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The long-term effects of CAPEX, R&D and acquisition expenditure on stock returns

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Abstract

We regress R&D expenditures, CAPEX and the cash-flow of acquisition on a quarterly basis on the stock market excess return of stocks included in the Russel 3000 index. Acquisitions are statistically significant in a model which includes the current and the lagged period as a part of a composite model with R&D and CAPEX. R&D expenditures are robust and statistically significant, both in the current period and in its first lag, though with different signs. The current period is a negative and the lag is a positive determinant of returns. The latter finding of a positive lagged effect is also found in previous studies. We provide fresh insights by combining the three variables as possible determinants of stock return.

Keywords: *R&D, CAPEX, Acquisitions, Fama-French, four factor model, Stock returns*

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Table of Contents

Abstract 1
Acknowledgements 2
1. Introduction 4
1.1 R&D literature review 5
1.2 CAPEX literature review 8
1.3 Acquisitions literature review 9
2. Hypotheses 10
3. Data 10
3.1 Variable definitions 11
3.2 Descriptive statistics 12
4. Methodology 15
4.1 Fama French and Carhart model 15
4.2 Fama-MacBeth Model 15
4.3 Model specification 16
5. Results 17
6. Robustness 24
7. Conclusion 27
7.1 Future research 27
References 28
Appendix 31

1. Introduction

The research question revolves around whether companies with high R&D, high capital expenditures (CAPEX) and large cash acquisitions in relation to market capitalization or total assets will gain abnormal returns on the stock market. Does the stock market acknowledge the potential future earnings advantages from high levels of expenditure, and which type of intensity ratios are useful to look at as an outsider?

Regressing R&D expenditures, CAPEX and the cash-flow of acquisition on the stock market excess return on almost 12 years of data, we find that acquisitions are significant in a model which includes the current and the lagged period as a part of a composite model with R&D and CAPEX. R&D expenditures are robust and statistically significant, both in the current period and in its first lag, though with different signs where the current period is negative and the lag is positive. The latter finding of a positive lagged effect is also found in previous studies.

Spending on R&D usually means companies will expense such costs immediately, instead of capitalizing the expenses as an asset, which would be depreciated over the expected lifetime of the asset. Expenditures related to other assets that provide a financial long-term benefit to the company will be capitalized, commonly property, plant and equipment (PP&E) costs. (Damodaran, 2012) R&D costs are expensed due to common accounting regulations, which is a substantial shortcoming of accounting standards from a valuation perspective. Investments into research, development and the capital stock are important since they will provide the company with future benefits; higher investment levels represent promising opportunities and signals confidence to the stock markets. On the other hand, increasing investments may also be a way for managers to build "empires", to improve their own status instead of solely acting on behalf of the stockholders (Titman, Wei and Xie, 2004).

We study American data because of the large availability of such data and because the accounting practices of US GAAP will provide us with specific insights when it comes to R&D expenses, since US firms cannot capitalize development expenses. Thus it will be easier to find the data than for European firms where some of the R&D expenses are capitalized and where R&D expenses in the financial statements do not fully reflect the true R&D expenses during that time period. We will also look at capital expenditures, because both R&D and CAPEX are creating a future economic benefit for the company and it can thus be argued that a company has a choice of either spending on CAPEX or on R&D to create future value and benefits. To provide some insight into the sample, the correlation between R&D and capital expenditure quarter by quarter is 0.38, and although there is a positive correlation, there is variability and companies are investing more funds into one of the two.
Since companies also have the option to acquire R&D and PP&E through purchasing other companies, instead of developing it themselves, we have included costs for acquisitions in a combined CAPEX variable. Acquisitions can be seen as an R&D expenditure or CAPEX, as they purchase investments

already undertaken by other companies, including patents and other type of rights to products or services. It is therefore important to control for acquisitions in our models.

There have been several previous studies on the relationship between R&D, CAPEX, and acquisitions respectively on stock returns. For instance Chan, Lakonishok and Sougiannis (2001) research the effects of R&D expenditures on stock returns, and Cordis and Kirby (2017) looks at CAPEX and stock returns. However, no previous articles study the joint effects of R&D, CAPEX and acquisitions. This is important to look at, as explained before, since R&D expenditures can come in different types, such as in mergers or acquisitions. Another reason for looking at the joint effects is to see whether the managers in the companies effectively use the firm's available resources rationally. The question however is whether the stock market can evaluate CAPEX or R&D projects or if the managers are taking on poor projects and is more interested in empire building or just to maximize their own utility.

In a 2002 paper by Chambers, Jennings and Thompson, they conclude that the Fama and French model underestimates the expected return for R&D intensive firms. Thus the Fama-French model is not totally applicable for R&D intensive firms. Chambers et al. also see this as an important field of future research due to the growing importance of R&D in the economy and in society, where we also see that there is a lack of research.

Our main contribution will be to combine the capital investment, R&D and acquisition literature by combining factors common in respective strand of literature into one model, gradually disentangling the effects by looking at more specific items, over the current period and with lags. Previous studies have focused on either R&D or CAPEX, whereas our interpretation is that these items are closely connected. Both of them are concerned with developing new products and offerings, *i.e.* future benefits to the firms. By adding an item connected to acquisitions, we are also considering the corporate option to purchase other firms' investments instead of in-house development.

1.1 R&D literature review

The study of research and development expenditures (R&D) developed in the 1980s with a focus on the recently computerized patent register in the US. The number of patent applications a company had would serve as a control variable for successful R&D expenses on stock market valuations (see for example Griliches, 1981 and Pakes, 1985). Even in the initial studies, there are significant relationships between intangible capital, proxied by patents and R&D expenses, and an increased market valuation of a company.[1]

[1] Using patents as an explanatory variable had it drawbacks, however, since patent applications do not necessarily proxy marketable product assets to companies perfectly and since all development expenditures do not lead to patent applications. (Pakes, 1985)

Subsequent studies following Griliches (1981) and Pakes (1985), focus on two main findings: firstly, on the market valuation effect of companies' long-term expense announcements in general and secondly on the direct effect of R&D expenses on stock market valuation as the dependent variable. The former type of study is represented by among others McConnell and Muscarella (1985), who find that industrial firms that publicly announce increased capital expenses experience significant stock market excess returns. Chan, Martin and Kensinger (1990) find significant excess returns on a two-day post R&D announcement period. By introducing an intensity variable, where company *i*'s expenses are divided by the industry average, they try to find cross-section anomalies, though only finding significant stock market excess returns for "high-tech" companies with high R&D intensity.

While the importance of development expenses was never in question, there was a debate on how actors interpreted them. On the one hand, management could be wary of increasing short-term expenses, which would reduce company profitability, reduce the market valuation of the company because of investor myopia and make it a takeover target. On the other hand, it could be argued that managers are short-sighted, being compensated by short-term profitability and not holding company stock privately, causing an agency problem. (Chan, Martin and Kensinger, 1990)

Hall (1993) builds on previous research by regressing R&D flows and R&D stock on market valuation. The flow is defined as expenditures in relation to physical capital assets, which Hall argues is a good indicator of the long-run behaviour of the firm, since the intrafirm variance of such expenditures is low. The stock variable is constructed by capitalizing past R&D expenditures, which is depreciated by 15 per cent annually. As control variables, he uses advertising expenditure to assets, a two-year moving average of cash-flow to assets and the current sales growth. He finds significant results for regressions of both the flow and the stock variables on stock market valuation, and that an annual depreciation of 15 percent is unrealistically low.

Chan, Lakonishok and Sougiannis (2001) in their seminal paper *The Stock Market Valuation of Research and Development Expenditures* examines the effects of R&D expenditures on the US stock markets with the stock market price of companies. Chan, Lakonishok and Sougiannis (2001) use a similar capitalization technique of past R&D expenditures that Hall (1993) implemented, but they depreciate the resulting asset more aggressively with an annual rate of 20 per cent. The R&D asset is added to total assets, and the authors first divide the sample into portfolios of quintiles depending on R&D to sales and then also divide the sample into portfolios of quintiles depending on R&D to market capitalization. They thereafter investigate portfolio returns on one, three and five year intervals. Excess returns on the sample portfolios are defined as the return less the return on control portfolios matched by size and book-to-market, and by size and adjusted book equity. They do not find a general relationship between the level of R&D expenditure and excess returns. However, excess returns are generally positive for R&D intensive firms, with the top quintiles formed on R&D to sales returning between three and four per cent more on a three-year period, and the corresponding quintiles formed on R&D to market value six to seven per cent in excess over three years.

As a robustness check to control for different investor attitudes towards risk not incorporated in the control portfolios and the reversal effect of past stock market losers being overrepresented in high R&D to market value quintiles, they regress stock returns using a version of Fama and French's (1992, 1993) three factor model and Carhart's (1997) four factor model. The momentum factor of Carhart is split into one long-term momentum factor, defined as the return from five until one year before portfolio creation, and one short-term momentum factor, which starts seven months and ends one month before. Here Fama and French's three factor model is introduced to the expenditure research, something that is replicated with slight variations in subsequent papers. Even when controlling for past stock performance through the momentum factors, they find a reversal effect in that firms in the top quintiles of R&D to sales are to a large extent past losers, which have kept their R&D expenditures stable and persevere through challenging market conditions. These firms have subsequently been rewarded by high returns on the stock market. The excess return variable alpha indicates a three year significant return of 6.89 per cent for the top quintile portfolio.

The motivation for their study, as for others during this time, is focused on the valuations and R&D implications for technology firms. There is an underlying assumption that the stock market may have difficulties appreciating expenses, even though the technology firms were expected to drive much of the development, and in extension the stock market, in the future.

Chambers, Jennings and Thompson (2002) confirm the excess return findings of Chan et al. but suggest that the positive relationship between high levels of R&D and excess stock returns depends on risks not being adequately controlled for rather than depending on market mispricing. This is caused by myopic investors.

Eberhart, Maxwell and Siddique (2004) conclude that shareholders experience significantly positive long-term abnormal stock returns following an unexpected increase in R&D expenditures, due to investor underreaction to the benefits of R&D. The benefits come from significantly positive abnormal operating performance in these companies, and the market is slow to react to these changes. Their approach is to divide the sample into high-tech, low-tech, high-growth and low-tech firms. Eberhart et al. (2004) test excess returns for firms increasing their R&D by using the Fama and French three factor model and Carhart four factor model, applying three different models: five-year sample, a rolling regression approach and a delisted-adjusted sample. Songur and Heavilin (2017) also conclude that there is an abnormal return from companies that increase their R&D expenses to an abnormal level. The abnormal return ranges however from 3.2 percent to 11.5 percent. Abnormal expenses are construed as positive or negative if deviating from the average over the three previous years. They test their results using the Fama and French model, Carhart and five factors where the Carhart model is amended with a liquidity factor.

1.2 CAPEX literature review

Looking at capital expenditure, Titman, Wei and Xie (2004) consider three approaches to evaluate its effect on market return: firstly, they measure portfolio excess returns in comparison to benchmarks, secondly, they use the Carhart model and lastly they are looking at returns on a short interval around announcement dates. They find a negative relationship between abnormal levels of capital investment and subsequent stock return. In a follow-up study on the Japanese market, Titman, Wei and Xie (2009), cannot replicate their previous findings. They claim this is not consistent with a risk-based explanation.

Polk and Sapienza (2006) find similar results as in the first study of Titman et al. (2004), that investments are positively correlated with low stock returns. Although Polk and Spaienza (2006) focus more on the discretionary spending of firms, it is interesting as the main source for Xing (2008), who investigates the value effect from capital expenditure, defined as the marginal investment expenses, on future equity returns on a yearly basis. She looks at the ratio of capex on net book value of fixed assets and on the investment growth rate in firms' capital expenditures. The results are that smaller firms have three times as high investment growth rates and higher investment-to-capital ratios than large firms. Portfolios of firms with low investment levels have significantly higher returns than those with high investments levels, and the effect of the Fama-French factor HML largely disappears when controlling for investments. When sorting on investment levels you are effectively sorting firms by the book-to-market ratio. Sorting firms into portfolios of investment intensity, Xing finds that stocks with high returns are associated with firms with the lowest past capital expenditure ratios.
As a robustness check, Xing (2008) conduct Fama-Macbeth regressions with lagged values of Xing's investment ratios, book-to-market, size, and the CAPM beta factor of volatility sensitivity. The lags are over a period of one year. For both capital investment ratios there is a negative and statistically significant relationship with future stock returns, both for the ratios in stand-alone and when controlling for size, book-to-market and beta.

Stambaugh, Yu and Yuan (2012) investigate 11 pricing anomalies reported in previous studies, not explained by the Fama-French three factor model, with high investments to assets being one of them. They report significant results going long in high-investment firms and going short in low-investment firms individually, but no significant returns from a long minus short strategy. Such a strategy is significant with an excess return coefficient of 0.74 percent per month in high sentiment months.

Cordis and Kirby (2017) found that the relationship between future stock returns and capital expenditures relative to the book value of capital stock is significantly negative. The relationship is robust using other controls, for instance to the market cap of the firm. However, they also found that there is a non-linear relationship, where firms' stock returns may be greater for investments at intermediate intensity levels, rather than at low or high levels, looking at the whole sample. The authors therefore rule out that the negative relationship between higher capital expenditures and negative returns should be because of some kind of overinvestment.

1.3 Acquisitions literature review

Two methods of evaluating acquisitions, one short-run announcement procedure, which estimates the abnormal return during some days around announcement date t=0. The other main method focuses on the abnormal stock performance of acquirers over several years. Agrawal, Jaffe and Mandelker (1992) found that stockholders of an acquiring firm will suffer a loss of around -10 percent over a five year post merger period adjusting for firms' size and beta. Loughran and Vijh (1997) investigate the long-term effects over five years post-acquisition of US-listed firms from 1970 until 1989, using a Fama-French setting where they benchmark the return of acquirers and acquired companies when compared to comparable companies based on size, or market value of equity, and book-to-market. They find significant negative returns of -25 percent over five years for firms using stocks as means of payment, whereas acquisitions by cash yields a significant excess return of 61.7 percent over five years, consistent with the means of payment hypothesis, which states that managers, who have insider knowledge of when their own company stock is overvalued, will use stock as their means of payment when acquiring firms; conversely, the managers will prefer cash-based acquisitions when their own stock is not overvalued. (Rau and Vermaelen, 1998)

One of the criticisms of pre-Fama French studies has been that they do not account for the size and book-to-market anomalies (Rau and Vermaelen, 1998). Rau and Vermaelen (1998) report similar results as Loughran and Vijh (1997), where mergers result in a negative abnormal return of 4 percent over a three year period for the acquiring shareholders and cash-based acquisitions yield 9 percent positive abnormal return over the same time interval, when adjusted for size and book-to-market. Mitchell and Stafford (2000) also find significant subsequent underperformance for acquirers.

Short-term event studies, investigates the abnormal stock return over the announcement date. The shortest window is measuring over one day before until one day after. Longer time-spans, in this context, could take into account the return from several days before the announcement until the closure of the acquisitions. Assuming markets are efficient, any new public information would immediately be incorporated into the stock price. Although some studies find positive short-term announcement effects, most studies, like for example Andrade, Mitchell and Stafford (2001) and Malmendier and Tate (2008) show that the short term effect for acquiring stockholders is significantly negative.[2] Malmendier and Tate find that in a subsample of only cash bids there are positive and significant abnormal stock returns of 0.45 percent over the actual benchmark return of the S&P 500 index at the 10 percent significance level.

2. Hypotheses

Our first hypothesis is that higher R&D, Capex and the cost of acquisitions will not lead to higher returns during the same time period, in our case the same quarter.

Our second hypothesis is the R&D, Capex and the cost of acquisitions in the previous period, quarter, will not lead to higher return in the stock.

Our third hypothesis is that the combination of different expenditures and lags will not lead to higher stock return.

All of our hypotheses are tested in a three-factor Fama-French or four-factor Carhart setting, where the factors are assumed to explain stock returns without mispricings. We hence posit the null hypothesis in all three cases that the addition of more variables will not lead to significant sensitivities to such factors.

3. Data

The sample consists of 4,397 firms with a total of 107,055 quarterly observations for the time period from the second quarter 2006 to the fourth quarter 2017, totalling 47 quarters. The data has been sampled from the Russell 3000 index, where we have used all of the companies included in the index that are not financial companies. Financial companies are excluded because they have very different characteristics in comparison to other companies. In this study, where we look at both R&D and CAPEX, these companies tend to have no such expenses and they could therefore skew the results. Chan et al. (2001) have also excluded financial companies in their sample. Eberhart et al. (2004) cut out all firms that did not have a certain minimum level of R&D intensity, thereby also excluding financial firms from their sample, since financials do not tend to have any R&D expenses. We have also included the stocks that have come and gone on a quarterly basis, so if a new stock enters the index, the new stock is included in our sample even if it is just there for one quarter. By updating the number of companies, we control for survivorship bias, which would be large if we only included stocks that existed in the first quarterly observation. We have also excluded common shares of different classes, so if a firm has both a and b shares listed we exclude one of them in order to not "double count" the effect in our sample. The risk-free rate used when calculating the market risk premium is the yield of a US 10-year government bond, which has been recalculated to a quarterly basis. We have used Bloomberg to retrieve our data, since it has a large database of all the variables that we require for this thesis. Fama, French (1992) and Carhart (1997) use a 1 month T-bill rate. Using a 10-year bond, will however ensure a positive rate throughout the sample time period.

[2] See Betzer et al. (2015) for a review of long-term and short-term acquisition studies.

3.1 Variable definitions

R&D expenses include the cost the firm has had for development in the current quarter. Since US firms are not allowed to capitalize R&D expenses, this will capture all the R&D expensed during the quarter. The CAPEX variable includes all the regular CAPEX in PP&E such as investing in new machinery etc. However, this measurement does not capture acquisitions and thus we will include acquisition expenses as well. Acquisition expenses is also a cash flow measurement and it does not capture firms that pay with equity in merger and acquisition deals.

In order for us to test whether our variables have some kind of explanatory power, we will create a "combined" variable where we combine R&D expenses, CAPEX and acquisitions and divide it by market capitalization at the end of the quarter. Using the definition of a variable to market capitalization was done by Chan et al. (2001) and we have thus used this definition when we construct our variables. R&D expenses, CAPEX and acquisition expenses are taken from the corresponding quarters' quarterly reports. We also include acquisitions in our tests since CAPEX and R&D can come in many different forms. Some firms in R&D intensive industries have low or non R&D expenses, but they instead acquire their R&D projects from other firms. This will not end up as an R&D expense in the income statement or in CAPEX, so we need to adjust for acquisitions in CAPEX in order to adjust for these firms that have had acquisition-based R&D. If we find statistical significance, then we will know that there exists explanatory power in at least one of the combined variables.

$$\text{Combined variable to market cap} = \frac{(\text{CAPEX} + \text{R\&D expenses} + \text{Cost of acquisitions})}{\text{market capitalization}}$$

We also augment the standard Fama-French three factor model with Carhart's (1997) extension, which adds a momentum factor capturing the eleven-month lagged stock return from *t-12* to *t-2* in order to capture the trend of the stock and so that our results are not an extension of past stock market performance. As with the Fama French three factor model, the addition of the momentum factor is based on observed phenomena, and this factor is able to explain a reversal effect of past performance first studied by Jegadeesh and Titman (1993). The variables small-minus-big (SMB) and high-minus-low (HML) for the three-factor model have been retrieved from Kenneth R. French's webpage. Also, the momentum factor (MOM) was retrieved from the same page, but there the monthly factor was recalculated as the rolling three-month cumulation of the factor and applied in our models.

In the main regressions we will divide the combined variable, so that it will consist of both R&D expenses to market cap and a term that we call "Adjusted CAPEX" to market cap, which includes both regular CAPEX and the cost of acquisitions.

$$\text{R\&D to market cap} = \frac{\text{R\&D expenses}}{\text{market capitalization}}$$

$$\text{Adjusted CAPEX to market cap} = \frac{(\text{CAPEX} + \text{Cost of acquisitions})}{\text{market capitalization}}$$

We will also use lagged variables where we take the previous quarters' value and use it in our regression on today's values. This will be used for the combined variable, R&D and Adjusted CAPEX to market capitalization.

The lagged variables are calculated with one quarter lag, and it represents the previous quarter's financial statements and market value. The reason is that some information take time to be fully integrated into the market valuation of stocks. The definitions for all the variables are summarized in table 1 below.

Table 1: Variable definitions

Variable	Description
RmRf	Market excess return. The return of Russel 3000 minus the return of a US 10 year government bond
SMB	Small minus big factor of Fama-French
HML	High minus low factor of Fama-French
Momentum	Momentum factor from Carhart's 4 factor model. The eleven month return lagged one month
Combined variable	CAPEX plus R&D plus acquisitions per quarter
Adjusted CAPEX to marketcap	CAPEX plus acquisitions per quarter as a share of marketcap by the end of the same quarter
CAPEX to marketcap	CAPEX per quarter as a share of marketcap by the end of the same quarter
Acqusitions to marketcap	Acquisitions per quarter as a share of marketcap by the end of the same quarter
R&D to marketcap	R&D per quarter as a share of marketcap by the end of the same quarter
Combined variable lag 1	The lagged t-1 quarter of the combined variable
Adjusted CAPEX to marketcap lag 1	The lagged t-1 quarter of adjusted CAPEX
CAPEX to marketcap lag 1	The lagged t-1 quarter of CAPEX
Acqusitions to marketcap lag 1	The lagged t-1 quarter of acquisitions
R&D to marketcap lag 1	The lagged t-1 quarter of R&D

3.2 Descriptive statistics

In this section, we will present the data that is used for this thesis, and also a discussion about the data. An overview of the data is presented in table 2. A Correlation matrix is also found in this subsection, which consists of all of the variables which is used in the regressions.

Table 2: Descriptive statistics

					Quantiles			
Variable	n	Mean	Std.Dev	Min	25%	Mdn	75%	Max
Stocknum	107 055	2247,65	1234,03	1,00	1183,00	2251,00	3312,00	4397,00
RmRf	107 055	0,02	0,08	-0,23	-0,01	0,04	0,06	0,16
SMB	107 055	0,13	3,57	-7,00	-2,41	0,32	2,00	12,01
HML	107 055	0,13	6,80	-13,62	-3,34	-0,36	2,70	23,85
MOM	107 055	0,00	0,08	-0,40	-0,02	0,01	0,04	0,16
Combined variable to market cap	62 189	0,05	0,30	-7,79	0,01	0,02	0,04	64,09
Capex and Acquisitions to market cap	107 006	0,04	0,65	-7,85	0,00	0,01	0,03	163,54
R&D to market cap	62 189	0,01	0,06	-0,01	0,00	0,01	0,02	13,27
Capex to market cap	107 006	0,02	0,13	0,00	0,00	0,01	0,02	21,95
Acquisitions to market cap	107 006	0,02	0,63	-7,87	0,00	0,00	0,00	163,49
Combined variable to market cap lag 1	58 811	0,04	0,29	-7,79	0,01	0,02	0,04	64,09
Capex and Acquisitions to market cap lag 1	102 613	0,04	0,65	-7,85	0,00	0,01	0,03	163,54
R&D to market cap lag 1	58 811	0,01	0,03	-0,01	0,00	0,01	0,02	3,37
Capex to market cap lag 1	102 613	0,02	0,10	0,00	0,00	0,01	0,02	16,61
Acquisitions to market cap lag 1	102 613	0,02	0,64	-7,87	0,00	0,00	0,00	163,49

From the descriptive statistics presented in table 2, our data have observations for almost all of the variables that we intend to use in our regressions. However, R&D expenditures are observed in only 62,189 instances in comparison to 107,055 observations that we have in our whole sample. The dataset has been retrieved from Bloomberg, and a lot of the minor companies included in the Russell 3000 index either does not report R&D expenses, or there is no data available from the companies, or Bloomberg does not retrieve the full data available from the companies. However 62,189 observations is still a large enough sample for us to get unbiased results.

Below in table 3, there is a correlation matrix for the variables used in this thesis. There is a high correlation between the variable for the current quarter and the last quarter. This is mostly trivial, since capital expenditures or R&D expenses does not tend to change much from quarter to quarter and thus there exists a high correlation between the variable for the current quarter and the lag. For instance, the correlation between R&D to market cap for the current quarter and for the lag is 0.7161. This implies some problems for our regression, since because of the high correlation between theses variables we will get variables that will be serially correlated and could potentially distort the regression variables. Because of this we will perform several regressions where we include both the variable for the current quarter in one regression and the lag in the other, to test the robustness of the variables and also to find out how much the serial correlation will affect the variable coefficients.

There is also a high correlation of 0.9322 between Adjusted CAPEX and the Combined variable. This is expected since the combined variable is a product of summing CAPEX, acquisitions and R&D expenses into one variable. These variables will thus not be in the same regressions so they will not affect the results. Looking at the other variables, the market risk premium, RmRf which is the market return minus the risk-free rate, exhibits some correlation with SMB, HML and the Momentum factor, however this correlation is not very high. The term is however uncorrelated with all the other terms. SMB, HML and the Momentum term exhibits the same relationship where it has some correlation with the Fama-French factors and with the Carhart momentum factor. However these factors are uncorrelated with the terms that we have constructed and that we are testing in our regressions. This gives us indication that these terms will not affect these terms in the regressions.

Table 3: Correlation matrix
This table show the correlation between the variables that are used in the regressions

Correlation Matrix	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
RmRf (1)													
SMB (2)	0.3832												
HML (3)	0.3854	0.4687											
Momentum (4)	-0.3353	-0.4729	-0.6755										
Combined variable (5)	-0.0594	-0.0187	-0.0247	0.0029									
Adjusted CAPEX to marketcap (6)	-0.0523	-0.0288	-0.0248	0.0123	0.9322								
CAPEX to marketcap (7)	-0.0328	-0.0205	-0.0152	-0.0024	0.7631	0.6647							
Acqusitions to marketcap (8)	-0.0411	-0.0205	-0.0198	0.0185	0.5744	0.7519	0.0073						
R&D to marketcap (9)	-0.0485	0.0085	-0.0144	-0.0164	0.7196	0.4195	0.6388	-0.0021					
Combined variable lag 1 (10)	-0.0215	0.0190	0.0000	-0.0449	0.5590	0.5676	0.3762	0.4278	0.3131				
Adjusted CAPEX to marketcap lag 1 (11)	-0.0179	-0.0003	-0.0042	-0.0252	0.4641	0.5437	0.3053	0.4584	0.1208	0.9608			
CAPEX to marketcap lag 1 (12)	-0.0087	-0.0004	0.0015	-0.0225	0.4262	0.4243	0.6402	0.0030	0.2549	0.4873	0.4795		
Acqusitions to marketcap lag 1 (13)	-0.0157	-0.0001	-0.0056	-0.0167	0.2998	0.3915	0.0038	0.5207	0.0006	0.8329	0.8818	0.0088	
R&D to marketcap lag 1 (14)	-0.0164	0.0697	0.0143	-0.0757	0.4339	0.1941	0.3159	-0.0189	0.7161	0.3324	0.0577	0.1235	-0.0006

4. Methodology

In this section, we present the models that we use in our analysis and regression. In section 4.1 we present the Fama-French and Carhart model. In 4.2 we present the Fama-MacBeth model which is the core for our robustness test and in 4.3 we present our regression models.

4.1 Fama French and Carhart model

The regression models applied will mainly originate from Fama and French's (1992, 1993) multifactor model. The Fama-French model originates from the CAPM model, based on Sharpe (1964) and Lintner (1965), where the return on an individual asset R_i depends on the sensitivity to a market volatility factor.

$$R_i = \alpha + \beta_1(R_m - R_f) + \beta_2 SMB + \beta_3 HML + \varepsilon_i$$

The Fama-French model consists of three factors. The first is the market risk premium which in turn will give us the market beta. The second term is the small minus big factor, where you take the return of a portfolio of the smallest and subtract the return of the largest companies based on market capitalization. The third factor is the high minus low, where you subtract the return of the portfolio of firms with highest book to market to the portfolio of firms that has the lowest book to market. This factor is meant to capture the historic excess return over small against large cap and growth against value companies.

The motivation for Fama and French to include these factors are not driven by some financial theory. The reason for the small cap anomaly should not depend on increased riskiness of the asset, as the risk as measured by volatility is accounted for by beta 1. The anomaly has been empirically researched and Fama and French's model has been able to account for, or explain, these valuation anomalies. Nonetheless, their model has become the standard asset pricing model since its inception, and is regularly the model to base new innovations upon. In addition, the Carhart (1997) model includes a momentum term. The momentum factor of Carhart is split into both a long-term momentum factor and one short-term momentum factor, which starts seven months and ends one month before. As stated above, we only include an eleven-month momentum lagged one month.

$$R_i = \alpha + \beta_1(R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 Momentum + \varepsilon_i$$

4.2 Fama-MacBeth Model

A Fama-MacBeth (1973) regression is a procedure to estimate cross-sectional coefficients for panel data in a time series. You first obtain the betas using an ordinary time series regression, one for every asset, with the benefit of obtaining time-varying betas. In the second step, you run a cross-sectional regression at every point in time, where returns are regressed on estimated betas from the first step. Apart from time-varying betas, another advantage of using Fama-MacBeth is that it can be used with unbalanced panels. You only use return on stocks which exist at some specific point in time.

$$R_{i,t} = \alpha_i + \beta_i factor_t + \varepsilon_{i,t}$$

$$R_t = \hat{\beta}_i \lambda_t + \alpha_t$$

In the last step, you calculate the lambdas for each factor and the pricing error α as the average of all time-series cross-sectional regression estimates.

4.3 Model specification

The Fama-French model is the basis for all regression models that will be constructed. The first regression includes the combined variable for R&D, CAPEX and acquisitions; it is tested on the Fama-French model and also on the Carhart momentum factor which will capture momentum effects.

$$R_i = \alpha + \beta_1(R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 Momentum + \beta_5 Combined\ variable_t + \varepsilon_i$$

We test this model further by adding a lagged variable to the model, to capture the lagged effects that exists from the previous quarterly report since it takes time to incorporate financial information. Cordis et al. (2017) also use lagged variables in their models.

$$R_i = \alpha + \beta_1(R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 Momentum + \beta_5 Combined\ variable + \beta_6 Combined\ variable_{t-1} + \varepsilon_i$$

Next, we split the combined variable into R&D expenditure to market cap and adjusted CAPEX, which includes regular CAPEX and acquisition expenses.

$$R_i = \alpha + \beta_1(R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 Momentum + \beta_5 R\&D_t + \beta_6 AdjCAPEX_t + \varepsilon_i$$

In the third model, there will be a lagged variable for both R&D and CAPEX. Since it takes time for the investors to incorporate information from the financial statements.

$$R_i = \alpha + \beta_1(R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 Momentum + \beta_5 R\&D_t + \beta_6 R\&D_{t-1} + \beta_7 AdjCAPEX_t + \beta_8 AdjCAPEX_{t-1} + \varepsilon_i$$

Furthermore, the Adjusted CAPEX term is disassembled into both "regular" CAPEX and into Acquisitions, to see whether these variables have individual explanatory power instead of testing the combined variable's explanatory power.

$$R_i = \alpha + \beta_1(R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 Momentum + \beta_5 R\&D_t + \beta_6 CAPEX_t + \beta_7 Acquisitions_t + \varepsilon_i$$

As with the previous regressions we add lagged variables. In this case we add it to R&D, CAPEX and Acquisitions.

$$R_i = \alpha + \beta_1(R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 Momentum + \beta_5 R\&D_t + \beta_6 R\&D_{t-1} + \beta_7 CAPEX_t + \beta_8 CAPEX_{t-1} + \beta_9 Acquisitions_t + \beta_{10} Acquisitions_{t-1} + \varepsilon_i$$

5. Results

This section presents the main regression results for our models that was specified in section 4.3. This section will also contain analysis regarding the results of the regressions.

The first regression in table 4 is the original Fama-French (1992) model regression, based on our sample. The risk premium has a significant beta coefficient of 1.101 and with a t-statistic of 107.54, which gives highly significant p-values. The variable HML with 1.26 in t-statistic is not statistically significant. The unexplained variation, alpha, is captured by the constant term which suggests that the unexplained return is around 1.08 per cent per quarter, it is also statistically significant with a t-statistic of 14.77.

The second regression is the Carhart's (1997) four factor model and consists of the Fama-French model and a momentum term. This in order to test the robustness of our data set and see if the results is consistent with the model since it will be the basis of all our coming regressions.

The third regression reports the original Fama-French model, plus Carhart's (1997) momentum factor, on total R&D, CAPEX and acquisitions in one variable. We perform this regression in order to test if we have any total effect of these items on the stock return. The model also include the momentum term as it will capture the trend of past winners and losers in the stock market. As can be seen in the regression table the "combined" variable is not significant at the 5 percent significance level with a value of -0.0353 and a t-statistics of -1.21. Our hypothesis stated that R&D, CAPEX and the cost of acquisition should not lead to any higher return in the current quarter. As can be seen in the results in table 4, the combined variable is not statistically significant and then we cannot reject the null hypothesis. Thus in order to further test our hypothesis, we need to disentangle the combined variable in order to test whether there exists some sort of explanatory power in either R&D, CAPEX or in the acquisition variable.

In the fourth regression we have extended the previous regression and added a lagged variable, since there exists a lagged effect for the market to react on updates in the firm's financial statements such as on quarterly reports. We performed a regression in order to determine how many lagged variables we should use in the regression and we find that the first lag of the "combined" variable is significant and will thus use it in our regression, see appendix A.1 for more information. In table 4, both the "combined" term and the lagged variable are significant. Thus we can reject the null hypothesis that R&D, CAPEX and the cost of acquisitions will not lead to higher stock returns.

Table 4: Fama-French and combined variable regressions
The table presents a summary of regressions. The first regression in the regression table is the Fama-French model while the second is the Carhart model. In the third and fourth regressions we have added the so called "combined variable". The combined variable is defined as the sum of R&D expenses, CAPEX, and Acquisitions and it is divided by the market capitalization of the company. The definition for the variables can be found in section 3.1 under variable definition. The full model specifications can be found in section 4.3. Note that the number of observations decreases from the second to the third and fourth regression. This is partly because there are missing values in our data and these observations will be discarded when performing the regressions. In the fourth regression some additional observations are missing because of the lagged variable, since this variable will take the previous quarters' values which may not exist in some instances.

	(1)	(2)	(3)	(4)
Fama-French factors				
Constant	0.0108	0.0109	0.0126	0.0115
	(14.77)	(14.89)	(7.51)	(4.34)
RmRf	1.1016	1.1028	1.0542	1.0579
	(107.54)	(107.87)	(69.73)	(64.05)
SMB	1.1629	1.0808	1.0933	1.0670
	(40.53)	(42.91)	(33.62)	(31.46)
HML	0.0211	-0.1452	-0.2296	-0.2325
	(1.26)	(-8.63)	(-11.11)	(-10.81)
Additional variables				
Momentum		-0.2045	-0.2064	-0.1816
		(-10.09)	(-8.00)	(-7.01)
Combined variable			-0.0353	-0.2206
			(-1.21)	(-2.70)
Combined variable lag 1				0.1905
				(4.49)
R-squared	0.1806	0.1825	0.1521	0.1635
Number of observations	107,055	107,055	62,189	56,877

t-values are given in the parentheses below the regression coefficients

R&D, CAPEX and acquisitions jointly have explanatory power, and in the next regressions we disentangle this variable into its constituent parts to see if these variables themselves have some explanatory power on their own.

In model 5, shown in table 5, we disentangle the combined variable into R&D to market cap and adjusted CAPEX to market cap and then regress our variables on the Fama-French model. The variable R&D to market cap becomes insignificant and does not affect the return of the stock. The Adjusted CAPEX to market cap is also statistically insignificant and thus we cannot say if adjusted CAPEX has any effect on returns.

Table 5: R&D, Capex and Acquisitions regressions
The table presents a summary of regressions. All the regressions in this table include the Fama-French three factor model and the Carhart momentum factor. The definition for the variables can be found in section 3.1 under variable definition. The full model specifications can be found in section 4.2.

	(5)	(6)	(7)	(8)
Fama-French factors				
Constant	0.0150	0.0014	0.01558	0.0007
	(6.14)	(0.46)	(5.46)	(0.23)
RmRf	1.0443	1.0645	1.0454	1.0622
	(65.02)	(56.50)	(63.98)	(58.75)
SMB	1.1025	1.0095	1.0958	1.0119
	(33.50)	(29.64)	(33.51)	(29.71)
HML	-0.2149	-0.2084	-0.2368	-0.2076
	(-11.42)	(-9.66)	(-11.43)	(-9.63)
Additional variables				
Momentum	-0.2149	-0.1503	-0.2149	-0.1478
	(-8.26)	(-6.06)	(-8.24)	(-5.98)
R&D to marketcap	-0.2559	-0.6760	-0.1451	-0.7494
	(-1.56)	(-2.08)	(-0.93)	(-2.68)
Adjusted CAPEX to marketcap	-0.0172	-0.1278		
	(-0.93)	(-4.97)		
R&D to marketcap lag 1		1.4908		1.5429
		(4.82)		(5.22)
Adjusted CAPEX to marketcap lag 1		0.0999		
		(4.19)		
CAPEX to marketcap			-0.1555	-0.0820
			(-3.38)	(-1.19)
Acqusitions to market cap			-0.0096	-0.1578
			(-0.76)	(-5.52)
CAPEX to marketcap lag 1				0.1975
				(3.18)
Acqusitions to market cap lag 1				0.0790
				(3.15)
R-squared	0.1550	0.1753	0.1562	0.1762
Number of observations	62,189	56,877	62,189	56,877

t-values are given in the parentheses below the regression coefficients

Model 6 in table 5 just takes the model from the first regression in table 5, and add the lagged variables for R&D to market cap and Adjusted CAPEX to market cap.

The number of lagged variables have been determined by a regression which is shown in appendix section A.2, which shows that using a one lagged variable is significant. Eberhart et al. (2004) suggest that there exists lagged effects for R&D expenses as it takes time for investors to correctly incorporate the value of R&D investments into the stock price; by adding lagged variables some of this effect will be captured and controlled for. The constant is not significant at the 5 percent significance level while the momentum term is significant at the 5 percent level. All the R&D and Adjusted CAPEX to market cap variables are statistically significant at the 5 percent significance level. The constant term is insignificant for our sample, indicating that there exists no pricing errors in the model. The momentum term, which could capture some of the effects of the constant, is also insignificant.

The R&D to market cap variable has a negative value of -0.67 with t-statistic of -2.08 for the current quarter and the lagged variable has a positive value of 1.49 with a t-statistic of 4.82. One of the explanations for this difference, which is discussed by Chan et al. (2001), is that firms with high R&D to market cap tend to be past losers. Thus the firms that had a high R&D to market cap in the previous quarter could be firms that have had a poor performing quarter and it could be that there is a reversion in the valuation of the company after the quarter when the investors have had time to evaluate the company's latest quarterly report. Looking at the economic significance, the combined value with the current and the lagged quarter is positive 0.82 or 82 percent. This is very high and gives a large impact on the return in the quarter. However looking at the descriptive statistics in table 2, one can see that the mean value of R&D to market cap is around 0.01. Thus using this value, the effect will become smaller, but still 8.2 percent per quarter, which we consider is clearly economically significant.

Eberhart et al. (2004) find that firms that unexpectedly increase their R&D expenses will get a five year abnormal return and that it takes time for the market to fully incorporate the information of increased R&D expenses. It is therefore possible that some of this effect is captured by the one quarter lagged R&D term since investors will have had time to incorporate this new information into their expectations. Songur and Heavilin (2017) investigate the lagged values of R&D investment and are thereby measuring the same lagged effect as is done in this paper. They also find similar results to Eberhart et al. (2004). We find that the value of the lagged R&D variable is consistent with previous research that higher R&D expenditures tends to give positive abnormal returns.

The adjusted CAPEX variable has a negative value of -0.12 and a t-statistic of -4.97 for the current quarter and a positive value of 0.10 with a t-statistic of 4.19 for the previous quarter. According to capital budgeting theory, the management of a firm should only undertake an investment decision if the investment creates shareholder value. We have a positive value for the previous quarter, which indicates that Adjusted CAPEX spent in the previous quarter would generate stock returns and shareholder value in the current quarter. However, the Adjusted CAPEX spent in the current period gives a negative return that is greater than the positive from one quarter ago, assuming the same market value in both periods. The economic significance of the Adjusted CAPEX term is not very large. The combined variation is -0.0279 or negative 2.79 percent per quarter. Observing the Adjusted CAPEX term in the descriptive statistics table 2, The Adjusted CAPEX have a mean value of 0.04. Thus multiplying this value with the Adjusted CAPEX term, the effect becomes negative 0.1116 percent. This gives a very small economic impact over a quarter, and thus we would not recommend applying a trading strategy based on this variable. However since the Adjusted CAPEX term includes acquisitions, a very large acquisition will make the effect larger, however the effect will still be small over a quarter.

One way to interpret this would be that all of the expenditures does not go to creating shareholder value and that firms overspend on CAPEX. As stated earlier, the long-term acquisition literature, which we are closer to, find significantly negative future return to acquiring firms. This would also be consistent with the findings of Titman et al. (2004) who find that companies substantially growing their capital investments tend to achieve negative-benchmarked stock market returns. They also find that firms that substantially increase their capital investment are also firms that previously have performed well, thus this is possibly what we could have captured in the negative values of our Adjusted CAPEX to market cap for the current period, whereas for one period prior it is positive. Furthermore, they find that managerial "empire" building tends to be penalized by the stock market, so that firms that both invest much in CAPEX and undertake acquisitions could be penalized by the stock market, which could be the effect which is captured in the Adjusted CAPEX term.

Cordis and Kirby (2017) also found that firms that take on high capital expenditures in relation to some measurements tend to have lower stock returns than firms with the opposite characteristic. This is in line with the results in our regression model, that high levels of CAPEX in relation to the firms' market cap tend to create negative abnormal returns.

In model 7 found in table 5, we have performed a regression where we have split the adjusted CAPEX term into both CAPEX to market cap and acquisition to market cap. The results given in table 5 means that R&D to market cap is not statistically significant which is also true for acquisitions. CAPEX to market cap with a t-statistic of -3.38 is statistically significant at the 5 percent level.

For model 8 in table 5, the same variables are included as in the previous regression, with the addition of lags for all of the variables. All of the coefficients are statistically significant at the 5 percent significance level, except CAPEX to market cap and the constant term. R&D to market cap and its lag have the same signs and about the same coefficient values as in the previous regression with the adjusted CAPEX terms, giving us that the R&D terms are robust even if we include new variables in the regression. R&D to market cap is also economically significant in this regression since the coefficients is almost the same as in the previous regression with the lagged R&D variable.

CAPEX to market cap will have a low economic impact over a quarter, and since the CAPEX to market cap is not statistically significant we cannot say anything about the economic significance. The lagged variable is, on the other hand, statistically significant and has a value of positive 0.1975. However, since the mean value of the lagged variable is 0.02, the variable will on average have an effect of 0.395 percent per quarter, which is very low and thus has no real economic significance of the return on the stock for the current quarter.
Unlike in the previous regression we now find that our acquisition term is statistically significant. The coefficient for the current quarter is negative -0.1578 with a t-statistic of -5.52 and for the previous quarter the coefficient is a positive 0.0790 with a t-statistic of 3.15. Thus the expenditure for an acquisition in the current quarter will give a negative return, whereas an acquisition in the previous quarter will give a positive return. This is also economically significant since the combined effect, assuming acquisition to market cap is the same for the current period and for the lagged variable, will equal an effect of -0.0788 or a negative effect 7.88 percent per quarter. This example however might not be the most realistic, since firms do not tend to make two large acquisitions in two consecutive quarters. A large acquisition will still be economically significant on the stock return. However, if the acquisition is very small in comparison to the firm’s market cap, for instance one percent of its market cap, it will have a very small effect and no economically significant impact on the firm’s stock return. This is trivial, since a small acquisition will not have a significant impact on the firm's cash flow and thus will not change the valuation of the firm significantly.

Agrawal, Jaffe and Mandelker (1992) found that stockholders of an acquiring firm will suffer a loss of around ten percent over a five-year post merger period adjusting for firms’ size and beta. This could potentially be some of the effect that we capture in the variable for the current quarter. One explanation could be that firms overpay for acquisitions or that they overestimate synergies, giving a negative market reaction to the acquisition.

According to De Bondt and Thaler (1985), the market tends to overreact to unexpected and dramatic events. Thus a large acquisition in the current quarter can be seen as a dramatic event and could in theory be seen as negative to the future of the company and thus the share price depreciate by a large amount. However, the lagged variable is positive and thus there exists some kind of reversion of the effect, which strengthens that the market overreact to the news of an acquisition. This could be because investors will receive more information about an acquisition as time progresses and thus the market valuation adjusts back to a level that is more in line with the long-term valuation of the company.

The hypothesis tested in this regression is that the combination of different expenditures and lags will not lead to higher stock returns. Even if the variables of CAPEX and acquisitions (excluding very large acquisitions, which have an economic impact) have a low economic impact on the stock return, the R&D

to market cap will have a significant economic impact on the stock return. Since all of the variables in model 8 are significant, except for the constant and CAPEX in the current period, we can reject the third null hypothesis that these variables would not lead to higher stock return.

Table 6: Lagged variables regressions

	(9)	(10)	(11)	(12)
Fama-French factors				
Constant	0.0098	0.0053	0.0060	0.0053
	(9.64)	(2.81)	(2.82)	(2.87)
RmRf	1.0768	1.0851	1.0848	1.0851
	(72.04)	(72.02)	(72.02)	(72.03)
SMB	1.0749	1.0567	1.0560	1.0567
	(32.14)	(31.63)	(31.73)	(31.63)
HML	-0.2325	-0.2216	-0.2221	-0.2217
	(-10.83)	(-10.32)	(-10.34)	(-10.33)
Additional variables				
Momentum	-0.1978	-0.1825	-0.1840	-0.1825
	(-7.78)	(-7.44)	(-7.49)	(-7.44)
Combined variable lag 1	0.0068			
	(1.78)			
Adjusted CAPEX to marketcap lag 1		0.0009		
		(0.32)		
R&D to market cap lag 1		0.3660	0.3774	0.3662
		(2.63)	(3.03)	(2.63)
Acqusitions to market cap lag 1			-0.0028	
			(-1.93)	
CAPEX to market cap lag 1			-0.0596	
			(-1.17)	
R-squared	0.1554	0.1570	0.1571	0.1570
Number of observations	58,517	58,811	58,811	58,811

t-values are given in the parentheses below the regression coefficients

In the last case, the different lags are regressed using the same asset pricing model as before. The different models are presented in table 6 below. In model 9, the first lag for the combined variable is significant at the 10 percent level. By further disentangling it into Adjusted CAPEX and R&D to market cap in model 10, the first variable is not significant whereas the latter is positive and significant at the 5 percent significance level. This result is robust both when dividing Adjusted CAPEX into Acquisitions and pure CAPEX in model 11 and when regressing the R&D lag on its own. The second hypothesis, that the lags will not lead to higher stock return, cannot be rejected as a whole. However, when it comes to the lag on

R&D to market cap, it is significant in model 10, 11, and 12. Also, the R^2 value only decreases slightly between model 11 and 12. Even though there are two more variables in model 11, they do not add much in explaining the variation in stock return.

6. Robustness

As a robustness check we perform Fama MacBeth (1973) regressions, where we first obtain the betas using a time series regression. In the second step, we run a cross-sectional regression at every quarter, where returns are regressed on estimated betas from the first step. The method is applied through the Asreg plug-in to Stata. The plug-in identifies a rolling window routine that fits the sample, and therefore allows for time-varying betas. The regression is computationally simple, and can account for unbalanced panels. Although old, their application is in practice still commonly used[3].

The regression for Fama MacBeth as found in model 13 in table 7. R&D to market cap, Adjusted CAPEX to market cap, and their respective lags are all significant at the 5 percent significance level. The Fama MacBeth regression confirms the signs of the variables in model 6, though their coefficients are much higher, since the input variables from the Carhart 4 factor model are the same for all observations, meaning the effects are captured by the additional variables. R&D and Adjusted CAPEX in the current time period are both negative, while both of the lags are positive.

As an additional robustness check, the variables are redefined from using market capitalization to using total assets in the denominator. Regression number 14 in table 7 is the same regression as the one performed in table 5 and regression 5. One can observe that the coefficients all have the same signs in both cases. The variables have the same statistical significance except the variable R&D. In the total asset regression, R&D is statistically significant at a 5 percent level and has a t-statistic of -6.47. Comparably the R&D to market cap has a t-statistic of -1.56, which is not statistically significant at a 10 percent level. The Adjusted CAPEX variables are statistically insignificant in both regressions on market cap and on total assets.

In the next robustness test in regression number 15, which is comparable with regression number 6 in table 5. Once again the variables have the same sign as in the market capitalization regression, except R&D to total assets lag 1 which have negative sign instead of a positive in the market capitalization regression. However since the coefficient is statistically insignificant we can in practice not say anything about the coefficient. Adjusted CAPEX to total assets in the current quarter is also statistically insignificant, which in the market capitalization regression it is statistically significant.

[3] See for example Xing (2008) and Cordis et al. (2017).

Finally in regression 12 that is comparable with regression 8 in table 5. All the variables exhibit the same sign as in the market capitalization regressions. The differences is in the statistically significance, where the variables R&D to total assets lag 1 and CAPEX to total assets lag 1 is statistically insignificant, where as it is statistically significant in the market capitalization regressions. The CAPEX to total asset for the current quarter is in this regression statistically significant whereas it is not in the market capitalization regressions.

The R&D to total assets for the current quarter in the current quarter is robust due to the coefficient having both the same sign, but also having the same coefficient, though it has some variation between the total asset regressions. The Fama-Macbeth regression further strengthen the robustness of the R&D to market capitalization, exhibiting a high t-statistic of -11.43, which is clearly statistically significant. Another variable exhibiting robustness is the Acquisitions to market capitalization lag 1. In both the Total asset regression and in the market capitalization it has a positive sign and is statistically significant.

Table 7: Fama-MacBeth and total assets regressions

This table shows the regression coefficients for Fama-MacBeth (1973) robustness regression. The table also includes the same type of regressions as in table 5, however instead of taking R&D, Adjusted CAPEX, CAPEX and Acquisitions to market capitalization, the variables are defined as to total assets instead of market capitalization. Regression 13 in the table is the Fama-Macbeth regression. The regressions 14 to 16 are the same as in table 5, however they are redefined as to total assets instead of to market capitalization.

	Fama-Macbeth regression	Total asset regressions		
	(13)	(14)	(15)	(16)
Fama-French factors				
Constant		0.0113	0.0095	0.0150
		(15.37)	(13.13)	(15.41)
RmRf		1.103	1.115	1.112
		(107.45)	(107.52)	(107.57)
SMB	0.0001	1.0821	1.0533	1.0534
	(0.06)	(42.75)	(41.99)	(42.07)
HML	-0.0024	-0.1428	-0.1460	-0.1492
	(-1.06)	(-8.46)	(-8.34)	(-8.53)
Additional variables				
Momentum	0.0044	-0.2029	-0.1805	-0.1813
	(1.60)	(-9.96)	(-9.59)	(-9.64)
R&D to marketcap	-7.6942			
	(-11.43)			
Adjusted CAPEX to marketcap	-0.3165			
	(-8.09)			
R&D to market cap lag 1	7.2165			
	(11.14)			
Adjusted CAPEX to marketcap lag 1	0.2347			
	(5.68)			
R&D to total assets		-0.0238	-0.0233	-0.0235
		(-6.47)	(-7.07)	(-5.86)
Adjusted CAPEX to total assets		0.0001	-0.0003	
		(0.21)	(-0.43)	
R&D to total assets lag 1			-0.0021	-0.0038
			(-0.44)	(-1.05)
Adjusted CAPEX to total assets lag 1			0.0018	
			(5.21)	
CAPEX to total assets				-0.4227
				(-7.41)
CAPEX to total assets lag 1				0.0268
				(0.52)
Acqusitions to total assets				0.0002
				(0.62)
Acqusitions to total assets lag 1				0.0019
				(9.54)
R-squared	0.1550	0.1828	0.1911	0.1923
Number of observations	56,877	105,965	101,388	101,388

t-values are given in the parentheses below the regression coefficients

7. Conclusion

Different combinations of CAPEX, R&D and acquisition expenditures in the current period and in the previous period can explain stock return. When only looking at the items in the current period, the explanatory significance wanes, and by lagging the variables the coefficients become significant with different signs. The current period expenditures are negative while the lags are positive, which points towards there being a reversal effect in spite of controlling for the momentum factor. According to De Bondt and Thaler (1985), investors tend to overreact to dramatic events, which may explain this kind of reversal where the market reacts negatively at first, but then cools down and interprets the expenditures in a positive way.

The impact of acquisitions is difficult to interpret. This expenditure is significant when the current period and the lag are regressed as a part of a bigger model, which includes CAPEX and R&D. The results of previous studies within acquisitions cannot be replicated in this study.

Chan et al. (2001) investigate the level of R&D in comparison to market cap in a portfolio setting, failing to establish a general relationship to stock market excess return, but instead finding a positive effect when regressing R&D intensive firms. Investigating this relationship in a slightly different way, we find that R&D intensity is a determinant of stock return, as R&D to market cap is a significant variable in most models and its lag is significant in every model it is included and as a stand-alone variable. It may be interpreted that the stock market needs some time to incorporate new information into expectations of its future outlook.

Lastly, Adjusted CAPEX is significant and negative in model 6, with Carhart four factor, R&D, Adjusted Capex and their respective lags, for the current period, and when disentangled into regular CAPEX and Acquisitions in model 7, which includes the four Carhart factors, R&D, CAPEX and acquisitions in the current period, the significant and negative effect from Adjusted CAPEX in model 6, is retained by the CAPEX variable. As in Cordis and Kirby (2017), the effect of capital expenditures is negative.

7.1 Future research

With regards to the findings in this study, an interesting extension could be to apply the quarter period with lags in a portfolio setting following Chan et al. (2001), to further examine the robustness of the models and to examine quintile coefficients.

To build on our robustness checks, another path could be to investigate expenditures with regards to other basis measurements or items than market cap and total assets.

Lastly, to investigate acquisitions in a different way from us, by including mergers, stock-based purchases using equity, and different combinations of merger and tender offers. This could provide fresh insight in a combination with the variables and lags presented in this study.

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Appendix

Table Appendix 1: Regressions with lagged variables
In model A1, we have regressed the lagged variables of the combined variable of R&D, CAPEX and acquisitions on the Fama-French model. We can see that we get significance for the first lagged variable and not on the other lagged variables at a 5 percent significance level.
In the A2 model, we have performed a regression including lagged variables up to order four for R&D to market cap and Adjusted CAPEX to market cap. Observing the p-values we can see that the first order lag is significant for both variables and is thus included in the main regressions.

	(A1)	(A2)
Fama-French factors		
Constant	0.0144	0.0030
	(8.42)	(1.29)
RmRf	1.0607	1.0718
	(63.04)	(53.29)
SMB	1.0229	0.9746
	(26.46)	(25.23)
HML	-0.2399	-0.2139
	(-10.11)	(-8.94)
Additional variables		
Momentum	-0.2059	-0.1701
	(-6.96)	(-6.00)
Combined variable to marketcap	-0.2393	
	(-3.99)	
Combined variable to marketcap lag 1	0.1471	
	(2.92)	
Combined variable to marketcap lag 2	0.0711	
	(1.74)	
Combined variable to marketcap lag 3	-0.0048	
	(-0.25)	
Combined variable to marketcap lag 4	0.0073	
	(0.46)	
R&D to marketcap		-0.6564
		(-2.39)
R&D to marketcap lag 1		1.5127
		(4.08)
R&D to marketcap lag 2		0.0378
		(0.15)
R&D to marketcap lag 3		0.1214
		(0.59)
R&D to marketcap lag 4		-0.2607
		(-1.70)
Adjusted CAPEX to marketcap		-0.0924
		(-3.79)
Adjusted CAPEX to marketcap lag 1		0.0733
		(2.67)
Adjusted CAPEX to marketcap lag 2		0.0244
		(0.88)
Adjusted CAPEX to marketcap lag 3		0.0059
		(0.39)
Adjusted CAPEX to marketcap lag 4		-0.0009
		(-0.06)
R-squared	0.1640	0.1786
Number of observations	44,724	45,302

t-values are given in the parentheses below the regression coefficients