Erasmus School of Economics

Mergers and Acquisitions: The Effect of Firm Relatedness on Shareholder Value in High-Tech Industries

Abstract

High-technology industries are characterized by high research and development investments, fast technological advancements and a high-risk nature. Mergers and acquisitions are a commonly used tool to keep up with the vast competition in these industries. This competitive and fast developing environment creates the expectation that big gains can be realized from mergers and acquisitions. In this paper, a research is conducted into the post-M&A value creation in high-tech industries and relatedness as a determinant of the magnitude of the value that is created. Cumulative abnormal returns of over 45% are observed in target firms, while the effect of mergers and acquisitions on acquiring firms remains ambiguous. Furthermore, relatedness is found to be a significant determinant of the value created.

Bachelor thesis Finance

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1. Introduction

Mergers and acquisitions are hot topics in economic research nowadays. Since 1997, total worldwide value of M&A activity more than doubled from $1.8 to $4.7 trillion in 2017 (Bloomberg, 2018). With this big increase in M&A activities, more economic research started looking into the effects and consequences of M&As. With this increase in research, more opinions about mergers and acquisitions were formed and the debate around the topics increased. Some researchers claim that both acquiring and target firm benefit from synergies after an acquisition (Bradley, Desai and Kim 1988). On the other hand, Jensen (1986) came up with the agency problem, claiming that mergers and acquisitions lead to agency costs, which in turn lead to value destruction. Nowadays, still no definite conclusion is drawn about the effects of mergers and acquisitions.

Existing literature stresses the possible benefits coming from mergers and acquisitions. Researchers found that on average, returns for target firms in mergers and acquisitions are 20%, whereas acquiring firms gain less than half of one percent (Datta, Pinches and Narayanan 1992). On the other hand, some researchers find that shareholders of the acquiring firm, on average, lose after an acquisition (Jarrell and Poulsen (1989), Afrawal, Jaffe, and Mandelker (1992) and Magenheim and Mueller (1988)). Jensen (1986) also found negative effects of mergers and acquisitions and came up with the problem of agency costs theory, as mentioned before.

In the US, high-tech industries have been booming for the last 30+ years. Ian Hathaway (2017) did a research on the magnitude of the high-tech sector. His findings were that in the years 1980-2015, the share of tech industries in total US GDP grew from 0.8% to 5.2%. Furthermore, he found that gross value added in tech industries showed an enormous growth of 834%, compared to an average of 37% growth in all other industries. This growth could be explained by the exponential technological advancements.

Mergers and acquisitions are often used tools for companies to obtain an advantage over their competitors, or to keep up with them. In high-tech industries, growth is essential for companies to survive. High-tech industries are characterized by big research & development investments and big technological advancements and high-risk investments. Since nowadays technology is advancing faster than ever, mergers and acquisitions are increasingly often used to enhance the companies' results. Due to these high tech investments, high-tech industries are considered high-risk, and thus returns are expected to be high. Therefore, expected post-M&A returns are substantially higher in high-tech industries than they would be in non-high-tech industries. In this paper, I will conduct a research into the value that is created in mergers and acquisitions in high-tech industries. We will look into the value creation for shareholders of

both acquiring and target firms, after which we can conclude whether the possible value loss in acquiring firms is compensated for by the shareholder gains in the target firms.

After researching if there is value created in mergers and acquisitions, the possible determinants of this added value are analyzed. In this paper, the focus is on the relatedness of the acquiring and target firms as a determinant of the value created post-M&A. The relatedness of acquiring and target firms is based on the macro- and mid-industries that the firms operate in. For a more thorough explanation, see the methodology section.

I will conduct this research based on one main research question, which I will dig more deeply into later in this paper:

"Is value created through mergers and acquisitions in high-technology markets and is there a relationship between the magnitude of the value creation and the relatedness of the acquiring and target firms?"

To be able to answer this question, I will review existing literature about mergers and acquisitions and I will draw up the hypotheses to help answering the main research question in section 2. In section 3, the process of data collection and the methodology will be discussed. The results are shown and discussed in section 4, after which I will conclude and discuss the findings of this research in section 5.

2. Related literature

In this section, I will review existing literature and opinions about mergers and acquisitions. As said, debate about mergers and acquisitions is ongoing, since there are still no decisive conclusions drawn about the value creation that occurs after M&A. First, I will explain the basic mechanisms behind mergers and acquisitions and the incentives that lead to M&A activity. Then, I will revise some work of financial researchers, creating a clear overview on the existing opinions on mergers and acquisitions.

2.1 Incentives for mergers and acquisitions

Mergers and acquisitions are a commonly used tool for companies. The objectives of mergers and acquisitions are not unanimous. If all theoretical assumptions of perfect markets would be held, no value creation through mergers and acquisitions would be possible. However, this is not the case and M&A researchers relax economic assumptions to find the effects and incentives for mergers and acquisitions. Incentives for mergers and acquisitions can be divided into two main categories: financial incentives and managerial incentives. Whereas financial incentives mainly cause the firm to reach a better position, resulting in financial benefits, managerial benefits are more prone to biases and subjectivity of managers.

2.1.1 Financial incentives

The most commonly used incentive used for mergers and acquisitions is efficiency gains. The first form of efficiency gains is economies of scale. Economies of scale occur when the variable cost of production is decreasing with the quantity of output. If variable production costs decrease when total output increases, efficiency gains are possible. If it is hard for a firm to realize this increase in total output through organic growth, the firm could benefit from realizing this growth through merging with another company, thereby increasing total output and gaining efficiency. In high-tech industries, economies of scale mainly occur due to the large R&D investments; complicated production processes may require large companies or large plants. The outcome of one project is uncertain, so small projects are risky and thus more costly (Stigler 1958). This implies that larger projects may bare smaller variable costs.

A second form of efficiency gains is economies of scope. Economies of scope occur when the simultaneous production of different products cause the total variable production costs to decrease. The intuitive and at the same time the most common explanation for economies of scope is the existence of sharable inputs: that is, inputs which, once produced for the production of one output, would be also available in the aid (fully or partially) of the production of another output (Panzar and Willig 1981). Examples of sharable inputs that could lead to economies of scope are power generators (that could generate multiple power sources, e.g. electricity or heat) that are usable at different times for different outputs and human capital that is applicable to the production of more than one output. In high-tech industries, economies of scope are mostly attributable to high R&D investments, similar to economies of scale. Cockburn and Henderson (2001) found that in the pharmaceutical industry, the superior performance of the incumbent firms was mostly due to scope economies, rather than due to scale economies.

A third form of efficiency gains is synergies. The simplest explanation of the term synergies is that synergies exist when the value and performance of the merged firm (the two firms combined) are greater than the sum of the values and performances of the two separated firms. Synergies is a form of efficiency gains that cannot be accomplished without a merger or an acquisition. There are two types of synergies: cost saving synergies and revenue increasing synergies. The former is mainly caused by the combination of the two firms assets. The main example for cost saving synergies is that a merged firm will need less employees than the two separated firms (for example, the merged firm does not need two CEO's). Other sources of cost saving synergies come from shared information technology, supply chain efficiencies, shared R&D and shared patents. Revenue increasing synergies come from the usage of each other's marketing and distribution networks, which enables the merged firm to create bigger revenues than

before the merger. In high-tech markets, synergies are mainly due to the transfer of knowledge. High-tech industries are characterized by high R&D investments and big amounts of patents. When two firms merge, these assets are combined, which could lead to synergies.

After efficiency gains, the second most mentioned incentive for mergers and acquisitions is growth. If firms want to grow, they face the choice between internal (organic) growth and external (inorganic) growth. Acquiring a firm in the market where the acquiring firm wants to grow or diversify is often an easier and faster way to grow than through organic growth (Trautwein 2006). Similar to growth, another motive for a firm to merge is the increase in market share, which could lead to an increase in market power. With the acquisition of a competing firm, part of the competition is eliminated from the market. Also, acquiring a competitor leads to a bigger market share for the acquiring firm. If the acquisition of another firm (with or within the industry) leads to cost reducing opportunities for the acquirer, the acquisition could also lead to a competitive advantage. These cost reducing opportunities could in turn be caused by above mentioned efficiency gains. Since high-tech markets are characterized by high R&D expenses and high technological advancements, firms engaging in horizontal mergers or acquisitions could benefit from the previous investments and knowledge of the firms that are being acquired or merged with.

A third motive for mergers and acquisitions is diversification. When firms acquire other firms for diversification purposes, they acquire a company that is in another industry, but that is somewhat related. A diversified firm will attract consumers (either business consumers of individual consumers), because they like to be supplied by one supplier rather than by multiple (Motta 2004). Diversification, similar to growth, can be achieved easier and faster through mergers and acquisitions, compared to organic diversification. An extra benefit of a strongly diversified firm is spreading of the risk portfolio. When a firm is highly diversified, i.e. the investment portfolio is also highly diversified, risk returns tend to be lower, which could lead to lower interest and financial distress costs. In high-tech industries, gains from diversifying mergers and acquisitions could occur when a firm's assets or resources can be used for the production of a good that is produced in another industry.

A fourth financial motive for a firm to engage in mergers and acquisitions can be that the tax burden of the merged firm is lower than the one of the two firms separated. This could be, for example, by relocating the headquarters of the company to another, lower taxed country.

2.1.2 Managerial incentives

Apart from financial, incentives for mergers and acquisitions can be influenced by the personal opinion of the manager of the acquiring firm. The first of these managerial incentives is called managerial hubris. The term hubris describes the phenomenon that managers tend to be overconfident when it comes to their own businesses. The hubris theory states that, due to this overconfidence, managers make mistakes when they value potential target companies. Due to this mispricing, they engage in an acquisition, even when there is no value creation potential for the shareholders of the acquiring firm. This overconfidence is caused by the lack of opportunities that managers have in their careers to perform a takeover. Because they have few opportunities, managers convince themselves that the deal could be profitable, thereby missing the fact that there might be errors in their valuation of the target firm (Roll 1986).

Other motives to engage in mergers and acquisitions are agency motives. According to these motives, managers engage in mergers and acquisitions to increase the welfare of the acquiring firm's management, while this may decrease shareholder value. One form of agency motives is presented in Jensen's 'Free-cash-flow problem'. According to Jensen (1986), managers are more likely to engage in mergers and acquisitions when the company has bigger free cash flows. When the company has free cash flows in excess of the cash flows needed for certain investments, managers are tempted to invest in rather uncertain investments (also consistent with the hubris hypothesis), instead of distributing the excess free cash flow to the shareholders. Research shows that managers in general tend to prefer own value over shareholder value, creating the agency motives for mergers and acquisitions.

2.2 Empirical evidence on mergers and acquisitions

In this section, I will discuss the existing research on mergers and acquisitions, As said, a lot of research exists on M&A, yet there is no generally accepted conclusion about the benefits and disadvantages. In the previous section, we looked from the point of view of the companies and the managers and their incentives to engage in M&A. In this section, I will focus on the outcomes of mergers and acquisitions and whether they actually lead to an increase in shareholder value.

2.2.1 Value creation

As seen in section 2.1, managers have several possible reasons to engage in mergers and acquisitions. The financial incentives are the incentives that can actually result in a benefit for the entire firm. These incentives lead either to efficiency gains, which result in a decrease of the total costs or to growth of the revenues of the company, both enhancing the total operational profits of a company. It is assumed that

these gains in profits are either distributed to the firm's shareholders, or that the gains are invested in positive NPV projects. In both cases, shareholder value increases in the long-run and value is created.

However, these gains do not necessarily lead to an increase in shareholders' value. Jensen (1986) came up with the 'free cash flow problem'. This problem states that when a firm has excess free cash flows, managers tend to invest these cash flows, regardless of the profitability of the investment opportunities. In this way, excess free cash flows are invested in projects with a negative NPV, resulting in a decrease of total shareholder value. The free cash flow problem presented by Jensen (1986) is consistent with the managerial hubris incentive and agency incentives for mergers and acquisitions, discussed in section 2.1.2.

A lot of research has been done on the value creation of mergers and acquisitions. For instance, Jensen and Ruback (1983) find that corporate takeovers create positive gains, which the target firms benefit of, and that acquiring firms do not loose after takeovers. Datta et al. (1992) find that on average, target firms gain over 20% after and acquisition and acquiring firms gain less than half of one percent, assuming that the takeover was successful.

2.2.2 Relatedness

There are multiple determinants that influence the magnitude of the shareholder value created after a merger or an acquisition. A possible determinant could be the degree to which there is the possibility to exploit economies of scale or scope. If an acquisitions occurs in a market where marginal costs decrease significantly with the increase of the production magnitude, there is a big chance that efficiency gains can occur after an acquisition. A second determinant could be the size of the companies that are active on the market. In the extreme case of perfect competition, a horizontal merger between two competing companies would hardly affect market power. On the other hand, when the market is most conform to the case of an oligopoly, a horizontal merger could greatly increase the market power of the merged firms. One could rationally conclude that the size of the firms active on the market has a positive influence on the magnitude of the possible gains from mergers and acquisitions. A third possible determinant of the magnitude of value creation after mergers and acquisitions is the degree of cultural fit. Several papers have been written about this effect. For example, Datta and Puia (1995) found a significant difference in the post-merger returns when comparing mergers of firms that had a small cultural distance to mergers of firms that had a big cultural difference. In their research, mergers with a small cultural difference had significant higher value creation than mergers with a poor cultural fit.

The determinant of the magnitude of value creation in mergers and acquisitions that is important in this research is the relatedness of the acquiring and target firm. Relatedness of the merging firms is often

mentioned as an important determinant of value creation. Relatedness of the firms is associated with the synergies that are extracted from the merger, which can create a competitive advantage. For example, an acquiring firm could benefit from value creation after a related acquisitions when the fixed costs of R&D can be spread over a larger amount of production. This value creation might not be possible in the case of an unrelated acquisition, because resources of acquiring and target firm could be specialized (often complementary). Benefits of related mergers and acquisitions could also come from technology and patents of the technologically superior firm being used by the other firm. In addition, related mergers and acquisitions can lead to better performance when either of the firms is able to use the knowledge of the other firm to enhance efficiency in its own production. Because of the familiarity that the acquiring firm ha in the target firm's industry, it can be expected that related mergers and acquisitions have a higher value creation potential (Datta and Puia, 1995).

Various economic research has been done on the influence of the relatedness of acquiring and target firms on value creation. Datta and Puia (1995) found significant evidence that cumulative abnormal returns of related acquisitions was higher than in unrelated acquisitions in the event windows (-30 , +30), (-20 , +20) and (-15 , +15). Also, several researchers have stated that related diversification strategies should outperform unrelated diversification (Salter and Weinhold (1979) and Rumelt (1974)).

However, existing literature is not unanimous on the effect of relatedness on value creation. Other researchers state that the extra value creation the related mergers and acquisitions might be linked to the characteristics of the markets rather than to the relatedness (Bettis and Hall (1982) and Lecraw (1984)). Furthermore, Chatterjee (1986) found evidence that unrelated targets significantly outperformed related, non-horizontal target firms. Finally, Lubatkin (1987) found no significant difference in the performance of related and unrelated target and acquiring firms. From this, it can be concluded that there is no clear drawn conclusion about the effect of the relatedness of acquiring and target firms on the post-merger performance and value creation.

2.2.3 Mergers and acquisitions in high-tech markets

Technology is becoming an increasingly big part of life and technological possibilities are expanding faster and faster. Because of this, high-technology markets are characterized by their high technological advancements, and consequently big research and development investments. This high-growth, high-risk nature of the high-technology-based industries gives rise to questions about value creation in these industries. The most important question is whether investors expect these characteristics to create bigger

value creation potential, or that they perceive the industries to be 'too risky' due to the high information asymmetry, resulting in being sceptical of mergers and acquisitions in high-tech markets.

On average over all industries, mergers and acquisitions are found to create positive gains for target firms of approximately 30%, and returns to acquiring firms close to of slightly above zero (Jensen & Ruback, 1983). Consistent with these findings, Kohers and Kohers (2000) found that one-day, one-week and one-month premiums paid in non-high-tech were 29.21%, 30.47% and 33.26%, respectively. They also research high-tech takeovers and find that average one-day, one-week and one-month premiums paid in high-tech takeovers are 37.89%, 37.41% and 45.13%, respectively. These premiums are considerably higher than premiums paid in non-high-tech takeovers.

Makri, Hitt and Lane (2010) found that in high-tech indiustries, "…complementary scientific knowledge and complementary technological knowledge both contribute to post-merger invention performance by stimulating higher quality and more novel inventions." They conducted their research using regression analysis, with different sorts of relatedness (i.e. technology relatedness and science relatedness) as the independent variable and invention novelty as their dependent variable.

Hagedoorn and Duysters (2002) studied the effects of mergers and acquisitions on the technological performance of companies. They performed this study using regression analysis on a sample of companies from the international computer industry, which is considered a high-tech industry. Their main finding was "that the so-called strategic and organizational fit between companies involved in M&As seem to play an important role in improving the technological performance of companies."

2.2.4 Research question and hypotheses

The required theoretical concepts are now discussed, as well as the existing economic research on mergers and acquisitions. To conduct a research into the value creation in mergers and acquisitions, the main research question is:

"Is value created through mergers and acquisitions in high-technology markets and is there a relationship between the magnitude of the value creation and the relatedness of the acquiring and target firms?"

To answer this research question, it is split up into two separated hypotheses. These hypotheses make it possible to answer the research question one part at a time. To answer H1, event studies are executed on the total sample of firms, testing whether cumulated abnormal returns are different from zero for

acquiring and target firms. For the second hypothesis, the sample needs to be separated into subsamples, after which event studies can be performed on the different subsamples.

H1: There is significant value creation in mergers and acquisitions in high-tech mergers and acquisitions.

H2: Relatedness has a positive significant relationship with the magnitude of value creation in high-tech mergers and acquisitions.

3. Data and methodology

All mergers and acquisitions are recorded and thus M&A activity is very well monitored. To research whether mergers and acquisitions create value on average, an event study was conducted into the effect of the announcement of the mergers and acquisitions on stock prices of the acquiring and the target firms. The event study compares returns on stock prices of the different event windows with benchmark returns, calculating the cumulative abnormal returns (CAR).

3.1 Data

In this section, the collection process of the data is discussed. First, I will discuss the collection of the data of mergers and acquisitions that qualify for this research. After, the collection of the control variables is discussed.

3.1.1 Collection of the transaction data

The data of the M&A deals were obtained from the ThomsonOne database. For acquiring the correct data for this research, the following restrictions were set:

- Both acquiring and target firms have to be public. Since total value creation is investigated, stock prices of both firms have to be available.
- Both firms are located in the United States of America.
- Announcement dates of the M&A activities used in the research is between 01/01/2007 and 31/12/2017.
- Only deals that were completed are taken into account.
- Only complete acquisitions are used, meaning that the percentage of shares owned by the acquirer after the acquisition is 100%.
- The minimal deal value is US$ 50 million.

Furthermore, the acquiring firm had to be operational in a high-technology industry. For this purpose, the following industries were included[1]:

- Drugs
- Computer and Office Equipment
- Pre-packaged Software
- Electronic and Electrical Equipment
- Communications Equipment
- Aerospace and Aircraft
- Measuring, Medical, Photo Equipment
- Telecommunications

After applying the correct criteria, the total sample consisted of 416 mergers and acquisitions. For the acquirers, data was available for 409 firms and for targets, data was available for 291 firms. After deleting acquisitions for which the estimation period overlapped with the announcement date of another acquisition by the same company, the sample that was left consisted of 378 acquiring firms and 291 target firms. The difference in these amount is accountable to the fact that some companies were deleted from the WRDS database due to different possible reasons. One possible reason could be that a firm went bankrupt in the years between the announcement date and now. For this reason, the number of acquirers does not match the number of targets in this sample. This has no effect on the significance of this research since this research does not focus on the combined value creation of the firms, in this research we focus the value creation in acquiring and target firms separately.

3.1.2 Control variables

For the completeness of the regression analysis, control variables are added to the model. In this research, firm-specific variables are used to measure their effects on the cumulative abnormal returns and to control for their influence in the effect of relatedness on post-M&A cumulative abnormal returns.

Total assets

Total assets is a measure that is commonly used as a proxy for the company's size. The total assets are a valid indicator of the amount of resources that a company has, and with bigger resources come bigger

[1] For an exact overview of all the specific industries involved in the research, see appendix 1.

opportunities to invest. Especially in high-tech environments, the assets of a company determine the abilities of a company to adapt to the high-investment nature of the high-tech industries.

Market value

Market value is a measure used to see what a company is worth to outside investors rather than what comes from the 'inside' resources that the company has. Market value has a direct connection to stock prices, and thus to shareholder value. Market value could therefore be a determinant of the cumulative abnormal returns coming from mergers and acquisitions.

Book value per share

Book value per share is, contrary to market value, the reflection of the 'inside' value that the company has. Book value per share reflects information about the valuation of the company's stock, i.e. whether stock prices are under- or overvalued. It also contains information about the manager's performance.

Common shares outstanding

The amount of common shares outstanding influences the relative growth in shareholder value when a company's total value increases. Since we are doing an investigation into the change in shareholder value, common shares outstanding should be included in the regressions.

Operating expenses

The operating expenses of a company reflect the way in which the available resources are managed, which reveals information about the efficiency of the production process. The efficiency of the production process, in turn, could reveal potential gains coming from mergers and acquisitions. As discussed in section 2, a determinant of value creation in mergers and acquisitions is the extent to which companies can benefit from the resources and processes of the company that they are merging with. This implies that an efficient production process gives room for post-merger efficiency gains.

Operating income

Operating income or profit reflects, by its name, the total result of the company's operations. The profit reflects the way a company operates and is correlated with the available resources, efficiency and free cash flows. The operating profit also influences shareholder value. The profitability of firms can contain information about the company's hidden competencies, i.e. about the know-how of a company.

Payment method

The method of payment in mergers and acquisitions is widely used as an indicator of the acquiring company's expectation of the value creation after the acquisition. If the acquiring company pays in cash, the target firm's shareholders are not dependent of the post-acquisition development of the company. However, when the acquiring company pays in stock, stockholders of the target firm will also be stockholders of the post-acquisition firm, and they will therefore be dependent on the post-acquisition performance of the company. This is a variable that needs to be controlled for when estimating the effect of relatedness on cumulative abnormal returns.

3.2 Methodology

In this section, I will discuss the methodology used in this research. In the first part of this section, the calculation of the cumulative abnormal returns is explained, which are needed for the execution of the event studies. In the second part, I will discuss the division of the sample into the subsamples based on the relatedness of the acquiring and target firms. After that, the mechanism of the event study is explained.

3.2.1 Cumulative abnormal returns

Fama, Fischer, Jensen and Roll (1969) found that there was little research on how stock prices adjust to new sorts of information. When researching this topic, they found that indeed stock prices tend to react to newly released information. To measure to what extent the stock prices are reacting to this new information, they developed the event study methodology. The development of this tool started a methodological revolution and is still used is plenty of economic research. Also in this paper, the event study tool is used.

The event study that is used in this paper calculates the reaction of the stock prices of the acquiring and the target firm to the announcement of the merger or acquisition. Since economic markets are fluctuating, the benchmark return, i.e. the 'standard return of the market', has to be calculated. To capture the total effect of the new information on the stock prices, Fama, Fischer, Jensen and Roll (1969) control for the relation between the stock price *i* and the return on a market index, resulting in the Market Model:

$$E(R_{it}) = \alpha_i + \beta_i R_{mt} + u_{it}$$

Where: $E(R_{it})$ = the expected return for stock i on day t

R_{mt} = the observed return on a broad stock market index

β_i = the beta coefficient of stock i

α_i = the idiosyncratic return on security i

u_{it} = the error term of the regression

This equation is used to calculate the normal returns on the stock price during the estimation period. It is important that the estimation period is not influenced by issues that are related to the event that you are trying to research. Therefore, the estimation period has to well in advance of the event window. For the estimation period, I choose a window that started 200 days before the announcement date of the acquisition and ended 50 days before the announcement. Because of the length of the estimation period, short temporary fluctuations in stock prices are less influential, making the estimation period a true reflection of normal returns of the stock prices.

When a return in an event window significantly differs from the return in the estimation period, it can be concluded that abnormal returns are present. Abnormal returns (AR) can be calculated as follows:

$$AR_{it} = R_{it} - (\hat{\alpha}_i + \hat{\beta}_i R_{mt})$$

Where: AR_{it} = the abnormal return for stock i on day t

R_{it} = the observed return for stock i on day t

R_{mt} = the observed return for Datastream MSCI World market index

$\hat{\beta}_i$ = the estimated beta coefficient of stock i

$\hat{\alpha}_i$ = the estimated idiosyncratic return on security i

Due to the so-called *event-date uncertainty*, which states that stock prices tend to have a high volatility around the announcement date, caused by the high variation around the event, abnormal returns are cumulated, which leads to the cumulated abnormal returns (CAR). The cumulated abnormal returns can be calculated using the following formula:

$$CAR_i(T_1, T_2) = \sum_{t=T_1}^{T_2} \widehat{AR}_{it}$$

Where: $CAR_i(T_1, T_2)$ = Cumulated abnormal returns of the sample in the event window (T_1,T_2)

Since the different event window have a different length in days, average CAR has to be calculated in order to be able to compare the different event windows. The cumulated average abnormal returns (CAAR) are calculated as follows:

$$CAAR(T_1, T_2) = \frac{1}{N}\sum_{i=1}^{N} C\hat{A}R_i(T_{1,} T_2)$$

For this research, seven different event windows are used: to check if there is a price run-up in the month prior to the announcement, the cumulated abnormal returns are calculated over the event window (-30,-1). The expected cumulated abnormal returns in these windows are zero. However, this assumption is hard to live up to. Some economic researchers found that half of the cumulative abnormal returns of an event were measured before the actual event (Jabboura, Jalilvand and Switzer (2000)). A possible explanation for this is insider trading[2]. Another two event windows are used to calculate the cumulated abnormal returns around the events: (-5,5) and (-1,1).These are the two most important event windows for the research, since they catch the actual effects coming from the events. Finally, one windows is used to capture the after-announcement effect in the month following the events: the window (1,30). By comparing the abnormal returns in these event windows, one can conclude about both the short-term and longer-term stock price reactions to the announcement.

3.2.2 Relatedness

A lot of research has been done on the total value creation effect of mergers and acquisitions. This paper studies the difference in post-M&A firm performance between mergers and acquisitions with different objectives. Seth (1990) compares related and unrelated acquisitions. He states that it is not safe to conclude that related acquisitions always outperform unrelated acquisitions, since significant synergies occur in both related and unrelated acquisitions. In this research, the event studies are performed in two stages. In the first stage, I ran event studies on the total sample, not differencing for the relatedness of the acquisitions. For the total sample, I ran one event study for the acquirers and one event study for the

[2] For papers on insider trading, see for example Jabboura, Jalilvand and Switzer (2000) and Arshadi and Eyssell (1991)

target firms. In the second stage, I divided the sample into three subsamples: related, semi-related and unrelated mergers and acquisitions.

To divide the total sample into the three subsamples, I looked at the macro- and mid-industry codes of the acquiring and target firms. These macro- and mid-industries are classified by ThomsonOne, based on the Standard Industrial Classification codes. The macro-industries used by ThomsonOne are based on the first to digits of the SIC-codes, whereas a mid-industry is represented by the first four digits of the SIC-code. The subsample related consists of mergers and acquisitions where both the macro-industry and the mid-industry correspond. The unrelated mergers and acquisitions are the ones where both the macro-industry and the mid-industry of the acquirer are different from those of the target. The third subsample, the semi-related mergers and acquisitions, are those of which the macro-industries correspond, but of which the mid-industries are different.

3.2.3 Event studies

For every subsample, two event studies are performed: one for the acquiring firms and one for the target firms. This cumulates to a total of 8 different event studies, two for the complete sample and two for every subsample. The purpose of the event studies on the total sample are in the first place for evaluating whether the post-M&A performance effects are the same in the sample used in this research as they are predicted by existing literature. Secondly, the results of the event studies on the total sample can be used as control variables to test if the post-M&A performance in the subsamples significantly differs from the post-M&A performance in the total sample. In this way, a conclusion can be drawn whether the relatedness of the acquisitions influences the performance. The hypothesis to test whether the mean CARs of these subsamples differ from the mean CARs of the total sample is:

$$H_0 : CAAR_1 = CAAR_2$$

$$H_a : CAAR_1 \neq CAAR_2$$

Testing the significance of the difference between these performances can be done by using a z-test. The z-statistic is calculated as follows:

$$z = \frac{(\bar{x}_1 - \bar{x}_2) - (CAAR_1 - CAAR_2)}{\sqrt{\frac{{\sigma_1}^2}{n_1} + \frac{{\sigma_2}^2}{n_2}}}$$

Where: $\bar{x}_i$ = Standardized random observations for subsample i

σ_i = Standard deviation of the CAARs of subsample i

n_i = Sample size of sample i

The standard deviation in this equation is calculated as follows:

$$\sigma = \sqrt{\frac{1}{N-1}\sum_{1}^{N}(CAR_i - CAAR)^2}$$

It is possible that this test suffers from biases. First of all, this test assumes that the cumulative abnormal returns are independent and identically distributed and that they follow a normal distribution. This could not be true, since when event windows of multiple acquisitions overlap, they could be correlated. This could cause a biased z-value. The second bias could come from the increased variance around the announcement date. Since the z-test does not incur this increased variance, variance is underestimated, causing the z-statistic to be upward biased.

3.2.4 Regression analysis

Apart from the event study method, a different method is used to measure the effect of the relatedness of acquiring and target firms. The second method used in this paper is regressions analysis. In this section, I will discuss the methodology of the regressions analysis used to measure the direct effect of the degree of relatedness on the magnitude of the cumulative abnormal returns.

To measure the direct effect of the relatedness of acquiring and target firms on the magnitude, the relatedness has to be defined in terms of variables. As said before in this paper, relatedness is split into three degrees: related, semi-related and unrelated. For this regression analysis, dummy variables were created for every degree of relatedness. The standard regression formula used for all regressions is as follows:

$$CAR_i = \beta_0 + \beta_1 * Related + \beta_2 * Semirelated + \varepsilon$$

Where: CAR_i = cumulative abnormal returns in event window i

β_0 = constant of the regression, representing unrelated acquiring and target firms

β_1	=	sensitivity of CAR_i to the variable $Related$
$Related$	=	dummy variable, which takes value 1 when the acquiring and target firms are related
β_2	=	sensitivity of CAR_i to the variable $Semirelated$
$Semirelated$	=	dummy variable, which takes value 1 when the acquiring and target firms are semi-related
ε	=	error term of the regression

The third dummy variable, Unrelated, was left out of the regression to avoid multicollinearity. As a consequence of this, the β_0 in this equation represents the expected CAR for the deals in which the acquiring and target firms were unrelated.

For this research, I will run different univariate regressions for every event window in the samples for acquiring and target firms. Since this research uses seven different event windows, this will add up to a total of fourteen univariate regressions.

There are a few shortcomings to this regression analysis. The first shortcoming is that this model could suffer from omitted variable bias due to factors that could influence both the error term and the independent variables. The second shortcoming is that the regressions could have low explanatory value due to a low value of the R^2. Despite of these shortcomings, this regressions analysis could still be of value. If significant coefficients are found for β_0, β_1 and/ or β_2, one could still draw useful conclusions on the influence of relatedness on the magnitude of the post-announcement CARs.

4. Results

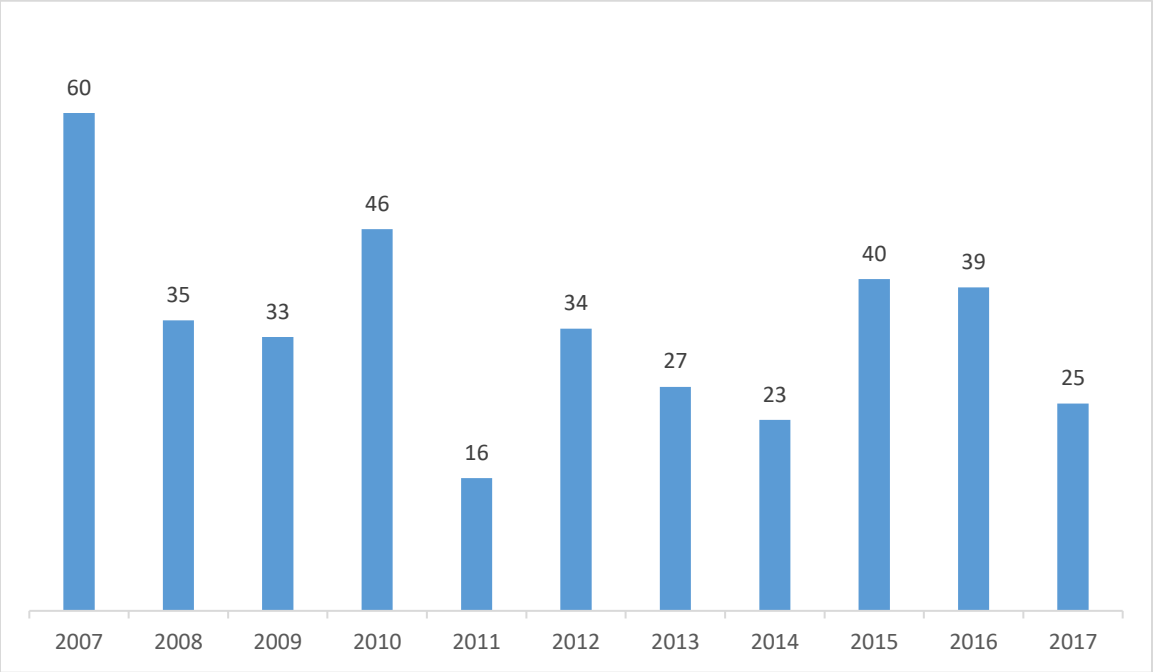
In this section, the results of the event studies will be discussed. The first part of this section consists of a short description of the sample, along with some descriptive statistics. Next, I will discuss the actual outcomes of the event studies and significance tests, separated for the different samples.

4.1 Descriptive statistics

As said in the data collection section, I collected a total final sample of 361 M&A deals in high-tech markets in the United States of America in the years 2007-2017. In table 1, the division of the M&A deals per year

is shown. The division of the mergers and acquisition activity over the years shows a few outliers, of which one high outlier in 2007. Due to the start of the financial crisis, mergers and acquisitions activities were volatile, which could have caused a merger bubble before the start of the crisis. The low outlier in 2011 could as well be caused by the financial crisis. When the economy is in regression, investment expenses are lower and companies are less likely to engage in mergers and acquisitions.

Figure 1: number of mergers and acquisitions announcements per year



In table 1, the division of the samples is presented. The related mergers and acquisitions are dominant in the samples of both acquiring and target firms, which is not unusual, since it is common for firms to select potential acquisition targets that are closely related to their own company. It should be noted that the most mergers and acquisitions in this sample are related, followed by semi-related, and the least amount of mergers and acquisitions are classified as unrelated. In Table 1, you can also see the division of the relatedness of the mergers and acquisitions over the years.

In table 2, the descriptive statistics of the acquiring and target firms are given. When looking at these statistics, we see that the statistics of the acquirers are approximately a factor ten times the statistics of the target firms. This observation is in line with rational expectations, since it is common that the acquiring firm is substantially bigger than the firm that is being acquired.

As seen in Figures 2 and 3, most of the mergers and acquisitions in the sample occurred in the healthcare and high technology industries[3]. This is not surprising, since in these industries have a high M&A-intensity and are generally considered very high-tech industries. Regarding the other industries, the mergers and acquisitions are the ones with high-tech characteristics, e.g. the involved firms have high R&D expenses. Furthermore, the division over the macro-industries is similar in the samples of acquiring and target firms.

[3] Macro-industries are as classified by ThomsonOne.

Table 1: Division of the acquiring and target firms over the subsamples of related, semi-related and unrelated mergers and acquisitions

		Acquirers	Targets
Total		**378**	**291**
Related	**Total**	**187**	**143**
	2007	35	0
	2008	15	0
	2009	14	11
	2010	18	21
	2011	7	7
	2012	11	10
	2013	17	20
	2014	14	15
	2015	23	23
	2016	20	23
	2017	13	13
Semi-related	**Total**	**103**	**86**
	2007	8	0
	2008	12	0
	2009	12	9
	2010	16	17
	2011	3	3
	2012	15	16
	2013	5	5
	2014	3	4
	2015	10	10
	2016	12	14
	2017	7	8
Unrelated	**Total**	**88**	**62**
	2007	17	0
	2008	8	0
	2009	7	6
	2010	12	12
	2011	6	6
	2012	8	7
	2013	5	5
	2014	6	6
	2015	7	7
	2016	7	7
	2017	5	6

Table 2: descriptive statistics of acquiring and target firms

	Acquirers				Targets			
	Average	St. Dev.	Minimum	Maximum	Average	St. Dev.	Minimum	Maximum
Total assets (in $1000)	20,157	58,683	4	797,769	2,139	7,299	0	133,830
Market value (in $1000)	22	55	0	647	2,246	5,815	1	86,523
Bok value per share (in 1000)	157	4,041	-820	159,636	7	12	-162	81
Shares outstanding (in 1000)	561	1,337	0	10,663	92	166	1	1,787
Revenues (in $1000)	11,391	25,633	0	233,715	1,250	3,476	0	46,984
Operating expenses (in $1000)	9,438	21,530	0	195,069	1,092	2,845	0	38,236
Operating income (in $1000)	1,950	5,186	-2,231	71,230	164	691	-1,865	8,748
Return on equity (%)	5	95	-2,690	1,398	-15	346	-5,602	9,811
R&D expense (in $1000)	833	1,846	0	16,625	89	196	0	2,486

Figure 2: division of acquiring firms over their macro-industries

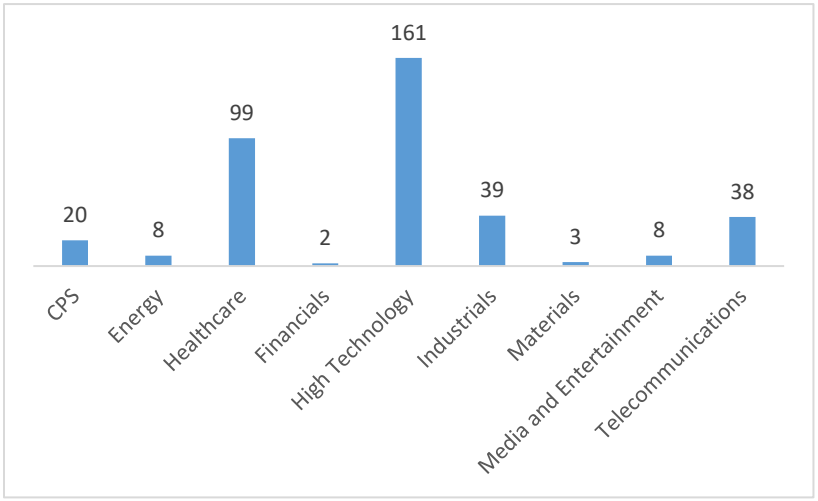
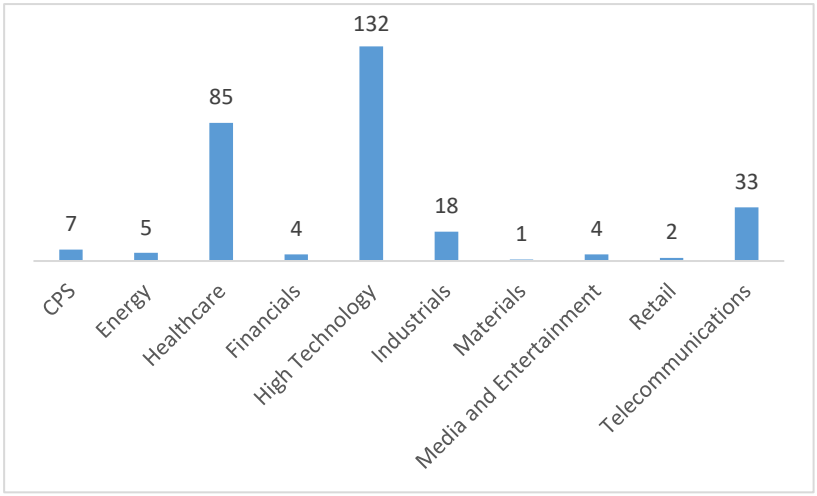


Figure 3: division of target firms over their macro-industries



4.2 Event study analysis

In this section, the results of the performed event studies are discussed. First, the outcome of the event studies on the total sample will be analyzed. Then I will analyze the outcomes of the separate event studies for every subsample. After a short summary on all the samples used, the different samples are compared and the actual effect of relatedness on value creation can be determined.

4.2.1 Total sample

When looking at the cumulative abnormal returns in the complete sample, we can see that although CARs are slightly negative for acquirers, only the CAR in the event window (1,30) is significant (Table 2). However, when we look at Table 3, we can see that results are different for target firms. For target firms, cumulative abnormal returns are positive in all event windows. Not only are all CARs positive for targets, they are all highly significant with P-values approaching zero. These observations are consistent with existing economic research. For instance, Datta et al. (1992) find that on average, acquiring firms gain less than half of one percent after an acquisition, whereas target firms gain over twenty percent. Furthermore, Jensen and Ruback (1983) state that corporate takeover create positive gains, that target firms benefit, and that acquiring firms do not lose. In this research, no clear conclusions can be drawn on the losses of acquiring firms. For target firms, there is a price run-up in the month preceding the announcement date and high abnormal returns after the announcement. This result is consistent with both papers cited before. However, the gains of the targets are higher than predicted by the papers.

Table 3: cumulated abnormal returns of the acquiring firms in the total sample. Significance is indicated at the 1%, 5%, and 10% level by ***, **, and *, respectively. The reported T-values and P-values are the results of a t-test with the null-hypothesis that the mean CAR is equal to zero.

Event window	Mean CAAR	Mean CAR	T-value	P-value	Significance
Before					
(t-30,t-1)	0.0003	0.0090	1.372	0.171	
Around					
(t-1,t+1)	-0.0009	-0.0026	-0.724	0.470	
(t-5,t+5)	-0.0006	-0.0066	-1.323	0.187	
After					
(t+1,t+30)	-0.0005	-0.0136	-2.016	0.045	**

Table 4: cumulated abnormal returns of the target firms in the total sample. Significance is indicated at the 1%, 5%, and 10% level by ***, **, and *, respectively. The reported T-values and P-values are the results of a t-test with the null-hypothesis that the mean CAR is equal to zero.

Event window	Mean CAAR	Mean CAR	T-value	P-value	Significance
Before					
(t-30,t-1)	0.0022	0.0650	4.647	0.000	***
Around					
(t-1,t+1)	0.1238	0.3715	10.948	0.000	***
(t-5,t+5)	0.0346	0.3811	11.333	0.000	***
After					
(t+1,t+30)	0.0019	0.0567	3.958	0.000	***

4.2.2 Related mergers and acquisitions

In the sample of related mergers and acquisitions, results for acquiring firms are slightly negative, but insignificant. For target companies, it can be seen that returns in the windows *before* and *after* are significant and around 5% in excess to the market benchmark. In the *around* event windows, cumulative abnormal returns are 40-42%, which is higher than the CARs in the total sample.

Table 5: cumulated abnormal returns of the acquiring firms in the sample of related mergers and acquisitions. Significance is indicated at the 1%, 5%, and 10% level by ***, **, and *, respectively. The reported T-values and P-values are the results of a t-test with the null-hypothesis that the mean CAR is equal to zero.

Event window	Mean CAAR	Mean CAR	T-value	P-value	Significance
Before					
(t-30,t-1)	0.0001	0.0036	0.335	0.738	
Around					
(t-1,t+1)	-0.0003	-0.0009	-0.176	0.861	
(t-5,t+5)	-0.0003	-0.0032	-0.428	0.669	
After					
(t+1,t+30)	-0.0006	-0.0168	-1.597	0.112	

Table 6: cumulated abnormal returns of the target firms in the sample of related mergers and acquisitions. Significance is indicated at the 1%, 5%, and 10% level by ***, **, and *, respectively. The reported T-values and P-values are the results of a t-test with the null-hypothesis that the mean CAR is equal to zero.

Event window	Mean CAAR	Mean CAR	T-value	P-value	Significance
Before					
(t-30,t-1)	0.0018	0.0551	3.205	0.002	***
Around					
(t-1,t+1)	0.1334	0.4002	6.936	0.000	***
(t-5,t+5)	0.0374	0.4117	7.172	0.000	***
After					
(t+1,t+30)	0.0015	0.0438	1.979	0.050	**

4.2.3 Semi-related mergers and acquisitions

In the sample of semi-related mergers and acquisitions, results are similar to the sample of related M&As. For acquiring firms, three out of four CARs are insignificant (Table 6), only the month previous to the announcement date shows small, positive and significant abnormal returns. For target firms, CARs are all significant at the 1% significance level and of approximately the same magnitude as they are in the sample of related mergers and acquisitions (Table 7).

Table 7: cumulated abnormal returns of the acquiring firms in the sample of semi-related mergers and acquisitions. Significance is indicated at the 1%, 5%, and 10% level by ***, **, and *, respectively. The reported T-values and P-values are the results of a t-test with the null-hypothesis that the mean CAR is equal to zero.

Event window	Mean CAAR	Mean CAR	T-value	P-value	Significance
Before					
(t-30,t-1)	0.0008	0.0229	2.066	0.041	**
Around					
(t-1,t+1)	-0.0008	-0.0024	-0.361	0.719	
(t-5,t+5)	-0.0007	-0.0075	-0.828	0.409	
After					
(t+1,t+30)	0.0000	0.0003	0.035	0.972	

Table 8: cumulated abnormal returns of the target firms in the sample of semi-related mergers and acquisitions. Significance is indicated at the 1%, 5%, and 10% level by ***, **, and *, respectively. The reported T-values and P-values are the results of a t-test with the null-hypothesis that the mean CAR is equal to zero.

Event window	Mean CAAR	Mean CAR	T-value	P-value	Significance
Before					
(t-30,t-1)	0.0033	0.0992	2.878	0.005	***
Around					
(t-1,t+1)	0.1340	0.4021	6.840	0.000	***
(t-5,t+5)	0.0379	0.4165	7.243	0.000	***
After					
(t+1,t+30)	0.0028	0.0851	3.248	0.002	***

4.2.4 Unrelated mergers and acquisitions

When looking at the results for unrelated mergers and acquisitions, the results surprisingly differ from results in the other samples. For acquiring firms, CARs are again slightly negative, but insignificant (Table 8). However, for target firms, abnormal returns are lower than they are in other subsamples. In this sample, post-announcement cumulative abnormal returns are just above 26%, which is roughly 15% below the post-announcement cumulative abnormal returns in other samples.

Table 9: cumulated abnormal returns of the acquiring firms in the sample of unrelated mergers and acquisitions. Significance is indicated at the 1%, 5%, and 10% level by ***, **, and *, respectively. The reported T-values and P-values are the results of a t-test with the null-hypothesis that the mean CAR is equal to zero.

Event window	Mean CAAR	Mean CAR	T-value	P-value	Significance
Before					
(t-30,t-1)	0.0001	0.0038	0.369	0.713	
Around					
(t-1,t+1)	-0.0022	-0.0067	-0.893	0.375	
(t-5,t+5)	-0.0012	-0.0134	-1.306	0.470	
After					
(t+1,t+30)	-0.0008	-0.0235	-1.628	0.107	

Table 10: cumulated abnormal returns of the target firms in the sample of unrelated mergers and acquisitions. Significance is indicated at the 1%, 5%, and 10% level by ***, **, and *, respectively. The reported T-values and P-values are the results of a t-test with the null-hypothesis that the mean CAR is equal to zero.

Event window	Mean CAAR	Mean CAR	T-value	P-value	Significance
Before					
(t-30,t-1)	0.0013	0.0404	1.918	0.060	*
Around					
(t-1,t+1)	0.0877	0.2630	8.776	0.000	***
(t-5,t+5)	0.0238	0.2613	8.971	0.000	***
After					
(t+1,t+30)	0.0016	0.0470	1.931	0.058	*

4.2.5 Summarizing the event studies

When looking at the results of the event studies on the sample of acquiring firms, unfortunately most coefficients are insignificant, making it difficult to draw clear conclusions based on these numbers. Only two coefficients of CARs of acquiring companies are significant. The first one is the slightly negative coefficient for event window (1,30) in the total sample. The second significant variable in the samples of acquiring firms is in event window (-30,-1) in the event window of semi-related mergers and acquisitions. However, these coefficients are of such a low value that they are not considered influential on cumulative abnormal returns.

For target firms, results are completely different. Cumulative abnormal returns in all samples are significant. When looking at the event windows before the announcement dates, one can see slight price run-ups in all samples. In the total sample, this price run-up s represented by the CAR in the event window (-30,-1) of 6.5%. Looking at the samples separately, we can see that price run-ups are 5.51%, 9.92% and 4.04%, respectively for related, semi-related and unrelated mergers and acquisitions.

The cumulative abnormal returns in the event windows *around* are all very significant, with p-values approaching zero. In the samples of related and semi-related mergers and acquisitions, cumulative abnormal returns in these windows are between 40% and 42% and the CAARs are more than 13% in the event windows (-1,1). In the sample of unrelated mergers and acquisitions, CARs are slightly over 26% and the CAAR in the window (-1,1) are 8.7%, which is substantially lower than in the related and semi-related samples.

When looking at the *after* event windows, cumulative abnormal returns decrease compared to the around event windows, and become similar to the level of the price run-ups in the month previous to the announcement date. The levels of the CARs in the event window (1,30) are 4.38%, 8.51% and 4.7%, respectively for related, semi-related and unrelated mergers and acquisitions. These results show that stocks of target companies show significant positive cumulative abnormal returns in the two months around the announcement date.

4.3 Regression analysis

In the previous section, I compared the event studies on the different samples. In this section, an alternative method will be used to measure the effect of the relatedness of the acquiring and target firms on the magnitude of the CARs in the different event windows.

Table 10 and 11 show the results of eight univariate regressions, of which four were performed on the sample of acquiring firms and four on the sample of target firms. Each regression has a cumulative abnormal return as the dependent variable. The independent variables in the regressions are the degree of relatedness. The two dummies Related and Semi-related are included as the independent variables in the regressions. The dummy variable Unrelated is omitted due to multicollinearity, which results in the constant of the regressions representing the case in which the acquiring and target companies are unrelated.

Table 10 shows the results for the sample of acquiring firms. When looking at the coefficients, it should again be noticed that they are insignificant. Based on these numbers, we cannot draw conclusions on the influence of relatedness on cumulative abnormal returns of acquiring companies.

Table 11 shows a different image. All constants are positive and significant, indicating positive significant post-announcement returns of target firms. The dummy variables Related and Semi-related show positive coefficients in the event windows (-1,1) and (-5,5) for the sample of target firms. This indicates that cumulative abnormal returns around the announcement date are significantly higher for target that are related or semi-related to their acquirer. No significant difference was found between the coefficients of the dummies Related and Semi-related.

Table 11: Results of univariate regressions with CARs as dependent variable and relatedness as independent variable in the sample of acquiring firms. The constant represents unrelated acquiring and target firms. The reported p-values are the results of the t-tests with the null-hypotheses that the coefficient corresponding to the p-value is zero. Significance is indicated at the 1%, 5%, and 10% level by ***, **, and *, respectively.

Dependent Variable	Constant (Unrelated)	P-value	Related	P-value	Semi-related	P-value
Before						
CAR (-30,-1)	0.0038	0.712	-0.0002	0.987	0.0191	0.206
Around						
CAR (-1,1)	-0.0067	0.372	0.0057	0.529	0.0043	0.666
CAR (-5,5)	-0.0134	0.191	0.0102	0.421	0.0058	0.670
After						
CAR (1,30)	-0.0235	0.104	0.0067	0.709	0.0238	0.173

Table 12: Results of univariate regressions with CARs as dependent variable and relatedness as independent variable in the sample of target firms. The reported p-values are the results of the t-tests with the null-hypotheses that the coefficient corresponding to the p-value is zero. The constant represents unrelated acquiring and target firms. Significance is indicated at the 1%, 5%, and 10% level by ***, **, and *, respectively.

Dependent Variable	Constant (Unrelated)	P-value	Related	P-value	Semi-related	P-value
Before						
CAR (-30,-1)	0.0404	0.055*	0.0147	0.589	0.0588	0.146
Around						
CAR (-1,1)	0.2630	0.000***	0.1371	0.036**	0.1390	0.036**
CAR (-5,5)	0.2613	0.000***	0.1504	0.020**	0.1551	0.017**
After						
CAR (1,30)	0.0470	0.054*	-0.0032	0.923	0.0381	0.287

In tables 13 and 14, you can see the results of multiple regressions on the two samples. In these regressions, CAR (-5,5) is the dependent variable. In the first column of both tables, regressions are run with the measures of relatedness as the independent variables. The results show that, as seen before, no significant coefficients are found for the acquiring companies, whereas for the target firms, all coefficients are significant and positive.

In the second column, year dummies are included in the regression, thereby controlling for time effects. When controlling for time effects, one can see that the R-squared of the regression shifts upwards and that the constant in the regression of acquiring firms is now significant. For target firms, significance of the coefficients increases even more and the coefficients are still all positive.

In the third column, all the control variables are included in the regressions. In the regression for the acquiring companies, we can see that the only significant coefficient is the constant, making it impossible to draw any conclusions from this regression, apart from the fact that it confirms what we saw before, namely that the cumulative abnormal returns for acquiring firms in unrelated acquisitions are negative on average.

In the regression for target firms, we can see that again, only a few of the coefficients show a significant p-value. This regression confirms that cumulated abnormal returns are higher for target firms when the merger or acquisition is related or semi-related, compared to an unrelated merger or acquisition. It must be said that the regression analysis with all control variables included has a big shortcoming. This shortcoming is that due to missing information, the number of observations is drastically reduced when including all the control variables, making it hard to find significant coefficients.

Table 13: Multiple regressions with CAR(-5,5) as the dependent variable in the sample of acquiring companies. In the first regression, year dummies are not included, thereby not controlling for year effects. In the third regression, all control variables are included. Numbers in brackets are p-values of the test that the coefficient is zero. Significance is indicated at the 1%, 5%, and 10% level by ***, **, and *, respectively.

	CAR (-5,5)	**CAR (-5,5)**	**CAR (-5,5)**
Constant	-0.011 (0.283)	-0.033** (0.033)	-0.035* (0.095)
Semirelated	0.008 (0.587)	0.006 (0.647)	0.015 (0.457)
Related	0.009 (0.508)	0.009 (0.479	0.002 (0.901)
Total assets			-0.000 (0.574)
Market value			-0.000 (0.665)
Book value per share			0.000 (0.474)
Common shares outstanding			0.000 (0.522)
Total revenues			-0.000 (0.856)
Operating expenses			(omitted)
Operating income			0.000 (0.569)
R&D			-0.000 (0.818)
Cash			0.003 (0.842)
Year fixed effects	no	yes	yes
R-squared	0.0012	0.033	0.0456

Table 14: Multiple regressions with CAR(-5,5) as the dependent variable in the sample of target companies. In the first regression, year dummies are not included, thereby not controlling for year effects. In the third regression, all control variables are included. Numbers in brackets are p-values of the test that the coefficient is zero. Significance is indicated at the 1%, 5%, and 10% level by ***, **, and *, respectively.

	CAR (-5,5)	**CAR (-5,5)**	**CAR (-5,5)**
Constant	0.261*** (0.000)	0.250*** (0.000)	0.038 (0.802)
Semirelated	0.155** (0.017)	0.133** (0.030)	0.401* (0.055)
Related	0.150** (0.020)	0.165*** (0.009)	0.426** (0.047)
Total assets			0.000 (0.326)
Market value			-0.000 (0.257)
Book value per share			0.000 (0.705)
Common shares outstanding			-0.000** (0.048)
Total revenues			-0.000 (0.721)
Operating expenses			(omitted)
Operating income			0.000 (0.926)
R&D			0.000 (0.303)
Cash			0.032 (0.848)
Year fixed effects	no	yes	yes
R-squared	0.0119	0.0388	0.4928

5. Conclusion

High-tech industries are characterized by high investments, high research and development expenses and fast technological advancements. Due to this climate, growth is essential for companies to survive and consequently, mergers and acquisitions are an increasingly used tool to realize this much needed growth.

However, the actual effects of the mergers and acquisitions in high-tech markets are ambiguous. As discussed in the section Literature Review, mergers and acquisitions are popular topics for economic research and many economics researchers have studied these areas, yet still no clear and resolute conclusion can be drawn from existing literature. In this paper, I conducted a research into the value creation in mergers and acquisitions in high-technology industries. For the research, I used a sample of 378 acquiring and 291 target American firms that participated in a merger or acquisition in the time period 2007-2017. For this sample, I researched whether acquiring and target firms show significant gains in their post-M&A stock prices. Furthermore, this paper analyses whether the degree to which the markets of the acquiring and target firms are related is a determinant of these abnormal returns.

The first part of the research in this paper was conducting event studies to measure the cumulated abnormal returns for the acquiring and target companies. For the acquiring firms, I found significant evidence that cumulated abnormal return short after the date of announcement are lower in the case that the acquiring and target firms are unrelated. In the event studies, no significant evidence was found that a higher degree of relatedness has a positive influence on post-M&A shareholder value.

For target firms, more decisive results were found in the event studies. Consistent with existing literature, post-M&A cumulative abnormal returns were high and significant for target firms. However, the CARs found in this research were of another dimension than CARs found by earlier researchers. Where existing literature predicts CARs of approximately 20-25% (Datta, Pinches and Narayanan 1992), this research found cumulative abnormal returns of over 35% for the total sample of target firms. This number is substantially higher than found in earlier research. When comparing the subsamples, separated based on the degree of relatedness, among each other, the results clearly distinct between unrelated mergers and acquisitions and the rest of the sample. In the mergers and acquisitions where the acquiring and target companies' industries were related or semi-related, cumulative abnormal returns were measured to be 40-42%. On the other hand, in the sample of unrelated mergers and acquisitions, cumulative abnormal returns were just over 26%.

After performing the event studies, regression analysis was executed. Univariate regressions were run, with the CARs as dependent variables and dummy variables of relatedness as the independent variables. The findings of the event studies were consistent with the findings of the regression analysis. In the results of the regressions on the sample of acquiring firms, coefficients of the dummy variables for relatedness were insignificant. Unfortunately, no conclusion can be drawn based on this numbers.

In the sample of target firms, the regression analysis showed significant evidence that cumulative abnormal returns are higher when target firms are related or semi-related to the acquiring companies, compared to when they are unrelated. This implies that the magnitude of value creation is expected to increase with the relatedness of the acquiring and target firms. However, no significant difference is found between cumulative abnormal returns in the samples of related and semi-related mergers and acquisitions. In the sample used in this research, related and semi-related mergers and acquisitions showed very similar cumulative abnormal returns.

In the second part of the regression analysis, I ran univariate and multiple regressions on the samples. In these regressions, control variables were added to the datasets. For acquiring firms, a significant and slightly positive coefficient was found for return on equity in both the univariate and the multiple regressions.

For target firms, the multiple regression showed no significant results due to information unavailability. The results of the univariate regressions showed significant evidence that cumulative abnormal returns are lower when acquiring and target firms are unrelated, but no significant evidence that returns are higher when acquiring and target firms are related. As discussed, this could be caused by an upward bias in the average returns of the sample. The results of the univariate regressions on the sample of target firms also showed evidence that cumulative abnormal returns are slightly, but significantly lower when the target firms are bigger.

Summarizing the findings of this research, I found significant evidence of value creation in target firms in mergers and acquisitions in high-tech markets. On average, cumulative abnormal returns were found to be 37.15% in the (-1,1) event window, which is substantially higher than post-M&A cumulative abnormal returns found in earlier research. Regression analysis confirms these findings, showing 15.22% lower cumulative abnormal returns when acquiring and target firms are unrelated, compared to related and semi-related firms. These findings imply that the high-investment, high-risk nature of high-tech industries results in a bigger value creation potential compared to other industries. However, it must be noted that

the effect of mergers and acquisitions on acquiring firm's shareholder value remains ambiguous since cumulative abnormal returns are close to zero and/or insignificant.

Interesting for further research can be to conduct a study that goes deeper into the differences in relatedness of the acquiring and target firms. In the sample used for this paper, the differences between the samples of related and semi-related mergers and acquisitions were minimal. It could be that my division into the three categories related, semi-related and unrelated was too rough. Further research could separate the sample into more subsamples to see if in that case, more detailed conclusions about relatedness in mergers and acquisitions can be drawn. Furthermore, one could research the differences between among high-tech industries. In this research, I conducted an event study on all firms in high-tech industries, not controlling for industry-specific difference among those industries.

6. Appendix

Appendix 1

List of mid-industries included in ThomsonOne

Medicinal chemicals and botanical products
Pharmaceutical preparations
In vitro and in vivo diagnostic substances
Biological products, except diagnostic substances
Electronic computers
Computer storage devices
Computer terminals
Computer peripheral equipment, nec
Calculating & accounting machines,except computers
Office machines, nec
Prepackaged Software
Power, distribution, and specialty transformers
Switchgear,switchboard equip
Motors and generators
Carbon and graphite products
Relays and industrial controls
Electrical industrial apparatus, nec
Household cooking equipment
Household refrigerators and home and farm freezers
Household laundry equipment
Electric housewares and fans
Household vacuum cleaners
Household appliances, nec
Electric lamp bulbs and tubes
Current-carrying wiring devices
Noncurrent-carrying wiring devices
Residential electric lighting fixtures
Nonresidential electric lighting fixtures
Vehicular lighting equipment
Lighting equipment, nec
Household audio and video equipment
Phonograph records,prerecorded audio tapes & disks
Electron tubes
Printed circuit boards
Semiconductors and related devices
Electronic capacitors
Electronic resistors
Electronic coils, transformers, & other inductors
Electronic connectors
Electronic components, nec
Storage batteries
Primary batteries, dry and wet
Electrical equip. for internal combustion engines
Magnetic and optical recording media
Electric equipment, nec
Telephone&telegraph apparatus
Radio & TV broadcasting & communications equipment
Communications equipment, nec
Aircraft
Aircraft engines and engine parts
Aircraft parts,equipment
Guided missiles and space vehicles
Guided missile and space vehicle propulsion units
Guided missile and space vehicle parts, nec
Search, detection, and navigation equipment
Laboratory apparatus and furniture
Environmental controls
Process control instruments
Totalizing fluid meters and counting devices
Instruments to measure electricity
Laboratory analytical instruments
Optical instruments and lenses
Measuring&controlling devices
Surgical and medical instruments and apparatus
Orthopedic, prosthetic, and surgical supplies
Dental equipment and supplies
X-Ray apparatus & tubes & other irradiation equip.
Electromedical and electrotherapeutic apparatus
Ophthalmic goods
Photographic equipment and supplies
Watches, clocks, clockwork operated devices, parts
Radiotelephone communications
Telephone communications, except radiotelephone
Telegraph and other message communications
Communications services, nec

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