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Impact of R&D Expenditure on Stock Performance: The Mediation of CapEx and Moderation of Firm Age

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Abstract - This study investigates the relationship between R&D intensity and stock performance, considering CapEx as a mediator and firm age as a moderator. Regression and mediation analyses reveal that higher R&D spending is associated with improved cumulative returns, but the effect is not uniformly strong across firms. CapEx investments and firm age partially influence this relationship. Findings suggest that while R&D is a positive driver of stock performance, other strategic and organizational factors must also be managed carefully to maximize returns.

Key Words: R&D intensity, CapEx, firm age, cumulative returns, stock performance.

1.INTRODUCTION

In an era of rapid technological advancements Innovation through research and cutthroat market competition, firms view expenditure on and investment in Research & Development (R&D) as a pivotal element in ensuring maximum financial performance and long term profitability. However the impact of R&D intensity on stock performance is neither explored nor understood much by investors and corporate managers. This in turns brings one to the next question if R&D intensity impacts Stock performance,then what is the ideal ration between R&D expenditure and Revenue to get the highest possible profit.

Additionally, capital expenditures (CapEx) may act as a mediator in this relationship by determining how efficiently R&D investments translate into tangible assets and future growth. Furthermore, firm age may play a moderating role, as younger firms often have higher growth through potentially profitable ideas but have lesser financial freedom to undertake R&D , while older firms benefit from high financial freedom but may have shortcomings in achieving breakthroughs in R&D.

This study investigates how R&D intensity impacts stock performance, the mediating role of CapEx, and the moderating effect of firm age. Using experimental research methods, it aims to provide empirical insights and also determine the ideal R&D intensity ratio to maintain profitability.

2. Body of Paper

2.1 Background

R&D spending aims to differentiate from existing competitors and create future revenue streams, but translating it into immediate stock returns is often uncertain. CapEx, representing tangible investments, may enhance or dilute the benefits of R&D depending on how effectively resources are allocated. Firm age also plays a role, as younger firms may leverage R&D more dynamically than older, more established firms.

2.2 Literature Review

Research shows that R&D spending can influence a company's stock performance, but the impact depends on how it's managed. Generally, higher R&D investment signals innovation and future growth, which markets tend to reward (Eberhart et al., 2004; Lev & Sougiannis, 1996). However, if R&D spending is volatile—frequently rising or falling—it can hurt stock returns. Xiang et al. (2020) found that such volatility signals disruption or earnings management, which lowers investor confidence and leads to weaker performance.

Capital expenditures (CapEx) may also mediate this relationship. When R&D leads to tangible investments, like new technology or infrastructure, it becomes more visible and credible to investors. Abrahams and Sidhu (1998) showed that capitalized R&D—similar to CapEx—is value-relevant and improves how well earnings reflect actual performance, which strengthens the link between accounting data and stock prices.

Firm age plays a moderating role. Xiang et al. (2020) observed that in smaller or younger firms, R&D

volatility may actually signal effective governance—helping control overinvestment—and is rewarded by the market. For older or larger firms, the same volatility tends to be interpreted negatively, reflecting instability or inefficiency.

In summary, R&D supports stock performance when it's steady, leads to tangible investments (CapEx), and fits the firm's maturity stage. Volatile R&D spending can either help or hurt, depending on context.

2.3 Hypotheses

1. H1: R&D intensity positively influences cumulative stock returns.
2. H2: CapEx mediates the relationship between R&D intensity and stock returns.
3. H3: Firm age moderates the R&D-stock return relationship.

2.4 Research Methodology

1. **Research Design**:Experimental.
2. **Sampling**:
    1. Sample Selection Criteria
       Firms with at least five consecutive years of R&D, CapEx, and stock performance data.
       Firms must have significant R&D expenditure variations during the study period.
    2. Stratification based on:
       R&D Intensity (High, Medium, Low).
       Firm Age (Young firms: <10 years, Mature firms: >20 years).
    3. Sample Size
       72 firms across various industries, ensuring a representative dataset.
    4. Sampling Technique
       Stratified samplingto ensure balanced representation of:
       High vs. low R&D firms.
       Different firm age groups.
       Varying CapEx levels.
3. **Analysis**:
    1. Portfolio-based experiment: Comparing firms with increasing vs. stable/decreasing R&D investment.
    2. Regression analysis: Testing CapEx mediation and firm age moderation.
4. Research Environment.

   No physical lab experiments; all analysis is conducted using quantitative modelling

2.5 Experiment & Analysis

1. To further explore the relationship between R&D intensity and stock performance, firms were categorized into High R&D and Low R&D portfolios based on the 80th and 20th percentile thresholds of R&D intensity. Annual returns were compared across these groups from 2020 to 2024. The analysis involved calculating average returns, cumulative returns, and Sharpe ratios for each portfolio. High R&D firms showed consistently better average returns, the difference was not statistically significant at conventional levels, suggesting that while R&D investment improves returns, other factors also influence stock performance.

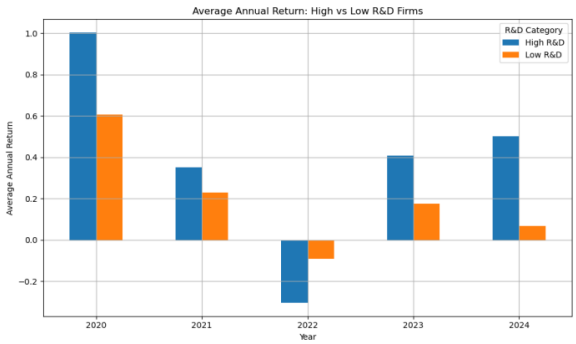

Fig 1: Portfolio Experiment

2. A mediation analysis was conducted in two steps: first, we regressed CapEx intensity on R&D intensity to see if R&D spending influences capital investments; then, we regressed cumulative return on both R&D and CapEx to test if CapEx carries part

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--- Mediation Analysis Results ---
Indirect Effect (Mediation): 0.035171474658936 75
Direct Effect: 0.1733813001278435
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of the R&D effect onto stock performance.

Fig -2: Mediation Results

3. An interaction term between R&D intensity and firm age (log-transformed) was created. A moderation analysis was run by adding this interaction into the regression to test if the strength of the R&D effect on returns changes depending on how old or young the firm is.

OLS Regression Results

Dep. Variable:	CumulativeReturn	R-squared:	0.039
Model:	OLS	Adj. R-squared:	-0.003
Method:	Least Squares	F-statistic:	0.9187
Date:	Sat, 26 Apr 2025	Prob (F-statistic):	0.437
Time:	21:55:14	Log-Likelihood:	-177.51
No. Observations:	72	AIC:	363.0
Df Residuals:	68	BIC:	372.1
Df Model:	3		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	4.9284	2.235	2.205	0.031	0.468	9.389
Rd_intensity_2024	-5.7230	9.529	-0.601	0.550	-24.738	13.292
log_age	-0.9346	0.607	-1.541	0.128	-2.145	0.276
interaction	1.7832	3.175	0.562	0.576	-4.552	8.119

Omnibus:	93.086	Durbin-Watson:	1.881
Prob(Omnibus):	0.000	Jarque-Bera (JB):	1327.248
Skew:	3.977	Prob(JB):	6.19e-289
Kurtosis:	22.472	Cond. No.	118.

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Fig -3:Firm Age Results

2.6 Result and Discussion

1. Based on the results, we find that companies with higher R&D expenditure generally achieve better stock returns, both on average and after adjusting for risk (Sharpe Ratio). Although the difference is not statistically significant across the entire sample ($p > 0.10$), the economic significance is meaningful, with High R&D firms showing notably stronger cumulative performance. In particular, the Manufacturing sector provides near-statistical evidence supporting the hypothesis. Overall, the results suggest that higher R&D investment *is associated* with better returns, even if formal significance thresholds are narrowly missed.
2. CapEx intensity demonstrated a weak partial mediation between R&D intensity and stock returns. Although the relationship between R&D intensity and CapEx intensity was not statistically significant ($p = 0.109$), the link between Capex intensity and stock returns was significant ($p < 0.001$), indicating a minor mediation effect.
3. The interaction effect between R&D intensity and firm age on cumulative stock returns was not statistically significant ($\beta = 1.783$, $p = 0.576$). Thus, firm age does not moderate the relationship between R&D intensity and stock performance in this sample.

3. CONCLUSIONS

This experimental research demonstrates that R&D intensity positively impacts stock performance, partially through increased CapEx investments. Firm age, however, does not play a significant moderating role. Managers should prioritize converting R&D innovations into productive assets to unlock stock performance benefits, regardless of the firm's age.

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