A Study on Impact of Research and Development Expenditure on Financial Performance of Indian Pharmaceutical Companies

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ABSTRACT: The project titled A study on financial performance‖ conducted in Ramco Cement Ltd is to analyze the financial position of the Company. The objective of this project is to find out the efficiency of the Company using financial ratios like profitability ratios, turnover ratio & solvency ratio of the Company, to find out the liquidity position of the Company, to study the performance of Company through comparative analysis and to provide suitable suggestions improving the financial performance of the Company. The project is pertained to the Company's data available for the past five years. The conclusions are drawn from the analysis done with the ratios, comparative, common size study. The study evaluates the financial position of the Company with respect to the past five years. It helps the Company to place itself among various other competitive companies. The study through the analysis reveals the pros and cons of the Company's financial status. It enables the reader to understand the various financial aspects of a Company through uncomplicated interpretation and findings for study purposes.

I. INTRODUCTION

In the fast-paced world of global business, companies strive for sustainable growth and a competitive edge. Research and development (R&D) spending stands out as a crucial investment, driving innovation and financial strength. This thesis explores the intricate relationship between R&D spending and financial performance across industries, aiming to uncover strategic insights for corporate leaders, investors, and policymakers. R&D expenditure symbolizes more than just financial investment; it represents a commitment to innovation and competitive advantage. By examining this relationship, the thesis aims to reveal underlying mechanisms and provide actionable insights for businesses navigating today's dynamic market. Understanding this link is vital for strategic decision-making and policy discussions, offering stakeholders a roadmap for success in an era of constant change and disruption. Through rigorous analysis and synthesis, the thesis delves into corporate strategy, financial analysis, and innovation management to shed light on the transformative potential of R&D spending.

II. METHODOLOGY

2.1 Research Objectives
Analyzing R&D expenses helps understand their impact on sales turnover, return on assets (ROA), return on equity (ROE)/net worth, and market capitalization. Higher R&D spending typically correlates with increased sales, improved ROA and ROE, and a higher market value, indicating a commitment to innovation and future growth.

2.2 Framing of Research Hypotheses
Hypothesis I:
R&D activities and Sales Turnover The concept of sales turnover is useful for tracking sales levels on yearly basis to evaluate meaningful changes in the selling activity level of a particular pharmaceutical company. In this study natural logarithm of Sales Turnover (variable name used as LN_ST) has been incorporated. The reason for which logarithm of Sales Turnover has been incorporated in this study is to ensure measurement compatibility with the other variables used in the panel regression model. The calculation period of Sales Turnover is one financial year (1st April to 31st March).

Sales Turnover = Monthly Sales X 12 Months

With respect to this study, following hypothesis will be tested. H1: R&D activities have significant relation with Sales Turnover
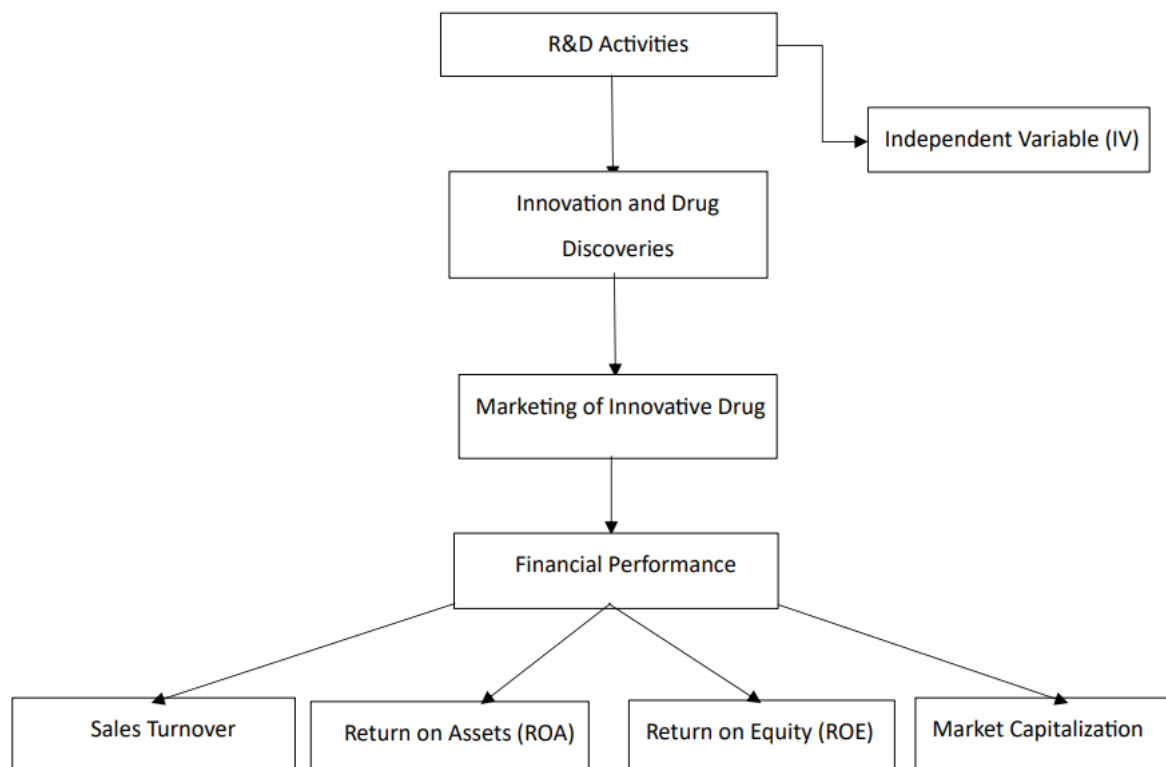
Hypothesis II:
R&D activities and Return on Assets (ROA) Return on Assets is an indicator which explains that how efficient the management is in converting the assets of the firms into net income. After reviewing the existing literatures it has been

found that in some studies where Return on Assets has been incorporated as financial performance related measuring variable. As far as the definition goes ROA is calculated by dividing a company's annual earnings by its total assets. In this research work, ROA has been considered as percentage.

$$ROA = Annual\ Earnings\ /\ Total\ Assets$$

H2: R&D activities have significant relation with Return on Assets

Hypothesis III:

R&D activities and Return on Equity (ROE) We know that Return on Equity is an indicator that shows how well the owners' resources have been utilized by the firm to achieve the most desirable objective of shareholders' wealth maximization. During reviewing the literatures, it has been found that various researchers have used ROE as a measure of financial performance in their respective studies. In this research work, Return on Equity has been considered as percentage.

$$ROE = Net\ Income\ /\ Average\ Shareholders'\ Equity$$

With respect to this study, following hypothesis will be tested.

H3: R&D activities have significant relation with Return on Equity

From the perspective of the investor, it's easy to get confused between ROA and ROE since these two financial performance related metrics seem pretty similar and they both measure a kind of return. Both ROA and ROE estimate a company's ability to generate earnings from its investments. But on ground reality they don't exactly represent the same thing.

The main factors that separate ROA and ROE are discussed in the following.

✓ Factor I-Measurement: ROA measures how much a company earns from their resources or assets. Whereas ROE deals with the amount of profit a company receives from the shareholder's investments.

✓ Factor II- Debt: Once of the important factors which differentiate ROA from ROE is debt which is included into the company's balance sheet. In case of ROA the balance sheet equation becomes

$$Total\ Assets = Liabilities + Shareholders'\ Equity$$

✓ Factor III-Role: ROA deals with operating management and helps to determine the efficiency of it whereas ROE helps to determine the efficiency of capital or financial management.

✓ Factor IV-Dividend: Preferred dividend is not required while calculating ROA, whereas ROE can be calculated by dividing preferred dividends from the numerator.

✓ Factor V-Formula: ROA can be calculated as: ROA= Net Profit / Average Total Assets ✓ whereas ROE is calculated as:

$$ROE= Net\ Profit\ /\ Average\ Shareholder's\ Equity$$

✓ Factor VI-Impact: ROA is better measure to determine the financial performance of a company. Whereas higher ROE does not impact impressive performance about the company.

✓ Factor VII-Effect: Higher ROE can be misleading with lower ROA and huge debt carried by the company.

Hypothesis IV:

R&D activities and Market Capitalization A number of researchers have taken Market Capitalization as one of the indicators of financial performance in their respective studies. As far as the concept of market capitalization is concerned it is essentially the amount of money it would take to purchase an entire company based on its current stock price. It is generally calculated by multiplying the total number of shares outstanding by the current price of a single share of stock.

Market Capitalization = Total Outstanding Shares X Present Share Price

2.3 Research Design

The list of the sample companies shown in Table 1 which is placed in appendix section. Study period has been chosen from 2012 to 2016 (1st April 2012 to 31st March 2016) i.e. 5 years to comply with financial year opening as well as closing norms.

Table 1. List of Indian Pharmaceutical Companies

Sl. No	Pharmaceutical Companies
1	Dr, Reddy's Lab
2	Biocon
3	Alembic
4	Cipla
5	Nacto Pharma
6	Suven Life Science
7	Indoco Remedies
8	Shipla Medicare
9	IPCA Laboratories

3.Data Analysis and Interpretation

Table 2 provides the complete overview of different types of variables (DV, IV and CV) which will be incorporated in the panel regression analysis for establishing the relationship between financial performance and R&D Activities with respect to Indian pharmaceutical companies listed with the national stock exchange (NSE) of India.

Table 2. Variable Description

Variable Code	Variable Description	Variable Notation	Variable Type	Measurement
Y1	Sales Turnover	ST	Dependent (DV)	Ln_ST
Y2	Return on Assets	ROA	Dependent (DV)	Annual Earnings / Total Assets
Y3	Return on Equity	ROE	Dependent (DV)	Net Income / Equity
Y4	Market Capitalization	MC	Dependent (DV)	Ln_MC
X1	R&D Intensity	RDI	Independent (IV)	R&D Expenses / Net Sales
X2	Ad & Marketing Intensity	AMI	Control (CV)	Ad & Marketing Expenses / Net Sales
X3	Capital Intensity	CI	Control (CV)	Fixed Assets / Net Sales
X4	Operating Expenses to Total Assets Ratio	OER	Control (CV)	Operating Expenses / Total Assets

Empirical Models

To determine the influence of R&D activities of NSE listed Indian pharmaceutical companies on their financial performance; panel regression analysis has been applied with the help of strongly balanced panel dataset by incorporating four different financial performance related variables: Sales Turnover, Return on Assets, Return on Equity and Market Capitalization one after another and the empirical models will be estimated in this study are shown in the following.

Ln_ST_{it} = $\alpha + \beta 1_{it} RDI_{it} + \beta 2 AMI_{it} + \beta 3 CI_{it} + \beta 4 OER_{it} + \epsilon_{it}$

ROA_{it} = $\alpha + \beta 1 RDI_{it} + \beta 2 AMI_{it} + \beta 3 CI_{it} + \beta 4 OER_{it} + \epsilon_{it}$ ROE_{it} = $\alpha + \beta 1 RDI_{it} + \beta 2 AMI_{it} + \beta 3 CI_{it} + \beta 4 OER_{it} + \epsilon_{it}$

Ln_MC_{it} = $\alpha + \beta 1 RDI_{it} + \beta 2 AMI_{it} + \beta 3 CI_{it} + \beta 4 OER_{it} + \epsilon_{it}$

Where, Ln_ST_{it} = Natural Logarithm of Sales Turnover

ROA_{it} = Return on Assets

ROE_{it} = Return on Equity

Ln_MC_{it} = Natural Logarithm of Market Capitalization

RDI_{it} = Research & Development Intensity

AMI_{it} = Advertisement & Marketing Intensity

CI_{it} = Capital Intensity

OER_{it} = Operating Expenditure to Total Assets Ratio

ϵ_{it} = Error Term Descriptive Statistics

Descriptive Statistics

Table 3 presents a comprehensive overview of 45 observations derived from nine NSE-listed Indian pharmaceutical companies over a five-year period. The descriptive statistics cover variables used in panel regression models, including sales turnover (Ln_ST), return on assets (ROA), return on equity (ROE), and market capitalization (Ln_MC), along with explanatory factors like research and development intensity (RDI), advertising and marketing intensity (AMI), capital intensity (CI), firm size (FS), and operating expenditure to total assets ratio (OER). Notably, R&D expenditure exhibits significant variance, with an average investment of 0.51 crore and a range from 0.01 crore to 4.71 crore. Conversely, advertising and marketing expenditure averages lower at 0.20 crore. Similarly, capital intensity and operating expenditure also show dispersion, likely influenced by varying business strategies and practices. Overall, these statistics offer insights into the financial performance of Indian pharmaceutical companies, highlighting the impact of diverse factors and strategies on company performance during the study period.

Table 3. Descriptive statistics

Variable	Obs.	Mean	S.D	Min.	Max.
LN_ST (Cr.)	45	7.43	1.36	4.50	9.65
ROA (%)	45	10.47	4.91	2.39	31.89
ROE (%)	45	17.10	8.95	4.12	45.62
LN_MC (Cr.)	45	8.65	1.36	6.63	10.99
RDI (%)	45	0.51	0.91	0.01	4.17
AMI (%)	45	0.20	0.27	0.01	1.34
CI (%)	45	1.05	0.28	0.62	2.00
OER (%)	45	1.10	1.24	0.15	4.39

Bivariate Correlation Matrix

It is imperative to check correlation among the variables before proceeding with the panel regression models. Table 4 reports the results of the pair-wise correlation between all the variables (dependent, independent and control variables) incorporated in the strongly balanced panel dataset for this study

Table 4. Bi-variate Correlation Matrix

Variables	LN_ST	ROA	ROE	LN_MC	RDI	AMI	CI
LN_ST	1						
ROA	0.301419	1					
	0.00	0.00					
ROE	0.296917	0.8715	1				
	0.00	0.00	0.00				
LN_MC	0.933166	0.157502	0.13378	1			
	0.00	0.00	0.00	0.00			
RDI	-0.42376	-0.30917	-0.29215	-0.25198508	1		
	0.00	0.00	0.00	0.00	0.00		
AMI	-0.53714	-0.29021	-0.28446	-0.451701	0.647761363	1	
	0.00	0.00	0.00	0.00	0.00	0.00	
CI	-0.17682	-0.49204	-0.65538	-0.02065327	0.278892614	0.146493	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OER	0.425093	0.078855	0.144979	0.455224622	0.359953143	0.071292	-0.05673
	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4 presents the bivariate correlation matrix showing the correlation between dependent variables (Ln_ST, ROA, ROE, Ln_MC), independent variable (RDI), and control variables (AMI, CI, FS, OER). The dataset is strongly balanced, indicating no serial correlation. All coefficient estimates are statistically significant at the 5% level, making this correlation matrix a good fit for the study.

Empirical Models and Panel Regression

The panel regression results for models I, II, III, and IV are summarized based on the Hausman Test outcomes. The preferred model is determined by comparing the p-value of the $\chi 2$ statistic: if it's less than 0.05, the Fixed Effect Model (FFM) is chosen, while if it's greater than 0.05, the Random Effect Model (REM) is selected. The results are then discussed for each model accordingly.

Empirical Model I: Random Effect Model

The model exhibits strong fit with $\chi 2 = 6930.69$ and $p < 0.05$. The $R2$ value is 0.9631, indicating that 96.31% of variability can be forecasted. RDI and AMI positively impact Ln_ST significantly at 1% level. FS has a positive significant effect at 5% level. CI also shows a positive significant effect at 1% level. OER positively impacts Ln_ST significantly at 10% level.

Empirical Model II: Fixed Effect Model

The model is a good fit for study with F Statistics = 5293.43 and $p < 0.05$. The $R2$ value is 0.9859, indicating the model can explain 98.59% variability. RDI positively affects ROA significantly at 1% level. CI has a positive significant effect on ROA at 1% level. Both AMI and FS variables positively impact ROA significantly at 1% level. OER positively influences ROA significantly at 5% level.

Independent Variables	Dependent Variable for Empirical Model #1 FEM Coefficients (p value) LN_ST	Dependent Variable for Empirical Model #2 FEM Coefficients (p value) ROA	Dependent Variable for Empirical Model #3 FEM Coefficients (p value) ROE	Dependent Variable for Empirical Model #4 FEM Coefficients (p value) LN_MC
Constant	4704.379*** 0	0.323*** 0	34.270*** 0	6305.0*** 0
RDI	1158.966*** 0	5.605*** 0	6.458*** 0	1828.51*** 0
AMI	1341.299*** 0	36.898*** 0	130.987*** 0	2344.07*** 0
CI	2016.204*** 0	1.502*** 0	10.232*** 0	7576.04*** 0
OER	5916.056*** 0	0.915*** 0	6.415*** 0	1513.43*** 0

Empirical Model III: Fixed Effect Model

The model is a good fit for study with F Statistics = 6127.28 and $p < 0.05$. The R^2 value is 0.9982, indicating the model can explain 99.82% variability. RDI positively affects ROE significantly at 1% level. AMI positively impacts ROE significantly at 5% level. CI has a positive significant effect on ROE at 10% level. FS positively influences ROE significantly at 5% level. OER positively affects ROE significantly at 5% level.

Empirical Model IV: Fixed Effect Model

The model is a good fit for the study with F Statistics = 595.90 and $p < 0.05$. The R^2 value is 0.9751, indicating the model can forecast 97.51% variability. RDI and AMI positively impact Ln_MC significantly at 1% level. CI has a positive significant effect on Ln_MC at 5% level. FS positively influences Ln_MC significantly at 5% level. OER positively affects Ln_MC significantly at 5% level.

Summarized Panel Regression Results:

Empirical Mode	DV	RDI_{it}	AMI_{it}	CI_{it}	OER_{it}
I	Ln_ST_{it}	S	S	S	S
II	ROA_{it}	S	S	S	S
III	ROE_{it}	S	S	S	S
IV	Ln_MC_{it}	S	S	S	S

The study finds significant positive impacts of Research & Development (R&D) activities on the financial performance of Indian pharmaceutical companies across all dependent variables (LN_ST, ROA, ROE, and Ln_ST). This reflects companies' enthusiasm for innovation and drug discovery, leading to new healthcare solutions and business opportunities. Advertising and Marketing Intensity (AMI) also positively influences financial performance, indicating effective marketing strategies. Capital Intensity (CI) and Firm Size (FS) show significant impacts, suggesting efficient asset utilization and effective management decisions. Operating Expenditure to Total Assets Ratio (OER) positively affects financial performance, indicating operational efficiency and competitive advantage. Overall, R&D investments play a crucial role in enhancing financial performance, reflecting long-term endeavors and breakthrough innovations benefiting both companies and society.

III. CONCLUSION

This study provides insights into enhancing financial performance in the Indian pharmaceutical sector through factors like research and development, marketing strategies, capital utilization, firm size, and operational efficiency. Moving

forward, pharmaceutical companies should prioritize investments in innovation, effective marketing, and strategic management to drive sustainable growth. Future research should address limitations by exploring additional factors, expanding the scope, and extending the analysis over a longer period. By doing so, stakeholders can gain deeper insights to foster innovation, drive economic growth, and improve healthcare outcomes.

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