produces similar results.

4.3. Test of Hypothesis H3

Panel C of Table 4 reports the regression results of the Life Cycle Hypothesis. The purpose of the regression is to examine the extent to which being in the middle part of product life cycle stage (relative to the other stages) adds to the market value of software development cost. In Panel-C; SIZE is the variable which is turning out to be significant at 1% level of significant. RDI, EPS and DEPS are significant at 5% level of significant. DRDI and DRDID are significant at 10% level of significant. R- Square is 0.75 by using OLS model. One unit increase in SIZE will lead to 55% decrease in RDR and same as 1 unit increase in EPS and DEPS will lead to 0.2% and 0.1% increase in RDR.

4.4. Test of Hypothesis H4

Panel D of Table 4 reports the results for the diversification hypothesis. The hypothesis predicts that R&D spending is more valuable for a diversified firm than not diversified firm. In Panel-D; RDI is the variable which is turning out to be significant at 1% level of significant. EPS and DEPS are significant at 10% level of significant. R- Square is 0.34 by using OLS model. One unit increase in EPS will lead to 0.3% decrease in RDR and same as 1 unit increase in DEPS will lead to 0.3% increase in RDR. Changes in R&D itself is significant in three of the regressions but the interaction term of change in R&D and the factors is, indicating some degree of

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investor sophistication. That is, investors do not simply regard more R&D spending as value-increasing activity unless the firm is either more productive (higher proportion of technical employees), has larger market share, provides diversified product offerings, or is in the middle stage of product life cycle - consistent with the predictions of our hypotheses. Overall, the empirical analyses offer support to the hypothesis that the market valuation of R&D is not cross-sectional constant and that market share, product diversification, product life cycle, and the frequency of product innovation together have some incremental ability to explain the cross-sectional variation in the market valuation of R&D expenditures.

Table 5. Results of the regressions to evaluate the effect of R&D variables on valuation of software firms (with robust standard errors)

Variable	*Intercept*	*RDI*	*DRDI*	*MNE*	*DRDID*	*EPS*	*DEPS*	*SIZE*	*BMV*	R^2
Panel A: The effect of percentage of labour intensity on the market valuation of R&D spending										
t-Statistics		3.87	-1.43	-0.95	-0.51	-1.03	1.78	-1.0	-0.01	0.50
Coefficient		23.095	-1.650	-0.306	-4.021	-0.001	0.001	-0.116	-0.008	
VIF		2.21	2.69	1.35	3.1	2.84	1.73	3.24	1.34	
Panel B: The effect of market share on the market valuation of R&D spending Parameter										
t-Statistics		1.99	1.85	-0.44	-0.83	1.1	-1.47	-1.72	-1.7	0.75
Coefficient		2.879	1.914	-0.012	-1.490	0.0001	-0.00009	-0.018	-0.116	
VIF		3.16	1.78	8.17	1.47	14.22	1.77	5.17	1.2	
Panel C: The effect of Age on the market valuation of R&D spending—Returns regression results										
t-Statistics		2.09	-1.76	-1.02	1.7	2.15	2.02	-2.71	1.4	0.75
Coefficient		7.448	-8.853	-0.248	8.800	0.002	0.001	-0.551	0.568	
VIF		2.88	59.15	1.32	57.06	3.64	2.46	4.43	1.46	
Panel D: The effect of H-index on the market valuation of R&D spending										
t-Statistics		2.52	-1.01	-0.39	-0.56	-1.75	1.87	1.49	-0.96	0.34
Coefficient		27.605	-2.693	-0.237	-4.405	-0.003	0.003	0.323	-4.478	
VIF		3.07	6.09	1.32	7.16	1.94	1.25	2.76	2.24	

V. CONCLUSION

This paper empirically investigates the impact of R&D expenditure on four key market valuation variables – labor intensity, market share, age and H- index - in Indian IT firms. We found that compared to large firms, smaller firms invest more on R&D and in turn are more productive in innovation. From the results we can also see that research and development intensity, difference in research and development intensity, earning per share, difference in earning per share are significantly related to the return from R&D. We conclude that the market valuation of R&D spending is a positive function of expected R&D productivity and related to labour intensity, the market valuation of R&D spending is positively related to a firm's product market share, market valuation of R&D expenditures is related to firm's average product life cycle stage and; the market valuation of R&D is higher for firms that diversify into different product categories (within the same industry) than those who do not diversify. An extension of this study could be to investigate the investor's valuation of R&D expenditure for the larger and the smaller firms in the Indian industries.

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