The Effect of Increases and Decreases in R&D Expenses on Company Performance

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The main data sample includes all U.S. non-ADR firms in the Compustat database Active and Research files between 1990 and 2009. From this main sample, unexpected and economically significant changes in annual R&D expenditures, denoted events, are identified. Abnormal stock returns for five years following an event are studied using multifactor models, while abnormal profit margins for the same period are measured using a matched firm methodology.

Small changes, both positive and negative, are shown to induce significant positive abnormal stock returns and positive abnormal profit margins, indicating superior stock and operating performance relative to peers. Large changes yield the opposite; significant negative abnormal stock returns and negative abnormal profit margins, respectively indicating worse-than-expected performance. These results are consistent with the notion of a R&D optimum.

The markets may be slow to react, or react incompletely, to the effect of increases and decreases in R&D expenditures on company performance.

Keywords: Research and Development, R&D, R&D expenses, R&D investments, Abnormal Stock Return, Abnormal Profit Margin, Efficient Market Hypothesis
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1 INTRODUCTION

Research and Development (R&D) is a core activity within any firm, as it is a vital source to obtain and maintain competitive advantages (Zien & Buckler, 1997). In fact, R&D grows increasingly important as the business climate shifts towards technology-centered production driven by innovations and improvement. Consequently, the ability to accurately evaluate R&D investments is paramount to any company seeking growth and improved profitability. Theoretically, R&D investment yield is the output’s expected rate of return over its projected productive lifespan, given some success probability. Empirically, however, valuation has proven difficult, due to the unpredictable long-term nature of R&D investment returns. Many projects never reach commercial use, while the successful projects’ proceeds vary greatly.

The accounting standards for R&D outlays are under constant intensive debate. Generally, expenses generating proceeds solely in the current period are expensed (i.e. recognized as expenses on the income statement), while expenses generating income over multiple periods are capitalized (i.e. recognized as assets on the balance sheet) and thus depreciated and amortized over the corresponding periods. Most, if not all R&D investments likely generate income over multiple periods and are arguably even more long-term than certain capital expenditures. However, current U.S. accounting principles require all R&D outlays to be fully expensed when incurred. This reflects the ever ongoing trade-off between accounting reliability and relevance. Regarding reliability, future proceed uncertainty justifies expensing. Conversely, regarding relevance, the substantial assets created by R&D projects generating income over multiple periods justifies capitalizing. Furthermore, a degree of freedom in constituting R&D remains. This discrepancy seriously hinders financial reporting of R&D intensive companies conceivably causing mispricing.

Company valuation is further complicated by the increasing amount of value tied to intangible assets. In particular, as evident from the ambiguous R&D accounting

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1 See e.g. Kothari et al. (2002), Healy et al. (2002) and Lev & Sougiannis (1996)
2 Generally Accepted Accounting Principles (GAAP) & Statement of Financial Accounting Standards (SFAS) No. 2
convention, R&D activity is difficult to accurately evaluate. As market value is fundamentally the net asset value, both tangible and intangible, mispricing in relation to R&D activity possibly occurs. Furthermore, as growth increasingly depends on R&D and is increasingly tied to intangible assets, mispricing likely intensifies. This has led to immense attention on market R&D activity assessment. For example, Chan et al. (2001) find large excess returns in the subsample of R&D intensive technology firms, while finding no relation between R&D intensity and stock returns in general. Eberhart et al. (2004) identify excess returns for increasing R&D expenditures, plausibly indicating market inefficiencies and R&D valuation inaccuracies.

Numerous studies examine market reactions to newly published information. For example, over (under)-reactions have been shown to occur following corporate events, such as stock repurchases (Ikenberry et al. 1995, 2000) or security offerings (Eberhart & Siddique, 2002). Further studies show stock mispricing attributable to firm characteristics, e.g. the common over-(under)performance of value (growth) stocks (Fama & French, 1992). Many of the studies show that these events are managerial decisions timed to take advantage of stock mispricing. In contrast to the Efficient Market Hypothesis (EMH) of Fama (1970), the market is inaccurate and slow to incorporate publicly available information, resulting in abnormal stock returns.

Examining R&D expenses and stock performance offers new market efficiency insights. If the prospects of a R&D investment are value-creating, i.e. NPV positive, the company stock should instantly reflect this value increase, eradicating any long-term abnormal returns. However, as emphasized by Eberhart et al. (2004) firms holding R&D spending constant offer no new information inducing market reactions. Therefore, identifying market reactions requires incorporating R&D changes. Although Eberhart et al. (ibid) and others have studied the effects of R&D increases, decreases are yet to be studied. Thus, this thesis contributes to the subject by studying the effect of increases and decreases in R&D expenses (hereafter R&D changes) on company performance.
1.1. **Aim of the Thesis**

The aim of this thesis is to study the effect of increases and decreases in R&D expenses on company performance. To study these effects, long-term abnormal stock returns and abnormal profit margins (APM) following R&D changes are examined; the former identifying market reactions to R&D changes, thus offering insights on market efficiency, the latter studying effects on operating performance.

1.2. **Contribution of the Thesis**

This thesis extends previous research in two vital aspects. Whereas previous studies have merely studied increasing or constant R&D expenditures, decreasing R&D expenditures are incorporated to find firstly, whether these changes have any effect on the aforementioned performance measures and secondly, whether the effect is symmetrical to the direction of change, i.e. whether an increase has the same or the opposite effect as a decrease. This facilitates entirely new interesting lines of thought and aspects of analysis. Firstly, one must acknowledge the motives for R&D investments to find that increases and decreases likely occur for entirely different reasons. For example, decreased R&D expenditures may be due to cost cutting, cost-rationalization or simply due to a saturated market no longer offering room for innovation or growth, each reason providing entirely different, even opposite, expectations on future prospects. On the other hand, increases in R&D can be motivated by an aggravated competitive environment demanding more investments or by a company simply possessing the ability to innovate. In addition to studying bilateral R&D changes, this thesis further contributes by including changes of different magnitude, due to possibly diverging motives.

Intriguing questions arise from the contemplation above. Rationally, significantly decreased expenditures more likely signals distress than increased or constant R&D. However, is a company increasing its R&D more, less or equally likely to be in distress than a company holding its R&D constant? Is increased R&D seen as positive and similarly decreased R&D as negative, or is it entirely context dependent? Furthermore, do large changes encounter stronger reactions than smaller changes? Conclusively, does the market fully incorporate the value of R&D?
1.3. **Structure of the Thesis**

After this introductory part, the thesis is divided into three main parts, constituting the theoretical framework (I), an empirical methodology (II) and finally result analysis (III). The theoretical part includes relevant theory surrounding R&D and market efficiency, and presents previous research related to this study. The empirical study contains sample creation procedures, descriptive statistics and research methods, followed by results. Throughout the empirical parts of the thesis, parts II and III, stock returns and operating performance measures are discussed under separate headings. Part III includes result analysis and discussion, followed by suggestions for further research and a conclusion.

1.4. **Delimitations**

This thesis is delimited to study the effects of R&D on company performance, measured by abnormal stock returns and abnormal profit margins. These proxies are measured using methods similar to Eberhart et al. (2004) to improve result comparison, while additional methods are excluded. Although changes in R&D may or may not affect other company performance proxies, these are not considered. A further limitation is the lack of previous empirical research in R&D decreases, inhibiting thorough result comparison.

Regarding the data sample, the initial restriction is to exclude periods prior to 1975, when U.S. R&D accounting practices were significantly altered. However, due to data access restrictions, R&D data prior to 1990 is inaccessible to the author. This partly limits parallel result comparison to Eberhart et al. (2004), which is the main reference point in previous research. Therefore, the sample consists of all U.S. non-ADR firms during 1990-2009. Similar to most previous research, ADR firms are excluded due to possibly diverging accounting conventions.
1.5. Abbreviations and Definitions

Table 1: Abbreviations and Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>Abnormal (excess) return</td>
<td>Return in excess of that predicted (by a model) or anticipated (by the market). Can be positive (i.e. more than predicted) or negative</td>
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<tr>
<td>CAPEX</td>
<td>Capital Expenditures, investments in fixed assets offering future benefits, often named investments in property, plant and equipment, i.e. PP&amp;E</td>
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<td>EMH</td>
<td>Efficient Market Hypothesis, Fama (1970)</td>
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<td>FASB</td>
<td>Financial Accounting Standards Board, responsible for setting accounting and financial reporting standards in the U.S</td>
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<tr>
<td>GAAP</td>
<td>Generally Accepted Accounting Principles, a framework of accounting guidelines in the US set by the FASB</td>
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<tr>
<td>IASB</td>
<td>International Accounting Standards Board, responsible for setting international accounting and financial reporting standards</td>
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<tr>
<td>IFRS</td>
<td>International Financial Reporting Standards, a framework of international accounting guidelines set by the IASB</td>
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<tr>
<td>M/B</td>
<td>Market to Book, the market value of a company divided by its book value</td>
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<tr>
<td>P/E</td>
<td>Price to Earnings, the share price of a company divided by its earnings per share</td>
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<tr>
<td>R&amp;D activity</td>
<td>A general term on a firm’s entire R&amp;D operations</td>
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<tr>
<td>R&amp;D costs, R&amp;D spending</td>
<td>See R&amp;D outlay</td>
</tr>
<tr>
<td>R&amp;D changes</td>
<td>Used to describe increases and decreases simultaneously</td>
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<tr>
<td>R&amp;D expense</td>
<td>The actual expensed amount of yearly R&amp;D outlays, i.e. the actual item on the financial statement</td>
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<tr>
<td>R&amp;D intensity</td>
<td>R&amp;D expenses relative to some firm size proxy, e.g. Net Sales</td>
</tr>
<tr>
<td>R&amp;D investment</td>
<td>An R&amp;D outlay, in the context of generating future cash flows</td>
</tr>
<tr>
<td>R&amp;D outlay</td>
<td>A general term for R&amp;D costs, when no relation to the actual item on the financial statement (i.e. R&amp;D expense) is defined. R&amp;D spending or R&amp;D costs used similarly</td>
</tr>
</tbody>
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PART I: THEORETICAL FRAMEWORK

2 R&D: KEY CONCEPTS

This chapter introduces key concepts relating to R&D activity, its accounting principles and characteristics. Due to R&D investment uncertainty, and to evaluation difficulty for outside investors, consistency in accounting and terminology is essential, both in this thesis and in general. Chapter 1.5 above describes abbreviations and defines terminology used in this thesis, while the subchapters below discuss different viewpoints on R&D.

The concept of R&D in general is defined in International Financial Reporting Standards (IASB, 2008) set by the International Accounting Standards Board as:

“Research is original and planned investigation undertaken with the prospect of gaining new scientific or technical knowledge and understanding.

Development is the application of research findings or other knowledge to a plan or design for the production of new or substantially improved materials, devices, products, processes, systems or services before the start of commercial production.”

The Financial Accounting Standards Board (FASB, 2008) employs a contextually identical definition under U.S. GAAP. Chauvin & Hirschey (1993) offer a more practical definition, where R&D outlays are seen as investments in intangible assets increasing future cash flows, and thus more clearly tied to company value. Intangible assets are defined as assets without physical substance that provide future benefits (GAAP 2008). However, the distinction between research and development is crucial in countries adopting IFRS, where the former is expensed while the latter is capitalized. Under U.S. GAAP, both research and development are fully expensed when incurred, offering some leeway in accounting procedures. Expensing and capitalizing rationales are more thoroughly discussed in chapter 2.2.

In the popular press, a multitude of terms describe R&D related attributes. Garcia & Calantone (2002) offer a review on the expressions associated with R&D and highlight the apparent ambiguity in use, e.g. the interchangeable use of product innovation and
product development or new, innovative and radical. Due to these inconsistencies, researchers, market participants and managers, among others, face difficulties in evaluating R&D projects or investments, or in comparing related studies. Garcia & Calantone (ibid.) exemplify, that managers see controversies in empirical studies even where none exist. Alternatively, managers conceivably falsely interpret or entirely disregard findings in studies using dissimilar terms. Consequently, investor ability to incorporate R&D investments to fair value in stock prices is significantly complicated, causing possible mispricing.

2.1. R&D: Expense, Investment or Asset?

To analyze the impact of R&D on company performance and value, the outlook on R&D needs consideration. R&D definitions and accounting standards undergo constant revision and current US GAAP requires all R&D outlays to be fully expensed when incurred, i.e. recognized as expenses on the income statement. Consequently, from a pure accounting perspective, labeling all R&D outlays of U.S. firms as expenses is not incorrect. However, some information is lost using this convention. Due to R&D outlays intending to generate future cash flows larger in present value than the initial outlay, they are per definition investments. Furthermore, R&D projects achieving commercial success create substantial assets. Therefore, R&D investment is used in this thesis to indicate a future cash flow generating activity, R&D expense is used in relation to the actual item on the income statement and R&D asset is used to emphasize the assets created by successful R&D projects. Owing to the expensing of R&D outlays, any R&D activity immediately reduces fiscal year earnings, having important implications on managerial decision-making. This and other characteristics of R&D investments are thoroughly discussed in chapter 2.4.

As Chan et al. (2001) point out, companies have some flexibility in what is included in R&D costs and furthermore, all R&D expenses are reported as one aggregate item on the income statement. Investor external analysis of R&D activity is thus notably complicated, leading to eventual valuation errors. Aboody & Lev (2000) summarize R&D informational asymmetries between insiders and outside investors into three main sources. Firstly, R&D projects are mostly exclusive and unique to the investing
company, in contrast to capital expenditures (e.g. property) that share similarities across firms. Therefore, one firm’s R&D productivity offers limited information to outside investors about another firm’s R&D. Secondly, no organized markets exist for R&D, contrary to most physical and financial assets. Therefore, no information is derivable from efficient market prices. Thirdly, as discussed above, R&D outlays are fully expensed. Capitalizing, with related periodical marking-to-market and impairment, offers investors present information about changes in asset values, contrary to immediate R&D expensing.

In a sufficiently efficient market\(^3\), the stock price incorporates the value of all net assets, both tangible and intangible, eliminating any relation between R&D and future stock returns. However, as intangible assets in general and R&D in particular are more difficult to externally evaluate than tangible assets, the relation may well hold. Furthermore, R&D intensive firms often have modest tangible assets and instead have potentially extensive intangible assets through successful R&D projects. Therefore, if these intangible assets are undervalued, benchmark valuation measures used by market participants, e.g. P/E or M/B, are conceivably thoroughly misleading for R&D intensive firms. Specifically, such firms receive excessive multiples due to undervalued book values and thus appear overpriced. (Chan et al., 2001)

Whether categorizing R&D as investments in intangible assets on the balance sheet or as expenses on the income statement, consistency in use is required to improve the informational value of R&D reporting and to minimize confusion.

### 2.2. Expensing versus Capitalizing R&D expenditures

Since 1975, the FASB has required companies to fully expense R&D outlays. In contrast, outside the U.S. firms are allowed to expense research costs and capitalize development costs (IFRS 2008). Generally, expenses generating proceeds solely in the current period are expensed, while expenses generating income over multiple periods are capitalized and written off during their economical lifespan. Most, if not all R&D investments are likely to generate income over multiple periods and are arguably even

\(^3\) Although a perfectly efficient market is purely theoretical at best, researchers agree that markets in practice exhibit some efficiency. See e.g. Fama (1970, 1998), and chapters 3.2 and 3.3 below
more long-term than certain capital expenditures. In short, the debate regarding R&D accounting convention revolves around the expected future benefits of R&D expenditures and the uncertainty of these benefits. This discrepancy reflects the classical trade-off between accounting reliability and relevance. According to standards set by the International Accounting Standards Board (IFRS 2008) accounting information is considered reliable if it “is faithful, factual, verifiable and neutral, and free of errors and bias” and relevant if it “has the capacity to make a difference for investors’, creditors’, or other users’ decisions”. Several authors discuss R&D expensing vs. R&D capitalizing, their pros and cons, and their implications on accounting reliability and relevance.

Kothari et al. (2002) offer rationale for both expensing and capitalizing. In favor of expensing is firstly the apparent uncertainty of R&D outlays’ future returns, justifying current U.S. expensing standards. The Association for Investment Management and Research (AIMR) (1993) conclude that distinguishing the R&D costs providing future returns from those providing none is practically impossible, even if on average returns are positive. Furthermore, Kothari et al. (2002) point out the insignificant value of R&D investments as collateral in credit decisions. In general, a balance sheet reflects the credit capacity, as assets can be used as collateral to secure debt. However, R&D investments have low collateral value due to the low liquidation value of unsuccessful projects. Dissimilarly, tangible assets such as property, plant and equipment, can serve alternative purposes and have high liquidation value, increasing credit capacity. Supporting this argument, Barclay et al. (1995) identify that R&D intensive industries are typically equity financed, while capital intensive industries generally use more debt financing. Therefore, due to the irrelevance of R&D assets in credit decisions and future return uncertainty, expensing is favored (Shi, 2003). Finally, expensing prevents management from capitalizing costs of improbably successful R&D projects or to delay or underestimate write-offs on impaired R&D assets (Healy et al., 2002).

Proponents of capitalization argue, and find empirical evidence, that capitalized R&D is more highly correlated with stock returns than when expensed (Lev & Sougiannis, 1996). Therefore, the capitalized R&D outlay, i.e. the asset created by R&D activity,
offers investors and creditors value-relevant information, and establishes a connection between R&D expenditures and future returns. This strongly contradicts the original statement by FASB (FASB Statement No. 2, 1974) emphasizing “no direct relationship between research and development costs and specific future revenues”. Lev & Sougiannis (ibid.) among others⁵, interpret empirical results on the positive relation between R&D and stock returns as evidence on R&D investments generating net future benefits. Shi (2003), however, questions this causality, as increased future cash flow uncertainty (due to increased R&D) increases stock risk, and consequently stock expected return. Shi (2003) thus contends that the expected future benefits are overstated, unless accounting for the increase in expected return. Alternatively, Bierman & Dukes (1975) argue that the uncertainty of future returns is mostly overestimated, as risks are measured from individual R&D projects, instead of the entire diversified R&D investment portfolio. Furthermore, AIMR (1993) concludes that the information in the capitalized R&D outlay is largely irrelevant, due to the indistinct relation between current costs and future benefits, supporting neither expensing nor capitalization. Thus, this trade-off remains an unresolved issue.

However, Goodacre & McGrath (1997) show that company valuation is on average not dependant on R&D accounting principle (i.e. expensing or capitalization). Similarly, Dukes (1976) shows that the aggregate investor adjusts R&D accounting differences and values the company rationally. This supports the no-effects hypothesis by Watts & Zimmerman (1986) that accounting principles having no effect on firm future free cash flows have theoretically no effect on stock prices. The mechanistic antithesis, however, suggests that investors are conceivably misled by accounting principles affecting reported earnings, without any underlying economically significant change. The mechanistic approach thus implies that the market predicts future cash flows by accepting financial statements as such, without thorough analysis.

GAAP (2008) and IFRS (2008) emphasize conservative accounting. The conservatism principle dictates that given two acceptable accounting alternatives, the one resulting in less income or more expenses is chosen. Consequently, a conservative approach rather overestimates losses and underestimates gains, given uncertainty. This counteracts

managerial optimism and minimizes fraudulent reporting. Lev et al. (2005) study whether R&D expensing is conservative or aggressive accounting compared to capitalization and whether this reflects in valuations. Instead of implying any fraudulent behavior, i.e. earnings manipulation, they define aggressive in relative terms. In other words, they study whether R&D expensing overestimates changes in earnings relative to capitalization. They find that the expensing convention is, in general conservative for emerging companies, while it is aggressive for mature companies. Furthermore, conservatively reporting firms appear undervalued, while those reporting aggressively appear overvalued. Emerging companies typically have high R&D growth, or in other words, they frequently increase R&D expenses, leading to potential excess return.

2.3. Motives for R&D Investments

Companies face increasingly tightened competitive environments in today’s fast paced market economy. Consequently, constant renewal and improvement is necessary to sustain and gain competitive advantages and is quite simply required for survival (Zien & Buckler, 1997). Calantone et al. (1997) point out that globalization has increased the need for innovations and product development. Clearly, the intensified competition on increasingly inter-connected markets has increased the need for R&D. Beath et al. (1989) identify two main motives for company R&D policy. The first, profit incentive, is by definition the incentive behind all investments, i.e. the pursuit of future profits through the investment larger in present value than the initial outlay. The second, competitive threat, reflects the value of being first to introduce a new innovation, i.e. the difference in profits when innovating before rivals and after, respectively. Beath et al. (ibid) show that, in general, the amount invested in R&D is approximated by the sum of these two effects, the “carrot” and the “stick”. Consequently, managers are confident in the returns generated by R&D and strive to initiate innovation.

Announcements to increase R&D have been shown to generally produce positive stock market reactions, i.e. positive event time abnormal returns. For example, Chan et al. (1990) find positive abnormal returns of 1.38 percent for two days following R&D increase announcements. Furthermore, Zantout & Tsetsekos (1994) inquires the

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6 Woolridge & Snow (1990) similarly report 1.13 percent two-day cumulative abnormal returns
response of rival firms to such announcements, or specifically, the effect on rivals’ market value. They hypothesize, whether competitors consider such announcements to signal that the announcing firm is first to innovate, thus gaining first-mover advantages, or whether competitors consider it a chance to free ride on competitor innovation. They point out that R&D investments often produce spillovers, i.e. the investing company is unable to keep the innovation benefits entirely to themselves, facilitating free riding. Bottazzi & Peri (2003) define the spillover effect as when the R&D output of one participant (firm, country, region etc.) is enhanced by another’s R&D input. As argued by Zantout & Tsetsekos (1994), the signaling effect of R&D in a zero-sum setting is thus two-fold; a relative loss due to lost first-mover advantages and a relative gain due to spillover free riding. Consequently, the stock market reaction, measured by rivals’ abnormal returns, is the perceived net effect of both signals. Lieberman & Montgomery (1988) argue that firms need to respond quickly to a competitive threat by either an alternative innovation or an imitation, or may otherwise face high entry barriers caused by the first-mover’s competitive advantage. This leads to an R&D arms race eradicating competitive advantages, further tightening competition and, given efficient markets, ultimately eliminating abnormal stock returns (Zantout & Tsetsekos, 1994).

However, announcements to increase R&D are entirely voluntary disclosures of private information, inducing rivals to also increase R&D thus tightening the competitive environment and reducing margins. An interesting question asked by Zantout & Tsetsekos (ibid.) thus arises: why do firms choose to announce R&D increases? Firstly, as increased R&D myopically reduces earnings, up front announcement shrinks the informational gap between investors and firms, possibly preventing a negative stock reaction to impaired earnings. This, however, does not explain why announcements are made before the R&D expenses realize and not afterward when earnings are reported. Consequently, this argues for choosing financial statements instead of announcements to identify R&D increases in this thesis, which is discussed more thoroughly in the empirical parts below. Secondly, if the signals described above have a negative net effect on rival firms, announcements may play a strategic role. Zantout & Tsetsekos (ibid.) report, consistent with previous research, positive abnormal returns for announcing firms, and further contribute by finding negative excess returns for rival
firms\textsuperscript{7}. These results offer rationale for R&D disclosure, indicating that the announcer’s first-mover advantage exceeds the rival’s spillover free riding. However, spillovers are still value-creating for rival firms. Spence (1984) regards spillovers as perfect substitutes for own R&D, while Jaffe (1986) estimate rivals’ profits to increase by 0.3 percent for every 1 percent increase in spillovers. Consequently, co-operative R&D alliances are increasingly common, and Chan et al. (1997) report that they do indeed offer convincing synergies.

From an entirely different point of view, a macro economical point of view discussed by Nickel (1996), competition improves resource allocation efficiency by reducing production costs and slack, thus enhancing the economy as a whole. As R&D leads to tightened competition, as discussed above, which in turn leads to improved macro economical efficiency, it is not unjustifiable to argue that R&D is macro economically beneficial. Since the seminal study by Schumpeter (1934) acknowledged the importance of technological change or innovation in economic development, R&D has become a part of macro economical policy making (Booth et al., 2006). Indeed, several countries have adopted R&D subsidies through grants or tax reliefs (Spencer & Brander, 1983). However, the efficacy of such governmental policies has been disputed\textsuperscript{8}. This thesis, however, disregards the underlying funding or potential subsidies of the studied R&D projects and rather examines R&D expenses unadjusted from financial statements.

2.4. Characteristics of R&D Investments

The defining characteristics of R&D investments are the long-term and uncertain future benefits. The initial investments are often extensive, vast resources are needed to complete the R&D projects, and still, the returns of successful projects are likely to realize only in the far future, while unsuccessful projects yield none (Chan et al., 2001). Consequently, R&D investments increase future earnings variability to a much larger extent than capital expenditures, as shown by e.g. Kothari et al. (2002) and Amir et al. (2007), indicating R&D and risk causality. Berk et al (2004) establish this relationship.

\textsuperscript{7} Two-day abnormal returns of 0.74 percent and -0.56 percent, respectively
\textsuperscript{8} See e.g. Beath et al. (1989)
Another interesting attribute, owing to R&D outlay expensing, is the direct negative effect of any R&D activity on short-term reported earnings. This gives managers, with performance related compensation, incentives to act myopically and discard even profitable R&D projects, presenting an example of Jensen & Meckling’s agent theory (1976). The management (agents) and the shareholders (principals) have asymmetrical information and incentives, resulting in the management not acting in the shareholders’ best interest. Stein (1989) points out that due to long-term R&D investment returns and managers’ myopic tendencies, mispricing may occur. Managers attempt to mislead the markets, i.e. inflate the stock price, by discarding potentially profitable long-term investments in favor of short-term reported earnings. Efficient markets adjust for this inflation and no stock price increase occurs. On the contrary, theoretically efficient markets punish such myopic behavior inconsistent with long-term shareholder wealth maximization, resulting in a negative stock reaction (ibid.). Jensen (1986) emphasizes that myopic managerial behavior is simply a result of incentives. Negligible managerial ownership or earnings related compensation creates incentives in favor of current earnings instead of long-term value creation.

Furthermore, if investors prefer short-term stock returns, i.e. have short investment horizons, as studies by Porter (1992) and Hall (1993) indicate, additional pressure is put on R&D investments. Rationally, short-term returns are, ceteris paribus, neither better nor worse than long-term, and NPV-positive long-term investments should by no means be rejected merely on the basis of investment horizon. Goodacre & McGrath (1997), however point out that even though individuals conceivably act myopically and irrationally at times, investors aggregated do not. This argues for studying changes in R&D on an aggregate market level in this thesis, instead of on a company specific level, as discussed more thoroughly in the empirical parts below.

2.5. **Strategic R&D Management**

Successful R&D investments are advantageous in numerous ways. They create new improved products or more efficient production processes, facilitating market penetration, increased market shares, decreased production costs and ultimately competitive advantages and improved earnings (Nobelius, 2004). However, proper
management of R&D processes is required to reap the benefits or to increase the probability of success (Calantone et al., 1997). According to Nobelius (2004) firms may be successful in creating innovations, yet fail to commercialize it. Devinney (1995) for example, emphasizes the importance of considering customer needs in product development. A product will fail to reach commercial success if it is misaligned with customer needs, regardless of technological superiority. Devinney (ibid.) summarizes that the focus of R&D management should thus be to gather information from the market and transfer it to the product. Calantone et al. (1995) continue that product target groups are exceptional sources of product development information and ideas. Consequently, managers have influence over many factors enhancing R&D projects’ probability of success (ibid.). However, the long-term nature of R&D complicates managing, as the results of managerial decisions are seen only far in the future (Patterson, 1998). Furthermore, as Tidd (2002) identifies, coherent managerial guidelines are yet to be set regardless of incessant research in innovation management.

2.6. Optimizing R&D expenditures

While R&D investments (i.e. R&D expenditure increases’) and their effects on firm value receive abundant attention, divestments (i.e. R&D expenditure decreases) remain incredibly unexplored. However, as Pakes (1985) points out, firms determine R&D activity to maximize the expected value of future cash flows, or in other words firm value. This implies that both increases and decreases are conceivably beneficial (or detrimental), depending on whether the firm is currently over- or underinvesting in R&D. Reingaum (1982) develops a model of optimal resource allocation to R&D, accounting for R&D uncertainty, longevity, spillover freeriding and rival R&D. Logically, decreasing excessive or increasing insufficient R&D expenditures brings a firm closer to its optimal level of R&D. Therefore, assuming an optimal R&D level exists, small changes, either positive or negative, likely imply optimization, i.e. decreasing redundant or increasing insufficient expenditures. Conclusively, the source of R&D expenditures’ effect on firm performance is conceivably not the direction of change but rather the magnitude.
3 EVALUATING R&D INVESTMENTS

Johnson & Pazderka (1993) employ three R&D profitability measurement categories. The first contains case studies evaluating specific innovations using benefit-cost analysis, while the second concentrates on the explanatory power of R&D in econometric production or cost functions. The third category, more closely related to this thesis, studies the effects of R&D on firm performance. Tidd (2002) divides this third category into two groups, using either financial and accounting measures (e.g. profitability) or market measures (e.g. stock return or market share growth).

Measuring investment profitability is theoretically straightforward. Likewise, an R&D investment’s return is the expected rate of return over the R&D output’s lifespan, given some success probability. However, the output’s success probability and the proceeds it generates are difficult to accurately estimate. Additionally, as the market value of a company reflects the value of its net assets, including intangible assets, inaccuracies in R&D evaluation may cause stock mispricing. As Chan et al. (2001) emphasize, however, efficient markets appraise R&D to its fair value, eliminating any connection between R&D and future excess returns. Therefore, to incorporate a broader analysis on the effects of R&D on firm performance, this thesis employs both a market measure (stock return) and a financial measure (profit margin), as discussed in part II below. The first offers insights on market efficiency, as discussed in the following chapters, the second identifying the actual benefit of R&D.

3.1 The Efficient Market Hypothesis

The archetypal financial study of market efficiency studies the correctness of market prices and their adjustment to newly published information. The efficiency is inferred either from the time span between publishing new information and the asset prices adjusting to this information or from the accuracy of the adjustment itself (Copeland et al., 2005). The Efficient Market Hypothesis (EMH) presented by Fama (1970) considered a market where prices fully reflect all available information as efficient, and that currently available information (including current asset prices) should thus be the most accurate estimator of future prices. This randomness in prices originates from the
random walk hypothesis of Kendall (1953), where tomorrow’s price is independent of today’s price, i.e. $P_{t+1} = P_t + \varepsilon_{t+1}$, where $\varepsilon_{t+1}$ is white noise. If we assume that a stock pays no dividend and has constant variance over time, and that investors are risk-neutral and money has no time value, the stock price follows a random walk. If the time value of money is allowed to be non-zero, a random walk with drift, i.e. a trend, is obtained (Cochrane, 2005). Consequently, no predictability in asset prices remains. Clearly however, these assumptions are purely theoretical at best.

Indeed, several studies have found indications of stock price predictability\(^9\), rejecting the random walk hypothesis and questioning market efficiency. Fama (1970) however, points out that random walk is not a necessary assumption for market efficiency, but rather the inclusion of information and collective expectations in asset prices. Fama (ibid.) identifies three subsets of information, upon which efficiency is tested: weak, semi-strong and strong form efficiency. These subsets impose historical prices, all publicly available information and all available information, respectively, to be reflected in asset prices. Consequently, newly published information in efficient markets is assumed to be incorporated to its fair in asset prices value without delay. Furthermore, Fama (1970) points out that asset mispricing may occur, but should however not be persistent.

Conclusively, given efficient markets, excess risk adjusted returns are unattainable in the long run and any above-average returns come with above-average risk, or are completely random (Malkiel, 2003).

3.2. Efficient Markets and R&D

As discussed above, stock price reactions to newly published information is in the heart of market efficiency studies. Although researchers are rightfully careful to unconditionally reject the EMH, mispricing indications are plentiful. For example, Ikenberry et al. (2000) and Eberhart & Siddique (2002) find excess returns following corporate events such as stock splits, equity offerings or stock repurchases, indicating undervaluation. Ikenberry & Ramnath (2002) call these self-selected events, due to

\(^9\) E.g. Fama & French (1992, 1993) find explanatory power in Book-to-Market rations, while e.g. Campbell & Schiller (1988) and Goetzmann & Jorion (1993) find it in Dividend yields
managers executing the events at a strategically beneficial moment. Consequently, managers time the events to profit from stock mispricing, e.g. choosing to announce an offering knowing the stock is overpriced relative to fundamentals and thus raising more capital. Further claimed signals of market inefficiency are return patterns and predictability based on firm characteristics. Lakonishok et al. (1994), for example, show high book-to-market value stocks outperforming low book-to-market glamour stocks. This indicates that value stocks are undervalued, while glamour stocks are overvalued.

Examining the effects of R&D changes on company performance is interestingly distinct to the studies listed above, as Eberhart et al. (2004) point out. First, R&D changes are managerial decision, not firm attributes. Second, R&D changes, especially decreases, are seldom announced formally, unlike the events above. Third, unlike financing decisions, R&D investment timing hardly benefits from stock mispricing.

A classical R&D output measure is the number of patents. However, Pakes (1985) points out two problems with the patent variable. First, extensive reliable data is unattainable. Second, large variations in patent counts are unexplainable, due to both granting economically implausible patents and rejecting viable patents. However, given effective markets, R&D investments are immediately reflected to fair value in stock prices, i.e. uniform to the investment’s expected impact on future free cash flows (Woolridge & Snow, 1990). Focusing on market value thus lessens problems in measuring R&D success and profitability. However, Pakes (1985) emphasizes that financial accounting measures (e.g. firm profits or productivity) are likely to react to R&D only with an often irregular lag. However, this thesis incorporates long-term profitability and excess return measures, as discussed in part II, alleviating any lag bias.

According to traditional valuation models, the market value of a firm is equal to the discounted value of future free cash flows both from assets already in place and from expected future investment opportunities (Miller & Modigliani, 1961). A relationship between abnormal stock returns and R&D changes thus indicates R&D misevaluation and market inefficiency. The following example illustrates this relationship. If a R&D investment is expected to increase future free cash flows thus creating shareholder value, the stock price in efficient markets immediately rises. If the reaction is correct, i.e. to fair value, the price increase is uniform to the discounted value of the future cash
flow, eradicating any abnormal returns. In a longer time period, the future stock price
development attributable to the R&D investment is uniform to the realized returns and
discounted future expected returns of the investment. However, an undervalued
(overvalued) investment yields positive (negative) excess returns.

3.3. Critique of the EMH

The EMH was practically universally accepted at the time of Fama’s (1970) seminal
study. However, as predictability patterns continuously emerge and as behavioral
finance economists offer psychological reasoning for stock market features, current
opinions are far less convinced (Malkiel, 2003). Consequently, economists and financial
practitioners begin to believe that these predictable patterns allow investors to earn
consistent excess returns.

The first signs of market inefficiency, or rather of non-random stock prices, are positive
short-run serial correlations, i.e. momentum, rejecting the random-walk hypothesis.\(^{10}\)
Similarly, Fama & French (1988) find negative long-term serial correlations, i.e. return
reversal. Behavioral economists find psychological characteristics in both short-term
momentum, as individuals are drawn to rising stock prices (Shiller, 2000), and long-
term return reversal, as investors (overconfident in their ability to predict future
earnings) overreact to market information (DeBondt & Thaler (1985) and Kahneman &
Tversky, 1979). Further predictability arises from stock price seasonality and firm
characteristics. For example, returns in January (Keim, 1983) and on Monday (French,
1980) tend to be higher, while small firms tend to outperform large (Fama & French,
1993)\(^ {11}\).

Many of these anomalies have prompted investment strategies aimed for arbitrage or
excess profits, e.g. the momentum strategy invests in firms that have performed well in
a previous period. Firstly however, although many have found statistically significant
excess returns utilizing such strategies, the EMH is far from rejected. As Malkiel (2003)
emphasizes, the excess returns are mostly or entirely consumed by transaction costs,
resulting in no economically and practically significant arbitrage. Indeed, when

\(^{10}\) See e.g. Lo & MacKinlay (1999)
\(^{11}\) Momentum Effect, Return Reversal, January Effect, Weekend Effect and Size Effect, respectively
measuring actual realized profits, the excess returns from such strategies are seldom positive (Lesmond et al., 2004). Secondly, as surveyed by Fama (1998), underreaction to company events (e.g. stock splits, public offerings etc.) occurs about as frequently as overreaction, while positive return correlation is about as common as negative. The anomalies are thus arguably unsystematic and inconsistent over time. According to Schwert (2001), price predictability anomalies diminish over time, possibly due to investors exploiting anomaly strategies until no arbitrage exist.

This event study provides tests on market efficiency, or rather indications on the degree of efficiency. Fama (1970), however, points out the inherent paradox in any market efficiency study. As excess returns per definition exceed expectations, market return proxies are first required. As proxies are calculated with a pricing model, any identified excess returns may either be actual signs of mispricing (i.e. market inefficiency) or errors in modeled risk-return relationships (i.e. return expectations). This reflects the Joint-Hypothesis problem presented by Fama (ibid.). Specifically, any excess returns following R&D changes may be due to changes in firm risk. Not implausibly, increasing R&D spending, which is inherently uncertain and risky, should be awarded by higher returns. Berk et al. (2004) demonstrate that a firm’s systematic risk may indeed change because of R&D investments. Caution is thus required when analyzing excess return results and formally rejecting market efficiency.

4 PREVIOUS RESEARCH

Although most of the theoretical background is already familiar from chapters above, the following chapters present the most central studies related to R&D and firm performance in more detail. The primary focus is firstly on relatively recent research, as R&D accounting standards constantly changes, possibly complicating comparison in time, and secondly on parts more closely related to this thesis. For example, the sample creation process in Eberhart et al. (2004) is nearly identical to this thesis and is thus presented in more detail. Consequently, of the four articles presented below, the former two, studying R&D, are considerably similar to this thesis, while the latter two offer supplementary insights on a similar long-term investment, capital expenditures. A short
summary presenting parallels in results and methodologies to this thesis, and reasoning behind potentially diverging results of R&D and CAPEX studies concludes the chapter.

4.1. **Eberhart, Maxwell & Siddique (2004)**

The study by Eberhart, Maxwell & Siddique (2004) titled “An examination of long-term abnormal stock returns and operating performance following R&D increases” published in The Journal of Finance, is very similar to this thesis and is consequently presented more meticulously. The authors examine long-term abnormal stock returns and profit margins following increases in R&D expenditures to find whether R&D increases are profitable investments and whether the market recognizes this benefit.

The authors study U.S. firms increasing R&D in any year between 1951 and 2001. On this initial 35,000 firm-year sample, they impose two constraints: the increase must be unexpected and economically significant. To be unexpected, a sample firm’s R&D intensity must increase, measured by R&D expenditures normalized by total assets. This constraint is logical, as growing firms are expected to increase R&D. To qualify as economically significant, R&D intensity must be at least 5 percent. Furthermore, a sample firm must increase its dollar R&D expenditures by at least 5 percent and its R&D intensity by at least 5 percent. Using these event definitions, a final sample of 8,313 firm-year observations, i.e. unexpected and economically significant increases, including 3,148 firms is obtained. Normalizing intensity by net sales, as the authors show, has practically no impact on the final sample, resulting in 8,932 observations including 3,278 firms.

The final main sample is divided into high and low-tech, and high and low-growth subsamples, as high-tech industries are far more R&D intensive, while high-growth firms have more profitable investments, generally reflecting in higher R&D expenditures. The authors estimate the results for the time periods 1951-2001 and 1974-2001 separately, as R&D accounting conventions were amended in 1974. However, this presumably has modest effect, as nearly all observations occur during the later period, due to reporting ambiguity in earlier years. Although the authors undertake numerous control samples and procedures, these are not presented in detail due to their

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12 As R&D intensity is a relative measure, a 5 percent increase is e.g. from 10% to 10.5%.
insignificant effect on obtained results. In general, the results presented below are mostly robust to all control procedures and subsamples.

The authors study market reactions by measuring monthly abnormal stock returns for the five years following R&D increases using both the Fama & French (1993) three-factor model and the Carhart (1997) four-factor model. These models estimate market returns by adding additional risk-factors to the CAPM’s single market risk-factor and are empirically superior to the CAPM. The three-factor model includes size and book-to-market as risk-factors, while the fourth factor introduced by Carhart (1997) discerns momentum\textsuperscript{13}. Thus, the model is as follows:

\[ R_{pt} - R_{ft} = \alpha + \beta (MRP_t) + \sigma (SMB_t) + \delta (HML_t) + \gamma (UMD_t) + \epsilon_t \ (Eq. 1) \]

\( R_{pt} \) is the average raw return for R&D increasing stocks in calendar month \( t \), \( R_{ft} \) is the 1-month T-bill return. MRP is the market risk premium, \( R_{mr} - R_{ft} \), where \( R_{mr} \) is the CRSP value-weighted market index return, SMB\(_t\) is the risk-proxy for size, i.e. the return of small stocks minus the return of large stocks, HML\(_t\) is the risk-proxy for value, i.e. the return of stocks with high B/M-ratio minus the return of stocks with low B/M-ratio, UMD\(_t\) is the risk-proxy for momentum, i.e. the return on high momentum stocks minus the return on low momentum stocks. Finally, the intercept alpha measures abnormal return.

To study the actual effects to which the market reacts, abnormal profit margins (APM) for the five years following R&D increases are measured. APM is measured as a R&D increasing firm’s PM minus its matched firm’s PM during an event year, and a positive APM thus indicates superior PM among R&D increasing firms. The matched firm does not increase its R&D, and has a PM closest to the sample firm among the same two-digit SIC\textsuperscript{14} code. For each year, the APM is computed for each R&D increasing firm within the previous 5 years. Then, the median APM for each year is measured, followed by the time-series average of this annual APM measure. The final APM measure thus reports the average APM among R&D increasing firm.

\textsuperscript{13} For more thorough model description and discussion, see chapters 6.2 and 6.3 below
\textsuperscript{14} Standard Industrial Classification, a four-digit code establishing primary business, the first two identifying a broader industry group, the last two specifying.
The authors obtain significant three and four-factor alphas (0.69 and 0.74 percent, respectively), representing positive monthly abnormal returns. These results are robust to practically all control procedures and in all subsample and hold true for both high and low-tech, and high and low-growth firms, although the Wald-test show high-tech alphas to be larger than low-tech alphas. Regarding operating performance, abnormal yearly profit margins are significantly positive, ranging from 0.75 to 5.22 percent depending on control methodology. As an additional measure, they examine abnormal changes in earnings and sales, using a similar definition of abnormal as in APM. However, they find no evidence of R&D increases affecting earnings or sales per se. These results are analyzed in conjunction with the results obtained in this thesis in coming chapters.

4.2. Chan, Lakonishok & Sougiannis (2001)

The article by Chan, Lakonishok & Sougiannis titled “The stock market valuation of research and development expenditures” published in The Journal of Finance, uses a different methodology to study similar causalities, namely R&D and stock valuation. They study whether returns vary depending on R&D intensities. Furthermore, similar relations are studied for advertising expenditures, although this part is only reported briefly.

The main sample consists of U.S. firms on NYSE, AMEX and NASDAQ during 1975-1995. Similar to most studies, R&D expenditures are normalized by total assets, total equity or net sales to measure intensity. The value of R&D capital is approximated by linearly amortizing past five year expenditures by 20 percent. Furthermore, industry subsamples are created, as intensities vary greatly.

The authors then divide the main sample into 6 portfolios depending on intensity separately for R&D to net sales and to book value of equity. Portfolio 0 thus represents R&D inactive firms, while portfolio 5 is the most R&D intensive. The portfolios are created at the end of April each year, based on most recent financial statements. Then, equally weighted buy-and-hold holding period returns (HPR) are calculated for the three years following portfolio formation. Furthermore, they study whether differences in the portfolios may be attributable to diverging risk profiles using a five-factor model, which includes a long-term momentum factor to the Carhart four-factor model.
The results vary depending on methodology. Firstly, when measuring expenditures relative to net sales, no differences, on average, are identified between R&D active (portfolios 1-5) and inactive firms’ (portfolio 0) returns. Similarly, when sorted by intensity, miniscule differences in returns between portfolios 1-5 are obtained. This indicates that the market, on average, incorporates the fair value of R&D. However, when considering varying risk-profiles using multifactor models, R&D active firms tend to outperform, yielding significantly positive alphas. Furthermore, a clear ascending pattern in alphas is observed relative to increasing R&D intensity, ranging from -0.14 to 0.55 from the least to the most intensive, respectively.

Secondly, when measuring expenditures relative to equity market value, differences in portfolio returns are identified, although the two intensity measures are greatly correlated. Portfolios of R&D intensive firms yield higher returns on average than portfolios of less intensive or R&D inactive firms. Similarly a somewhat consistently ascending pattern in portfolio returns relative to increasing intensity is observed. Furthermore, the multifactor model obtained similar results, indicating higher alphas for more R&D intensive firms, and again negative for inactive firms. Similar results are found for portfolios created by advertising costs, as advertising-intensive portfolios earn, on average, higher average excess returns than the less intensive over the three-year period following portfolio formation.

The authors interpret the results for R&D active firms’ superior performance, as signs of strength due to managers continuing investments despite the myopically decreasing effect on earnings. Similarly they argue that R&D intensive firms are those most likely to have performed poorly in past periods, reducing equity market value and consequently increasing intensity, although expenditures remain fairly constant. Furthermore, constant expenditures, despite poor past performance pressuring managers to cut costs, indicate confidence in future prospects. The market appears to disregard this information, or is alternatively slow to incorporate its value. An interesting side note is the positive correlation between R&D intensity and return volatility, validating R&D uncertainty.
4.3. McConnell & Muscarella (1985)

The study “Corporate capital expenditure decisions and the market value of the firm” by McConnell & Muscarella published in The Journal of Financial Economics, offers interesting additional analysis to R&D investments. Capital expenditures, like R&D, are investments expected to create future benefits. However, unlike R&D, they are investments into fixed or physical assets, often named property, plant and equipment, or PP&E. McConnell & Muscarella (ibid.) study the effect of CAPEX increases and decreases on firm value and is thus strikingly similar to this thesis. Furthermore, they include R&D change announcements, although only finding a few such cases. If the markets conceive these investments as value-creating, an immediate share price increase should occur. However, investors have been shown to under (over)-react to corporate announcements, as discussed above, resulting in mispricing and abnormal returns. The major contrast between CAPEX and R&D is their perceived uncertainty of future benefits, documented by Kothari et al. (2002). Capital investment proceeds are often rather accurately estimated beforehand, unlike R&D investments. Although the paper is rather dated, CAPEX accounting conventions have not changed significantly since its publication. The methodology is not as meticulously presented as in the R&D studies above, as this article is included mostly to provoke thought.

The paper studies firm value reactions to CAPEX increase and decrease announcements to find firstly, whether markets immediately respond by revaluing announcing firms’ prices and secondly, whether this response is equal to the investment’s net effect on future free cash flows. Theoretically, an unexpected announcement to increase (decrease) CAPEX should increase (decrease) market value, due to the effect on net present value. However, if the investment opportunity rates of return equal the market required return, neither should affect market value, due to zero net present value.

The authors study market responses to CAPEX announcements in the popular press using event-time analysis of NYSE and AMEX stocks between 1975 and 1981. The authors regard any change as unexpected. As investments yielding only the market required return should not affect market values, the authors divide the sample into

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15 8 increase and 5 decrease announcements were specifically identified as R&D
industrials and public utilities. Public utilities are often state-owned and regulated to earn only their cost of capital. They obtain a sample of 547 announcements by 285 industrials and 111 announcements by 72 public utilities, all relatively evenly distributed over the seven year time period, although most occurred during December through May. Not surprisingly, the majority of announcements were increases, accounting for roughly ¾ of cases.

After identifying the announcements, two-day mean returns following the announcement are compared to the mean return of +/- 60 day comparison period excluding +/- 10 days. The results are much in line with the theoretically expected outcome; increases (decreases) exhibit statistically significant positive (negative) announcement period excess returns for industrials (i.e. firms with NPV-positive investment opportunities) and statistically no announcement period excess returns for public utilities (i.e. firms with NPV-zero investment opportunities). Furthermore, follow-up studies by Blose & Shieh (1997) and Vogt (1997) find positive correlation between the investment and market reaction magnitudes. The authors make two conclusions on these results. Firstly, managers reveal value-relevant information by announcing CAPEX changes. Secondly, the announcements are generally consistent with valuation theory, where an unexpected increase in NPV-positive investment opportunities creates value (NPV-zero opportunities do not). The size maximization hypothesis, where managers seek to increase firm size and overinvest in capital projects (empire building) is thus rejected in favor of value maximization, at least in the short-term.

However, in stark contrast to the mindset in this thesis, McConnell & Muscarella (ibid.) studied short-term risk-unadjusted returns. These results thus do not shed light on market efficiency or on market response accuracy. The following study by Titman et al. (2004) offers some insights on risk and market-adjusted long-term stock returns following CAPEX increases.

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16 The authors defined all companies not classified as public utilities as industrials.
Similarly to the article above, Titman et al. studied CAPEX (or capital investments, CI) increases in “Capital investments and stock returns” published in The Journal of Financial and Quantitative Analysis. However, they focus on long-term price effects instead of short-term announcement reactions. They argue that it is difficult to interpret short-term positive excess returns, due to firms announcing only favorable and due to higher stock prices perhaps facilitating increased investments, not vice versa. There are also potential negative price responses to CAPEX increases, due to managerial empire building, overinvesting in capital projects and acting in their own interests instead of the shareholders’.

The authors test stock returns following CI by forming portfolios based on levels of abnormal capital investments (ACI) on NYSE, AMEX and Nasdaq firms during 1973-1996, excluding financial institutions. They further divide the sample based on their investment discretion, defined by cash flows or leverage. They measure abnormal capital investment as capital expenditures scaled by sales divided by the average last three year capital expenditures scaled by sales, thus measuring CI-intensity much like R&D-intensity measures above. This convention thus implicitly assumes CAPEX to grow proportionately to sales and any deviation is defined abnormal. The main sample includes nearly 60,000 firm-year observations averaging 2,560 firms per year, although missing data reduces it to 1,635 firms a year. The authors use three different methods for evaluating portfolio returns. Firstly, five-year excess returns on portfolios based on CI-intensity are measured relative to benchmarks with very similar firm characteristics, i.e. size, B/M and momentum. Secondly, the Carhart (1997) four-factor model is applied. Finally, following Chopra, Lakonishok & Ritter (1992), short-term market-adjusted returns for three days around quarterly earnings announcements are studied.

Using the first method, portfolio formation, a clear descending pattern in returns is observed relative to increasing intensities, for the 5-year test period, with monthly excess returns ranging from 0.04% to -0.13% for the lowest and highest CI-portfolio respectively. Similarly, a zero-investment CI-spread portfolio with a long position in the two lowest CI-portfolios (portfolio 2 and 3) and a short position in the two highest portfolios (4 and 5), earns a statistically greater excess return than the portfolios on
average. Consequently, firms that invest the least appear to outperform firms investing more. The CI-spread earns positive excess returns for 5 years following formation, while the 6th year shows no statistically significant excess. The four-factor model validates these results, obtaining statistical significance and similar excess patterns: low CI-portfolios still yield, on average, about 2% per year more than high CI, and the CI-spread earns statistically positive excess. Therefore, return deviations are not attributable to differing risk-profiles, at least not to risk-factors captured by the Carhart model. Similarly, the same pattern emerges for market-adjusted three-day announcement period returns, where announcement returns aggregated to annual returns show a decreasing pattern in increasing intensities.

The authors find that the negative relation between abnormal capital investments and subsequent returns is largely dependent on the threat of hostile takeovers. Specifically, the correlation seems to reverse during periods where hyperactive takeover markets punished overinvesting firms, preventing empire building, and disappear during less prevalent takeover periods. These results indicate that investor underreact to the negative effects of empire building. Furthermore, the negative correlation is stronger for firms with higher cash flows or lower debt ratios, which are more likely to overinvest. However, the authors give other potential explanations for the results. Firms may have time-varying rates of return and therefore invest more when expected returns, and cost of capital, are low. Furthermore, the different CI-portfolios may exhibit differing risk-profiles outside of those captured by the Carhart model, an interesting remark considering the models used in this thesis.
4.5. **Summary of Previous Research**

The studies above have shown highly consistent results, nearly irrespective of methodology. Both cross-sectional multifactor models and portfolio formations find a positive correlation between R&D-intensity and long-term excess returns, while the opposite holds for CI-intensities, on average. Furthermore, increases in R&D are shown to have a long-term effect on excess returns, while announcements to increase CAPEX are rewarded with short-term price increases.

This discrepancy in results between R&D and CAPEX is conceivably caused by a multitude of factors. The investments have differing motives, their accounting treatment differs and empire building only exists among CAPEX investments. However and perhaps most importantly, their risk-profiles greatly vary. As Kothari et al. (2002) show, R&D investments yield future benefits far more uncertain than CAPEX investments. Specifically, R&D’s contribution to future earnings volatility is far greater. Consequently, riskier investments should yield higher returns, and the markets may disregard or misprice this regarding R&D.

What remains uncertain, however, is the effect of decreases in R&D on future returns. Surely, R&D increases and decreases occur for entirely different reasons, possibly affecting market reactions and stock pricing. The empirical part below thus contributes to the subject by including R&D decreases.
PART II: EMPIRICAL METHODOLOGY

5 DATA

The main sample includes all U.S. firms\(^{17}\) in the Compustat database Active and Research files between 1990 and 2009. Therefore, the sample includes currently active and inactive\(^{18}\) firms, thus alleviating survivorship bias. This bias is more thoroughly discussed in chapters below. The entire initial sample consists of 20,524 firms, however, 3,703 firms on average report sufficient R&D data for each time period year. These main sample firms are hereafter termed sample firms. Clearly most sample firms are either not reporting R&D, have no R&D expenses, or are inactive. Furthermore, at the time of writing, many are still to report 2009 figures or these have not yet been implemented in the database. Still, a sample of over 74,000 firm-year observations offers a solid ground for research. For this sample, annual R&D expenditures, net sales and total assets are obtained from Compustat for each firm. Furthermore, monthly logarithmic returns are calculated from monthly adjusted close prices, which adjust for dividends and price altering events such as splits.

Annual financial statement data offer a remarkable advantage compared to interim or quarterly figures, being more thoroughly reviewed and thus more reliable. This reliability is of even greater importance in this study due to R&D accounting opacity. However, shorter period figures facilitate identifying changes more closely to the actual event. For example, annual financial statements may portray investments made up to over a year ago. Nevertheless, this thesis studies market reactions to newly published information. The market is informed of R&D figures only when the financial statements are published, regardless of when the R&D expenses were incurred. Furthermore, in order for a stock response to occur, the published information must convey new information, or in other words, changes. Therefore, this study incorporates annual changes in R&D.

\(^{17}\) Similar to Eberhart et al. (2004), ADR shares (American Depository Receipts) are excluded

\(^{18}\) Inactive indicates merged, acquired, bankrupt or delisted firms
Table 2 below presents main sample means for fundamental variables for selected years throughout the time period, and for the entire time period on average. R&D intensity ratios are calculated by aggregating annual numerator and denominator values separately, as recommended by Chan et al. (2001), as extreme outlier ratios skew the average ratios across firms. The last column shows the number of firms reporting sufficient data. In the interest of space, every year is not shown.

<table>
<thead>
<tr>
<th>Year</th>
<th>R&amp;D expenses (M$)</th>
<th>R&amp;D/Assets (%)</th>
<th>R&amp;D/Sales (%)</th>
<th>Nr. Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>27.6</td>
<td>0.8</td>
<td>1.5</td>
<td>3,130</td>
</tr>
<tr>
<td>1992</td>
<td>28.5</td>
<td>0.8</td>
<td>1.6</td>
<td>3,473</td>
</tr>
<tr>
<td>1994</td>
<td>28.1</td>
<td>0.8</td>
<td>1.6</td>
<td>3,942</td>
</tr>
<tr>
<td>1996</td>
<td>30.6</td>
<td>0.8</td>
<td>1.7</td>
<td>4,626</td>
</tr>
<tr>
<td>1998</td>
<td>37.4</td>
<td>0.7</td>
<td>1.8</td>
<td>4,709</td>
</tr>
<tr>
<td>2000</td>
<td>45.1</td>
<td>0.7</td>
<td>1.6</td>
<td>4,376</td>
</tr>
<tr>
<td>2002</td>
<td>50.1</td>
<td>0.6</td>
<td>1.8</td>
<td>3,903</td>
</tr>
<tr>
<td>2004</td>
<td>57.3</td>
<td>0.6</td>
<td>1.6</td>
<td>3,688</td>
</tr>
<tr>
<td>2006</td>
<td>74.8</td>
<td>0.7</td>
<td>1.8</td>
<td>3,422</td>
</tr>
<tr>
<td>2008</td>
<td>96.2</td>
<td>0.7</td>
<td>1.9</td>
<td>2,921</td>
</tr>
<tr>
<td>2009</td>
<td>151.7</td>
<td>0.7</td>
<td>2.5</td>
<td>561</td>
</tr>
<tr>
<td>1990-2009 Ø</td>
<td>46.0</td>
<td>0.7</td>
<td>1.7</td>
<td>3,703</td>
</tr>
</tbody>
</table>

Clearly, firms devote increasing amounts into R&D. Still, R&D intensity measure invariability is apparent; firms keep expenditures constant to assets and sales and consequently increase (decrease) expenditures relative to increasing (decreasing) assets and sales. The large discrepancy for the last year may be due to the small number of firms reporting sufficient data at the time of writing. Not inconceivably, the firms
reporting financial statements earlier are larger in size. The fact that both of these intensity measures remain constant indicates that either may be used for identifying unexpected changes in R&D, as discussed below.

5.1. Event Definition

Similar to Eberhart et al. (2004), this thesis studies changes in R&D or more precisely market reactions to these changes. From the main sample, R&D changes are thus identified. For the market to react to newly published information, the information must be unexpected and economically significant. Consequently, for an R&D change to be incorporated in this study, it as well must be unexpected and economically significant. First, as the market expects R&D expenditures to co-move with firm size, i.e. increase when the firm grows or vice versa, an unexpected change is when firm R&D intensity changes. Second, to be economically significant, R&D intensity\(^{19}\) must be at least 5 percent, expenditures must change by at least \(p\) \% and intensity must change by at least \(p\) \%. Eberhart et al. (2004) choose \(p=+5\), but this study incorporates changes of different magnitude, i.e. \(p = [-50, -10, -5, +5, +10, +50]\). A change fulfilling these requirements is then considered unexpected and economically significant. Table 3 below summarizes event definitions.

<table>
<thead>
<tr>
<th>Variables and limits to identify yearly unexpected and economically significant R&amp;D changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D intensity</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>(&gt; 5) %</td>
</tr>
</tbody>
</table>

On top of these strict event definition limits, data validation measures are included. First, decrease events caused by firms suddenly not reporting R&D expenditures or announcing outsourced R&D\(^{21}\), thus resulting in seemingly zero expenditure, were excluded from the sample. Similarly, excluded were decrease events caused by suddenly missing data. Furthermore, extreme outlier values were manually examined.

\(^{19}\) Measured here as R&D expenses to Total Assets

\(^{20}\) As R&D intensity is a relative measure, a 5 percent increase is e.g. from 10\% to 10.5\%.

\(^{21}\) Such announcements were manually searched to the author’s best ability from firm web pages.
and deviations replaced by handpicked financial statement data. Finally, as Compustat R&D data is available to the author as from 1990, the first year an event can occur is 1991. Table 4 below summarizes the obtained events for varying values of p for the entire time period, as well as number of events for varying values of p for varying years. R&D changing firms are hereafter denoted event firms.

**Table 4: Obtained Events**

Panel A shows the total number of events and unique firms for different values on p (R&D change limit) for the entire time period. Panel B shows total number of events for selected years.

<table>
<thead>
<tr>
<th>PANEL A: R&amp;D events and firms for entire sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>p</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td># Events</td>
</tr>
<tr>
<td># Firms</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PANEL B: R&amp;D events for selected years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>1991</td>
</tr>
<tr>
<td>1993</td>
</tr>
<tr>
<td>1995</td>
</tr>
<tr>
<td>1997</td>
</tr>
<tr>
<td>1999</td>
</tr>
<tr>
<td>2001</td>
</tr>
<tr>
<td>2003</td>
</tr>
<tr>
<td>2005</td>
</tr>
<tr>
<td>2007</td>
</tr>
<tr>
<td>2009</td>
</tr>
</tbody>
</table>
Figure 1 above clearly illustrates the apparent distributional difference in increase and decrease events. Indeed, the number of positive events for varying limits are mutually almost perfectly positively correlated, as are negative events. However, all positive and negative events aggregated are practically uncorrelated.

However, this event definition methodology contains an inherent limitation, which is also partly present in the analysis of Eberhart et al. (2004). As the event portfolios are partially overlapping (e.g. all R&D changes larger than 10 per cent are included in both the +5% and the +10% portfolios) analyzing differences across change limits is greatly complicated. This overlap causes by construction the near-perfect correlation between equally-signed events. For example, due to this overlap any negative abnormal returns for large R&D changes may skew the results for smaller changes, causing them to portray smaller abnormal returns. Therefore, results using these event definitions do not explicitly portray differences between small vs. large changes, but rather differences between changes larger than p. Thus, any wide-ranging conclusions on the usefulness of R&D changes of certain magnitudes based on these event definitions are unfeasible. However, these limits are used as primary event definition for two main reasons. Firstly, they facilitate direct comparison and extension to the results of Eberhart et al. (2004). Secondly, the change limits illustrate the underlying pattern of abnormal stock returns following R&D changes of varying values on p. The results in Table 7 below indicate that abnormal returns shift signs for some p (± 5% ≤ p < ± 50%) and consequently that markets underreact until some change limit p, while overreacting for larger changes.

---

22 In Eberhart et al. (2004), the positive abnormal returns for 5% increases are conceivably skewed by negative abnormal returns for larger increases. The results in Table 7 and 8 below support this.
To approximate this limit and to overcome the limitation in result analysis caused by the overlap, the event definition thus requires modification. Consequently, change limits are expressed in fully-bounded rather than left-bounded intervals, truly representing changes of certain magnitudes. This facilitates studying the market reaction small, moderate and large changes in R&D explicitly, all still unexpected and economically significant. Table 5 below presents the bounded intervals that represent small, moderate and large changes.

Table 5: Bounded Change Intervals

<table>
<thead>
<tr>
<th></th>
<th>Small Changes</th>
<th>Moderate Changes</th>
<th>Large Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>± 5% ≤ p &lt; ± 20%</td>
<td>± 20% ≤ p &lt; ± 50%</td>
<td>± 50% ≤ p &lt; ± ∞</td>
<td></td>
</tr>
</tbody>
</table>

Table 6 below summarizes the obtained events for varying bounded intervals of p. Clearly, the events for large changes are by construction identical to those in Table 4. The bounded interval events (i.e. small and moderate changes) are remarkably similar in sample size, while large increases occur much more frequently due to the unbounded maximum. Large decreases are still uncommon relative to other events. Furthermore, positive (negative) events of varying magnitudes are still mutually correlated, although far less than using left-bounded limits, as expected.

Table 6: Obtained Events for Bounded Change Intervals

<table>
<thead>
<tr>
<th>Change</th>
<th>Small Increase</th>
<th>Moderate Increase</th>
<th>Large Increase</th>
<th>Small Decrease</th>
<th>Moderate Decrease</th>
<th>Large Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td># Events</td>
<td>1284</td>
<td>1391</td>
<td>3,140</td>
<td>1055</td>
<td>1234</td>
<td>660</td>
</tr>
<tr>
<td># Firms</td>
<td>909</td>
<td>1063</td>
<td>2,229</td>
<td>807</td>
<td>986</td>
<td>563</td>
</tr>
</tbody>
</table>

23 These intervals are chosen on the basis of the author’s judgment and the results from left-bounded change limits, indicating that abnormal returns shift signs in the interval [± 5%, ± 50%].

24 Correlations range from 0.9 - 1.0 for left-bounded limits and from 0.5 – 0.6 for fully-bounded limits.
6 R&D AND STOCK RETURNS

This chapter presents the methodology for examining abnormal stock returns following R&D changes, identified using the different event definitions from above. The expected return on an asset is a function of its systematic risk, i.e. \( R_i = f(\text{risk}) \). The expected return of a risky asset is thus always in excess of the risk free rate in the economy. Abnormal return is per definition return in excess of that predicted (by a model) or expected (by the market). Therefore, risk-return relationships and market expectations must be correctly modeled. However, an asset's co-movement with the market, i.e. market beta, is not the only priced risk factor. In general, the expected return of a risky asset is obtained by aggregating all priced risk factors \( i \):

\[
E(R_i) = R_f + \sum_{i=1}^{n} \beta_i \times RiskFactor_i \quad (\text{Eq. 2})
\]

6.1. Abnormal Returns

The classical CAPM, adding the asset-market co-movement as the single risk factor in Equation 2, fails empirically to model expected returns. More specifically, it fails to explain return differences in portfolios sorted by size or B/M ratio, as discussed by Fama & French (1993), among others. According to the CAPM, these portfolios have equal expected returns, as none of these factors contribute to market beta. This is illustrated in Figure 2 below, where realized returns are plotted against returns predicted by the CAPM (right) and the Fama & French three-factor model (left). The figure shows the greatly differing realized returns of portfolios sorted by size and B/M, where portfolio 11 indicates lowest B/M and lowest size, while 55 indicates the highest. Several empirical studies have documented the superior returns of small (the size effect) and value stocks (the value effect), relative to their counterparts (large and glamour stocks) which is evident from the figure below.
Figure 2: CAPM (a) vs. 3-factor model (b) (Lettau & Ludvigson, 2001)

Clearly, the CAPM fails to explain this difference, modeling equal returns for all portfolios and resulting in a $R^2$ of zero. Simultaneously, the Fama & French three factor model performs much more accurately, with the $R^2$ value indicating that 80% of the difference in B/M and size sorted portfolio returns is explained by the model. A perfect pricing model would plot all observations on the 45-degree line and naturally have a $R^2$ of 100%.

Abnormal return of asset $i$ in general, denoted $\alpha_i$, is thus defined as return in excess of the expected return, as shown in Equation 3. Clearly, a perfect pricing model would yield zero abnormal return.

$$\alpha_i = E(R_i) - \left( R_f + \sum_{i=1}^{n} \beta_i \times RiskFactor_i \right) \quad (Eq.3)$$

Therefore, when studying abnormal returns, the choice of pricing model is paramount. Indeed, as discussed in chapter 3.3, any abnormal return may either be actual signs of mispricing (i.e. market inefficiency) or errors in modeled risk-return relationships (i.e. return expectations).
Due to the empirical superiority of multifactor market models, the general model in Equation 3 is transformed to proxy for the differing returns of small and large firms, high and low B/M firms, and high and low momentum firms, i.e. the size, value and momentum effect, respectively. Furthermore, instead of single assets, expected returns now correspond to a portfolio of event firms, i.e. R&D changing firms. Thus, equation 3 is transformed to a multifactor pricing model, i.e. the Carhart (1997) four-factor model:

\[ \alpha = E(R_{pt}) - \left[ R_{ft} + \beta(MRP_t) + s(SMB_t) + h(HML_t) + m(UMD_t) \right] \] (Eq.4)

Or, in regression form:

\[ R_{pt} - R_{ft} = \alpha + \beta(MRP_t) + s(SMB_t) + h(HML_t) + m(UMD_t) + \epsilon_t \] (Eq.5)

Here, \( R_{pt} \) is the average logarithmic return for the portfolio of event stocks in month \( t \), where a stock is included if \( t \) is within 4-64 months following its R&D change. This three month lag is included to allow the markets to be informed of the change. Although some firms may report financial data either sooner or later (with fiscal year either corresponding to calendar year or not), the market on average is expected to be informed of R&D events. Thus for example, if a sample firm increases R&D by an unexpected and economically significant amount in 1998, its stock returns for April 1999 to March 2004 are included in the portfolio. \( R_{ft} \) is the 1-month T-bill return. MRP is the market risk premium, \( R_{mr} - R_{f} \), where \( R_{mr} \) is the equally-weighted average logarithmic return on all Compustat Active and Research firms, SMB\( _t \) is the return on a portfolio of small stocks minus the return on a portfolio of large stocks, HML\( _t \) is the return on a portfolio of stocks with high B/M minus a portfolio of stocks with low B/M, and UMD\( _t \) is the return on a portfolio of high momentum stocks minus a portfolio of low momentum stocks\(^{25} \). If the momentum factor is excluded, the model diminishes to the Fama & French (1993) three-factor model. However, only small differences in the models’ explanatory powers are established. Finally, \( \alpha \) measures abnormal return, i.e. the return on the portfolio of event firms, on average, in excess of model expected returns for sample firms. Consequently, \( \alpha \) indicates market efficiency and reaction

\(^{25}\) Monthly factor returns of SMB, HML and UMD and more detailed methodology descriptions are available on Kenneth French’s hompages, under http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html
accuracy, and any excess return is thus in contrast to the EMH, although any formal rejection is ill-advised, as discussed in chapter 3.3.

These portfolios are formed separately for all R&D change event limits, both left- and fully-bounded, and the model then regressed accordingly. For example, for p=+5%, the methodology is a replication of Eberhart et al. (2004) and results are expected to be nearly identical although the time period slightly differs. Worth repeating though is the inclusion of both negative and larger values on p, as well as fully-bounded change intervals, as such events are, to the author’s knowledge, yet to be studied in financial literature.

6.2. Research Hypotheses: Abnormal Returns

The regression in Eq. 5 is thus used to test the following abnormal return research hypothesis:

\[ H_0: \text{No abnormal returns following R&D changes, } \quad H_0: \alpha = 0 \]

\[ H_1: \text{Abnormal returns following R&D changes, } \quad H_1: \alpha \neq 0 \]

According to previous research, and logical expectations, the hypothesis could be made one-sided and symmetrical to the direction of R&D change, i.e.:

\[ H_0: \alpha = 0 \quad H_0: \alpha = 0 \]

\[ H_1: \alpha > 0, \text{ for } p > 0 \quad H_1: \alpha < 0, \text{ for } p < 0 \]

However, according to good statistical practice, one-sided tests are to be used when theory or well-established practice mandates certain directionality. Clearly, neither is fulfilled here and two-sided hypotheses are thus used.

7 R&D AND OPERATING PERFORMANCE

While the previous chapter presented methods to examine market reaction correctness, i.e. market efficiency, to changes in R&D, this chapter studies the actual effect of the
change, i.e. the effect upon which the market may react. Similar to Eberhart et al. (2004) operating performance is thus examined.

7.1. Abnormal Profit Margin

Profit margins (PM), i.e. EBIT/Sales, are measured for all event firms for the 5 years following the R&D change. Abnormal profit margin (APM) is then defined as the difference in PM during these 5 years between an event firm and its matched firm. Loughran & Ritter (1997) advocates choosing matched firms that do not experience the same event as the event firm during the event year. Therefore, the matched firm is in the same two-digit SIC code as the event firm and has not made the same unexpected and economically significant R&D change (i.e. of the same magnitude $p$) as the event firm. The matched firm may, however, have an R&D event of differing magnitude $p$ during the event year. This matching procedure is hereafter denoted \textit{variable match}, due to the matching sample varying depending on $p$. Thereafter, the firm with the PM closest to the event firm during the event year, i.e. R&D change year, is defined as the matched firm. If matched firm data for all 5 subsequent years is not available, the next closest PM is chosen for those years that data is missing. Again similar to Eberhart et al. (2004), for each year, the median of all event firm APMs is calculated. Thereafter, the time-series average and volatility is computed on these annual median APMs to perform statistical significance t-tests.

As an additional test of matching robustness, the matched firm is chosen from a sample of firms that do not experience any R&D event during the event year (i.e. of any magnitude $p$). This matching procedure is hereafter denoted \textit{fixed match}, due to the matching sample remaining fixed regardless of $p$.

7.2. Research Hypotheses: Abnormal Profit Margin

Again, per definition, any abnormal measures are expected to be zero. The abnormal profit margin research hypotheses are thus:

$H_0$: No abnormal profit margins following R&D changes, \hspace{1cm} $H_0$: $\text{APM} = 0$

$H_1$: Abnormal profit margins following R&D changes, \hspace{1cm} $H_1$: $\text{APM} \neq 0$
8 RESULTS

The following subchapters present results separately for abnormal stock returns and abnormal profit margins, while the last part of the thesis analyses and discusses these results as a whole.

8.1 Abnormal Stock Returns

Table 7 below reports obtained abnormal returns and factor loadings using Carhart, Fama & French and CAPM models for the entire sample. Standard errors in the models are corrected for heteroscedasticity and autocorrelation following Andrews (1991). As expected and noted above, the three- and four-factor models show minor differences, observing for example significant positive monthly abnormal returns of around 0.45% for 5% R&D increases, slightly lower yet positive abnormal returns for 10% increases, and significant negative monthly abnormal returns for -50% decreases of around 0.70%. The results for p= +5% are near identical to those in Eberhart et al. (2004), enhancing result validity and reliability. The single-factor CAPM reports similar results, although obtaining lesser statistical significance and explanatory power. Still, all models are highly significant\(^{26}\) and explain up to 95% of return variation. Although the models’ explanatory powers appear excessive, values are consistent to those obtained by Chan et al. (2001). However, for all models, the explanatory power of portfolio return variability greatly decreases for p= -50%, indicating that these event firms show some return variability pattern not captured by the models, which is non-existent for other values of p. This may be related to the higher risk, although more research on the matter is needed. For example, the event firm portfolio monthly return volatility is significantly greater for decreases than for increases, and for larger changes than smaller, ranging from a monthly standard deviation of 8.6% (for p= +5%) to 10.0% (for p= -50%). This steady increase in risk may be portrayed by the decreasing abnormal returns.

Even though other values on p show no statistical significance, a clear pattern in abnormal returns emerges. Small increases (5% and 10%) exhibit positive abnormal returns and large increases (50%) negative abnormal returns. Furthermore, the same is

\(^{26}\) F-test probvalues are below 1%, rejecting the null hypothesis of zero R-square.
approximately true for decreases, with -5% decreases inducing positive abnormal returns and larger decreases negative returns. As discussed in chapter 5.1, the event definitions are modified once this pattern is discovered. As abnormal returns appear to shift signs for some p in the interval [±5%, ±50%], portfolios of small, moderate or large R&D changing firms are explicitly identified using the fully-bounded change limits in Table 5. The six event portfolios using these bounded change limit intervals are then regressed using Carhart, Fama & French and CAPM models. Due to factor loading invariability in the three models, only Carhart 4-factor results are presented below in Table 8. By construction, the results for large changes are identical to those presented in Table 7.

As argued by Eberhart et al. (2004), the event samples include a possible bias due to overlapping data. If a firm’s consecutive R&D change events of the same magnitude occur in less than five years time, return data will partly overlap. As some data is thus replicated, a downward bias in standard errors may occur, falsely identifying significant alphas. Therefore, Table 9 presents abnormal returns for a sample excluding any overlapping data, where an event firm is included no more frequently than once every 5 years.
Table 7: Abnormal Stock Returns, Full Sample

\[ R_{pt} - R_{ft} = \alpha + \beta(MRP_t) + s(SML_t) + h(HML_t) + m(UMD_t) + \varepsilon_t. \]

\( R_{pt} \) is the raw average logarithmic return for the portfolio of event stocks in month \( t \), where a stock is included if it is within 4-64 months following its R&D change. \( R_{ft} \) is the 1-month T-bill return. MRP is the market risk premium, \( R_{mt} - R_{f} \), where \( R_{mt} \) is the equally-weighted average return on all Compustat Active and Research firms, SMB is the return on a portfolio of small stocks minus the return on a portfolio of large stocks, HML is the return on a portfolio of stocks with high B/M minus a portfolio of stocks with low B/M, and UMD is the return on a portfolio of high momentum stocks minus a portfolio of low momentum stocks. \( \alpha \) measures abnormal return. *, ** and *** indicate statistical significance on the 1, 5 and 10% level, respectively. All values in percentages.

<table>
<thead>
<tr>
<th></th>
<th>+5 %</th>
<th>+10 %</th>
<th>+50 %</th>
<th>-5 %</th>
<th>-10 %</th>
<th>-50 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-factor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \alpha )</td>
<td>0.45*</td>
<td>0.37*</td>
<td>-0.14</td>
<td>0.12</td>
<td>-0.03</td>
<td>-0.68***</td>
</tr>
<tr>
<td>MRP</td>
<td>1.29*</td>
<td>1.32*</td>
<td>1.44*</td>
<td>1.34*</td>
<td>1.38*</td>
<td>1.48*</td>
</tr>
<tr>
<td>SMB</td>
<td>0.24*</td>
<td>0.24*</td>
<td>0.21**</td>
<td>0.20**</td>
<td>0.18</td>
<td>0.02</td>
</tr>
<tr>
<td>HML</td>
<td>-0.58*</td>
<td>-0.59*</td>
<td>-0.63*</td>
<td>-0.55*</td>
<td>-0.54*</td>
<td>-0.51*</td>
</tr>
<tr>
<td>UMD</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.01</td>
<td>0.04</td>
<td>0.06</td>
<td>0.10</td>
</tr>
<tr>
<td>R^2</td>
<td>95%</td>
<td>95%</td>
<td>93%</td>
<td>94%</td>
<td>93%</td>
<td>77%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>+5 %</th>
<th>+10 %</th>
<th>+50 %</th>
<th>-5 %</th>
<th>-10 %</th>
<th>-50 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-factor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \alpha )</td>
<td>0.46*</td>
<td>0.37**</td>
<td>-0.14</td>
<td>0.11</td>
<td>-0.05</td>
<td>-0.70**</td>
</tr>
<tr>
<td>MRP</td>
<td>1.30*</td>
<td>1.33*</td>
<td>1.44*</td>
<td>1.33*</td>
<td>1.35*</td>
<td>1.42*</td>
</tr>
<tr>
<td>SMB</td>
<td>0.23*</td>
<td>0.23*</td>
<td>0.21**</td>
<td>0.21**</td>
<td>0.20**</td>
<td>0.07</td>
</tr>
<tr>
<td>HML</td>
<td>-0.57*</td>
<td>-0.59*</td>
<td>-0.63*</td>
<td>-0.56*</td>
<td>-0.56*</td>
<td>-0.54*</td>
</tr>
<tr>
<td>R^2</td>
<td>95%</td>
<td>95%</td>
<td>93%</td>
<td>94%</td>
<td>93%</td>
<td>76%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>+5 %</th>
<th>+10 %</th>
<th>+50 %</th>
<th>-5 %</th>
<th>-10 %</th>
<th>-50 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-factor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \alpha )</td>
<td>0.55***</td>
<td>0.47</td>
<td>-0.07</td>
<td>0.19</td>
<td>0.02</td>
<td>-0.72***</td>
</tr>
<tr>
<td>MRP</td>
<td>1.48*</td>
<td>1.51*</td>
<td>1.62*</td>
<td>1.50*</td>
<td>1.52*</td>
<td>1.54*</td>
</tr>
<tr>
<td>R^2</td>
<td>89%</td>
<td>89%</td>
<td>87%</td>
<td>88%</td>
<td>87%</td>
<td>73%</td>
</tr>
</tbody>
</table>
Table 8: Abnormal Stock Returns, Bounded Change Interval

\[ R_{pt} - R_{ft} = \alpha + \beta (MRP_t) + \gamma (SML_t) + \delta (HML_t) + \epsilon (UMD_t) + \epsilon_t. \]

\( R_{pt} \) is the raw average logarithmic return for the portfolio of event stocks in month \( t \), where a stock is included if \( t \) is within 4-64 months following its R&D change, \( R_{ft} \) is the 1-month T-bill return. MRP is the market risk premium, \( R_m - R_f \), where \( R_m \) is the equally-weighted average return on all Compustat Active and Research firms, SMB is the return on a portfolio of small stocks minus the return on a portfolio of large stocks, HML is the return on a portfolio of stocks with high B/M minus a portfolio of stocks with low B/M, and UMDt is the return on a portfolio of high momentum stocks minus a portfolio of low momentum stocks. \( \alpha \) measures abnormal return. *, ** and *** indicate statistical significance on the 1, 5 and 10% level, respectively. Small, Moderate and Large changes represent R&D change limits \( p \) in the respective intervals \([±5\%, ±20\%], [±20\%, ±50\%] \) and \([±50\%, ±\infty\%] \). All values in percentages.

<table>
<thead>
<tr>
<th>4-factor</th>
<th>Small Increases</th>
<th>Moderate Increases</th>
<th>Large Increases</th>
<th>Small Decreases</th>
<th>Moderate Decreases</th>
<th>Large Decreases</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \alpha )</td>
<td>1.20*</td>
<td>0.79*</td>
<td>-0.14</td>
<td>1.02*</td>
<td>-0.10</td>
<td>-0.68***</td>
</tr>
<tr>
<td>MRP</td>
<td>1.02*</td>
<td>1.16*</td>
<td>1.44*</td>
<td>1.15*</td>
<td>1.31*</td>
<td>1.48*</td>
</tr>
<tr>
<td>SMB</td>
<td>0.19*</td>
<td>0.31*</td>
<td>0.21**</td>
<td>0.33*</td>
<td>0.24*</td>
<td>0.02</td>
</tr>
<tr>
<td>HML</td>
<td>-0.33*</td>
<td>-0.48*</td>
<td>-0.63*</td>
<td>-0.38*</td>
<td>-0.51*</td>
<td>-0.51*</td>
</tr>
<tr>
<td>UMD</td>
<td>-0.00</td>
<td>-0.03</td>
<td>-0.01</td>
<td>0.06***</td>
<td>0.49</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Table 9: Abnormal Stock Returns, No Overlap

As above, but an event firm can only be included once every 5 years, thus excluding overlapping data. All values in percentages.

<table>
<thead>
<tr>
<th>4-factor</th>
<th>+5</th>
<th>+10</th>
<th>-5</th>
<th>-10</th>
<th>Small Incr.</th>
<th>Mod. Incr.</th>
<th>Large Incr.</th>
<th>Small Decr.</th>
<th>Mod. Decr.</th>
<th>Large Decr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \alpha )</td>
<td>0.28**</td>
<td>0.28**</td>
<td>0.14</td>
<td>0.01</td>
<td>1.15*</td>
<td>0.82*</td>
<td>-0.13</td>
<td>0.94*</td>
<td>-0.13</td>
<td>-0.81**</td>
</tr>
<tr>
<td>MRP</td>
<td>1.34*</td>
<td>1.35*</td>
<td>1.33*</td>
<td>1.35*</td>
<td>1.1*</td>
<td>1.17*</td>
<td>1.44*</td>
<td>1.15*</td>
<td>1.39*</td>
<td>1.46*</td>
</tr>
<tr>
<td>SMB</td>
<td>0.22*</td>
<td>0.22*</td>
<td>0.23*</td>
<td>1.05*</td>
<td>0.21*</td>
<td>0.32*</td>
<td>0.23*</td>
<td>0.36*</td>
<td>0.25*</td>
<td>0.012</td>
</tr>
<tr>
<td>HML</td>
<td>-0.60*</td>
<td>-0.60*</td>
<td>-0.55*</td>
<td>-0.55*</td>
<td>-0.4*</td>
<td>-0.49*</td>
<td>-0.49*</td>
<td>-0.42*</td>
<td>-0.52*</td>
<td>-0.52*</td>
</tr>
<tr>
<td>UMD</td>
<td>-0.00</td>
<td>-0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>-0.01</td>
<td>-0.05***</td>
<td>-0.00</td>
<td>0.05</td>
<td>0.02</td>
<td>0.10</td>
</tr>
</tbody>
</table>
The results for fully-bounded event limits clearly show how the overlap in event firms using left-bounded event limits and the differences in factor loadings skew the results especially for small changes: the positive abnormal returns of small changes are far greater using fully-bounded intervals, as they are no longer skewed by the negative abnormal returns of large changes. The results for bounded change limits validate the emerged patterns in Table 7. For positive events, small and moderate increases yield positive abnormal returns, while large increases show none. For negative events, small decreases yield positive abnormal returns, moderate decreases yield none and large decreases yield negative abnormal returns.

The results for the sample excluding any duplicated overlapping data further validate the results. Furthermore, the abnormal returns using this sample achieved similar statistical significances as the samples including overlapping data, alleviating any concerns of sample creation errors and downward biases in standard errors.

Ergo, on average, small changes, either increases or decreases, in R&D are followed by positive abnormal returns, while large changes show negative abnormal returns. Therefore, the markets appear to underreact to the benefit of small R&D changes, while overreacting to larger changes. This result appears intuitive; small changes easily go undetected, while drastic changes receive abundant attention, the effects of which are possibly overstated. Furthermore, as most apparent from the differences between moderate increases and decreases, the market is more prone to overreact to decreases than it is for increases.

8.2. Abnormal Profit Margin

Table 10 below presents the obtained abnormal profit margins (APM) for all of the 10 different R&D change events. Similar to abnormal returns, small changes show positive, while larger show negative APM.27 Furthermore, as for abnormal returns for left-bounded change limits, the drastically negative APM for large changes greatly reduce the APM of smaller changes. For example, even though small increases show positive APM, +5% increases are greatly negative, due to the significant negative APM of larger

27 All APM measures show statistical significance on the 1% level using the variable match, although the Student t-test is partly vulnerable for non-normal sample distribution.
increases. The main difference between APM and abnormal return results is the limit where results shift signs. For abnormal returns, moderate increases still show positive returns, while inducing negative APM. Furthermore, the left-bounded 5 and 10 percent changes show positive returns yet negative APM. However, this is again attributable to the even more negative APM of larger changes. Therefore, the fully-bounded change limits, i.e. small, moderate and large, more accurately describe the effect of changes in R&D on operating performance.

Differences between the variable and fixed matching procedures are small. Nearly all APM measures are closer to zero using the fixed match, although this is to be expected, as the sample of firms in the fixed match does not include firms undergoing for example large opposite changes in R&D, which normally exhibit significantly negative profit margins. All firms in the fixed match sample have R&D changes below 5% per construction and as these firms more rarely exhibit extreme profit margins, APM measures are bound to be closer to zero. As the sample of firms in the fixed match is per construction far smaller than in the variable match, the matching is not as precise. This results in higher volatilities in the yearly median APMs, which in turn leads to lower levels of statistical significance. This is apparent in Table 10, where APMs in Panel A are all significant on the 1% level, while some Panel B values are no longer indifferent from zero on the 1% level. Still, the same conclusions hold: Small changes induce negative APMs while large changes induce significantly negative APMs.
Table 10: Abnormal Profit Margins

Profit margins (PM), i.e. EBIT/Sales, are measured for all event firms for the 5 years following their R&D change. Abnormal profit margin (APM) is then defined as the difference in PM for each of these 5 years between an event firm and its matched firm. In Panel A, the matched firm is in the same two-digit SIC code and has not made the same unexpected and economically significant R&D change as the event firm. In Panel B, the matched firm is in the same two-digit SIC code and has not made any unexpected and economically significant R&D change. Thereafter, the firm with the PM closest to the event firm during the event year, i.e. R&D change year, is defined as the matched firm. If matched firm data for all 5 subsequent years is not available, the next closest PM is chosen for those years that data is missing. For each year, the median of all event firm APMs is calculated. Thereafter, the time-series average and volatility is computed on these annual median APMs to perform statistical significance t-tests. *, ** and *** indicate statistical significance on the 1, 5 and 10% level, respectively. Small, Moderate and Large changes represent R&D change limits p in the respective intervals [±5%, ±20%], [±20%, ±50%] and [±50%, ±∞%]. All values in percentages.

Panel A: Variable Match

<table>
<thead>
<tr>
<th>Increases</th>
<th>+5%</th>
<th>+10%</th>
<th>Small Increases</th>
<th>Moderate Increases</th>
<th>Large increases</th>
</tr>
</thead>
<tbody>
<tr>
<td>APM</td>
<td>-3.2*</td>
<td>-3.7*</td>
<td>1.1*</td>
<td>-3.3*</td>
<td>-6.8*</td>
</tr>
<tr>
<td>Decreases</td>
<td>-5%</td>
<td>-10%</td>
<td>Small Decreases</td>
<td>Moderate Decreases</td>
<td>Large Decreases</td>
</tr>
<tr>
<td>APM</td>
<td>-2.7*</td>
<td>-3.9*</td>
<td>1.0*</td>
<td>-1.9*</td>
<td>-12.1*</td>
</tr>
</tbody>
</table>

Panel B: Fixed Match

<table>
<thead>
<tr>
<th>Increases</th>
<th>+5%</th>
<th>+10%</th>
<th>Small Increases</th>
<th>Moderate Increases</th>
<th>Large increases</th>
</tr>
</thead>
<tbody>
<tr>
<td>APM</td>
<td>-1.4*</td>
<td>-2.0*</td>
<td>0.7%*</td>
<td>-0.6%</td>
<td>-5.1*</td>
</tr>
<tr>
<td>Decreases</td>
<td>-5%</td>
<td>-10%</td>
<td>Small Decreases</td>
<td>Moderate Decreases</td>
<td>Large Decreases</td>
</tr>
<tr>
<td>APM</td>
<td>-1.8***</td>
<td>-2.6***</td>
<td>0.3*</td>
<td>-1.6*</td>
<td>-14.9*</td>
</tr>
</tbody>
</table>
PART III: RESULT ANALYSIS

9 RESULT ANALYSIS

In this chapter, the results obtained for both abnormal returns and abnormal profit margins, shown above, are analyzed and discussed as a whole. Furthermore, suggestions for further research based on the results obtained are given in the next subchapter.

In general, if an event positively affects performance or more accurately expectations thereof, stock prices theoretically instantaneously increase, ceteris paribus. For an event negatively affecting performance, the opposite holds true. If markets initially correctly adjust for such events, no abnormal returns materialize. The results show that changes in R&D affect company stock and operating performance. The markets may be slow to react upon these effects, or react incompletely, as suggested by long-term abnormal stock returns following R&D changes. However, wide-ranging conclusions on market efficiency based solely on these measures are ill-advised, as R&D changes conceivably contain risk-return aspects unaccounted in this abnormal stock return methodology.

As shown in Table 10, small changes in R&D result in positive abnormal profit margins for a five-year period, or in other words, result in better than expected operating performance or superior performance relative to peers. On the other hand, large changes show significantly negative abnormal profit margins, indicating that these event firms perform far worse than expected or than their peers. The abnormal stock return results in Table 7 or more accurately the fully-bounded change intervals in Table 8 show convincing symmetry to abnormal profit margin results; small changes induce positive abnormal returns, while large change yield negative abnormal returns. As these abnormal returns suggest, markets may not fully adjust, or adjust slowly, to R&D changes’ effects on operating performance, measured by Ebit/Sales relative to peers.

Moderate increases and decreases result in negative APMs, although abnormal stock returns vary. On one hand, increases result in positive abnormal returns. On the other hand, decreases yield no abnormal returns. However, this result may partly portray the choice of moderate change event definition, i.e. the change limit intervals. As moderate changes are in the interval \([\pm 20\%, \pm 50\%]\) and clearly include rather large changes,
which are shown to result in very negative APMs, moderate changes may be skewed. Therefore, changes close to the lower bound ±20% likely yield similar results as small changes, while changes close to the upper bound ±50% conceivably show results similar to large changes. Therefore, changes up to a limit p between ±20% and ±50% are likely to result in positive abnormal returns and APMs, while changes larger than this limit result in negative values. Analytically identifying this limit, however, is not within the scope of this thesis and offers interesting grounds for further research.

As discussed in chapter 2.6, these results conceivably convey the hypothesis of Pakes (1985) and Reingaum (1982) suggesting that there exists an optimal level of R&D. Therefore, small changes, either positive or negative, imply R&D expenditures close to optimum and consequently efforts to reach the optimum, whereas large changes imply levels of R&D expenditure far from the optimum. Furthermore, small changes plausibly imply commitment to investment stream-lining, resulting in better-than-expected performance, consequently yielding positive abnormal stock returns and APMs.

9.1. **Suggestions for Further Research**

First, as discussed above, there is conceivably a limit p, between ±20% and ±50%, where APMs and abnormal returns shift signs. Identifying this limit offers interesting grounds for research, as it distinguishes the limit where R&D changes shift from beneficial to detrimental, regarding operating performance. Second, as there are vast differences in the R&D intensities across industries and firms, sample subdivisions may offer interesting analysis on how the effects of R&D changes vary across firms. These subsamples may for example include high/low-tech or high/low growth, as is done by Eberhart et al. (2004), or industry subsamples, as is done by Chan et al. (2001). Third, as discussed in chapter 4, capital expenditures show similarities and differences to R&D expenditures. Therefore, using the same event definitions as in this thesis, studying the effects of both increases and decreases in capital expenditures on operating performance and stock prices further examines the relationship between these expenditures. Fourth, as evident from the abnormal return results, the factor models’ explanatory power of portfolio return variability greatly decreases for p= -50%, indicating that these event firms show some return variability pattern not captured by the models, which is non-
existent for other values of p, i.e. other R&D changes. Further examining the firms that significantly decrease R&D expenditures offers interesting grounds for research, as these firms clearly show some characteristic difference to other firms, which based on their higher return volatility may be related to higher stock risk. Fifth, there are conceivably priced risk factors not included in the multi-factor model employed here, although it is shown to perform well empirically. Therefore, research on additional risk factors may improve the result validity of this, and other, stock return studies.

10 CONCLUSION

In modern economies, firm value is increasingly tied to intangible assets. However, intangible asset valuation proves difficult due to accounting ambiguity and market inefficiency. As R&D outlays are fully expensed when incurred, financial statements possibly fail to convey the substantial long-term benefits, complicating external valuation and causing stock mispricing. Consequently, the debate over R&D expensing vs. capitalizing continues. The conceivable initial mispricing of changes in R&D expenditures induces abnormal returns. However, any abnormal return may be due to actual mispricing or due to false return proxies, reflected by the Joint-Hypothesis problem. Therefore, this thesis employs an empirically robust multifactor model to study the effects of changes in R&D expenditures on company performance, as measured by stock return and operating performance following these changes. The findings indicate that R&D changes affect company stock and operating performance. Small changes result in increased operating performance over five years, superior to peers, as shown by positive abnormal profit margins, whereas large changes are exceptionally detrimental to operating performance. This conceivably conveys the importance of stream-lined investments and optimal R&D expenditures.

Conclusively, this thesis extends the results of Eberhart et al. (2004), finding systematical abnormal returns and abnormal profit margins following R&D changes. The markets may partly disregard the benefit of small R&D changes, inducing positive abnormal returns, while the detriment of large R&D changes on operating performance yields negative abnormal returns, both results consistent with the notion of a R&D optimum.
SVENSK SAMMANFATTNING (SWEDISH SUMMARY)

BAKGRUND

Forskning och Utveckling (FoU) är en av företagets viktigaste aktiviteter, eftersom den är avgörande i att erhålla och bevara konkurrensfördelar (Zien & Buckler, 1997). FoU har blivit allt viktigare då företagsmiljön är allt mer teknologicenterad och förändringar sker i allt snabbare takt. Följaktligen, har kunskapen att göra lönsamma FoU-investeringar och effektivt utnyttja dessa blivit en avgörande faktor för tillväxt och framgång (Bottazzi & Peri, 2003). FoU är dock mycket kostsamt och oförutsebart, d.v.s. riskfyllt, och dessutom långsiktigt, vilket kan försvara värderingen av FoU-investeringar. Flera projekt utnyttjas aldrig kommersiellt, medan avkastningen på lyckade projekt varierar avsevärt.

Bokföringsstandarden för FoU-utgifter är under ständig debatt. Allmänt kostnadsför, d.v.s. tas upp som kostnader i resultaträkningen, alla sådana utgifter som avkastar endast under nuvarande räkenskapsår, medan sådana som avkastar under en längre tid kapitaliseras, d.v.s. tas upp som tillgångar i balansräkningen. De flesta FoU-investeringar förväntas avkasta under en längre tid, dock börsamtliga FoU-utgifter kostnadsföras enligt nuvarande amerikanska GAAP bokföringsprinciper. Detta avspeglar debatten mellan relevans och reliabilitet inom bokföringen. Å ena sidan angående relevans, rättfärdigas kapitalisering på grund av de betydande tillgångarna som FoU frambringar, vilka skapar värde över flera räkenskapsperioder. Å andra sidan angående reliabilitet är FoU-investeringarnas avkastning mycket osäkert, vilket försvvarar kostnadsföringen.

Företagsvärderingen försvåras ytterligare av den ökande delen av tillgångar som är bundna i immateriella tillgångar. Särskilt FoU-verksamhet är svår att värdera noggrant, vilket märks i de bokföringsprinciperna. Eftersom marknadsvärdet består av nettotillgångarna, både materiella och immateriella, orsakas möjligen felprissättning i samband med FoU. Dessutom, då tillväxt i allt större grad beror på FoU och därmed immateriella tillgångar, förstärks felprissättningen. Detta har lett till enorm uppmärksamhet på marknadens värdering av FoU-verksamhet. Till exempel Chan et al. (2001) finner stor excessavkastning bland FoU-intensiva företag teknologiföretag,


Undersökningen av FoU-utgifter och aktieavkastning skapar ny insyn i marknadseffektivitet. Ifall FoU-investeringarna är värdeskapande, d.v.s. NPV-positiva, kommer företagsvärdet att omedelbart öka, vilket bortskaffar långsiktiga excessavkastningar. Emellertid medför konstanta FoU-utgifter ingen ny information och följaktligen inte heller någon marknadsreaktion, vilket poängteras av Eberhart et al. (2004). Därför bör marknadsreaktioner undersökas i samband med förändringar i FoU-utgifter. Fastän Eberhart et al. (2004), bland andra, har undersökt effekten av ökningar i FoU, har minskningar ännu inte undersöks. Därmed kontribuerar denna avhandling med att studera effekten av både ökningar och minskningar i FoU-utgifter på företagets prestation.

SYFTE

Syftet med denna avhandling är att undersöka effekten av ökningar och minskningar i FoU-utgifter på företagets prestation. För att undersöka dessa effekter, beräknas långsiktig excessavkastning och excesslönsamhet till följd av FoU-ändringar.
KONTRIBUTION

Denna avhandling kontribuerar till den nuvarande forskningen på två intressanta sätt. För det första inkluderas förutom ökningar även minskningar i FoU-utgifter, för att se ifall dessa har en inverkan på företagets prestation och huruvida denna effekt är symmetrisk i hänseende till förändringens riktning, d.v.s. ifall en ökning har samma eller motsatta inverkan som en minskning. För det andra inkluderas olika stora förändringar. Detta möjliggör intressant tankegång och unik analys, eftersom motiven för FoU-ökningar säkerligen avviker från minskningar. Till exempel kan FoU-minskningar bero å ena sidan på kostnadsnedskärningar eller å andra sidan på att en mättad marknad inte längre erbjuder kapacitet för innovation och tillväxt, båda med olik inverkan på företagens framtidsförutsättningar. FoU-ökningar kan igen drivas av att försvårade konkurrenstillstånd kräver ytterligare insatser eller av att ett företag helt enkelt innehar förmågan att förnya sig. Därmed undersöker denna avhandling effekten av ökningar och minskningar av olika storlekar på företagens aktieavkastning och lönsamhet på den amerikanska marknaden.

TIDIGARE FORSKNING


Författarna erhåller signifikant positiv excess avkastning på 0,7% per månad över femårspanohen efter FoU-ökningen. Likväl finner de, att operativa lönsamheten är bättre för de företag som gör FoU-ökningen än för de som inte gör en liknande ökning.
Empiri

Datasamplet i denna avhandling innefattar samtliga företag i Compustat databasens Active och Research-filer under tidsperioden 1990-2009, och innehåller därmed både för tillfället aktiva och inaktiva företag. Därefter definieras en FoU-förändring som en förändring i årliga FoU-utgifter med mer än p%, en förändring i FoU-intensiteten mätt som utgifter/tillgångar med mer än p% och en FoU-intensitet som är högre än 5%. Eberhart et al. (2004) använde endast p = 5% i deras undersökning, medan denna avhandling inkluderar p = [-50, -10, -5, +5, +10, +50] [ % ]. Dessutom definieras små, medelstora och stora förändringar med respektive slutna intervallgränser: \(\pm 5\% \leq p < \pm 20\% ; \pm 20\% \leq p < \pm 50\% ; \pm 50\% \leq p < \pm \infty\).

Efter dessa förändringar undersöks excessavkastning under fem år efter FoU-förändringen med multifaktormodellen i Ekvation 5 på s. 38, varav fyra-, tre- och enfaktorvarianter används. I modellen \(R_{pt}\) genomsnittliga månatliga, logaritmiska avkastningar under månad t, där en sampelaktie är inkluderad ifall t är i intervallet 4-64 månader efter en FoU-händelse. Regressionen görs skiljt för positiva och negativa händelser. Denna lag tillåts för att försäkra om att marknaden blivit informerad om FoU-förändringen. \(R^\alpha\) är 1 månads T-bill räntan, MRP är marknadsriskpremiet, där \(R^m\) är likvägda genomsnittliga logaritmiska avkastningen på alla sampelföretag. SMB är avkastningen på små företag minus avkastningen på stora, HML är avkastningen på företag med hög B/M minus avkastningen på företag med låg och UMD är avkastningen på företag med hög momentum minus avkastningen på företag med låg. Slutligen, \(\alpha\) mäter excessavkastningen.

Likväl undersöks excesslönsamhet (APM) som skillnaden i Ebit/Omsättning mellan företagen som förändrar FoU och dessa företags matchade par, där matchningen görs där skillnaden är minst.

Undersökningshypoteserna är därmed:

\[H_0: \alpha = 0 \quad \text{H}_0: \text{APM} = 0\]

\[H_1: \alpha \neq 0 \quad \text{H}_1: \text{APM} \neq 0\]
RESULTAT

Resultaten för excessavkastningarna hittas i tabellerna 7, 8 och 9, medan APM-resultaten hittas i tabell 10. Det märks klart, att små förändringar, både positiva och negativa, orsakar positiv månatlig excessavkastning under fem år efter FoU-förändringen på ca 1%, medan stora förändringar medföljs av negativ månatlig excessavkastning på -0,1% och 0,7% för ökningar respektive minskningar.

Samma mönster uppkommer för APM, där företag som gör små FoU-förändringar är lönsammare än matchade företaget, medan stora förändringar är väldigt skadliga för lönsamheten.

KONKLUSION


REFERENCES


