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Determinants of the performance of firms that engage in High-Tech Mergers and Acquisitions

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Abstract

The high-technology sector is characterized by high Research and Development costs, high risk, and an everlasting challenge to keep innovating. The nature of this industry makes it an environment in which the possible benefits resulting from a merger or acquisition, such as synergy effects, are self-evident, at least in theory. Whether mergers succeed in realizing the prospected results, is the topic of this paper. More specifically, this paper examines the short-term abnormal returns of acquiring and target firms that engage in a merger or acquisition, as well as the driving factors behind these returns. Acquiring firms earn, on average, a negative return of 2.35 percent, compared to a positive return of 27.2 percent earned by target firms. For acquiring firms, only the payment method plays a significant role in determining these returns. For target firms, the payment method, its equity value and its size, relative to the acquiring firm, all turn out to significantly affect the returns.

Keywords:

Mergers, Acquisitions, High-technology, Event study, Performance.

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1. Introduction

Mergers and acquisitions (M&A) are among the most widely studied corporate events by academics (Hackbarth and Morellic, 2008). More specifically, the behavior of stock returns for both the acquiring and the target firm around the announcement date of the merger or acquisition. Nevertheless, true consensus about whether or not mergers[1] are beneficial for the acquirer and target has thus far not been achieved. On the one hand, there are researchers claiming that the synergies arising from a merger contribute to positive returns after a merger, especially so when both firms operate in the same industry (Hoberg and Philips, 2012). These synergies may in turn be explained by efficiency improvements, market power, and tax benefits (Davos, Kadapakkam and Krishnamurthy 2009). On the other hand, according to Jensen (1986), the agency problem leads to misalignment between the company's shareholders and its management. This could result in a merger taking place not for the benefit of either one firm, but because of managers acting out of self-interest.

Whether or not mergers and acquisitions do in fact succeed in creating economic value is the subject of this study, by examining the abnormal returns of firms that engage in a merger or acquisition. Subsequently, the determinants of these abnormal returns around the announcement date of mergers and acquisitions in the High-Tech industry of the United States will be captured. This will be done by way of analyzing a sample of completed mergers which were announced in the period 2000-2019, the first year of which was the year that the dotcom bubble burst. After controlling for the variability in regulation, industry size and merger waves across these years, the results of the study will provide a unique insight into the performances of high technology mergers and their determinants. This was done in a time period where the overall sentiment towards the high technology sector was far more conservative than during the sub 2000 period, which is when most studies discussed in this and the following section were conducted. Furthermore, the current study will take both the acquiring and the target firms into consideration, as opposed to just either one.

The business of mergers and acquisitions of firms has increased tremendously in the past few decades. Global M&A value has grown from $500 billion in 1994 to $1.500 billion (or $1.5 trillion) in 2018 (Boston Consulting Group, 2018). On top of that, the magnitude of the High-Tech industry in the United States has seen an increase of an even larger degree. The High-Tech sector accounted for a mere 0.8 percent of the United States' GDP in 1980 and had grown to a staggering 5.2 percent in 2015 (Ian Hathaway, 2017). These are just a few statistics that indicate that mergers within the High-Tech industry are becoming ever more relevant.

[1] From now onwards, "mergers" will be used to indicate both mergers and acquisitions, unless specified otherwise.

When it comes to the actual observed returns for both acquiring and target firms around the announcement date, the results found for acquiring firms are the most inconsistent. Asquith, Bruner and Mulins Jr. (1983) and Dodd & Ruback (1977) found positive returns for the acquiring firm following the announcement of a merger. On the contrary, Jarrell and Poulsen (1989) and Moeller, Schlingemann and Stulz (2005) found, on average, negative short-term returns for the acquiring firms in tender offers (acquisitions). For target firms on the other hand, the agreement that target shareholders do in fact benefit from a merger taking place is nearly unanimous (Healy, Palepu and Rubak 1992). However, what the exact determinants of these observed abnormal returns for targets are, remains highly debated.

The returns of High-Tech stocks tend to be characterized by a high volatility. Gharbi, Sahut and Teulon (2014) found the high Research and Development (R&D) costs in this particular industry as a possible explanation. High R&D costs could lead to higher information asymmetry, thus making the stock a riskier investment for shareholders. According to the Capital Asset Pricing Model (CAPM) (Sharpe, 1964), a higher volatility of a stock should correspond to a higher expected return. When examining the stock returns of firms involved in a merger or acquisition, we thus expect to see higher returns for firms that operate in the High-Tech industry, compared to firms that operate in other fields.

In this paper, the post-merger performance of the acquiring and target firm with respect to the High-Technology industry in the U.S. will be studied. Thereafter, the determinants of the observed return will be established. The study will be conducted by way of answering the following research question, which will be further elaborated on in the 'Research question and hypotheses' section:

What are the determinants of abnormal returns around the announcement date for firms that engage in a merger or acquisition in the High-Technology sector in the U.S.?

In formulating a complete and satisfying answer to this question, existing literature with respect to this subject will be reviewed in Section 2, after which several hypotheses will be formulated. In Section 3, the process of gathering data and the methodology section will be discussed. The results of the research will be reviewed and discussed in Section 4. Section 5 will conclude the paper.

2. Related literature

In the next section, an overview will be provided of the existing literature regarding mergers and acquisitions. Firstly, different theoretical incentives behind a merger or acquisition taking place will be elaborated on. Thereafter, actual empirical evidence with respect to the performance of stocks after the announcement of a merger or acquisition will be reviewed, as well as the ongoing debate among researchers on stock performance after a merger.

2.1 Why merge in the first place?

When a merger between two large companies is announced, the news tends to dominate financial headlines. Why is it that companies, that sometimes don't even operate in the same industry, decide to merge? Roughly speaking, the incentives to merge can be divided into two different categories. Firstly, there are the incentives that have the best interest of the firm at heart, also known as financial incentives. If mergers are realized on the basis of these incentives, they will likely result in value creation between the firms, and consequently, positive stock returns. Secondly, there are the managerial incentives. If mergers are realized solely in pursuit of managerial incentives, they may result in value destruction between the firms. This is consistent with the agency theory of Jensen (1986).

2.1.1 Financial incentives

The single most important financial motive to engage in a merger is the often referred to 'synergies' that arise when two firms decide to merge. In essence, synergies describe the concept of a merged firm being able to create more value than the sum of the two individual firms. These synergy effects can be attributed to numerous factors, which can be grouped into two main categories: cost-saving synergies and revenue-increasing synergies.

Cost-saving synergies

One way that cost reduction can occur, is when the redundant workforce of the merged firms is laid off. After all, a merged firm only needs one legal team, one headquarters, one executive board and so on. The decreased production costs due to economies of scale also lead to lower total costs, which occur when the production costs decrease with the quantity of output. The latter will likely be applicable to the High-Tech industry, due to high R&D costs. When millions of dollars have been spent on the development of a production plant, the combined quantity of output by one and the same production plant will naturally lower the average cost per product.

Another way total costs can be reduced is by economies of scope, which occur when the simultaneous production of different products by one firm is more cost-effective than two separate firms

each producing one of the two products, due to the shared usage of inputs. Inputs such as human capital or industrial devices can be used to produce a certain type of output (product), after which it can be used in the production of another type of output. With respect to High-Tech mergers, economies of scope could also very well arise due to the high R&D investments that characterize this industry. For example, this would occur when a laptop producing firm would use its manufacturing plant to produce a variety of electronic devices, such as mobile phones and televisions.

Other types of cost-saving synergies, which are bound to occur in the High-Tech sector, is the combined knowledge and technology between the two merged firms. Similar to the economies of scope, the investment made by a firm in its developed technology, as well as its highly knowledgeable and skilled workforce, can be shared among the firms after the merger.

Lastly, efficiencies in the firms' supply chain, shared patents, and the shared investment in future R&D can all bring about cost-saving synergies. In the High-Tech industry especially, it is crucial to keep innovating and designing new products to stay afloat in this competitive market. A famous company that failed to do so is Nokia. Its management's lack of vision and innovative ability caused it to keep losing market share in the mobile phone business, leading to it being acquired by Microsoft in 2014. The shared patents and R&D investments of a merged firm thus allow it to keep its innovative edge.

Revenue-increasing synergies

Revenue-increasing synergies can occur when the merged firm is able to gain a foothold in a new market. This can either be because of the implementation of a new product line, or because of the old product line being expanded into a new geographical area, where the acquired firm had already established a strong market position, or both. In these cases, the combined distribution network, brand recognition and customer base of the two separate firms will help the merged firm establish a solid position in the newly entered market. Through the acquisition of a firm that operates in another industry, the acquirer will also be able to bring about diversification in its product range. This allows customers to buy different products from one and the same supplier, much to their satisfaction (Motta, 2004). On top of that, diversification leads to a reduction of risk that the firm carries, due to its more diversified investment portfolio.

Another revenue increasing synergy can be brought about by the increased market power of the merged firm in a competitive industry, which enables it to set higher prices. However, antitrust authorities keep a watchful eye on mergers that would result in a company gaining too great a deal of market power. In some cases, these authorities will disallow a merger to take place in a late stage of the deal cycle, causing both parties to lose the money already invested in the deal process.

Although there are numerous ways to realize synergy effects between two merged firms, they can all be offset by the negative effect of integration problems (Olie, 1990). They occur if two different firms with vastly different management styles or cultural fit decide to merge, with value destruction as a consequence. If the integration problems account for more negative results than the synergy-effects do for positive results, the combined value of the two firms will actually be less than the sum of the two individual firms.

Growth is another big strategic incentive for the prospective merger of two firms. Growth of a firm can be done either internally, or externally (Mermalstein et al, 2014). Internal growth, also known as organic growth, can be realized by a firm when it uses its own resources to generate higher revenue and profits, and subsequent reinvestment of these profits in its own firm. Inorganic growth is realized through the acquisition of another company in the same industry, or in an industry that the acquirer wants to gain a foothold in. According to Trautwein (2006), it is much easier and faster for a company to grow by inorganic growth, as opposed to organic growth. The combined capital of the two firms can also enable the merged firm to invest in positive Net Present Value (NPV) projects, that it otherwise wouldn't have had sufficient capital for. This combined amount of capital can provide for enough collateral that the firm needs to take on a loan from a creditor to invest in the project (Trautwein, 1990). Had it not been for the merger, this growth opportunity would have been forfeited.

Lastly, there are several tax benefits a merged firm can take advantage of. For example, if one of the two firms has suffered a financial loss, this loss may be offset by the profit of the other firm, known as a tax loss-carry forward. However, (Davos, Kadapakkam and Krishnamurthy 2009) found that of the average 10.64 percent increase in equity value of 264 large merged firms, a mere 1.63 percent was attributable to tax benefits.

2.1.2. Managerial incentives

In addition to financial incentives, there are a number of other incentives that can lead management to the decision to merge. The problem with these managerial incentives, however, is that they don't fully align with the interests of the firm and its shareholders. A manager is primarily interested in fulfilling his own personal short-term goals, which often translates into a desire to expand the business to increase his personal power, status and in the end; his wages. The shareholders, on the other hand, are more interested in the creation of value in the long term, to maximize their returns. This conflict of interest is best described by 'Hubris' (Roll, 1986), and the 'Free-cash-flow problem' (Jensen, 1986).

The term 'hubris' is an overarching characteristic of overconfidence or arrogance. When the term

is used in regard to a firm's management, it describes the situation where a manager places too much confidence in his own business, as well as in his ability to run it. Due to this overconfidence, the valuation of a possible take-over target will be biased upwards. This overvaluation will result in management thinking that there is a possibility to create value through a merger, when in reality there is none. This bias is enhanced by the fact that there are only so many merger opportunities that a manager comes across during his career. As a result, when the opportunity does arise, he convinces himself that the deal must be profitable, failing to notice his own valuation errors.

The free-cash-flow problem states that, in the event where a company has an abundance of free cash, that is, more cash than it needs for its planned investments, management will be more tempted to engage in uncertain investments. It is yet another example of an agency problem, because management would rather use the cash to expand the business, than to distribute the cash to shareholders in the form of dividends. However, Huang and Walking (1987) found that targets involved in a cash-financed acquisition showed significantly higher returns in comparison to stock-financed acquisitions. Thus, the acquisition of another firm by payment of cash doesn't necessarily lead to value destruction.

Another reason that mergers may not realize the performance that the planned synergies would indicate, is the role of M&A advisors. These investment bankers will often argue that a merger is beneficial to their clients' management, when in fact, it is in the bankers' best interest. For their advisory roles in the AT&T/TCI merger, both Goldman Sachs and Credit Suisse First Boston earned around $30 million. With these amounts of money at stake, M&A advisors may be tempted to persuade the firms' management teams to go through with the merger.

2.2 Empirical Evidence on Mergers and Acquisitions

In the previous section, we looked at the different theoretical perspectives from the point-of-view of both the firm and its management, arguing why a merger might or might not result in value creation for the acquirer and target firm. But what is observed in practice? An abundance of research has been conducted on this subject, and not all results lead to reconcilable conclusions. In this section, we will be looking at the actual results that previous research has yielded with respect to mergers and acquisitions as a whole, after which we will zoom in on the results for mergers and acquisitions in the High-Tech industry.

2.2.1 Performance of Mergers and Acquisitions

When two firms engage in a merger or acquisition, it is clear that there are a number of ways that value can potentially be created through synergies. If this is the case, the merged firm will start generating higher revenues and profits than the two firms did between them before the merger. This will result in

either cash dividends being distributed to the shareholders, or reinvestments in positive NPV projects, through which the firm can realize growth. In both cases, this will lead to positive stock returns for the shareholders. On the other hand, when mergers are the result of the rather myopic point of view of the firm's management, value destruction will likely follow, resulting in negative stock returns.

The research conducted on value creation after Mergers and Acquisitions altogether varies widely in setup and goals. First of all, there is a distinction to be made between long-term and short-term results. The short-term returns usually cover a period of no longer than 30 days, but often no more than a few days, following the announcement day of a merger or acquisition. The long-term returns can be as long as 10 years after the announcement day. The research conducted in this paper will investigate into the announcement returns of a merger or acquisition, which is why we will only consider empirical results found on the short-term in this section.

2.2.2 Value Creation

In the empirical results of virtually every event study, a disparity is found between the abnormal returns realized by the acquirer and those realized by the target around the announcement of the merger. This can mainly be attributed to the control premium. The control premium is the surplus that an acquirer pays above the market price of a target to gain a controlling interest in a target company. As a result, acquiring shareholders may not profit significantly from a merger announcement, whereas target shareholders receive significant wealth gains. Dodd and Ruback (1977) found for the first month after the announcement of a merger, a Cumulative Abnormal Return (CAR) of 20.58 percent for targets where the merger was eventually successful, and 18.96 percent for targets of unsuccessful mergers. For both successful and unsuccessful mergers, no statistically significant results were found for acquirers, where the CAR seemed to fluctuate around zero. In a study conducted by Eckbo (1983), he found that in a sample of horizontal mergers, target firms realized an abnormal return of 14.08 percent over the first 31 trading days in the (-10,20) period[2], and 3.13 percent over the announcement day alone, provided the merger wasn't challenged by government for violating antitrust laws. For the bidding firms, small positive but statistically insignificant results were found for all seven periods surrounding the announcement date. Andrade et al (2001) found similar results. For a sample of over 3,500 mergers during the 1973 to 1998 period, an average abnormal return of 23.8 and 16.0 percent was found for the (-20, close) and the (-1, 1)

[2] (-10,20) denotes a period of 10 days prior to the announcement date to 20 days after the announcement date.

periods, respectively. For the bidding firms, again, no significant results were found. All event studies used the market model as a benchmark.

2.2.3 Empirical determinants of abnormal returns

The next question, naturally, is which factors determine the observed abnormal returns. Evidently, value creation can be materialized through synergies of two merging firms, which can be brought about by, among other things, scale and scope economies. It is not unthinkable that there is a higher change a merged firm can exploit scale and scope economies when two firms are related to one another.

There are multiple ways 'relatedness' can be defined, but one of them is the size of the target firm, relative to its acquirer. Moeller, Schligemann and Stulz (2004) found that the returns around the announcement date of a merger were, on average, 2.0 percent higher for relatively large targets, compared to relatively small targets. This so-called 'size effect' was independent of the payment method used, nor did it depend on the firm being public or private. One possible explanation for this effect is that the size of the target firm relative to the buyer may influence the motivation and attitude of the target firm's top management (Kitching, 1967; Walsh, 1989). If these top managers feel overlooked and unimportant, a sense of alienation from the firm may follow, preventing a merger from reaching its full potential. Another reason why relatively large targets may earn higher returns is the increased possibilities to exploit economies of scale (Linn and Switzer, 2001; Switzer, 1996).

Another way to describe relatedness of two merging firms is whether or not they operate in the same type of industry. Eckbo (1983) compared the returns of merging firms that operated within the same industry with merging firms that operating across different industries and found that target firms in horizontal mergers earned larger abnormal returns. Walsh (1989) also found the merger type (related or unrelated) to be a decisive factor in explaining stock returns. Related mergers may result in higher synergy effects due to similar operations and productions, as well as in a higher market power of the merged firm.

A third way to describe 'relatedness' is the corporate cultural fit between the two firms. Cultural fit is a decisive factor when it comes to the successfulness of the integration process of the merged firms. A lack of cultural fit and a subsequent failing integration process can have devastating effects on the returns of both the acquiring and target firm. Weber (1996) found the perception of the acquired firm's management with regard to corporate fit to be positively associated with the effectiveness of the integration process of mergers in the banking sector. Further, Datta and Puia (1995) found that, for multiple time windows around the announcement date of a merger, the stocks of acquiring firms that had a large cultural distance (bad cultural fit) with the target firm, performed significantly worse than those

with a small cultural distance (good cultural fit) to the target firm. As said, integration and managerial problems may be the cause.

Another factor which seems to play a noteworthy role in the value creation following mergers, is the payment method. Huang and Walkling (1987) found a CAR of 29.3 percent for targets around the announcement period (i.e. t = -1 + t = 0) of mergers that were financed entirely by cash, compared to a CAR of 14.4 percent for targets that were involved in purely stock-financed mergers. The CAR earned by targets in mergers that were financed by both cash and stocks (mixed) lay in between those numbers, with a CAR of 23.3 percent. They ascribe the substantially higher returns for cash-financed mergers to tax-related circumstances. Cash payments are taxable in the year of the merger, whereas the tax paid on stock payments is deferred to the moment the stock is sold. When shareholders are forced to pay immediate taxes on their gains, they will demand higher premiums to offset this disadvantage. Wansley, Wane and Yang (1983) report similar results for target firms.

In another study, Asquith, Bruner and Mullins (1998) found an average two-day announcement excess return of 0.2 percent for bidding firms in cash-financed mergers, although statistically insignificant. Bidding firms involved in common stock-financed mergers, however, earned an abnormal return of -2.4 percent, which was significant at the 1 percent level. This difference in returns of 2.6 percent between cash-financed and stock-financed mergers is significant with a t-statistic of 9.25. Mixed offers earned a return of -1.47 percent, the difference between cash alone and stock alone being insignificant. For target firms, the two-day announcement excess return was 13.85 percent, on average, for mergers financed with common stock, compared to 27.47 percent for cash mergers. The higher returns for bidders in cash-financed mergers may be attributable to the signaling effect (Yook, 2003). A merger paid by in cash is a power signal, which an acquiring firm's management will only send out when it doesn't perceive its own shares as being overvalued. This can be indicative of a healthy firm, boosting the market's sentiment of that particular firm.

There are numerous other factors that may play a role in the determination of abnormal returns of stocks following a merger. However, the relatedness of firms and payment method are the ones that previous studies have found the most consistent results on, when studying the short-term performance of a merger, which is why they have been discussed in more detail in this section. The other possible factors comprise the total assets, equity value, enterprise value, operating income, net income, revenue, earnings per share (EPS), return on equity, price per earnings and the market to book ratio of both the

acquirer and target firms. These factors will be further elaborated on when the study of the current paper will be set out, in the data and methodology sections.

2.2.4 Mergers and Acquisitions in High-Technology Markets

The last 30 years have shown a tremendous increase in M&A activity in the High-Tech sector. The High-Tech sector. As a whole, the High-Tech sector is characterized by high R&D investments, high risk and high growth opportunities, when compared to other industries. These features of the High-Tech sector have a profound effect on the M&A activity in this sector. Targets are often small start-ups with a high-growth potential and future cash flows that are hard to predict, making it an ambiguous task to estimate those firms' exact value. As Koher and Kohers state in their paper (2000, p. 40): 'In addition to their high growth potential, however, another distinctive feature of high-tech industries is the inherent uncertainty associated with companies whose value rely on future outcomes or developments in unproven, unchartered fields.' As a result, there is a higher degree of uncertainty around mergers in the high-tech sector which, according to the risk-return tradeoff, is associated with a greater probability of higher returns.

The observed performance of firms involved in high-tech mergers seem to be consistent with this risk-return tradeoff, according to Koher and Kohers (2000). They find an average one-day abnormal return of 37.89 percent for targets in high-tech mergers, compared to 29.21 percent for targets involved in mergers of non-tech firms. One difficulty in interpreting this result is the fact that their sample of tech firms consisted of public targets only, whereas a large fraction of the targets in the High-Tech industry are, as said before, privately held firms.

Another way of measuring the performance of a merger is by examining the innovative performance of firms following a merger or acquisition. This is especially applicable to the High-Tech sector, where it is assumed that the transfer of knowledge and research-driven advancements is a prominent incentive to engage in a merger or acquisition in the first place. Hagedoorn and Duysters (2002) found that for the computer industry, the organizational and strategic fit seems to play an important role for the technological performance of M&A active companies. The acquisition of research-intensive companies can thus have a positive effect on the technological and innovative performance of the acquiring companies, because of the ''possibility to improve its technological skills and expected learning capabilities.'' It should be noted that these effects will most likely manifest themselves in the long term, as it will take time for two firms to integrate and bundle their innovative capacity. Therefore, it is doubtful how much of these effects will be observable in the short term. The argument that mergers within the High-Tech sector may boost R&D and patent synergies of the merged firms, is supported by findings of Hitt et al (1991). Their results indicate that mergers between firms that are unrelated have an adverse

effect on the R&D and patent intensity.

All in all, the uncertainty surrounding mergers and acquisitions in the High-Tech industry causes it to remain an intensively studied subject when it comes to the risk-return trade off of high growth opportunities and complementary increased investment risk.

2.2.5 Research questions and hypotheses

In the previous sections, a number of relevant studies that were conducted in the past with respect to this subject, have been discussed. In this section, a bridge will be made towards the objective of the current paper. The broad, overall research question of this paper is:

What are the determinants of abnormal returns around the announcement date for firms that engage in a merger or acquisition in the High-Technology sector in the U.S.?

By way of answering this research question, the research to be conducted will study several different hypotheses, which are all based on the previously discussed existing literature. First of all, we know that a merger will generally lead to value creation for the target firm, but not for the acquirer, due to the control premium.

H1: Target firms in high tech-mergers will show significant positive abnormal returns around the announcement date of a merger.

H2: Acquiring firms in high tech-mergers will not show any significant returns around the announcement date of a merger.

Furthermore, we have seen that the opportunities to exploit economies of scale is positively related to the size of the target firm, relative to the acquiring firm. In addition, a large target firm's management may be more appreciated and valued by the acquiring firms, compared to a small target's management.

H3: Relative size is positively related to abnormal returns for high-tech mergers and acquisitions.

It follows from numerous studies that R&D and patent-related synergies are more likely to be present between two merging firms that operate in the same industry. Because the high-tech industry is

one where R&D and patent investments are essential elements of the firms' operations, it is expected that this relatedness is an important determinant of abnormal returns.

H4: Industry relatedness is positively related to abnormal returns for high-tech mergers and acquisitions.

Lastly, the method of payment when acquiring a company can have a substantial effect on the returns following the acquisition, due to a higher premium demanded by shareholders in cash-financed acquisitions, as well as the signaling effect.

H5: Abnormal returns in high-tech mergers and acquisitions will be higher for cash-financed mergers and acquisitions, compared to stock-financed mergers and acquisitions.

3. Data

The specifics of any merger or acquisition that is completed are monitored and registered by numerous financial databases, which are at researchers' disposal when conducting their analyses. In this paper, a number of event studies will be carried out on a certain sample of mergers and acquisition, to determine if any value is created following the announcement. In the following section, the process of selecting an appropriate sample of mergers and acquisitions will be discussed. Thereafter, the descriptive statistics will provide an overview of the characteristics of the acquirer and target firm samples.

3.1 Collection of transaction data

The database used to collect the transaction data needed to conduct this research is called '*Thomson One'*. To end up with an appropriate sample, the following restrictions were imposed to the database:

- The macro industry in which the acquiring firm operates is the High-Technology sector. A list of which mid-industries this sector comprises will follow below. This restriction does not apply to the target firm. This way, the value creation between firms that operate in the same industry can be compared to the value creation between firms that do not.
- Both the acquiring firm and the target firm are located in the United States of America.
- Both the acquiring and target firm have to be public. This is to ensure that the stock prices of both firms are available.
- The transaction value was disclosed.
- Only mergers or acquisitions that were completed are considered.
- The date on which the merger or acquisition was announced is between 01/01/2000 and 12/31/2018.
- The total value of the deal is at least $100 million.

The reason for only considering mergers with a total deal value of at least $100 million is to eliminate small startup targets with distorted multiples, such as an extremely high P/E multiple, due to their high growth opportunities. Those multiples may interfere with our regression analyses results later on.

As said, the acquiring firm has to be operating in the High-Technology sector. This sector comprises the following mid-industries:

- Computers & Peripherals
- E-commerce / B2B
- Electronics
- Internet infrastructure
- Internet software & services
- IT consulting & services
- Other high technology
- Semiconductors
- Software

Corrections to the sample

After applying these criteria, the sample consisted of 394 acquirers and 394 targets. Some corrections still had to be made to the sample. An estimation window will be used during which the normal returns of the acquiring firms will be estimated. This will be further elaborated on under the 'Cumulative Abnormal Returns' section. All the observations where acquiring firms that were involved in a merger or acquisition for which the estimation window overlapped with another acquisition by that same acquirer, were removed from the sample. The very purpose of the estimation window is to assess what the returns of the acquiring firm would have been in absence of the acquisition, so another acquisition will naturally interfere with these 'normal' circumstances. This restriction does not apply to target firms, as no two different acquirers will take over one and the same target, at least not in a period of time that is anywhere near as short as the estimation window.

For some other mergers or acquisitions, no public data with respect to the returns was available. One possible explanation for this is that the merger firm in question went bankrupt between the announcement date and now. After correcting for these missing observations, we are left with a sample of 338 acquirers and 363 targets. This discrepancy in numbers will have no further effects on the results for the main objective of this study, which is to assess the returns and their determinants for both samples separately. At the end of the methodology section, the combined value of both firms will also be discussed. For these results, only the acquirers that still have a corresponding target in the sample will be used, resulting in a sample of 338 observations.

3.2 Descriptive statistics

The total sample of acquiring firms consists of 338 observations, whereas the sample of target firms consists of 363 observations. In the figure below, the number of deals that were announced are shown per year. For this figure, the sample of the target firms were used, as this sample still includes the observations deleted in its counterpart sample of acquiring firms, due to their overlap with the estimation period. For the purpose of descriptive statistics, this overlap naturally poses less of a problem, as the goal of these statistics is to make inferences about the merger activity per year.

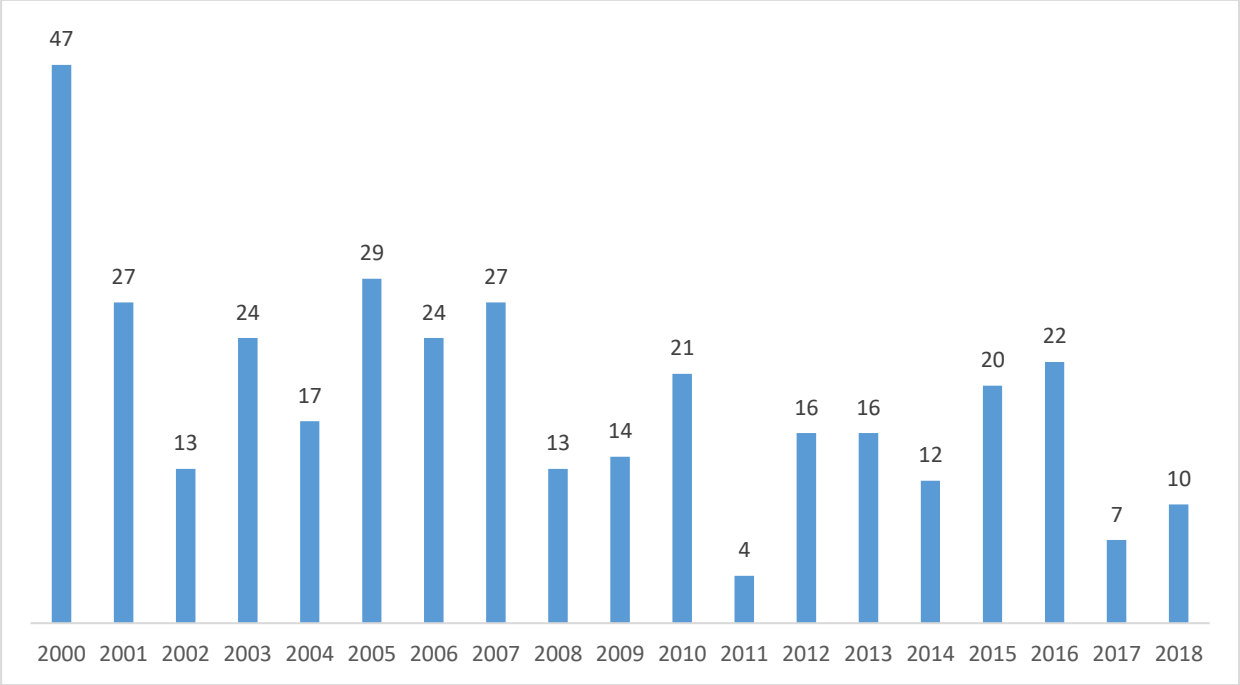

Figure 1: the number of high-tech M&A announcements per year

In figure 1, a clear outlier is observable for the number of mergers that occurred in the year 2000. This outlier, and the sharp decline in merger activity in the high technology sector in subsequent years, is most likely attributable to the burst of the dotcom bubble in 2000. Another clear decrease in merger activity can be seen when comparing the years 2008 and 2009 to the years 2005-2007, which is a clear indication of the economic crisis. During this economic fallout, investment expenses dwindled, and firms were far less likely to engage in mergers or acquisitions. The fact that the high technology sector is generally regarded as an especially risky one makes this all the more evident.

Tables 1 and 2 show the distribution of the variables that will be included in the regressions as dummy variables, which are the industry-relatedness between the two firms and the way the merger is financed. The tables show that payment in cash is the most occurring way of financing the transaction in

both the target sample and the acquirer sample. Payment in stock and a mixed payment of both cash and stock each make up a similar portion of the total samples. When it comes to the industry relatedness between two corresponding firms, most firms that engaged in a merger operated in the same mid-industry as the corresponding acquirer or target. The number of mergers between firms that operated in the same macro-industry, but not the same mid-industry (semi-related), is also fairly well represented in both samples. Mergers between firms that operated in different macro-industries make up the smallest portion of both samples. This is in line with expectations, as these mergers will, in theory, provide with the fewest opportunities to realize synergies.

Table 1: payment method distribution across both samples

	Acquirers	*Targets*
Cash	175	195
Stock	84	83
Mixed	79	85
Total	338	363

Table 2: industry-relatedness distribution across both samples

	Acquirers	*Targets*
Related	171	180
Semi-related	114	128
Unrelated	53	55
Total	338	363

Tables 3 and 4 show the descriptive statistics of both the target and acquirer sample. They contain some of the core financial statistics of the firms, several of which will be used in the regression analyses in the following section. The numbers represent the values for the firm's specific financial statistic at the end of the control period, that is, 50 days before the merger is announced. That way, the announcement of the merger will not yet have had any effect on the firm's financials. It is clear from these table that the acquiring firms are substantially bigger. This is in line with expectations, as acquisitions of small, high growth firms by bigger firms are common within the high-tech sector.

Table 3: descriptive statistics of the acquirer sample

	Average	*St. Dev.*	*Minimum*	*Maximum*
Total assets (in $1,000)	15,433	29,600	0	193,475
Equity value (in $1000)	31.841	71.085	0,0509	537.193
Enterprise value (in $1,000)	29,173	65,300	-6.784	597,271
Operating income (in $1,000)	1,730	4,880	-13,401	55,241
Net income (in $1,000)	1,220	3,820	-13,356	41,733
Revenue (in $1,000)	11,113	24,000	0	156,508
Earnings per share (in $)	1.242	1.908	0	15.15
Return on equity (in %)	2.823	31.032	-257.49	100.95
Price per earnings	139.469	919.751	0	14,107
Market to book ratio	5.453	17.825	-2.21	239.42

Table 4: descriptive statistics of the target sample

	Average	*St. Dev.*	*Minimum*	*Maximum*
Total assets (in $1,000)	2,010	3,650	0	20,975
Equity value (in $)	1,341	3,018	0	26,945
Enterprise value (in $1,000)	2,820	3,916	0	15,049
Operating income (in $1,000)	123	306	-378	1,633
Net income (in $1,000)	6.026	349	-2,234	769
Revenue (in $1,000)	1,833	4,620	0	33,554
Earnings per share (in $)	0.505	1.207	0	15.41
Return on equity (in %)	-7.077	49.403	-323.14	40.63
Price per earnings	53.236	106.747	0	1181.3
Market to book ratio	4.458	9.922	-27.92	104.1

4. Methodology

In this section, an elaboration will be given as to how the abnormal returns will be measured, as well as the control variables on which the CAR will be regressed. This will then provide us with an insight into the relevant determinants of the CAR.

4.1 Cumulative Abnormal Returns

According to the efficient market hypothesis of Fama (EMH) (1970), all available information about firms is, at any moment, fully and instantaneously incorporated in that firm's stock price, which should make it impossible for anyone to beat the market. Given that premise, Fama, Fischer, Jensen and Roll (1969) have invented a way to assess the effect that newly released information has on the prospects of a firm and its stock's price. They came up with the event study methodology, which compares a certain event's effect on a firm's stock returns to a benchmark return, that is, the return that would have been realized in absence of the event. The benchmark that most scholars use when studying the returns around the announcement data of a merger is calculated using the classical market model (Sharpe, 1964) (e.g. Andrade et al, 2001; Huang and Walking, 1987; Moeller, Schlingemann and Stulz, 2005), and it will be used as a benchmark in the current paper as well. As the market model controls for economic fluctuations, it captures the expected return of a certain stock i under normal market conditions, contingent on the return on the market portfolio, the individual stock's risk as measured by beta, and certain conditions that are unique to the firm:

$$R_{it} = \alpha_i + \beta_i R_{mt} + u_{it} \qquad (1)$$

Where:

R_{it}	=	the expected return for stock *i* on day *t*
α_i	=	the idiosyncratic (firm-specific) risk of stock *i*
β_i	=	the beta coefficient of stock *i*
R_{mt}	=	the observed return on a market portfolio
u_{it}	=	error term of the regression

Equation (1) shows the normal returns that will be estimated for a certain estimation period, during which it is certain that no news of the merger has reached any individual or institution that may thereby affect the price of the stocks in question. Therefore, it is of utmost importance that the estimation

window does not overlap with the window for which the abnormal returns are being assessed, i.e. the event window. In other words, the estimation window has to end well before the event window starts. Accordingly, the estimation window during which the coefficients of equation (1) will be estimated will cover the period of 200 days prior to the merger announcement and ends 50 days prior to the announcement date (-200, -50). The lengthy nature of the estimation period will control for any short-term fluctuations in the normal returns. The abnormal returns can then be computed by subtracting the estimated returns in the estimation window of equation (1) from the returns that are actually observed during the event window:

$$AR_{it} = R_{it} - (\hat{\alpha}_i + \beta_i R_{mt}) \qquad (2)$$

Where:

AR_{it}	=	the abnormal return for stock *i* on day *t*
R_{it}	=	the actual (observed) return for stock *i* on day *t*
$\hat{\alpha}_i$	=	the estimated idiosyncratic (firm-specific) return on security *i*
β_i	=	the estimated beta coefficient for stock *i*
R_{mt}	=	the observed return for Datastream MSCI World Market Index

The next step is to choose the event window over which the returns will be observed to determine their abnormality. Andrade et al. (2001) found that the most statistically reliable way to establish whether or not a merger announcement leads to value creation or value destruction, is to use traditional short-window event studies. During this period, it is relied on the efficient market hypothesis' prediction that the market is able to incorporate the news of the merger or acquisition, and the market's subsequent expectations regarding value creation or value destruction as a result of the merger, into the firm's stock prices. In the same fashion as the study conducted by Entrade et al. (2001), the first event window that we will use will start one day before the merger announcement, and end one day after (-1, 1).

As mentioned before, according to the strong EMH, every piece of information that is publicly available should, at any time, instantly be incorporated in a firm's stock price. If this were the case, the entire effect of the merger announcement should be captured by the (-1, 1) period, as the stock's prices would immediately adjust, reflecting the market's prospects of the firms involved in the merger. However, whether this theory actually holds in the real world is highly questionable. In fact, there are multiple

arguments that plead against it. One of which is the possibility of a delayed reaction of the market when it comes to processing the announcement and incorporating the information into the stock's prices. To allow for some leeway in the process of incorporating the merger announcement into the price, the event window of (-5, 5) will also be used, as is done by, among others, Dutta and Kumar (2009). The strong EMH also predicts that the expected stock returns during the (-30, -1) period should be equal to zero. Numerous studies have shown, however, that significant returns were earned prior to the announcement of the merger was made public (e.g. Keown & Pinkerton, 1981; Elliot, Morse & Richardson, 1984). To investigate into this so-called price run-up in the month prior to the announcement, the event window of (-30, -1) will also be used. Lastly, an event window is used to capture the returns following the month of the announcement, to check if they differ significantly from the announcement day-returns. This window will cover the (1, 30) period. For every event window, the daily returns as captured by equation (2) are then cumulated, resulting in the Cumulative Abnormal Returns:

$$CAR_{i(T_1,T_2)} = \sum_{t=T_1}^{T_2} AR_{i,t} \qquad (3)$$

Where: $CAR_i\,(T1,\ T2)$ = Cumulated abnormal returns of stock *i* during the event event window (T_1, T_2)

Since the estimation windows vary in length, the average CAR has to be determined, in order to compare the returns of different estimation windows with one another. This results in the CAAR, which is the measure of return that will be used in the statistical significance tests when assessing the significance of the observed returns of the estimation windows as a whole.

$$CAAR_{i(T_1,T_2)} = \frac{1}{N}\sum_{i=1}^{N} CAR_{i(T_1,T_2)} \qquad (4)$$

4.2 Joint Cumulative Abnormal Returns

Although the main objective of the current paper is to determine the percentual abnormal returns and their corresponding determinants for the acquirer and target firm samples separately, it deserves to be noted that the size of both firms largely affects the absolute economic value that is created through a merger.

It is obvious from the descriptive statistics of both samples that the acquiring firms are in many regards, much bigger firms. Hence, a small negative percentage earned by the acquirer could more than offset a large positive percentage earned by the target. Therefore, another interesting number to consider is the joint Cumulative Abnormal Return, or joint CARs. This will provide an insight as to how much net economic gain the merger truly brought about, relative to the total value of the merged firm. It will be computed by the following formula:

$$Joint\ CAR_i = \frac{Market\ Value\ Target_i}{Total\ Market\ Value_i} * CAR\ Target_i + \frac{Market\ Value\ Acquirer_i}{Total\ Market\ Value_i} * CAR\ Acquirer_i \quad (5)$$

4.3 Control variables

In section 4.1, the way in which the CAR is computed is described. To investigate what the determinants of the CAR are, a number of different control variables will be used in univariate regressions with the CAR as the dependent variable and the different determinants as the independent variables. Those variables that turn out to have significant explanatory value, will then be used in a multivariate regression, the results of which will reveal which determinants best explain the abnormal returns following the announcement of a merger or acquisition. The variables are specific financial figures for the firms in question, which are gathered through Datastream. The numbers that are used for each financial variable represent their value as of 50 days prior to the announcement of the merger. That way, the financials of the firms are unaffected by any news relating to the merger. The control variables that will be used in the regressions can be split into two groups: categorical variables and continuous variables.

Categorical variables

As mentioned in the literature section, researchers in previous empirical work on mergers and acquisitions have found significantly higher returns for both acquiring firms and target firms in cash-financed mergers, compared to stock-financed mergers (e.g. Asquith, Bruner & Mullins, 1998; Huang & Walkling, 1987; Wansley, Wane & Yang, 1983). One possible explanation is tax-related, due to the immediate taxation of cash transactions, resulting in a higher premium demanded by shareholders. Another explanation is the signal of an apparent healthy firm that management aims to send out.

The mergers in the sample used for this paper are financed in one of three ways; purely cash-financed, purely stock-financed or a mixture of the two. As this results in a categorical variable that can take three possible values, it will be treated as a dummy variable in the regressions. The standard regression that will be used in the univariate regression for payment method is the following:

$$CAR_i = \beta_0 + \beta_1 * Mixed_i + \beta_2 * Stock_i + \varepsilon \quad (6)$$

Where

CAR_i	=	Cumulative Abnormal Returns in event window *i*
β_0	=	Constant, representing cash-financed mergers
β_1	=	Sensitivity of the CAR to mixed-financed mergers
$Mixed_i$	=	Dummy variable, which takes the value 1 if the merger is financed with both cash and stock, and 0 otherwise
β_2	=	Sensitivity of the CAR to stock-financed mergers
$Stock_i$	=	Dummy variable, which takes the value 1 if the merger is stock-financed, and 0 otherwise
ε	=	Error-term of the regression

One of the three dummy variables is left out of the regression to avoid multicollinearity. This means that β_0 represents the situation where the merger is financed purely with cash. The sample also included some mergers that were financed with warrants or options. They were treated as if they were paid with stock.

Another categorical variable that the CAR for each event window will be regressed on, is whether or not the acquiring and target firm operate in the same industry. Eckbo (1983) and Walsh (1989) both found significantly higher post-announcement returns for target firms that operated in the same industry as the acquiring firm. Synergy effects may very well be the cause, due to the similar operations and productions among the two firms. In order to establish the effect of the type of industry that the target operates in, on the returns after a merger announcement, again dummy variables were used, each representing a degree of industry-relatedness. From the sample, it is known whether the target firm operates in the same mid-industry (related), in the same macro-industry (semi-related), or in a different macro-industry (unrelated) than the acquiring firm. Hence, the univariate regression for industry is the following:

$$CAR_i = \beta_0 + \beta_1 * Semirelated + \beta_2 * Unrelated_i + \varepsilon \qquad (7)$$

Where

CAR_i	=	Cumulative Abnormal Returns in event window *i*
β_0	=	Constant, representing the case where both firms operate in the same mid-industry
β_1	=	Sensitivity of the CAR to both firms operating in the same macro-industry
$Semirelated_i$	=	Dummy variable, which takes the value 1 if both firms operate in the same macro-industry
β_2	=	Sensitivity of the CAR to both firms operating in different macro-industries
$Unrelated_i$	=	Dummy variable, which takes the value 1 if both firms operate in the different macro industries
ε	=	Error-term of the regression

Again, the third variable is left out of the regression to avoid multicollinearity. As such, β_0 represents the situation where both firms operate in the same mid-industry (related industries).

The multivariate regression will include all the variables that turn out to be significant in the univariate regressions. In case both the dummy variables for payment method and the dummy variables for industry are significant, an interaction term will be added to the multivariate regression to account for the interaction effects between the two dummy variables.

Continuous variables

These are the variables that can take any value, as opposed to the binary values the dummy variables can take. The continuous variables that will be included in the regressions can be divided into two different categories; financials that are standalone entities and financial ratios.

Total assets is a commonly used proxy for the size of a firm. The more assets a firm has, the more resources it can use to invest in positive NPV projects, and thereby generate higher revenues. The characteristics of the high-tech sector, such as the high R&D investments and high fixed costs, make the amount of assets a competitive advantageous factor of firms operating in this industry. In order to control

for outliers in the sample, the natural logarithm of total assets, rather than total assets itself will be used in the regressions.

Another variable that relates to the size of the firm is the *equity value*, or market capitalization, which represents the value that is available to equity investors, or the total value of the firm after the debts have been paid off. It shows how much the firm is worth to outside investors, and it is computed by multiplying a firm's stock price by its number of outstanding shares. As it is directly linked to the firm's stock price, it is a possible determinant of the CAR. Again, to control for outliers in the sample, the natural logarithm of equity value will be used.

Moeller, Schligemann and Stulz (2004) have found significantly higher post-merger announcement returns for relatively large targets, when compared to smaller targets. This could be due to the fact that smaller targets' management are more prone to being overlooked by the acquirer's management, keeping the merger from realizing its full financial potential. Another reason may be the higher synergy potential arising from the merger with a larger target. The variable *relative size* is used, being the ratio of the equity value of the target and the equity value of the acquirer.

Note that some observations in both samples, targets for the most part, don't have a corresponding firm in the counter sample anymore, due to the elimination of these firms from the sample for reasons explained earlier. However, both samples still contain an adequately large number of observations for this variable. For all the other variables, the values for the firms could be established irrespective of the presence of their corresponding firm in the counter sample.

Operating income, or earnings before interest & taxes (EBIT), is a measure of the profitability that is realized through a company's operations. It is computed by subtracting the cost of goods sold (COGS), operating expenses and depreciation & amortization (D&A) expenses from the revenue figure. The high-tech industry is an exceptionally capital-intensive one. As such, operating income, which takes D&A expenses into account, is a valid indicator of a firm's profitability, and thus a possible determinant of the CAR. Due to the fact that operating income can take a negative value, it is impossible to use the natural logarithm of this variable.

The following variables will be the financial ratios that will be included in the regressions. When it comes to price movements of individual stocks, equity analysts monitor the *earnings per share* (EPS) figure very closely. In particular, whether or not a stock earns its projected EPS figure for the current term. As it is such an important indicator for the performance of individual stocks, it is worth investigating if it is of explanatory value when it comes to merger performance.

Another important financial is the *price per earnings* ratio. Calculated either by dividing equity value by total earnings or share price by EPS (both sides divided by number of outstanding shares), the P/E figure is an indicator for under- or overvaluation of stocks. A stock is said to be overvalued if its P/E is

above its industry average. However, high P/E stock can still be justifiably priced if it concerns a firm with very high growth potential and is therefore using its earnings to reinvest in itself. The latter scenario is regularly seen in the high-tech sector, where R&D costs tend to be very high.

Lastly, the *market to book value* (M/B) is another indicator of over- or undervaluation of a stock. For this figure, the market value of a stock is compared to its book value. The book value of a company is equal to its total assets minus its liabilities, preferred shares and intangible assets. Its market value is equal to its equity value. If the book value is higher than the market value, analysts generally consider the stock to be undervalued.

5. Results

In the following section, the results of the event studies will be discussed. The realized Cumulative Abnormal Returns of both samples across the different event windows will be reviewed, as well as the outcomes and implications of the univariate and multivariate regression analysis.

5.1 Event study analysis

Through the event study, the abnormal returns, compared to the benchmark, were determined for each day of the different event periods, as was comprehensively explained in the methodology section. For each and every day where the average abnormal return differed significantly from zero, those returns were accumulated, resulting in the accumulated abnormal return. In the next section, a brief overview will be given of the values of these realized CAR's, and how they compare to earlier empirical research. Thereafter, the regression analyses will be reviewed, which will implicate which variables have an explanatory relationship with these CAR's.

5.1.1 Realized abnormal returns

The returns of each day during the (-5,5) event windows for both the acquiring and target sample, and whether the returns for each day differs significantly from zero, is shown in table 5 below.

Table 5: average abnormal return per day across the whole samples. Significance is indicated at the 1%, 5% and 10% level, with ***, **, and *, respectively. The significance is the result of a t-test for which the zero hypothesis is that the average abnormal return is equal to zero.

Day	*Acquirer*	*Target*
-5	0.00438*	0.00593*
-4	0.00241	0.00192
-3	0.00205	0.00728***
-2	-0.00102	0.00304
-1	0.00143	0.00831***
0	-0.0148***	0.190***
1	-0.0101***	0.0736***
2	-0.00324*	0.00205
3	-0.00477***	-0.000121
4	-0.00130	-0.000272
5	-0.00147	-0.000726

It can be inferred from table 5 that the most significant abnormal returns were realized within the (-1, 1) window. To be able to compare the results of both samples, the results will be accumulated over this period for both samples in their regression against possible determinants. Although the average

abnormal return for day -1 is not significant for the acquirer, the total window of (-1, 1) for both samples are highly significant, with p-values approaching zero.

As such, the Cumulative Abnormal Returns that were realized during this period are -2.35 percent for the acquiring firms and 27.2 percent for the target firms, 19.0 percent of which was earned on the announcement day (t = 0) alone. No true consensus has ever been reached on the stock returns of acquirers following a merger or acquisition. Asquith, Bruner and Mulins Jr. (1983) and Dodd & Ruback (1977) found positive returns for the acquiring firm following the announcement of a merger. On the contrary, Jarrell and Poulsen (1989) and Moeller, Schlingemann and Stulz (2005) found, on average, negative short-term returns for the acquiring firms in tender offers (acquisitions).

The results are, however, consistent with the generally accepted notion that a merger or acquisition leads to value creation for the target firm. Anrade et al (2001) found a positive return of 16.0 percent during the (-1, 1) period for a sample of 3.500 firms during the 1973-1998 period. The current study's return of 27.2 percent during that same period is consistent with the high returns that targets involved in high-tech mergers and acquisitions regularly manage to earn, although it is not as high as the 37.89 percent that Koher and Kohers (2000) found for publicly held targets in their study. One explanation that may account for the difference is the fact that the sample of Koher and Kohers comprised of mergers announced during the sub 2000 period, when the general outlook of technology firms was exceptionally favorable. The sample of the current study starts in 2000, the year that the dotcom bubble finally burst.

Joint CAR

As explained in the methodology section, the joint CAR will also be examined to assess how much net economic gain the merger truly brought about, relative to the total value of the merged firm.

The average joint CAR for the (-1, 1) period is 2.067 percent. These results are consistent with the findings of Mulherin and Boone (2000), who found a combined return of 3.56% earned in the (-1, 1) event window for their sample, and Mulherin (2000), who found a combined return of 2.53% during the (-1, 0) event window.

5.1.2 Event windows abnormal returns

In the previous section, it was determined for each day separately, which realized abnormal return differed significantly from zero around the announcement day of the merger or acquisition. Next, the CAR for all the event windows was established separately, as well as the average abnormal returns that were realized per day in the event windows, in other words, the CAAR. For the (-30, -1) and (1, 30) event windows specifically, the results will indicate whether or not the strong version of the EMH holds with respect to these returns. The returns across the different event windows are shown in table 6 and 7.

Table 6: event window abnormal returns for the acquirer sample. Significance is indicated at the 1%, 5% and 10% level, with ***, **, and *, respectively. The significance is the result of a t-test for which the zero hypothesis is that the average abnormal return is equal to zero.

Event window	*Mean CAR*	*Mean CAAR*	*T-value*	*P-value*
Before				
(-30,-1)	0.0027	0.000	0.319	0.750
Around				
(-1,1)	-0.0235	-0.0078	-4.79	0.000***
(-5,5)	-0.0264	-0.0024	-3.88	0.000***
After				
(1,30)	-0.0662	-0.0022	-5.83	0.000***

Table 7: event window abnormal returns for the target sample. Significance is indicated at the 1%, 5% and 10% level, with ***, **, and *, respectively. The significance is the result of a t-test for which the zero hypothesis is that the average abnormal return is equal to zero.

Event window	*Mean CAR*	*Mean CAAR*	*T-value*	*P-value*
Before				
(-30,-1)	0.0694	0.0023	5.65	0.000***
Around				
(-1,1)	0.272	0.0907	19.05	0.000***
(-5,5)	0.291	0.0265	19.16	0.000***
After				
(1,30)	0.258	0.0086	14.38	0.000***

The returns for the different event windows are all extremely significant, with the exception of the runup period (-30, -1) for the acquirer sample. An average abnormal return of 6.94% during the runup period for target firms seems to suggest that some inside information about the merger may have been leaked before the merger or acquisition was announced to the public. This does not come as a surprise, as numerous previous studies have found significant abnormal returns prior to the public announcement of a merger or acquisition (e.g. Keown & Pinkerton, 1981; Elliot, Morse & Richardson, 1984).

For the target firms, the (1, 30) event window shows a substantial average return of 25.8 percent. This is in line with the findings of Dodd and Ruback (1977), who found an average CAR of 20.58 for targets during the first month after the announcement of the merger or acquisition. Interestingly, the acquiring firms show even stronger negative returns during the same period than they did during the (-1, 1) event window).

The significant abnormal returns during the (-5, 5) and (1, 30) event windows for both the acquirer and target sample do implicate that there is a delayed reaction of the market to the announcement. It

follows from tables 6 and 7 that the strong EMH, according to which all available information is at any time fully incorporated into a stock's price, holds for neither sample.

5.1.3 Regression analysis

Univariate and multivariate regression analysis was used to capture the determinants that explain the realized returns that we discussed in the previous section. To accomplish this, a number of regressions were run in STATA, with the CAR (-1, 1) as the response variable on the left side, and the different determinants as explanatory variables on the right side.

First, all the possible determinants were run against the CAR in univariate regressions to ascertain if any significant relation exists between the CAR and the variable in question. Two different sets of dummy variables were created, one for the payment method and one for the relatedness of the industries that the target and acquirer operate in. For the payment dummy regression, the "Cash" option was left out of the regression to avoid multicollinearity. The same went for "Related" in the relatedness dummy regression. All other (continuous) variables were run in their totality against the CAR.

Both samples comprise mergers that were announced in the time period of 2000 to 2018. Over the years, differences in regulation, industry size and merger waves may all have had an effect on the merger activity, the realized abnormal returns and their corresponding determinants. By not accounting for these effects, the regressions may suffer from unobserved heterogeneity, leading to a bias in the estimates. To account for this possibility, fixed effects were used in all univariate and multivariate regressions. This created temporary dummy variables for each different year, with the year 2000 as the base variable. By ensuring the variance of the residuals does not differ over the years considered, the coefficients found in the analysis will be more robust and provide a better estimation of their true value. The results of the univariate regressions are shown in table 8.

Even though the fixed effects should largely correct for the robustness of the coefficient estimates, a robustness check was performed to make sure all heterogeneity was eliminated. The estimates of the coefficients and their standard errors with only the fixed effects incorporated in the regressions were compared to the same robust regressions. The results are summarized in appendix A. The coefficients are the same for both types of regressions, and their significance remains. It can be concluded that the fixed effects successfully accounted for the robustness of the estimates.

Table 8: univariate regressions for both samples. Significance of the coefficients is indicated at the 1%, 5% and 10% level, with ***, **, and *, respectively. The significance is the result of a t-test for which the zero hypothesis is that the coefficient is equal to zero.

Variable	***Acquirer***	R^2	*Obs.*	***Target***	R^2	*Obs.*
Ln(Assets)	0.003	0.142	336	-0.063	0.211	58
	(0.244)			(0.127)		
Ln(Equity value)	0.003	0.139	338	-0.050	0.123	362
	(0.315)			(0.000)***		
Operating income	0.000	0.139	337	0.000	0.286	61
	(0.820)			(0.400)		
Relative size	-0.007	0.149	312	-0.067	0.091	312
	(0.383)			(0.006)***		
EPS	-0.001	0.137	336	-0.016	0.074	361
	(0.716)			(0.197)		
P/E	0.000	0.187	273	0.000	0.121	248
	(0.712)			(0.920)		
M/B	0.000	0.137	338	-0.002	0.074	363
	(0.782)			(0.249)		
Dummystock	-0.030	0.140	338	-0.121	0.080	363
	(0.029)**			(0.004)***		
Dummymixed	-0.036	0.151	338	-0.133	0.093	363
	(0.003)***			(0.000)***		
Dummysemirelated	-0.005	0.136	338	0.000	0.071	363
	(0.666)			(1.000)		
Dummyunrelated	-0.018	0.140	338	0.026	0.072	363
	(0.202)			(0.542)		

Something striking about the results shown in table 8 are the extremely insignificant coefficients of the relatedness-dummies, contrary to what previous empirical studies would suggest. Therefore, for both relatedness-dummies in each sample, their interaction effect with each of the other explanatory variables was determined as well. The results are shown in appendix C, which only includes the interaction terms that were at least statistically significant at the 10 percent level. For the acquirer sample, the interaction effect between the dummy for unrelated firms and the relative size of the firms, as well as the interaction effect between the dummy for semi-related firms and relative firm size were significant. For the target sample, the interaction effect between the dummy variable for unrelated firms and the market to book value proved significant, as well as the interaction effect between the dummy for semi-related firms and the dummy for stock-financed mergers. However, even with the noise caused by the interaction effects being eliminated from the coefficients of the relatedness dummies, the coefficients remained highly insignificant, which is why they were not incorporated in the multivariate regressions.

It follows from the univariate regressions that for the acquirer sample, only the dummies for the payment method were significant; the dummy variable for stock payments and the dummy variable for mixed payments of stock and cash were significant at the 5% and 1% significance level, respectively. Since these are the only significant variables for the sample, no further analysis was carried out in a multivariate regression, since only significant variables should be included. The results indicate that the CAR will, on average, be 3.0 percent and 3.6 percent lower when the merger or acquisition is financed with stock or with a mix of cash and stock, respectively. This is partially consistent with the findings of Bruner and Mullins (1998), who found that mergers financed with common stock earned on average, a 2.6 percent lower return, compared to cash financed mergers. They did not, however, find any significant results for mixed payments. The results of this study seem to indicate that a significantly lower return is earned by acquiring firms as soon as stock plays any part in the financing of the transaction.

For the target sample, several variables were significant at the 1% level; the natural logarithm of equity value, relative size of the firms, and both dummies for payment method. Therefore, these variables were included in the multivariate regression, to investigate the relationship between the variables themselves, and whether they maintain their explanatory power, regardless of the interaction with the other variables. Since only the payment method turned out to be significant, and not the industry relatedness, there is no need to include an interaction term in the multivariate regression to account for interaction effects between two different sets of dummy variables. The results of the multivariate regression for the target sample are shown in table 9.

Table 9: results of the multivariate regression for the target sample. Significance of the coefficients is indicated at the 1%, 5% and 10% level, with ***, **, and *, respectively. The significance is the result of a t-test for which the zero hypothesis is that the coefficient is equal to zero.

CAR	*Coef.*	*St. Dev.*	*T-value*	*P-value*
Ln(equityvalue)	-0,040	0.013	-2.98	0.003***
Relative size	-0.042	0.024	-1.75	0.081*
Dummystock	-0.112	0.048	-2.34	0.020**
Dummymixed	-0.134	0.042	-3.18	0.002***
Constant	0.558	0.096	5.82	0.000***
Adjusted R^2	0.096			
Obs.	312			

According to table 7, the variables maintain much of their explanatory value, even in the multivariate regression. The least significant variable, relative size, is still significant at the 10% level in the regression. Remarkably, all of the variables actually have a negative effect on the CAR.

The natural logarithm of equity value and relative size of the firm both capture a similar characteristic of the target firm; its size. The equity value captures the target's size in absolute terms, and relative size captures it in relation to the size of the acquirer. It is no surprise, therefore, that the coefficients of both variables carry the same sign, namely, a negative one. This negates the argument that larger firms should earn higher returns due to the possibilities to exploit synergy effects, as the size-effect found by Moeller, Schligemann and Stulz (2004) suggested. One possible explanation that size can actually have a negative effect on stock returns are integration problems (Olie, 2000). They arise if two different firms with vastly different management styles or 'cultural fit' (Datta & Puia, 1995) decide to merge, with value destruction as a consequence. Another possible reason, which the descriptive statistics in table 3 and 4 suggests, may be that a substantial fraction of the M&A activity within the high-tech industry are acquisition of small firms with a high growth potential, that are then able to realize large profits. Large, mature target firms often don't have the same level of growth potential.

The results found for the payment methods do, on the other hand, agree with empirical research, at least to a certain extent. Asquith, Bruner and Mullins (1998) found an average return of 13.85 percent for target firms that were financed with common stock, compared to 27.47 percent for cash mergers. In another study conducted by Huang and Walkling (1987), the authors found a CAR of 29.3 percent for targets around the announcement period of mergers that were financed entirely by cash, compared to a CAR of 14.4 percent for targets that were involved in purely stock-financed mergers. The CAR earned by targets in mergers that were financed by both cash and stocks (mixed financing) lay in between those numbers, with 23.3 percent. The discrepancies between stock and cash financed mergers found in both studies are similar to the results in table 9 and may be attributable to the signaling effect (Yook, 2003). Targets that were acquired by a mixed payment of stock and cash, however, show even lower returns in table 9. Analogous to what the returns of the acquiring firms show in table 8, it seems that any involvement of stock in the payment method instantly means a significantly lower return on the target's stock.

It has thus been established which determinants play a significant role in explaining the Cumulative Abnormal Returns of the stocks. How these results relate to the hypotheses will be discussed in the concluding section.

Determinants of long-term CAR

It may be interesting to see if determinants considered in the previous analysis also explain abnormal returns over longer periods of time. However, there are a number of reasons why the process of determining the long-term abnormal returns may be more problematic. First, over long time periods, it is difficult to isolate the stock movements that can be attributed to the merger. Naturally, the longer the merger announcement has been in the past, the more factors may have come into play that influenced the stock price in some way or another, but that were unrelated to the merger announcement. Secondly, according to the EMH, it is relied upon the market's efficiency to incorporate all available information into the stock's prices. We have seen in the sections above that the strong version of the EMH does not hold for this study. Nonetheless, critics might argue that the longer away from the announcement we are, the less this has anything to do with information regarding the merger, but rather, information regarding new operational or strategic activities of the firm. Finally, the long-term event studies might suffer from data mining bias due to the overlap of firms that acquire multiple firms during the event window. These difficulties must all be taken into account when assessing the results of the long-term study.

With that having been said, for both samples, another number of event studies were performed to determine the abnormal returns over a period of both one and two years. Subsequently, the abnormal returns of the firms over a period of one month, one year and two years following the announcement of the merger again made up the left part of the regressions, with the same explanatory variables on the right-hand side. The results of the univariate regressions are shown in appendix B. For the acquirer sample, the natural logarithm of assets and the natural logarithm of equity value show to be significant at the 5% level in explaining the one-month-CARs. Only the dummy stock variable is significant in the 1-year-CAR regression. These results are somewhat consistent with the short-term results.

For the target sample, the natural logarithm of equity value, relative size, and the payment dummies are highly significant in explaining the one-month-CARs. For the one-year and two-year CARs however, they are not to any degree consistent with the short-term results. Instead of the variables that were found to be significant in the short-term regressions, operating income and the market to book value ratio now show to be significant. It may be worthwhile to investigate these results in future research.

6. Conclusions

Mergers and acquisitions in general have seen a tremendous increase over the last few decades. The potential benefits are, at least in theory, endless. There are numerous ways to exploit synergy effects between two merging firms. In the high-tech sector, which is characterized by high research and development costs, high risk, high growth and an everlasting necessity to keep innovating, a merger or acquisition can be especially profitable. However, many mergers take place for other reasons, among which are strategic issues, management egos and the excitement that surrounds a merger or acquisition.

The question arises whether the firms that engage in a merger or acquisition are actually able to realize the potential synergies, and thus create value. In the academic field, the answer to this question with respect to target firms is generally answered affirmatory, as these firms typically show high abnormal returns in the post-announcement period. For acquiring firms, the results found in empirical research are more ambiguous. In addition, what exactly drives the observed abnormal returns is still highly disputed among researchers. This is what the current paper aims to clarify.

After having analyzed the drivers that previous studies have found to be of explanatory value in explaining stock returns of firms that were part of completed mergers, in the high-technology sector and otherwise, a research question and a number of supporting hypotheses were formulated. This provided the starting point for the design of the event study.

After having applied a number of restrictions to the Thomson One database, the final sample consisted of 338 acquiring firms and 363 target firms that were involved in completed mergers and acquisitions in the high technology sector that were announced in the years 2000 to 2018. Through the event study tool on Datastream, the daily returns of all the firms' stocks were gathered for a number of event windows surrounding the announcement of the merger or acquisition. These returns were then compared to a benchmark market return, the coefficients of which were estimated during a specified estimation window. These returns, more specifically, the Cumulative Abnormal Returns (CAR), made up the left part of the regressions that were run. A number of different determinants, the relevance of which were established in the methodology section, made up the right half of the regressions. These determinants were characteristics that related to the size, financials and other specific aspects of the firms in question, as well as the deal structure of the merger or acquisition in general. The regression analyses showed which of these determinants had a significant relation with the accumulated abnormal returns.

For the acquirer sample, an average CAR of -2.35 percent was found for the (-1, 1) event window. In that same time frame, the targets sample managed to earn an average CAR of 27.2 percent. These results were largely consistent with previous empirical results. Although the results found for the

acquiring firms in this paper were significantly negative, earlier research suggested that the observed abnormal returns of acquirers seemed to float somewhat arbitrary around zero. On the contrary, the returns found for the target firms reinforced the notion that target firms are, in general, capable of earning substantial positive returns. Even after controlling for the fact that acquiring firms were, on average, considerably larger firms than the target firms, the joint CAR still turned out positive. This indicates that the mergers did in fact, on average, create economic value. All in all, the results lead to a confirmation of the first hypothesis, and a rejection of the second hypothesis.

H1: Target firms in high tech-mergers will show significant positive abnormal returns around the announcement date of a merger.

H2: Acquiring firms in high tech-mergers will not show any significant returns around the announcement date of a merger.

After having run the univariate regressions, where the CAR of the (-1, 1) event window was run against the different variables in separate regressions, the natural logarithm of equity value, the relative size of the firms and both dummies for the payment method (stock and mixed) all turned out highly significant for the target sample. These results were largely reproduced in the multivariate regressions, where all of the variables incorporated in the regression remained largely significant. For the acquiring firms, the only variables that proved to be significant in the univariate regressions were the dummy variables for the payment method. As for the coefficients of the variables in the multivariate target regression, both the natural logarithm of equity value and relative size turned out to have a significant negative effect on the CAR. As both variables relate to the size of the target firm, it was expected that these variables would actually have a positive effect on the stock returns, due to the higher potential to realize synergy effects. However, integration problems between the merged firm's management may have caused the synergy effects to be more than offset. In any case, the results lead to a rejection of the third hypothesis.

H3: Relative size is positively related to abnormal returns for high-tech mergers and acquisitions.

These synergy effects are also what the fourth hypothesis was grounded on. It was expected that industry-relatedness between target and acquiring firms would facilitate the realization of synergy effects, due to the high research and developments costs that are typically seen in the high technology sector, as well as the knowledge-specific nature of the industry. Unfortunately, no significant effects were found for the industry-relatedness dummy variables in either regression. This leads to a rejection of the fourth hypothesis.

H4: Industry relatedness is positively related to abnormal returns for high-tech mergers and acquisitions.

For both the acquirer and target firm samples, the dummy variables for the way the transaction was financed, namely purely stock financed and financed with both cash and stock, were both significantly negative. The negative coefficient for the stock dummy in the regressions is in line with expectations, as earlier research had shown that firms involved in purely cash-financed mergers showed significantly higher stock returns than those that were financed by stock. This could very well be due to the tax benefits related to cash-financed mergers**.** Cash payments are taxable in the year of the merger, whereas the tax paid on stock payments is deferred to the moment the stock is sold. When shareholders are forced to pay immediate taxes on their gains, they will demand higher premiums to offset this disadvantage. These results of the regression analyses for both samples do not lead to the rejection of the fifth hypothesis.

H5: Abnormal returns in high-tech mergers and acquisitions will be higher for cash-financed mergers and acquisitions, compared to stock-financed mergers and acquisitions.

For future research, it could be interesting to further explore the relatedness between merging firms. The categorization of firms into different mid- and macro industries, which was the basis of the assignment of the dummy variables in the current study, is arguably somewhat arbitrary. There are many more ways that firms can be related to one another. Furthermore, the results of the empirical analysis showed that the abnormal returns earned by target firms were negatively related to its (relative) size, contrary to what different theories of synergy effects would predict. If, and to what extent this is caused by integration problems between the firms' management, as well as possible ways to resolve them, deserves further study. Finally, this paper mainly focused on the short-term abnormal returns following the announcement of a merger or acquisition, and the determinants of these returns. As it turned out, the determinants of the long-term CAR were largely irreconcilable with the short-term determinants. The origins of this divergence in results could also be the subject of future research.

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APPENDIX A

Table 10: robustness checks for all explanatory variables that were significant in the univariate regressions. Significance of the coefficients is indicated at the 1%, 5% and 10% level with ***, ** and *, respectively. The significance is the result of a t-test for which the zero hypothesis is that the coefficient is equal to zero.

	Coef.	*St. Dev.*	*T-value*	*P-value*
Acquirer				
Dummystock	-0.030	0.014	-2.20	0.029**
Dummystock (robust)	-0.030	0.016	-1.85	0.065*
Dummymixed	-0.036	0.012	-2.99	0.003***
Dummymixed (robust)	-0.036	0.012	-2.98	0.003***
Target				
Ln(equity value)	-0.050	0.011	-4.60	0.000***
Ln(equityvalue) (robust)	-0.050	0.013	-3.98	0.000***
Relative size	-0.067	0.024	-2.79	0.006***
Relative size (robust)	-0.067	0.028	-2.41	0.017**
Dummystock	-0.121	0.042	-2.89	0.004***
Dummystock (robust)	-0.121	0.037	-3.27	0.001***
Dummymixed	-0.133	0.036	-3.69	0.000***
Dummymixed (robust)	-0.133	0.033	-3.99	0.000***

APPENDIX B

Table 11: determinants of the long-term Cumulative Abnormal Returns of the acquiring firms sample (one month, one year, and two years) and their significance. Significance of the coefficients is indicated at the 1%, 5% and 10% level with ***, ** and *, respectively. The significance is the result of a t-test for which the zero hypothesis is that the coefficient is equal to zero.

Variable	*1-month CAR*	*1-year CAR*	*2-year CAR*
Ln(Assets)	0.014	0.053	-0.613
	(0.031)**	(0.178)	(0.397)
Ln(Equity value)	0.012	0.005	-0.350
	(0.035)**	(0.896)	(0.583)
Operating income	$4.62*10^{-9}$	$1.42*10^{-8}$	$-4.98*10^{-9}$
	(0.053)*	(0.308)	(0.984)
Relative size	-0.016	-0.049	-0.722
	(0.366)	(0.636)	(0.724)
EPS	0.008	0.002	0.017
	(0.179)	(0.960)	(0.799)
P/E	0.000	0.000	0.000
	(0.513)	(0.585)	(0.986)
M/B	0.000	0.003	-0.005
	(0.753)	(0.466)	(0.948)
Dummystock	-0.028	-0.423	1.917
	(0.393)	(0.029)**	(0.591)
Dummymixed	-0.039	-0.245	-0.676
	(0.166)	(0.143)	(0.827)
Dummysemirelated	0.012	0.037	3.773
	(0.637)	(0.804)	(0.170)
Dummyunrelated	-0.035	0.059	-0.318
	(0.280)	(0.762)	(0.929)

Table 12: determinants of the long-term Cumulative Abnormal Returns of the <u>target</u> firms sample (one month, one year, and two years) and their significance. Significance of the coefficients is indicated at the 1%, 5% and 10% level with ***, ** and *, respectively. The significance is the result of a t-test for which the zero hypothesis is that the coefficient is equal to zero.

Variable	*1-month CAR*	*1- year CAR*	*2-year CAR*
Ln(Assets)	-0.059	0.072	0.114
	(0.214)	(0.541)	(0.599)
Ln(Equity value)	-0.052	-0.080	0.138
	(0.000)***	(0.135)	(0.189)
Operating income	0.000	$2.4*10^{-6}$	$3.34*10^{-6}$
	(0.429)	(0.011)**	(0.027)**
Relative size	-0.067	-0.053	-0.030
	(0.023)**	(0.637)	(0.891)
EPS	-0.014	0.027	0.039
	(0.339)	(0.645)	(0.737)
P/E	0.000	0.000	0.000
	(0.888)	(0.669)	(0.773)
M/B	-0.002	-0.048	-0.092
	(0.351)	(0.000)***	(0.000)***
Dummystock	-0.140	-0.233	-0.429
	(0.008)***	(0.258)	(0.284)
Dummymixed	-0.139	-0.230	-0.521
	(0.002)***	(0.197)	(0.141)
Dummysemirelated	-0.006	0.090	0.191
	(0.870)	(0.550)	(0.526)
Dummyunrelated	0.005	0.134	0.234
	(0.918)	(0.517)	(0.562)

APPENDIX C

Table 13: the significant interaction effects between relatedness-dummy variables and other explanatory variables in the <u>acquirer</u> sample. Every third row shows the value of the interaction term, indicating the coefficient difference of the other variable in question when the relatedness-dummy takes the value 1. Significance of the coefficients is indicated at the 1%, 5% and 10% level with ***, ** and *, respectively. The significance is the result of a t-test for which the zero hypothesis is that the coefficient is equal to zero.

	Coefficient	*T-value*	*P-value*
1.dummyunrelated	0.019	1.03	0.305
Relativesize	0.005	0.59	0.556
Dummyunrelated#c.Relativesize (=1)	-0.74	-2.27	0.024**
1.dummysemirelated	-0.021	-1.49	0.137
Relativesize	-0.008	-0.91	0.361
Dummysemirelated#c.Relativesize (=1)	0.049	2.36	0.019**

Table 14: the significant interaction effects between relatedness-dummy variables and other explanatory variables in the <u>target</u> sample. Every third row shows the value of the interaction term, indicating the coefficient difference of the other variable in question when the relatedness-dummy takes the value 1. Significance of the coefficients is indicated at the 1%, 5% and 10% level with ***, ** and *, respectively. The significance is the result of a t-test for which the zero hypothesis is that the coefficient is equal to zero.

	Coefficient	*T-value*	*P-value*
1.dummyunrelated	0.070	1.68	0.093*
MB	-0.001	-0.84	0.402
dummyunrelated#c.MB (=1)	-0.031	-4.21	0.000***
1.dummysemirelated	0.025	0.73	0.466
1. dummystock	-0.061	-1.49	0.137
dummysemirelated#dummystock (=1 1)	-0.122	-1.72	0.086*