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The role of patents in M&A transactions in Scandinavia

An event study of patents´ effect on short-term shareholder return for acquirers and targets

Henrik Aasgaard Hisdal & Herman Øytese Andersskog

Supervisor: Kyeong Hun (Kyle) Lee

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NORWEGIAN SCHOOL OF ECONOMICS

Abstract

This thesis investigates whether patents affect the acquirer´s or the target´s cumulative average abnormal returns on M&A announcements in Scandinavia. The event study methodology check for the abnormal shareholder returns over a [-20→20] event window. The two samples consist of announcement returns for 103 acquirers and 74 targets from 01.01.2001 to 15.11.2021. The sample only includes majority acquisitions. The M&A data is collected from SDC Platinum and Bloomberg Terminal, while the patent data is collected from Google Patents. This study uses the natural logarithm of patents to determine its effect on the acquirer´s return

The results show that patents' effect on shareholder returns is statistically significant for acquiring companies that already have a patent. The effect is significant. On the other hand, there is no significant evidence on the acquirer´s shareholder value if the target has a patent or the total number of patents in the deal. In the event windows [-2→2] and. [-1→1] a one percent increase in patents averagely yields a 0.025 percent and 0.018. percent increase in acquirer's shareholder value, respectively. The effect is significant at a 5 percent level. Moreover, the effect is more significant when looking at deals where the acquirer is the only party with a patent.

A two-sided t-test tests the effect of a target patent dummy variable on the target´s shareholder value for seven different event windows. The t-tests indicate no significant effect in any of the event windows, and this thesis shows no evidence for patents increasing the target´s shareholder return.

Table of Contents

List of figures

List of tables

1.0 Introduction

Innovative firms play a vital role in driving innovation (Aghion, Bacchetta, Ranciere, & Rogoff, 2009; Block, Thurik, & Zhou, 2013; Bos & Stam, 2014). Thurik, Stam, and Audretsch (2013) highlighted how this effect is multiplied for modern entrepreneurial economies. Patents are the most frequently used indicator for technological output (Danguy, de Rassenfosse, & van Pottelsberghe de la Potterie, 2009). For that reason, this thesis focuses on patents as an innovative force.

Being innovative as a firm also affects the probability for a target to exit through M&A (Lehto & Lehtoranta, 2004; Cotei & Farhat, 2018; Kato, Onishi, & Honjo, 2021). Thus, reducing the chances of an involuntary exit (Harada, 2007). Innovative performance may therefore lead to stronger survivability for firms. Having a granted patent also reduces the probability of involuntary exit by 14 percent, holding all other variables equal (Schautschick & Greenhalgh, 2013). Therefore, we will be looking at the acquirer´s interest for targets with patents compared to companies without patents to see if the premia are higher when there is a patent in the transaction. Acquiring patents through M&A is an alternative to R&D for the acquirer and is frequently sought in M&A transactions (Gaughan, 2018).

To check whether acquirers benefit in focusing on patents in M&A transactions, we will first introduce the M&A concept. Schoenberg (2006) studied managers´ subjective evaluation around M&A and revealed how only 44-56 percent of managers deem the company´s M&A actions as successful. M&A is one of the most researched fields in finance due to the uncertainty related to each deal (Gaughan, 2018). Each M&A transaction has a unique aspect, which the acquirer must grasp to succeed. M&A announcements are met with doubt from investors, as it is a considerable investment for the acquirer (Koller, Goedart, & Wessels, 2020).

1.1 The event study methodology

To study the effect of patents around M&A announcements, we will be using an event study on the M&A announcements. We follow MacKinlay´s (1997) approach to event studies. To account for systematic risk, we will be using the market model. The market model has comparable advantages compared to other models, such as the constant mean model (Dyckman, Philbrick, & Stephan, 1984). The benefit of using the market model is using a benchmark during the event window of an event study. Thus, we can estimate the beta of each security and predict the moment if no event was present.

To calculate the beta of each security, we have used a 250 day estimation period, which is in line with Peterson´s (1989) advice of using between 100 and 300 days as an estimation period. The event window used in this thesis is 20 days prior and post to the M&A announcement date, plus the official announcement date; the event window is 41 days. Researchers find most evidence accumulated through event studies on shareholders´ return for acquiring parties using an event window of fewer than 150 days (Kato, Onishi, & Honjo, 2021). Literature around event studies divides when it comes to the return for shareholders. Some studies find a positive CAR (Uhlenbruck, Hitt, & Semadeni, 2006; Arnold & Parker, 2007), while other researchers find the opposite (Gregory & McCorriston, 2005; Schoenberg, 2006; Kuipers, Miller, & Patel, 2008). Research paradigm and approach to the methodology significantly affect event study research results (MacKinlay, 1997; Kato, Onishi, & Honjo, 2021). In other words, the literature on the evidence event studies provide on acquirer´s shareholder value and M&A announcement is not conclusive.

The event window we focus on is [-2→2], [-1→1], and [0], to see if the CAR is significant on the M&A announcement date and if patents can affect the CAR. We include the [0] window, but according to event study methodology, a sufficient event window should include a broader time horizon to account for information leakage. Also, a company likely releases M&A news after the market closes, meaning the news is not reflected until day one of the event window (MacKinlay, 1997).

1.2 Testing for significance

After calculating the CAR for both acquirers and targets, we will test for the significant effect of the variables included. We use a multi-linear regression to test for significant effects for acquirers through the ordinary least squares (OLS) method. The response variable is the acquirer´s CAR, while the explanatory variable is the natural logarithm of patents. Before including the explanatory variable, we control for multiple variables most frequently included in event studies and the variables we deem to minimize omitted variable bias. The included control variables are cross-industry, cross-border, M&A experience, relative size, the acquirer´s market capitalization, payment type, and deal attitude. We perform the OLS for event windows [-20→-1], [-2→2], [-1→1], [0], and [1→20].

We choose not to perform an OLS for targets because neither SDC Platinum nor Bloomberg Terminal suffice adequate synergy data. Not having the expected synergy data leads to high omitted variable bias in the regression model. Thus, check for how patents affect the target´s price on M&A announcements. We will perform a t-test using patents as a dummy variable.

2.0 Literature review

2.1 Mergers and acquisition

Merger and acquisitions (M&A) are the sought-after solutions to company growth when the internal, organic growth proves insufficient (Gaughan, 2018). M&A are a corporate strategy that companies consider for several reasons, such as to venture into a new geographic market or capture a vital technology advantage that aids the company in remaining competitive in its current market. Even though there are several reasons to perform M&A transactions, the primary goal is to generate shareholder value, but the motives may also benefit the acquiring party´s management (Hagendorf, 2010; Junni & Teerikangas, 2019). While the fundamental reason behind M&A is creating shareholder value, there are also occurrences such as the management acquiring a company due to the increased prestige of managing a more prominent company (Gaughan, 2018).

There are several types of M&A transactions. Finance professional refers to an acquisition most commonly as when an acquiring company buys the majority of a target company (over 50 percent of the target company´s shares) of the target, such as a business unit or a division (Junni & Teerikangas, 2019). In a merger, on the other hand, a new company is formed, in which the merging companies have a relatively equal share. Managers do often use the term “merger” metaphorically to pitch to the target that an eventual acquisition would be a combination of roughly equal stake in the new company. Other types of M&A are minority acquisitions, divestments, buyouts, and takeovers. Thus, the dynamics and results of M&A differ significantly from the type of method, as there are different characteristics and challenges for each M&A method (Gaughan, 2018). For the research in this paper, we will solely be looking at majority acquisitions, referred to as a merger, acquisition, or M&A deal throughout the thesis.

M&A has been a popular field in finance research, but as the M&A market has been booming in 2021 so far, M&A transaction volume and value are currently reaching new heights (Wiersholm, 2021). The field is a point of discussion because of the many uncertainties related to an M&A transaction. Also, M&A is a transaction of substantial impact for both the acquirer and the target. With 2020 being a trying time for the world´s economy due to the implications of the coronavirus, the M&A market took a hit as well. Initially, the M&A drop-off due to the pandemic was worse than the 2008-2009 financial crisis (Kengelbach, et al., 2020). Compared to 2019, the worldwide deal count and deal value fell by 8.3 percent and 13.2 percent in 2020, respectively (Kengelbach, et al., 2021). Even though the deal volume declined in all regions, the deal volume did not fall uniformly, as Europe and the Asia Pacific were affected the hardest.

Investors often meet M&A with doubt, something one can observe through the vast and ever-growing amount of literature on how M&A implicates a company´s shareholder return post-M&A performance (Gaughan, 2018). Although the average stock return of an announced merger is 5.8 percent, the target captures most of the return due to the high premiums that acquirers often pay in M&A transactions (Koller, Goedart, & Wessels, 2020). The global long-term acquisition premium since 1990 to the median one-week share price of the target is 30.7 percent (Kengelbach, et al., 2021), and year-to-date in 2021, M&A transactions are both completed over the long-term median EV/EBITDA ratio and acquisition premium. The currently high acquisition premiums mean even higher synergies for an M&A transaction to be successful. A study from 2011 (Christensen, Alton, Rising, & Waldeck) showed that the M&A failure rate is between 70 and 90 percent, yet the M&A market today is at an all-time high. The study further points out how no robust theory identifies the success and failures of M&A transactions. Thus, investors meet M&A transactions with volatility in both parties´ share price, and merger announcements often lead to a dip in acquirers' share price (Christensen, Alton, Rising, & Waldeck, 2011).

2.2 Creating value through M&A

According to prior empirical work, there is no magic formula to make an acquisition successful and value-creating. Due to every deal being unique, some researchers identify an acquisition as a piece of art, where there is different strategic logic behind every project (Gaughan, 2018; Zhu, Xia, & Makino, 2015).

The most crucial and challenging aspect of creating value through M&A is that each deal must have its strategic logic, and the acquiring firm has the skills and experience to execute deal and deal programs (Koller, Goedart, & Wessels, 2020). Furthermore, it is essential that the rationale behind the deal can be translated to something tangible and should not be an abstract concept like market positioning and growth. The strategic rationale behind a deal should fit into at least one of six archetypes to create value (Koller, Goedart, & Wessels, 2020)

1. Improve the performance of the target company.

2. Consolidate to remove excess capacity from an industry.

3. Create market access for the target's (or, in some cases, the buyer's) products.

4. Acquire skills or technologies more quickly or at a lower cost than they could be built in-house.

5. Exploit a business's industry-specific scalability.

6. Pick winners early and help them develop their businesses.

2.2.1. Patents as a value-creator

One way to create value through these archetypes is by exploiting IP, especially patents (Rivette, Kline, & Nothhaft, 2014). A research company that invents a groundbreaking technology in a field is not necessarily the best condition to exploit it or does not have enough capabilities or resources to maximize its scalability. It would then be in the best interest to merge and optimize the utilization of the technology. For example, a company patenting an invention may not maximize the potential of the patents and is better off selling it to another company. As firms might lose a competitive advantage by selling patents, research has shown that targets prefer selling their whole company instead (Mousavi, 2011).

Also, in highly competitive industries, it might be cheaper and more efficient for firms to acquire new technology by acquiring a firm compared to developing it by themselves (Koller, Goedart, & Wessels, 2020). As acquiring patents might create value in terms of cost-efficiency and scalability, it can also increase revenues and decrease cost in several other ways, thereby improving performance margins. At the same time, it can lock out competitors from market shares as they keep their technology to themself.

From the revenue side, royalty payments can make significant incremental income to the patent owner, where a royalty payment is an amount paid by a third party to the product owner to use/sell the product. To illustrate how markable these revenue streams can be, over 1 billion USD, and around 11% of IBM's total revenue stream came from royalty payments in the late 1990s (Rivette, Kline, & Nothhaft, 2014). Also, if the acquirer depended on the target's patent and paid royalties to use it, this cost would be eliminated.

On the other side, acquirers with patents could also increase the target´s revenue stream by exploiting intellectual property, for example, by adding new features to target's existing products that the companies could not have developed had the companies remained independent (Koller, Goedart, & Wessels, 2020). The M&A can create market access for the targeted products by increasing each product's peak sales level, reaching the increased peak sales faster, and extending each product's life (Gaughan, 2018). Upselling products with new features could also increase revenue by increasing the product's price.

In 1975, only 17% of the total market value at S&P 500 were IP, particularly patents. As the importance of innovation has become a crucial point to stay competitive for firms, this has changed significantly, and in 2020 over 90 percent of the total market value at S&P were IP (IP CloseUP, 2021). Also, firms with patents tend to outperform firms without patents when comparing the Ocean Tomo 300 patent index to S&P 500 (Ocean Tomo, 2019). In 2011, Bena and Li (2014) studied how corporate innovations are affected in M&A deals. One of their findings was that if technologies for both parties in the deals are related, targets produce a significantly higher innovation and patent output, hence increased R&D efficiency. Further, Bena and Li discovered the importance of patents on synergies in M&A transactions, hence leading to value creation.

Solow (1956) and Romer (1994) describe human capital as catalysts for economic growth and value creation. The theory emerges from the idea that nations are highly diversified in the form of business models, and overall, it will create value for the country but might not be right on a company-based level. Human capital recognizes that different labor needs different skills and capabilities and will only enhance value if the human capital is related to the company's business. A merger is more likely to occur if both parties relate to technology or patents. If the target has similarities to the acquiring company, the two companies will overlap in human capital (Bena & Li, 2014). Lee et al. (2018) researched human capital relatedness on M&A performance and discovered a positive relationship. Human capital-related synergies come from removing duplicate tasks, resulting in labor costs and increased productivity.

2.3 Measuring value creation in M&A

Value creation can be measured in various ways depending on different perspectives. From a country-based perspective, value creations are measured in GDP fluctuations and measure the wealth of a country (Acemoglu, Aghion, Bursztyn, & Hemous, 2012). On the society level, value creation reflects the total value added to the company, stakeholders, and society (Gholami, 2011). On the other hand, a company has different stakeholders; the valuation methods must clarify its target type of stakeholders. Also, there have been various ways to measure value-added when the investor bit is clear.

In the past, there was a big focus on maximizing short-term shareholder value by maximizing short-term profits. However, solely relying on maximizing short-term accounting-based profits may destroy long-term value creation (Moeller, Schlingemann, & Stulz, 2004). The result may be shattering, encapsulated by the financial crisis in 2008. Focus on short-term returns often happens due to firms pumping up metrics and profits by cutting costs and investments, making them unprepared for future growth and completion (Gaughan, 2018).

Today, firms primarily focus on return on invested capital (ROIC) and growth when measuring value creation (Koller, Goedart, & Wessels, 2020). Further, these two components determine future free cash flow, which reflects today's stock price; hence movements in stock price should reflect value creation if the stock market is efficient. Therefore, basing value creation on historical accountant measurements that do not account for free cash flow would yield misleading results. Studies have also proved that firms focusing on maximizing free future cash flow outperform firms that do not (Koller, Goedart, & Wessels, 2020). We will, in this research, measure value creation in movements in the stock price and assume the market is efficient.

2.4 M&A activity in Scandinavia

This thesis will focus on the Scandinavian M&A market. We look into the Scandinavian M&A market and not a single country due to the larger sample. We will control cross-border deals but believe the cultural differences between Sweden, Norway, and Denmark to be minimal. M&A value in Scandinavia has steadily declined since 2017, whereas the most significant fall in the deal value was in 2020. However, the deal volume in 2020 was similar to 2016. As for 2021, the deal value looks promising, and the levels are similar to the record year, 2017. The annual deal volume has held steady the past five years, with a slight reduction in 2020. (Spivak, 2021)

2.4.1 M&A activity in Sweden

M&A activity in Sweden has had a good 2021, where deal value and volume have increased by 354 percent and 56 percent compared to 2020, respectively (Svernlöv, 2021). The annual total value of the Swedish M&A market is $118.7 billion. Svernlöv emphasizes that the tremendous growth compared to 2020 is due to the pandemic´s substantial impact on M&A transactions in 2020. Still, M&A activity in Sweden looks promising for Q4 2021 and into 2022. Compared to Q3 2020, which was a very active M&A period in Sweden, Q3 2021 has a 9 percent higher deal volume and a 375 percent higher deal value. M&A activity seems healthy and heads for records in 2022 (Spivak, 2021).

2.4.2 M&A activity in Norway

Not surprisingly, M&A activity in Norway fell due to the pandemic compared to the two previous years, presented in figure 2.1 (Wiersholm, 2021). However, 2021 has been a prosperous year for both the global and the Norwegian M&A market. Globally, the first six months of 2021 recorded a semi-annually all-time high deal value of $2.6 trillion, with optimism driving the activity (Guerzoni, 2021). In Norway, deal value and deal volume are up by 366 percent and 77 percent, respectively, in H1 2021 compared to H1 2020 (Wiersholm, 2021). Referring to the relatively significant increase in deal value compared to deal volume, it is clear that big M&A deals were an essential factor for the 2021 numbers. For example, SoftBank acquired a 40 percent share in AutoStore for $2.8 billion. For Q3 and Q4 2021, Wiersholm (2021) deemed the Norwegian M&A market to continue its strong growth from Q1 and Q2 2021, and that deal value and the number of deals may reach a new all-time high.

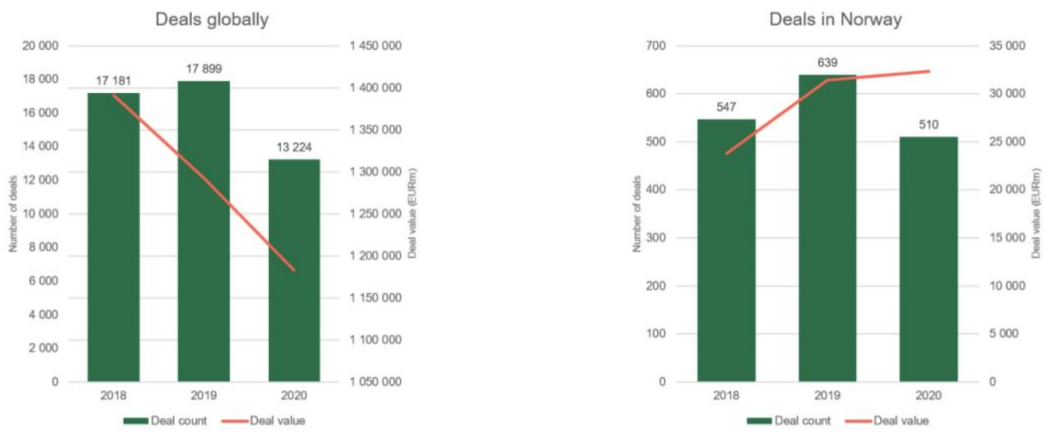

Figure 2. 1: M&A market both globally and in Norway (2018-2020)

How the pandemic affected the M&A market both globally and in Norway https://www.wiersholm.no/en/newsletter/norway-ma-and-ipo-trends-and-insights-2020.

2.4.3 M&A activity in Denmark

Following the trends of both Sweden and Norway, Denmark´s deal volume is set for records in 2021. In Q2 2021, the deal volume increased by 205 percent compared to Q2 2020. The growth is over double the percentage growth of the European M&A market (Oaklins, 2021). Denmark shows a strong transaction appetite in 2021, and ever since Q3 2020, the M&A volume has been at a new record level every quarter. According to the report from Oaklins, the Danish M&A market heads for new records in 2021. After H1 2021, the M&A volume already accounts for over 75 percent of the previous record year, 2018.

2.5 Merger waves

A popular field within M&A is the pattern M&A activity follows. Figure 2.2 shows how mergers do happen in waves. There are periods where M&A activity is plentiful and other periods are much slower; mergers happen in waves. Many have tried to explain causation for merger waves, and we wish to include a segment about merger waves as it is of great importance for M&A activity.

Several studies suggest that merger waves happen due to acquirers' stock being overvalued and do thus offer stock to targets in such times (Shleifer & Vishny, 2003; Rhodes-Kropf & Viswanathan, 2004; Gugler, Mueller, & Yurtoglu, 2007). Schleifer and Vishny (2003) and Rhodes-Kropf and Viswanathan (2004) studied the connection between overvalued markets and merger waves. Figure 2.2 shows how the dotcom bubble and the financial crisis occurred during a merger wave, providing evidence Rhodes-Kropf and Viswanathan´s theory. Schleifer and Vishny researched the relation of neoclassical theory and merger waves but found the studies incomplete. For an investor, overvalued markets can, at first glance, be a naïve approach to explain merger waves, as the target´s shareholders can simply not accept stock during merger waves. However, Rhodes-Kropf and Viswanathan further discovered that even if the target rationally reduces the expected value of a stock offer in a known overvalued market, a fully rational target still makes mistakes with overvaluation. Even though the target is aware that investors generally overestimate the market, the target's stock is also affected by the same overvaluation. The overvaluation of the offer is of increasing possibility as the market's overvaluation increases. Therefore, Rhodes-Kropf still found a positive correlation between the overvaluation of the market and merger waves.

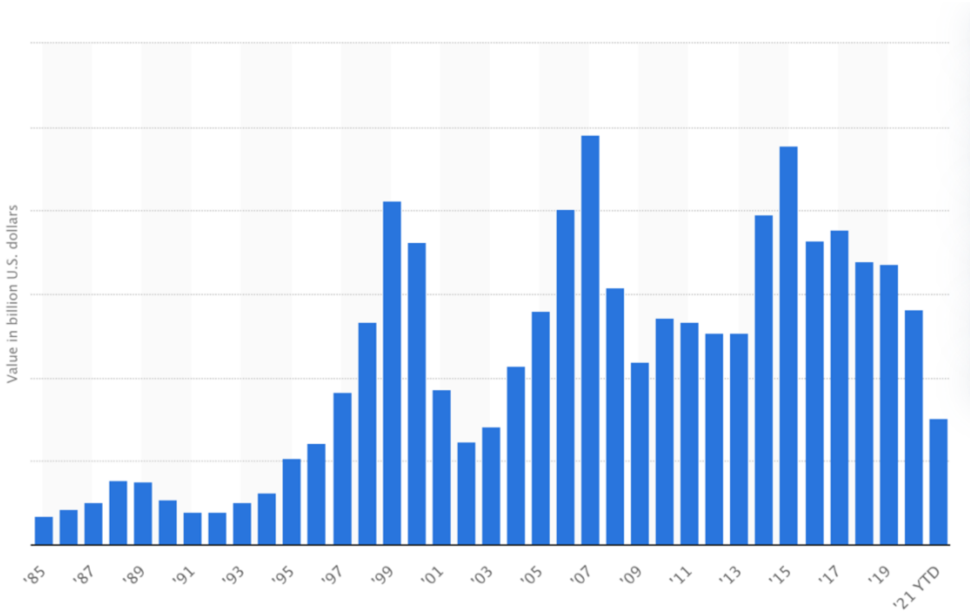

Figure 2. 2: Worldwide deal value in U.S dollars

Figure 2.2 shows the worldwide deal value in U.S dollars. Source: https://www.statista.com/statistics/267369/volume-of-mergers-and-acquisitions-worldwide/

Other studies such as Mitchell and Mulherin (1996) and Harford (2005) studied the neoclassical explanation of merger waves. Harford (2005) discovered that "merger waves occur in response to specific industry shocks that require large reallocation of assets." Harford emphasized that there must be sufficient capital liquidity to make asset reallocation possible. If adequate capital liquidity is not present, the economic, regulatory, or technological shocks may cause specific industry shocks, but not a merger wave on its own. The study further elaborates that merger waves do not happen due to misevaluation of the market, as prior studies suggest (Rhodes-Kropf & Viswanathan, 2004; Shleifer & Vishny, 2003) but because economic expansion leads to lower transaction costs, and subsequently, a merger wave.

2.5.1 Patent waves on merger waves

In a later study, Harford, Denes, and Duchin (2018) investigated the relationship between patent expirations and merger waves. The study analyzed clusters of patent expirations, defined by a patent wave, and how these waves have historically behaved concerning a merger wave.

The findings through two different studies were that the likelihood of an industry merger wave following a cluster of patent expirations increased by 4.4 percent to 4.6 percent. The study further comments how there has to be a patent expiration wave within several industries for a merger wave to begin. The same studies also showed how premiums were 8.2 percent to 16.2 percent larger in a patent expiration wave, showing how companies are willing to pay a significantly higher premium to acquire new patents when patents expire. Therefore, patent waves impact M&A waves.

The reason why a patent wave takes place is due to a burst of innovations around a significant technological breakthrough (Denes, Duchin, & Harford, 2018). A patent wave took place in the late 1990s when the business service industry included patents such as personal computers and printers. Twenty years later, following the expiration of the patents, a merger wave took place in the same industry due to the fear of power. In recent times, the pharmaceutical industry has been highly driven by patents. The median acquisition premium for pharmaceutical companies in the first half of 2016 was 60 percent, whereas some premia were as high as 90 percent. A study by McKinsey (2020) found that the main reason for much of the M&A activity and the high acquisition premium in the pharmaceutical industry is the fear of losing revenue when the company´s patents expire.

2.6 Valuation of patents

When looking at how obtaining patents through M&A affects the acquirer´s shareholder value, we wish to include a segment that establishes how patents are valued. We have a segment for the valuation of patents due to the uncertainties around the actual value. Valuing the patents of the target company belongs to the intellectual property (IP) due diligence of the M&A process. The four different types of IP are (1) patents, (2) copyrights, (3) trademarks, and (4) trade secrets. The accounting statement of the target company may not include the value of IPs before the due diligence process. The IPs may have considerable value, meaning a fair valuation range is crucial to arriving at the informed purchase price (Heer, Harvey, Stulberg, & Kutsyna, 2020).

The optimal patent valuation for the parties involved would be the “fair market value,” which means the price seller and buyer are willing to transact when each party has access to all the relevant information. There is no compulsion that the transaction goes through (Flignor & Orozco, 2006). Finding a fair value of patents is thus crucial concerning M&A and can determine whether the transaction is considered a success or a failure. However, a mature marketplace does not exist for buying and selling patents in the same way for tangible assets (Upcounsel, 2021). Therefore, patents are difficult to value and do not have a globally recognized approach as physical assets have by depreciating the assets' value over time. Thus, finding the fair market value for a patent is challenging.

As there is no single globally recognized valuation method for patents, investors commonly use the following three methods: (1) the cost method, (2) the market method, or (3) the income method.

2.6.1 The cost method

The cost method is the simplest, and it is solely based on the cost of obtaining a patent, and the valuation is determined by the price it would take to substitute the patent outside the scope of legal protection. Hence, it is also known as the cost of replacement or the replacement cost method (Flignor & Orozco, 2006). The cost method is also the most objective, as the replacement cost is based on the projected cost to obtain the patent today. The investor should not mix the method with historical cost, as valuing a patent on the initial cost of obtaining the patent gives little incentive to create future patents. Investors base the fundamentals of the technique on the fact that an investor would not pay more for an asset than it would cost to obtain the same benefits of the asset in another way. The method often presents a floor or ceiling price for the patent and aids investors in further determining the value (Pitkethly, 1997).

2.6.2 The market method

A highly trusted valuation approach for patents is the market method (Pitkethly, 1997). The market method values a patent after what a similar patent under similar circumstances would cost. It is essential for the market method that patents are traded at an active market between parties at arm´s length. For a market to be active, it must fulfill three conditions (Bader & Rüether, 2009):

1. The goods in the market are homogenous
2. There lies an agreement between buyers and sellers.
3. The prices of the patents are publicly known

If such a market is present, investors frequently use the method to value patents in a transaction. However, the main problem is finding comparable patents, as patents provide a unique approach. There is no certainty that a company can justify comparing two patents with a sum.

Another crucial point for the market method is if a company uses the patent in question as a proxy for the new patent to its best use (Parr & Smith, 1994). Parr and Smith further empathized that the two similar patents could be identical but still bear different values, solely given by a company using a patent more effectively than another. Thus, if a company does not take advantage of the patent to its maximum potential, the similar patent will not be fit to provide as a proxy. Thus, there are also high uncertainties with using the marked method to value patents in an M&A transaction.

2.6.3 The income method

The income method builds on the projected future cash flows of utilizing the patent (Heer, Harvey, Stulberg, & Kutsyna, 2020). The income method is based on intrinsic value instead of the patent's cost or current market price. For the technique to have a sound theoretical background, Robert Pitkethly (1997) emphasized that one needs to account for the uncertainty of the cash flows and the element of time when deriving a price for the patent. The most common way is through a DCF analysis of the patent, using a discount factor that also accounts for uncertainties, meaning a premium over the company's usual cost of capital. Determining the economic life of the patent is a necessity for this method to be considered valid. Holder and Riggs (1985) further weigh how the discount factor should reflect the current stage of the patent. New litigated patents are significantly riskier than those that have remained valid for 15 years. Hence, the discount factor should be higher for the initial years of the patent and should use a discount factor that varies based on the risk associated with future cash flows.

2.6.4 Arriving at a fair value

As aforementioned, there are different conditions for each method to work optimally, making it unbecoming to use a single method for patent valuation. The valuation process for patents is similar to valuing a company to arrive at a fair market value. One uses the most reliable valuation methods available and constructs a range of values (Hodder & Riggs, 1985). Valuing a patent involves an even higher number of uncertainties than a company consisting of both tangible and intangible assets, given that the value of a patent is built around a substantial tension when it comes to the projection of cash flows.

3.0 Hypothesis

Intellectual property makes up a significant amount of a firm's market value intellectual property (IP CloseUP, 2021), and primary patents have become one of the main drivers in M&A deals (Mousavi, 2011). Patents alone can generate significant synergies for acquirers (Bena & Li, 2014; Rivette, Kline, & Nothhaft, 2014; Koller, Goedart, & Wessels, 2020). The prior studies find royalties, innovation, scalability, creating market access, and productivity as major determinants to patent-related synergy gains. With high synergy potentials related to a deal, targets expect increased shareholders returns (Berk & Demarzo, 2019). The same holds for the acquirer´s shareholders as long as the net synergy potential (synergy gain - premium) is positive.

Researchers have done much research on the relationship between patents and M&A. The most recognized research papers within this field have primarily focused on post-merger performances, innovation output, and shared knowledge in the related deals (Bena & Li, 2014; Calipha, Brock, Rosenfeld, & J, 2018; Sevilir & Tian, 2012). On the other hand, we find a lack of research on how portfolios of patents affect M&A returns around their announcement date. Some prior research is on M&A returns, but most focus on emerging markets or specified industries with high patent intensity (Hassan, Patro, Tuckman, & Wang, 2007; Kim, Oler, Sanchez, & M., 2020; Lee & Yoon, 2015). The studies discovered a positive relationship between patents and abnormal M&A announcement return for acquirer and target shareholders.

Scandinavia is a wealthy region, with Norway ranked 4th, Denmark ranked 6th, and Sweden ranked 12th in the world by GDP per capita in 2020 (O'Neill, 2021). Most of the GDP in Scandinavia arises from sectors such as energy, fishing, telecommunication, and manufacturing, all of which are highly patent-intensive sectors (IMF, n.d.).

We find a lack of studies on how portfolios of patents affect M&A announcement returns combined with the big part of Scandinavia's economy belonging to high patent-intensive sectors. This research paper investigates how portfolios of patents affect announcement returns to Scandinavian M&A deals. To our knowledge, there is no research conducted within this field, and we provide research with five different main hypotheses to fulfill this gap.

Hypothesis 1: The amount of total granted patents in a deal prior to M&A announcement will increase abnormal acquirer shareholder returns.

We wish to examine the relationship between the acquirer´s M&A announcement returns and the number of patents in the deal to check for a significant relationship between the two. Hypothesis 1 thus examines the effect of the total amount of patents on acquirers´ CAAR.

Hypothesis 2: The number of acquirers granted patents prior to the M&A announcement increases abnormal acquirer shareholder returns.

Hypothesis 3: The number of targets granted patents prior to the M&A announcement increases abnormal acquirer shareholder returns.

When examining the relationship between patents and companies´ M&A announcement return, we wish to see if there lies a difference in which party has granted patents. Therefore, hypotheses 2 and 3 address the effect of both the target´s and acquirer´s granted patents on the acquirer´s return around the M&A announcement.

Hypothesis 4: The number of acquirers granted patents prior to the M&A announcement increases abnormal acquirer shareholder returns, given that only the acquirer is in the position of patents.

Hypothesis 5: The number of targets granted patents prior to the M&A announcement increases abnormal acquirer shareholder returns, given that only the target is in the position of patents.

As hypotheses 2 and 3 examine the effect of whether the acquiring party or the target has granted patents, we also wish to study the effect if only one party has patents prior to the M&A announcement. Hypotheses 4 and 5 focus on this effect.

Hypothesis 6: If the target has granted patents prior to the M&A announcement, the target will face positive abnormal returns.

According to Gaughan (2018), the premium is the primary determinant for a target´s stock price reactions on the day of an M&A announcement. Hypothesis 4 builds on the possibility that granted patents positively influence synergy potential, increasing the premium.

4.0 Methodology

4.1 Event study

We will be carrying out an event study to assess an abnormal return related to the acquisition of patents. Event studies are the most frequently used analytical tools to determine abnormal or excess returns for specific events (Peterson, 1989). In our case, the particular event in question is the M&A announcement date. James Dolley (1933) was the first economist to publish an event study paper. Dolley used the event study to examine a stock split's impact on the corresponding price. Since then, event studies had improved gradually until the late 1960s, when the methodology similar to today was introduced (Ball & Brown, 1968; Fama, Fisher, Jensen, & Roll, 1969). Fama et al. introduced the market model, including the returns of a benchmark to estimate how the stock price would move if there were no events. Using a benchmark excludes the influence of external factors, making it more evident if the abnormal return is significant.

4.1.1 Event study usage

It is worth mentioning that even though the basics of event studies have remained similar since the 1960s, many different variations have been introduced (Peterson, 1989). Thus, there is no standard event study methodology. The event study used in this paper is one of many variations, but the one we deem to be the best fit is similar to the one MacKinlay (1997) used when studying the effect of bad, no, and good news for a company. The event study variation in this paper does have some alterations to MacKinlay's approach since M&A announcements make the event period different for each row in the data sample.

Further, an event study relies on an efficient market, where the market price reflects all information available. Fama (1970) illustrated the Efficient Market Hypothesis (EMH). The hypothesis explains how a weak-form, semi-strong, and strong market efficiency affects the stock price before the official announcement date. Up to the date of the announcement, all stocks trade at a fair price.

Fama (1970) states that stock prices should "fully reflect" all available information in an efficient market. When new information is available, prices should only adjust to their new fair value; otherwise, the price should remain unchanged. With this statement, an assumption of all investors being fully rational follows.

As it is impossible to predict when new information will enter the market, it is impossible to outperform the market portfolio over time, as there are no under or overvalued securities in the market (Fama, 1970).

Further, Fama alternates between three conditions of market efficiency.

1. The weak form
2. The semi-strong form
3. The strong form

Each form has its underlying theory of what information reflects stock price movements.

The weak form states that historical prices, volume, and short interest reflect all stock price movements. In other words, it would be impossible to generate an excess return above the market portfolio over time based on trend analysis because the future stock price incorporates all the information.

In the semi-strong form of market efficiency, all public information is incorporated in the stock price, hence impossible to exploit public news to generate a return above the market portfolio.

If the market efficiency is strong, all information refers to public and private information. With private information, we mean insider information that is not publicly available. An example of private information could be employees exploiting inside information and investing in their firm, knowing that their new assets produce the products at a lower marginal cost, leading to margin improvements. As this information reflects stock price movements, opportunities to make market anomaly returns disappear.

By relying on the EMH, we can observe security in an interval up to the announcement date to see how the stock moves compared to the market. As the impact on a security´s price from the merger announcement is affected on the day of the announcement, we can test for abnormal returns and check whether the M&A announcement is value-creating or value-destroying.

Although the EMH is a cornerstone in financial theories, the reality is that markets are not fully efficient. The collective judgment of investors will sometimes make mistakes, given the difference in rationality in participants in the market (Malkiel, 2003). Thus, the reality is frequent pricing irregularities and partly predictable patterns. Moreover, an imperfect market is necessary for investors to uncover information, which a perfect market would already reflect in the price (Grossman & Stiglitz, 1980). In an efficient market, investors cannot obtain extraordinary returns. Even though EMH (1970) is a central theory in finance, it builds on several conditions to hold, which in reality will not be present.

Thus, the period of interest is expanded to a broader area around the announcement date to capture market inefficiencies. The event period should, at minimum, include the day after the announcement. The period extension should capture the effect on the market if the announcement news were to drop after the market closed on the event day (MacKinlay, 1997). As rumors around a merger could reach the market before the official announcement date, the days before the event day may also be of interest, making it reasonable to include these in the period of interest. According to Peterson (1989), the optimal event window should consist of all information around the announcement, including the lag of speed adjustments. Still, the event window should at the time be short enough to exclude all other information not coming solely from the event. This way, one can adequately examine the effect of the event. Peterson proposed a 21-day event window, including ten days before the event, the day itself, and ten days after.

4.1.2 Calculation of the abnormal returns

It is necessary to calculate the firms' abnormal returns in the event window to tell if the effect of the announcement is significant. The abnormal return is defined by “the actual ex-post return of the security over the event window minus the normal return of the firm over the event window” (MacKinlay, 1997). To compute the abnormal return, we, therefore, need the expected return for each firm to estimate how the stock price would have moved had the M&A announcement not taken place. The formula for abnormal return is

$$AR_{it} = R_{it} - E(R_{it}|X_t) \qquad (1)$$

AR_{it}, R_{it}, and $E(R_{it}|X_t)$ are abnormal, actual, and expected returns for time t and firm i. To estimate the expected return in time t for firm i, one can use the constant mean or market models. We have chosen to use the market model, given its potential improvement over the constant mean model (MacKinlay, 1997). Comparing the firm's return to the return of a market portfolio includes the systematic return for firm i, reducing the variance of the abnormal return. The return for each security i using the market model is

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \qquad (2)$$

R_{it} and R_{mt} are the return for i security and the market, respectively. ε_{it} is the zero mean disturbance term with an expected value of 0 and variance equal to $\sigma_{\varepsilon\ t}^{2}$. α_i, β_i, and $\sigma_{\varepsilon\ t}^{2}$ are the parameters for the market model (MacKinlay, 1997). Using the parameters, we can estimate the return of security i during the event window.

The next step in the event study is to set up the timeline for the event study. The event study consists of the estimation window, starting at $t=T_0$, the start of the event window, $t=T_1$, the date of the specified event, t=0, and the end of the event window, $t=T_2$. The length of the estimation window and event window is $L_1 = T_1 - T_0$ and $L_2 = T_2 - T_1$, respectively. The post-event window is from $T_2 + 1$ to T_3 and has a length of $L_3 = T_3 - T_2$. It is beneficial for the preciseness of the study that the estimation window and event window do not overlap. Figure 4.1 presents the event study timeline. As aforementioned, the event window is usually more comprehensive than just the event date, t=0. The estimation period is typically 100 to 300 days prior to the event window (Peterson, 1989). (MacKinlay, 1997)

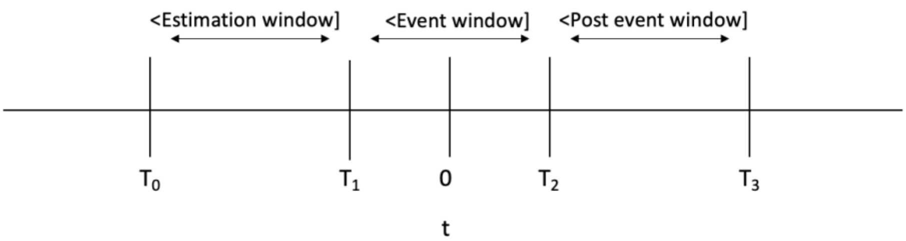

Figure 4.1: Event window illustration

Illustrates the components of the event window. T1 – T0 presents the estimation window, T2 – T1 presents the event window, and T3-T2 presents the post-event window. The M&A announcement date is t.

4.1.3 Estimation of the market model

The market model includes using the estimation window to estimate how the security would move in the event window had the event not occurred. The market model's estimation procedure uses ordinary least squares (OLS), which under general conditions is consistent (MacKinlay, 1997). The covariance gives the estimation beta between the actual return for the security and market minus the mean return of the security and the market in the estimation period. The estimation beta is given by

$$\hat{\beta}_i = \frac{\sum_{\tau=T_0+1}^{T_1} (R_{i\tau} - \hat{\mu}_i)(R_{m\tau} - \hat{\mu}_m)}{\sum_{\tau=T_0+1}^{T_1} (R_{m\tau} - \hat{\mu}_m)^2} \qquad (3)$$

$$\hat{\alpha}_i = \hat{\mu}_i - \hat{\beta}_i \hat{\mu}_m \qquad (4)$$

$$\hat{\sigma}^2_{\varepsilon_i} = \frac{1}{L_1 - 2} \sum_{\tau=T_0+1}^{T_1} (R_{i\tau} - \hat{\alpha}_i - \hat{\beta}_i R_{m\tau})^2 \qquad (5)$$

where

$$\hat{\mu}_i = \frac{1}{L_1} \sum_{\tau=T_0+1}^{T_1} R_{i\tau}$$

and

$$\hat{\mu}_m = \frac{1}{L_1} \sum_{\tau=T_0+1}^{T_1} R_{m\tau}.$$

Where R_i and R_m is the actual return in the estimation period, L_1, the estimated α_i is the return of security i that exceeds the mean return of the market multiplied by the beta of security i.

Using the parameters found above, it is now possible to measure and analyze the abnormal return for security i. The abnormal return (AR) is given by

$$AR_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt} \qquad (6)$$

Calculated on an out-of-sample basis, AR_{it} defines the disturbance term of the market model. Following the conditions of the market model, the abnormal returns will be jointly normally distributed under the null hypothesis. The variance of the abnormal return consists of two joints, the disturbance variance, and the sampling error in $\hat{\alpha}_i$ and $\hat{\beta}_i$ (MacKinlay, 1997):

$$\sigma^2(AR_{it}) = \sigma^2_{\varepsilon_i} + \frac{1}{L_1}\left[1 + \frac{(R_{mt} - \hat{\mu}_m)^2}{\hat{\sigma}^2_m}\right]. \qquad (7)$$

The second joint of the equation leads to a serial correlation of the abnormal returns, but as the estimation window, L_1, increases, the joint approaches zero. With a sufficiently large L_1, the variance of the abnormal returns will be $\sigma^2_{\varepsilon_i}$. Thus, the market model assumes (8) that the second joint of equation (7) is zero and can use the null hypothesis that the event's impact has no significant effect to draw interference over any period within the chosen event window. Following, under the null hypothesis, the abnormal return for each observation in the event window has a distribution of

$AR_{it} \sim N(0, \sigma^2(AR_{it}))$.

After assuming the normal distribution for the abnormal returns, the next step in the market model is aggregating the abnormal returns in the event window. The aggregation is both through the time of the event window and across the securities in the sample (MacKinlay, 1997). For N events included in the event study, the aggregated abnormal return and its variance with a large estimation window for a sample is given by

$$\overline{AR}_t = \frac{1}{N}\sum_{i=1}^{N} AR_{it} \tag{9}$$

and

$$var(\overline{AR}_t) = \frac{1}{N^2}\sum_{i=1}^{N} \sigma^2_{\varepsilon_{it}} \tag{10}$$

and enables for calculating the abnormal return for any event period. Further, an event study applies the cumulative abnormal return (CAR) over the chosen event window. The cumulative abnormal return between the start (t_1) and the end (t_2) of the event window is calculated by

$$\overline{CAR}(t_1, t_2) = \sum_{t=t_1}^{t_2} \overline{AR}_t \tag{11}$$

and the variance of the CAR is the variance of the interval is the cumulative variance in the event window (MacKinlay, 1997).

The distribution of the CAR comes from the same assumption that the event windows for the securities do not overlap; thus, the covariance in the CAR is zero. The inference of CAR is

$$\overline{CAR}(t_1, t_2) \sim N(0, \overline{CAR}(t_1, t_2)\ ) \tag{12}$$

and can be used to test whether the null hypothesis holds or if the returns are significantly different from zero. We test the null hypothesis using the variance of the aggregated CAR and the aggregated CAR from equation 11

$$\theta_1 = \frac{\overline{CAR}(t_1, t_2)}{var(\overline{CAR}(t_1, t_2))^{\frac{1}{2}}} \sim N(0, 1) \qquad (13)$$

5.0 Data sample and control variables

5.1 Data sample

This section presents the data used in this thesis, including patent data. The steps taken will be presented chronologically, starting with data collection and cleaning, before presenting the descriptive data.

5.1.1 Data Collection

We have used Thomson Reuters SDC Platinum M&A (SDC) database and Bloomberg Terminal to collect data. NHH granted access for both. The first step was collecting data from SDC, where we applied the following filters to the SDC M&A database:

- The M&A transaction was announced between 01.01.2001 and 15.11.2021.
- The M&A transaction is completed.
- Both acquirer and target are from Denmark, Norway, or Sweden.
- Cross-nation and cross-industry M&A transactions are in the sample.
- Both acquirer and target are publicly traded 273 days before the announcement. 273 days are necessary due to the 250 days estimation period, a three-day wait period before the event window, and the [-20, 20] event window.
- The deal value is over $1 million.
- The stake of the target that the acquirer owned the transaction was over 50 percent.
- The stake of the target that the acquirer held before the M&A announcement was below 50 percent.

The reason for using a time horizon from 01.01.2000 to 15.11.2021 is that event study research papers usually stretch over approximately 20 years (MacKinlay, 1997). Although some prior studies have used monthly return data (Fama, Fisher, Jensen, & Roll, 1969), later studies highlighted the severe benefits of using daily data (MacKinlay, 1997; Morse, 1984). Morse observed information effects four and seven times on a 5 percent and 1 percent confidence interval using daily returns instead of monthly returns. However, some researchers criticize daily returns due to its possibility of bias in betas because of nonsynchronous trading (Morse, 1984). Nevertheless, the bias is not critical in identifying information effects, and monthly stock return is thus not a preference compared to daily stock return (Morse, 1984; J. Brown & B. Warner, 1985; Dyckman, Philbrick, & Stephan, 1984). We find the non-significant effect of the daily return bias using the Scholes and Williams (1977) and Dimson (1979) methods. Thus, we choose daily return data in this thesis.

The reason for looking at Scandinavian M&A transactions is due to a rise in M&A in the region (Wiersholm, 2021; Spivak, 2021; Svernlöv, 2021; Oaklins, 2021). Scandinavia also has similar cultural characteristics, and we include all three countries for a bigger sample. Also, the Scandinavian economy is highly dependent on patent-intensive industries.
We control for cross-border deals to minimize the effect of cultural differences.

After executing the first order on SDC, we searched thoroughly for the necessary data needed for the event study. The reason for not excluding all the securities with missing data in SDC, such as transaction value or the acquirer's market capitalization, is that we had a look through Bloomberg Terminal to check for the missing data there. This way, we could maximize the number of observations in our event study.

Further, we used Bloomberg Terminal to collect daily stock prices for both acquirers and targets over a total of 294 days, as the estimation window is 250 days and the event window is [-20, 20], a total of 41 days, and a three day wait period after the estimation period. The data for indices were also collected using Bloomberg Terminal. The chosen index is MSCI Nordic Countries. Since the data consists of three countries, we used a broader index instead of each security´s national index, e.g., the Oslo Børs. Using the broader index MSCI Nordic will also ensure that our index is not heavily weighted in specific industries (Koller, Goedart, & Wessels, 2020).

5.2 Descriptive data variables

5.2.1 Nation and year

After cleaning data, the data set consists of 103 acquirers and 74 targets. There is a dissimilarity between the amount of target and acquirer due to Bloomberg Terminal having more available information for the acquirers regarding security price in the 274 days before the M&A announcement. However, as we use the acquirer and target data independently, there are no complications due to the matching numbers.

Tables 5.1 and 5.2 present the location of the M&A transactions divided into nation and year. For acquirers, a great majority of the M&A transactions take place in Sweden, with 55 out of the total 103. M&A activity in the sample for Denmark and Norway is quite similar, with 20 and 28 transactions, respectively. The exception is mainly due to the difference in M&A activity in 2006, where the M&A activity in Norway had a busy year.

	Sweden	*Denmark*	*Norway*	*Total*
2001	6	1	0	7
2002	0	0	0	0
2003	0	2	1	3
2004	5	1	1	7
2005	4	1	3	8
2006	2	1	7	10
2007	2	0	3	5
2008	0	2	2	4
2009	6	0	2	8
2010	5	1	0	6
2011	2	0	0	2
2012	0	3	1	4
2013	0	2	1	3
2014	1	1	0	2
2015	3	0	0	3
2016	2	1	1	4
2017	2	0	1	3
2018	2	3	0	5
2019	4	0	1	5
2020	6	1	3	10
2021	3	0	1	4
Total	55	20	28	103
%	53%	19%	27%	100%

Table 5. 1: Acquirers´ total M&A announcements by year for each country

Summarizes acquirers´ total M&A announcements by year for each country. Out of the 103 M&A transactions in the sample, 53 percent have a Swedish acquirer, 19 percent have a Danish acquirer, and 27 percent have a Norwegian acquirer.

The situation is more or less the same for targets, with most of the targets originating from Sweden, with 35 out of the total 74 transactions. Denmark and Norway make up 14 and 25 percent of the sample, respectively.

	Sweden	*Denmark*	*Norway*	*Total*
2001	4	2	2	8
2002	1	0	1	2
2003	0	3	1	4
2004	3	1	1	5
2005	2	0	2	4
2006	3	0	6	9
2007	2	0	2	4
2008	0	1	2	3
2009	3	0	1	4
2010	1	0	0	1
2011	3	0	0	3
2012	0	2	1	3
2013	0	1	0	1
2014	0	1	0	1
2015	1	0	0	1
2016	1	0	1	2
2017	0	0	1	1
2018	3	2	0	5
2019	2	0	2	4
2020	3	1	1	5
2021	3	0	1	4
Total	35	14	25	74
%	47%	19%	34%	100%

Table 5.2: Targets´ total M&A announcements by year for each country

Summarizes targets´ total M&A announcements by year for each country. Out of the 74 targets in the sample, 47 percent are Swedish, 19 percent are Danish, and 34 percent are Norwegian.

5.2.2 Cross-industry, cross border, payment method, transaction value, and acquirer market capitalization

Table 5.3 summarizes cross-industry, cross border, and the payment method used for each acquirer for each nation. Acquirers from Sweden, Denmark, and Norway have completed 20, 2, and 11 cross-industry M&A transactions over 01.01.2001 to 15.11.2021. Given that Sweden has the highest M&A activity in our sample, there is no surprise that the nation also has the highest amount of cross-industry. However, Sweden has 60.6 percent of the cross-industry M&A activity, which is of close proportionality to the 53 percent the nation had of the total mergers. A cross-industry M&A occurs if the first two digits of the SIC code match for target and acquirer. We collected the SIC code from SDC Platinum. Sweden represents 91.7% of the cross-border activity. Cross-border activity for Denmark and Norway amounts to 0 and 1, respectively.

Looking at payment methods for each country, Denmark most frequently funds M&A activity with 90 percent or more stock, with a total of 70 percent of the M&As funded with stock and only 20 and 10 percent with cash mix, respectively. Sweden and Norway have a stock payment ratio of 52.7 percent and 42.9 percent, respectively. Norway funds most of its M&As with cash (53.6 percent) and only 3.6 percent with a mixed payment. Sweden funds 32.7 percent of M&As with cash and 14.5 percent with a mixed payment.

Looking at the average transaction value for each nation, the biggest deals in the sample take place in Norway, where the average transaction value is $1,375.83M. Norway´s average transaction value is notably more than the average transaction value of both Sweden and Denmark, which is $342.31M and $654.71M, respectively. The high transaction value in Norway means the nation stands for 54.7 percent of the total transaction value in the sample. Sweden and Denmark contribute to the remaining share by 26.7 percent and 18.6 percent, respectively. The average acquirer market cap is largest in Sweden ($4,871.89M), followed by Norway ($4,050.80M) and lastly, Denmark ($1,094.86).

	Sweden	Denmark	Norway	Total
Cross-industry	20	2	11	33
Cross border	11	0	1	12
Payment method				
Stock payment	29	14	12	55
% of the national total	52.7%	70.0%	42.9%	

Cash payment	18	4	15	37
% of the national total	32.7%	20.0%	53.6%	
Mix payment	8	2	1	11
% of the national total	14.5%	10.0%	3.6%	
Average transaction value ($M)	342.31	654.71	1,375.83	683.92
Transaction value ($M)	18,826.91	13,094.25	38,523.10	70,444.26
% of total	26.7%	18.6%	54.7%	100.0%
Average acquirer market cap ($M)	4,871.89	1,094.86	4,050.80	3,915.28
Number of deals with Patents				
Both parties	3	1	2	6
Acquirer	12	5	9	26
Target	7	2	5	14
A patent included in the deal	16	6	12	34
% of total	47%	18%	35%	100%

Table 5. 3: Descriptive statistic of variables

Summarizes the cross-industry, cross-border payment method for each country. All variables are presented as dummy variables. Cross-industry M&A transactions are transactions where the first two digits of the acquirer and target SIC codes match. Stock (cash) payments are defined as 90 percent or more of the transaction value paid by stock (cash). If the payment is less than 90 percent stock or cash, the payment method is defined as a mix. The % of the national total represents the corresponding payment method´s share of the payment method for each country. Average transaction values are each country's average and total transaction values in a million USD, respectively. The average acquirer market cap is the average market for each nation in a million USD for each acquirer. The number of deals with patents is dummy variables for deals including granted patents for both target and acquirer, deals where the acquirer has a granted patent, the target has a granted patent. Lastly, the deal includes a granted patent from whichever party.

5.3 Patent data

Google Patents (n.d.) is used to collect patent data regarding the deals included in the sample, alongside public patent registers. According to the Patent Law, the life of a patent is no longer than 20 years from the date the patent application was filed and no shorter than 17 years from issuance (Trojan Law Offices, 2019). Thus, we retrieve only patents granted within 17 years to its related deal.

When collecting the data, each firm in our sample is checked manually against the database. We collect data for the number of total patents included in each deal, the patent´s owner (acquirer or target), and how many patents are granted by the owner.

5.3.1 Winsorizing patent data

Due to some firms having an extreme amount of granted patents, we are winsorizing the patent data. Winsorizing data means we set all outliers to the value of a specified percentile, which will reduce how heavily outliers influence our analysis. We prefer winsorizing to trimming the outliers as we prefer to keep the data and see how having an extensive amount of patents affects abnormal returns. We winsorize granted target patents on the upper 99% percentile and acquirer patents at the 95% upper percentile.

5.3.2 *Descriptive* patent *data*

Table 5.3 further presents the number of granted patents included in deals for each country and total. As Sweden stands for 53 percent of the M&A activity in the sample, it is proportionate that the nation has 47 percent of the deals, including granted patents. Denmark and Norway constitute 18 percent and 35 percent of the deals, including granted patents. The total number of deals with granted patents is 34, 33 percent of the acquirer sample. Out of the 34 deals, the acquiring party has a granted patent in 26 deals, whereas the target has a granted patent in 14. In 6 of the deals, both parties had a granted patent.

6.0 Control variables and explanatory variables

6.1 Control variables

In this section, we present the control variables used in the study. We consider earlier M&A event study research when selecting control variables. We deem the selected variables to be most relevant when later looking at the effect of the explanatory variables, patents.

6.1.2 Payment Method

Payment method is a central field when looking at M&A announcement returns and receives considerable interest from researchers (Rhodes-Kropf & Viswanathan, 2004; André & Ben-Amar, 2009; Shleifer & Vishny, 2003; Faccio & Masulis, 2005). Stock financing is preferred when acquirers' stock prices are likely to be overvalued in bull markets (Shleifer & Vishny, 2003). Acquires choose stock financing when synergy gains are risky to share the risk with the target (Shleifer & Vishny, 2003; Koller, Goedart, & Wessels, 2020). On the contrary, companies prefer cash financing in the opposite situation. In cases with no clear path, a mixed payment of cash or stock is the acquirer´s preference.

Research from Agrawal, Jaffe, and Mandelker (1992) and Loughran and Vijh (1997) concludes that paying with cash is value-creating, and paying with stocks is value-destroying. To capture payment method M&A determinants effects, we include the payment method as dummy variables, (1) stock financing and (2) cash financing. The dummies equal 1 if 90% or more of the transaction value the acquirer pays in stock or cash, and 0 if not. If the dummy variables equal 0 on both occasions, the acquirer finances the deal with a mixed payment. A mixed payment means the acquirer uses 10 to 90 percent of stock or cash to finance the deal.

6.1.2 M&A experience

Experienced individuals who encounter situations tend to perform better than individuals who lack experience (Magnusson, 1981). Prior studies have yielded different results when looking at M&A experience as a determinant of acquisition performance. Barkeman and Schijven (2008) found a positive relationship between M&A experience and performance. Their research argued that experienced acquirers could develop specific routines that make their acquisition processes more effective and thus lead to better performance. On the other hand, Hayward (2002) and Kusewitt (1985) found a negative relationship between the variables as a whole but a positive relationship if prior mergers were related to new acquisitions. The negative relationship to experienced acquirers often follows the same pattern from earlier success, leading to pitfalls when encountering new aspects. We include M&A experience as a numeric variable to control these effects, even though initial founding is not persistent. One unit change in the M&A experience variable means one more/less acquisition completed in the past five years.

6.1.3 Year dummy

M&A activity is highly cyclical due to changes in internal and external factors such as industry shifts, tech, regulations, patent expirations, valuations, and more. These factors also affect returns related to acquisitions, and the factors vary from one year to another. Prior research discovered that acquisitions in an upward economy destroyed value by 1.28 percent in a three-day event window to its announcement (Bouwman, Kathleen, & Nain, 2009). PwC (2019) discovered similar findings from another perspective where M&A in an economic downturn generated an excess return of 2.06 percent compared with economic upswings. The findings result from managers being too optimistic about synergies and returns in bullish markets but more cautious in bear markets. We add year dummy variables to control the year-fixed effects to strengthen our regression.

6.1.4 Size of the acquirer

Following the prior research of Moeller, Schlingemann, and Stulz (2004), the abnormal return achieved in an M&A announcement differs significantly for small and big firms. Their studies found that the equally weighted abnormal announcement returns for a sample of 12,023 firms between 1980 and 2001 were 1.1 percent. Moreover, small firms' abnormal return associated with acquisitions exceeded the abnormal return related to acquisitions by big firms by 2.24 percent. The significant difference in abnormal announcement returns between small and big firms may arise for several reasons. Moeller, Schlingemann, and Stulz also pointed out how bigger firms on average pay a higher acquisition premium to be one of the reasons for the difference in abnormal announcement returns for small and big firms. Sirower (1994) found a negative relation between acquisition premiums and immediate shareholder returns. We define the size variable as the natural logarithm of acquirers' market value four weeks before the announcement date.

6.1.5 Relative size

If mergers get close in relative size, implementation becomes more difficult and complex, and generating synergies becomes harder. As a result, mergers that tend to be close in market value face negative abnormal returns. These results are consistent with later studies using relative size as control variables (Fuller, Netter, & Stegemoller, 2002; Alexandridis, Fuller, Terhaar, & Travlos, 2013).

We recreate Fuller, Netter, and Stegemoller´s relative size variable to control its impact on M&A announcement returns. The variable is created by dividing the deal´s transaction value by acquirers' market value four weeks before the announcement.

6.1.6 Friendly takeover

A hostile takeover is categorized as a rejection of an acquisition offer, often publicly, whereas a friendly takeover has a friendly approach to a takeover bid. Friendly takeovers often create synergies that make both the bidder and the target firm better off than hostile takeovers (Morck, Shleifer, & Vishny, 1988). A problem with hostile takeovers is that the target can use several takeover defense strategies, like the poison pill that forces the acquirer to pay a higher premium to get control of the target, hence decreasing value creation potential (Koller, Goedart, & Wessels, 2020). These takeover strategies have been proven to increase the premium paid for the acquisition and solely decrease value creation potential (Comment & Schwert, 1995). A friendly takeover dummy variable equals 1 if the deal is friendly and 0 if otherwise.

6.1.7 Cross-border

When domestic firms do not obtain the intended growth rate, the company may be more beneficial to expand into new geographics to seek growth. Globalization has reduced barriers between countries significantly, and foreign direct investment through mergers has been more usual (Gaughan, 2018). However, expanding into new geographics also bear risks related to cultural difference, political stability, tax regimes, and regulations. Researchers have several studies to discover how cross-border mergers affect value creation. Prior research shows mixed findings, where some find that cross-border generate positive abnormal returns compared to domestic ones, and vice versa.

According to Chari, Ouimet, and Tesar (2005), cross-border mergers tend to perform poorer than domestic mergers if both parties are in a developed economy. If the acquirer belongs to a developed economy and the target in an emerging economy, the research concluded a positive relationship with the acquirer´s performance. At last, the researchers state that when both parties belong to a developed economy, the similarity between the risks determines the deal's implementation regarding cross-border deals. Our thesis includes countries with extensive similarities, so we think there will not be a big issue. Still, we have a dummy variable to capture the effect. The dummy equals 1 if the deal is a cross-border merger and 0 if the deal is domestic.

6.1.8 Cross-industry

Earlier studies have shown that different types of M&A affect both long and short-term stock performances for the acquirer, especially for conglomerates. From 1970-1982, 60% of all acquired companies were sold or divested within 1989 (Gaughan, 2018). In more recent years, Megginson, Morgan, and Nail (2004) conducted a study with 204 mergers to quantify this result. The study discovered that cross-industry acquisitions lost 4.39 percent market cap on the announcement date following a cross-industry merger. The acquirer's stock performance was also negative over a long-term aspect. To create a cross-industry dummy variable, we match the two first digits of the acquirer´s and target´s Standard Industry Classification (SIC) code. A two-digit match means the two parties are in the same industry by SDC Platinum´s standard but not in the same sub-industry (Berger & Ofek, 1995; Comment & Jarrell, Corporate focus and stock returns, 1995). The variable equals 1 if the acquirer and target are not industry-related and 0 otherwise.

Some researchers criticize the SIC code approach to finding related industries due to the conflict regarding multi-division entities because the approach classifies multi-division entities by yearly enterprise revenue. Clarke (1989) exposed the weakness of the SIC code approach effectively by demonstrating how it classifies a company with 40 percent of its revenue in SIC code 3211 and 30 percent in both 2842 and 2845 as SIC code 3211. Acquisition of a target in SIC code 28xx would thus classify as cross-industry in our sample. However, many researchers use the SIC code approach and deem it the most appropriate to identify cross-industry M&A transactions (Berger & Ofek, 1995; Comment & Jarrell, Corporate focus and stock returns, 1995).

6.2 Patents as the explanatory variables

This thesis studies how patents in M&A deals can explain any CAR variation; thus, we create three patent variables based on our patent data. To test hypotheses 1-3, accessing acquirer shareholder return movements, we create a natural logarithm variable of the number of granted patents. The variables are the natural logarithm of (1) the number of granted patents the acquirer has prior to the deal announcement, (2) the number of granted patents the target has prior to the deal announcement, and (3) the number of total granted patents prior to the deal announcement. As the sample includes a wide diversity of companies, and the difference of patents for both acquirer and target differ, using a normal logarithm helps avoid skewness in the data. As mentioned, we winsorize the number of patents granted by the upper 95% and 99% percentile for acquirers and targets.

Due to a lack of information regarding synergies related to deals, we create a dummy variable when studying how granted patents by target affect the target's shareholder returns. If the target has a granted patent, the variable equals 1, otherwise 0.

There are six different models for each event window on patents´ effect on the acquirer´s shareholder value:

- Model 1: the effect of the natural logarithm of patents the acquiring party has in the deal.
- Model 2: the effect of the natural logarithm of patents the target party has in the deal.
- Model 3: the effect of the natural logarithm of the total number of patents in the deal.
- Model 4: the effect of the natural logarithm of patents the acquiring company has in the deal, given that the target company does not have a patent.
- Model 5: the effect of the natural logarithm of patents the target company has in the deal, given that the acquiring company does not have a patent.
- Model 6: the effect of the natural logarithm of patents the acquiring company and target company has in the deal.

7.0 Results

This section summarizes the results found in this thesis. We present the results using an extension of the ordinary least squares (OLS) regression model, the multiple linear regression (MLR). We use the MLR for the CAR for each of the event windows [-20→-1], [-2→2], [-1→1], [0], and [1→20] using several control variables and the natural logarithm of patents as the explanatory variable.

Figure 7.1 presents how acquirers with and without patents perform around the announcement date. We observe a difference in CAAR whether it is a patent in the deal. In our sample, deals including no patents perform the worst. On the other hand, the greatest return occurs when the acquirer has a patent. We will further examine if patents significantly affect the acquirer´s CAR. Firstly, we summarize the effect of the control variables included.

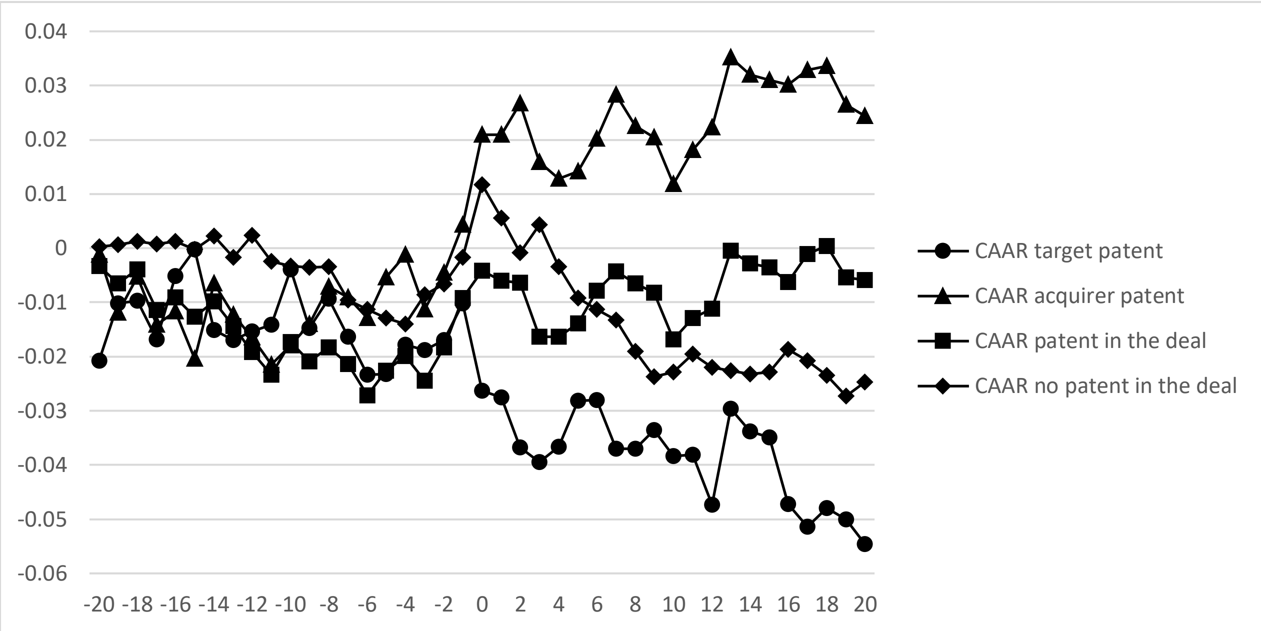

Figure 7. 1: Acquirer CAAR in the event window [-20→20]

Summarizes the acquirer´s CAAR in the event window [-20→20] and the effect of patents, using patent as a dummy variable. CAAR target patent is the return when the target has a patent, CAAR acquirer patent is the return when the acquirer has a patent, CAAR patent in the deal is when there is a patent in the deal, and CAAR no patent in the deal is when no patent is present in the deal.

7.1 The effect of control variables

The following MLR includes variables that correlate, but as it is multicollinearity between control variables, it is allowed in the model without breaking the assumptions of MLR. The model still holds as long as the multicollinearity is not between explanatory variables (Allison, 2012).

The following model for control variables is used in the thesis

$CAR_i = \beta_0 + \beta_1$*CrossI + β_2*CrossB+ β_3*MAexp+ β_4*RelSize + β_5*LOGMV+ β_6*Stock+ β_7*Cash + β_8*DealAtt+ β_9*y1 + β_{10}*y2 + β_{11}*y3 + β_{12}*y4 + β_{13}*y5 + β_{14}*y6 + β_{15}*y7 + β_{16}*y8 + β_{17}*y9 + β_{18}*y10 + β_{19}*y11+ β_{20}*y12 + β_{21}*y13 + β_{22}*y14 + β_{23}*y15 + β_{24}*y16 + β_{25}*y17 + β_{26}*y18 + β_{27}*y19 + β_{28}*y20 + β_{29}*y21

The chosen control variables are explained in section 6.1. Table 7.1 summarizes the effect of the chosen control variables included in the MLR for each event window. We do not include the impact on CAR of having patents in this table; we will include the determinant variables later. Event windows [-2→2], [-1→1], and [0] are the ones we are focusing on in this paper, whereas [-20→-1] is included to evaluate if any information around the M&A announcement is leaked before the announcement date. Also, we include the event window [1→20] to see the acquirer´s CAR after the announcement date. As mentioned before, the first day after day 0 can be the first trading to reflect the effect of the M&A announcement on share price, given that many companies release the news after the market has closed.

	CAR ew(-1,-20)	CAR ew(-2,2)	CAR ew(-1,1)	CAR ew(0)	CAR ew(1,20)
Intercept	−0.158	−0.112	0.009	−0.029	0.119
	(0.132)	(0.154)	(0.106)	(0.101)	(0.167)
Cross Industry	0.038	0.051+	0.031	0.012	0.031
	(0.026)	(0.031)	(0.021)	(0.020)	(0.033)
Cross Border	0.021	0.024	0.018	0.008	0.051
	(0.039)	(0.046)	(0.032)	(0.030)	(0.050)
Acquirer´s M&A experience	−0.002	−0.003	−0.001	0.000	−0.002
	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)
Relative size	0.019	−0.003	0.012	0.016	0.002
	(0.015)	(0.017)	(0.012)	(0.012)	(0.019)
ln market cap acquirer	0.004	−0.002	−0.006	−0.004	0.004
	(0.006)	(0.008)	(0.005)	(0.005)	(0.008)
Stock payment	0.078*	0.043	0.014	0.000	0.006
	(0.039)	(0.045)	(0.031)	(0.030)	(0.049)
Cash payment	0.096*	0.035	0.028	0.004	0.000
	(0.047)	(0.054)	(0.037)	(0.036)	(0.059)
Friendly attitude	0.042	0.039	0.008	0.021	−0.227**
	(0.062)	(0.073)	(0.050)	(0.048)	(0.079)
Num.Obs.	103	103	103	103	103

Heteroskedasticity robust standard errors in parantheses.

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table 7. 1: MLR on control variables

Summarizes MLR on the control variables used, except effect from patents, and the fitted values for each variable on the event windows [-20→-1], [-2→2], [-1→1], [0], and [1→20], which is are the selected event windows to check for CAR in this thesis. Intercept presents the intercept CAR. Cross industry and cross border are both dummy variables, which has a value of 1 if the M&A was done by parties from different industries or different nations. Cross industry is determined by the two first digits of the companies´ SIC being different, collected from SDC Platinum. Acquirer´s M&A experience is a linear variable which is the acquirer´s number of M&A transactions completed over the past 5 years, collected from Bloomberg Terminal. A completed M&A transaction yield a successful takeover of another company in this circumstance. Relative size is the transaction value of the deal over the market capitalization of the acquirer 4 weeks prior to the M&A announcement. Ln market value acquirer is the natural logarithm of the market capitalization of the acquirer 4 weeks prior to the M&A announcement. Stock (cash) payment is a dummy variable which has a value of 1 if the M&A was funded by 90 percent or more by stock (cash). Friendly merger is a dummy variable with value=1 if the M&A was considered friendly by SDC Platinum. The MLR also includes a year dummy for each year from 2001-2021 (not presented in table 4, to coupe for the l effect each year can have on the CAR.

Cross-industry has a positive relationship in the sample with CAR for all event windows. The effect is significant on a 10 percent level for the [-2→2] event window. The effect indicates that shareholders see a positive relationship with acquiring companies differentiating through M&A. The coefficient implies that a cross-industry merger yields a 5.1 percent higher CAR for the acquirer.

Cross-border also has a slight positive relationship with the CAR for all event windows, but the findings are insignificant. Cross-border M&A activity may be of increased risk (David & Singh, 1994). Still, as both parties included in every deal are from Scandinavia, the cultural difference between the companies may be of less significance.

The number of M&A transactions that the acquiring company has completed in the last five years has minimal effect on the CAR in all event windows. There are positive sides to having M&A experience, as the acquirer may learn from its mistakes. On the other hand, doing multiple M&As may also lead to the manager being overconfident from previous success, i.e., a success trap. Aspects that worked in past deals may not be the solution in new deals, which the acquiring party may overlook. Some acquirers will follow a prior success formula without considering the new deal's unique aspects.

We find no significant evidence looking at the relative size of the acquiring and the transaction value, and the effect of the acquirer's size. This finding is not according to Moeller, Schlingemann, and Stulz (2004), which found that smaller acquirers had a higher CAR on the announcement date than bigger firms. The sample used in their study was from the U.S market, where one can find companies with a considerably higher market cap than one can find in our sample from Scandinavia. This aspect might influence the difference in the findings.

Further, CAR's payment method is slightly favorable for all event windows. Both stock and cash payment have significance for the acquirer´s CAR over the last 20 days to 1 day before the M&A announcement. If both stock and cash have a value of 0, the transactions use a mixed payment. Acquirers using a mixed payment for the event windows [-2→2], [-1→1], and [0] have a slightly negative effect, but the evidence is not significant. The year dummy captures the CAR in years with higher or lower CAR compared to other years, e.g., the effect of merger waves. Thus, the year dummy may capture the effect of stock mergers during merger waves.

According to Morck, Schleifer, and Vishny (1988), deals that are considered friendly should have a positive effect on the CAR of the M&A announcement. In our sample, the friendly merger dummy variable has a slightly positive impact but is insignificant for all event windows except the [1→20] event window. For the latter, having a friendly attitude has a significantly negative effect on the CAR, which contradicts the findings of Morck, Schleifer, and Vishny. However, as a tiny part of the sample is of non-friendly mergers, the result may also be a coincidence. Even more, the event window is not one of the three event windows that include the M&A announcement.

7.2 The effect of patents on the acquirer´s CAR

The MLR with patents will be presented one event window at a time, following a chronological order for the event window´s starting point.

7.2.1 Effect of patents in the [-20→-1] event window

We include the event window [-20→-1] to check for information leakage. Additionally, the event period bolsters eventual evidence if the effect should be insignificant for the pre-announcement date event window but significant for the event windows around the M&A announcement.

As table 7.2 presents, there is no significant relationship between the natural logarithm of patents variables and the models. The table indicates a slight negative relationship for the CAR between 20 days and one day before the announcement, as models 2, 5, and 6. The effect of having a granted patent for the acquirer is of very little significance, according to models 1, 3, and 6. Model 4 projects that the total effect of the natural logarithm of patents has a minor impact over the period. As this event window does not include the M&A announcement date, no significant finds indicate little information leakage, should there be a significant relationship between patents and acquirer´ M&A announcement CAR.

Acquirer CAAR(-20->-1) window

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	0.110	0.092	0.082	0.135	0.121	0.094
	(0.174)	(0.167)	(0.175)	(0.171)	(0.167)	(0.173)
ln Patent Acquirer	−0.002					0.001
	(0.012)					(0.012)
ln Patent Target		−0.018				−0.018
		(0.014)				(0.014)
ln Total patents			−0.009			
			(0.012)			
ln Only patent acquirer				0.007		
				(0.013)		
ln Only patent target					−0.044	
					(0.038)	
Num.Obs.	103	103	103	103	103	103

Heteroskedasticity robust standard errors in parantheses.
+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table 7.2: MLR on patent variables [-20→-1]

Summarizes the effect of patents on the CAR in the event window [-20→-1]. All six models include the control variables covered in section 6.1 and a year dummy variable between 2001 and 2021. The patents are all in natural logarithms. A 1 percent increase in patents yields a β_i percent increase in CAR, i.e., the relationship between CAR and patents has a log-log relationship. The intercept in each model is the fitted value for acquiring companies before the average effect of each of the included variables. Model 1 shows the impact of the acquiring party having a patent, and model 2 shows the effect of the target having patents CAR. Model 3 shows the relationship between the natural logarithm of total patents and the CAR. Model 4 shows the effect of only the acquirer having a granted patent, and model 5 shows the relationship between only the target having granted patents. Models 4 and 5 require that the other party in the M&A transaction does not have a granted patent before including the effect of granted patents in the deal. Model 6 contains both explanatory variables from models 1 and 2 together.

7.2.2 Effect of patents in the [-2→2] event window

Table 7.3 summarizes the event window [-2→2], including two days before and past the event, as well as the official announcement date itself. We identify the same pattern as in the [-20→-

1] event window, as the natural logarithm of only the acquirer having patents positively affects the CAR. In contrast, patents for the target negatively affect the acquirer´s CAR. Looking at model 4, we observe a 5 percent significant relationship between the acquirer´s CAR and ln only patent acquirer. According to model 4, when only the acquirer in the M&A transaction has a patent, the CAR increases by 0.025 percent for a 1 percent increase in the number of patents. With a 0.12 standard error, the MLR shows how this result is statistically significant at a 5 percent level, given by the "*" next to the fitted value. The evidence proposes a strong relationship between the acquirer´s CAR and the natural logarithm of the acquirer´s granted patents when the acquiring party is the only party with patents in the M&A transaction in the [-2→2] event window. The effect of a 1 percent increase in acquirers granted patents when not restricting the target´s patents to equal 0 is not statistically significant (model 1). The overall natural logarithm of patents is also not statistically significant (model 3)

Acquirer CAAR(-2->2) window

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	−0.064	−0.134	−0.078	−0.055	−0.111	−0.080
	(0.159)	(0.155)	(0.162)	(0.153)	(0.155)	(0.158)
ln Patent Acquirer	0.013					0.016
	(0.011)					(0.011)
ln Patent Target		−0.015				−0.019
		(0.013)				(0.013)
ln Total patents			0.008			
			(0.011)			
ln Only patent acquirer				0.025*		
				(0.012)		
ln Only patent target					−0.023	
					(0.035)	
Num.Obs.	103	103	103	103	103	103

Heteroskedasticity robust standard errors in parantheses.

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table 7. 3: MLR on patent variables [-2→2]

Summarizes the effect of patents on the CAR in the event window [-2→2]. All six models include the control variables covered in section 6.1 and a year dummy variable between 2001 and 2021. The patents are all in natural logarithms. A 1 percent increase in patents yields a β_i percent increase in CAR, i.e., the relationship between CAR and patents has a log-log relationship. The intercept in each model is the fitted value for acquiring companies before the average effect of each of the included variables. Model 1 shows the impact of the acquiring party having a patent, and model 2 shows the effect of the target having patents CAR. Model 3 shows the relationship between the natural logarithm of total patents and the CAR. Model 4 shows the effect of only the acquirer having a granted patent, and model 5 shows the relationship between only the target having granted patents. Models 4 and 5 require that the other party in the M&A transaction does not have a granted patent before including the effect of granted patents in the deal. Model 6 contains both explanatory variables from models 1 and 2 together.

7.2.3 Effect of patents in the [-1→1] event window

We present the effect of patents in the [-1→1] event window in table 7.4. As the change from the [-2→2] event window is just one day prior and past the M&A announcement, one can expect similar results for patents in both windows. The [-1→1] event window offers an even narrower approach to look specifically at the acquirer´s CAR around the announcement date. Referring to model 4, we still observe a 5 percent significant relationship between the acquirer´s CAR and ln only patent acquirer. According to model 4, when only the acquirer in the M&A transaction has a patent, the CAR increases by 0.018 percent for a 1 percent increase in the number of patents that the acquirer has. With a 0.08 standard error, the MLR shows how this result is statistically significant at a 5 percent level, given by the "*" next to the fitted value. The significant p-value proposes a strong relationship between the acquirer´s CAR and the natural logarithm of granted patents for the acquirer when the acquiring party is the only party with patents in the M&A transaction in the [-1→1] event window. The effect of a 1 percent increase in patents, including the granted patents the target has in the M&A transaction, is also significant at a 10% level (model 6). Model 6 implies that a 1 percent increase in acquirers´ granted patents increases the acquirer´s CAR by 0.015 percent.

Acquirer CAAR(-1->1) window

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	0.054	−0.006	0.044	0.050	0.010	0.043
	(0.109)	(0.107)	(0.111)	(0.105)	(0.106)	(0.108)
ln Patent Acquirer	0.012+					0.015+
	(0.007)					(0.007)
ln Patent Target		−0.010				−0.014
		(0.009)				(0.009)
ln Total patents			0.008			
			(0.008)			
ln Only patent acquirer				0.018*		
				(0.008)		
ln Only patent target					−0.021	
					(0.024)	
Num.Obs.	103	103	103	103	103	103

Heteroskedasticity robust standard errors in parantheses.

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table 7. 4: MLR on patent variables [-1 →1]

Summarizes the effect of patents on the CAR in the event window [-1 →1]. All six models include the control variables covered in section 6.1 and a year dummy variable between 2001 and 2021. The patents are all in natural logarithms. A 1 percent increase in patents yields a β_i percent increase in CAR, i.e., the relationship between CAR and patents has a log-log relationship. The intercept in each model is the fitted value for acquiring companies before the average effect of each of the included variables. Model 1 shows the impact of the acquiring party having a patent, and model 2 shows the effect of the target having patents CAR. Model 3 shows the relationship between the natural logarithm of total patents and the CAR. Model 4 shows the effect of only the acquirer having a granted patent, and model 5 shows the relationship between only the target having granted patents. Models 4 and 5 require that the other party in the M&A transaction does not have a granted patent before including the effect of granted patents in the deal. Model 6 contains both explanatory variables from models 1 and 2 together.

7.2.4 Effect of patents in the [0] event window

The acquirer´s CAR in the event window [0] is presented in table 7.5 and shows how the CAR is affected by the natural logarithm of patents on solely the announcement date. This plot, as aforementioned, has a weakness of not including the day after the announcement and does thus capture the M&A announcement effect on the security if the acquirer publishes the news aftermarket closing hours on SDC´s posted announcement day. However, the outcome should still be similar to the [-1→1] and [-2→2] event windows. Looking at model 4, we now observe a 10 percent significant relationship between the acquirer´s CAR and ln only patent acquirer. The p-value indicates weaker evidence than the two prior models. According to model 4, when only the acquirer is in the M&A transaction, the CAR increases by 0.013 percent for a 1 percent increase in the number of patents that the acquirer has. With a 0.08 standard error, the OLS shows how this result is statistically significant at a 10 percent level, given by the "+" next to the fitted value. Model 1 shows a 10 percent significant relationship between patents and CAR, with a 0.012 percent increase in CAR for each percent increase in acquirer´s patents. The model shows a relationship between the acquirer´s CAR and the natural logarithm of granted patents for the acquirer when the acquiring party is the only party with patents in the M&A transaction in the [0] event window. However, the relationship does not offer as strong evidence as model 4 for event window [-1→1] and [-2→2]. The reasons can be multiple, but the most obvious guess for a weaker fit would be to include the day after the M&A announcement. We have a window only including the announcement date to see eventual differences in results.

Acquirer CAR(0) window

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	0.005	−0.041	−0.006	0.002	−0.028	−0.004
	(0.104)	(0.102)	(0.106)	(0.102)	(0.101)	(0.104)
ln Patent Acquirer	0.009					0.011
	(0.007)					(0.007)
ln Patent Target		−0.008				−0.010
		(0.009)				(0.009)
ln Total patents			0.006			
			(0.007)			
ln Only patent acquirer				0.013+		
				(0.008)		
ln Only patent target					−0.032	
					(0.023)	
Num.Obs.	103	103	103	103	103	103

Heteroskedasticity robust standard errors in parantheses.

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table 7.5: MLR on patent variables [0]

Summarizes the effect of patents on the CAR in the event window [0]. All six models include the control variables covered in section 6.1 and a year dummy variable between 2001 and 2021. The patents are all in natural logarithms. A 1 percent increase in patents yields a β_i percent increase in CAR, i.e., the relationship between CAR and patents has a log-log relationship. The intercept in each model is the fitted value for acquiring companies before the average effect of each of the included variables. Model 1 shows the impact of the acquiring party having a patent, and model 2 shows the effect of the target having patents CAR. Model 3 shows the relationship between the natural logarithm of total patents and the CAR. Model 4 shows the effect of only the acquirer having a granted patent, and model 5 shows the relationship between only the target having granted patents. Models 4 and 5 require that the other party in the M&A transaction does not have a granted patent before including the effect of granted patents in the deal. Model 6 contains both explanatory variables from models 1 and 2 together.

7.2.5 Effect of patents in the [1→20] event window

Table 7.6 summarizes the effect of granted parties on the acquirer´s CAR past the official announcement date in the [1→20] event window. It is worth noting that this event window still includes the day after the official announcement date and may, for that reason, include the actual announcement effect the official M&A announcement has on the acquirer´s CAR. We include the [1→20] event window to see if shareholders may process the information between securities with and without patents differently in the days following the announcement. Having patents is significant at a 1 percent level in both model 4 and model 6. A one percent increase in patents increases the acquirer´s CAR by 0.029 percent when only the acquirer has a patent and 0.025 percent when including the target´s patents in the same model. Also, the effect is significant at 5 percent level in model 1 and 10 percent level in model 3. Event windows [1→20] is the only occurrence where we find a significant effect in model 3, the natural logarithm of having an increasing number of patents in the deal. Model 3 estimates that a one percent increase in total patents in a deal increases CAR by 0.018 percent.

Acquirer CAAR(1->20) window

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Intercept	−0.076	−0.171	−0.082	−0.092	−0.156	−0.088
	(0.132)	(0.133)	(0.136)	(0.128)	(0.131)	(0.132)
ln Patent Acquirer	0.022*					0.025**
	(0.009)					(0.009)
ln Patent Target		−0.009				−0.015
		(0.011)				(0.011)
ln Total patents			0.018+			
			(0.010)			
ln Only patent acquirer				0.029**		
				(0.010)		
ln Only patent target					−0.040	
					(0.030)	
Num.Obs.	103	103	103	103	103	103

Heteroskedasticity robust standard errors in parantheses.

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table 7.6: MLR on patent variables [1→20]

Summarizes the effect of patents on the CAR in the event window [1→20]. All six models include the control variables covered in section 6.1 and a year dummy variable between 2001 and 2021. The patents are all in natural logarithms. A 1 percent increase in patents yields a β_i percent increase in CAR, i.e., the relationship between CAR and patents has a log-log relationship. The intercept in each model is the fitted value for acquiring companies before the average effect of each of the included variables. Model 1 shows the impact of the acquiring party having a patent, and model 2 shows the effect of the target having patents CAR. Model 3 shows the relationship between the natural logarithm of total patents and the CAR. Model 4 shows the effect of only the acquirer having a granted patent, and model 5 shows the relationship between only the target having granted patents. Models 4 and 5 require that the other party in the M&A transaction does not have a granted patent before including the effect of granted patents in the deal. Model 6 contains both explanatory variables from models 1 and 2 together.

7.3 Summary of acquirer´s return

According to the models above, patents have a 1-10 percent significance level on the CAR for the acquirer on the M&A announcement date. As for event windows [-2→2], [-1→1], [0], and [1→20], the most significant findings occur when only the acquirer has granted patents.
We find the most robust evidence between the natural logarithm of granted patents and the acquirer´s CAR in the [1→20] event windows when only the acquirer had a patent at the M&A announcement date. The effect was significant at a 1 percent level. The reason why companies with granted patents performed significantly better 20 days after the M&A announcement is hard to pinpoint. However, the interval includes the day following the official M&A announcement. As mentioned earlier, many companies release news about M&A activity after the market closes, meaning the market does not reflect the effect of the released information before day 1 in our event window. It is of the highest possibility that this causes significant evidence in the [1→20] event window.

The event window that solely includes the announcement date, [0], shows weaker evidence between granted patents and the acquirer´s return. The only significant find in table 7.5 is a 10 percent significant relationship between the natural logarithm of the acquiring party´s granted patents and its CAR. This event window has weaker evidence supporting MacKinlay´s (1997) theory that one should include a longer time horizon than just the announcement date, as these days may capture a considerable part of the effect. The most valid event windows in this thesis are thus [-2→2] and[-1→1].

We find no significant evidence looking at the [-20→-1] event window for granted patents and CAR in any of the models, meaning that the significant effect took place on the actual announcement. The findings are strong evidence for the return related to patents on the announcement date. If there were a significant effect between patents and acquirer´s return before the announcement, it would weaken the possibility that patents have a substantial impact regarding the announcement return if these companies were to have an abnormal return of the entire event window. It is also an indication that there was little information leakage in the sample.

The relationship between the acquirer´s granted patents and CAR was positive for all the related models. What this positive relationship derives from is not clear, as there may be several omitted variables, causing omitted variable bias in the model. However, we have included all the variables we deem to be a good fit for the model, which has been central in prior research on how M&A announcement affects the company´s stock price.

Looking at the tables above, we can indicate a negative relationship between the target´s number of patents granted and the CAR of the acquirer. None of the findings in any of the models were significant. Thus, there is no substantial evidence that any of the M&A transactions were believed to have significant value by acquiring a new patent for the acquirer company, which may be better utilized. However, as with the relationship between acquirer´s granted patents and acquirer´s CAR, there may be omitted variables causing a bias. It is, however, not clear which variables this is and the relationship between the natural logarithm of the target´s patents and acquiring party´s return on the M&A announcement date.

Additionally, the sample consists purely of both acquirer and target from Scandinavia. Scandinavia has a similar culture nationwide, meaning the variable cross-border might show more significant evidence in samples including more diverse nations. An example of such a sample would be the entire Europe.

The control variables are the ones we deem most appropriate to look at the effect of patents. However, there is no control variable related to research and development (R&D) spending. Patents are related to innovative power, and including a variable controlling for R&D spending might capture some of the patents acquired in the sample. We looked into an appropriate variable, but SDC Platinum did not offer appropriate data, meaning we would drastically need to reduce the sample. As the sample already consists of 103 acquirers and 74 targets, we excluded the R&D

7.4 The patent´s effect on target´s return

We will look at the target´s return in a deal involving patents. Figure 7.2 shows the return for targets with (triangles) and without (squares) patents over the event window [-20→20]. The figure indicates that targets with a patent have a higher return than deals not involving patents.

However, most of the return is observed up to the M&A announcement date, indicating information leakage. We will further determine if this effect is significant.

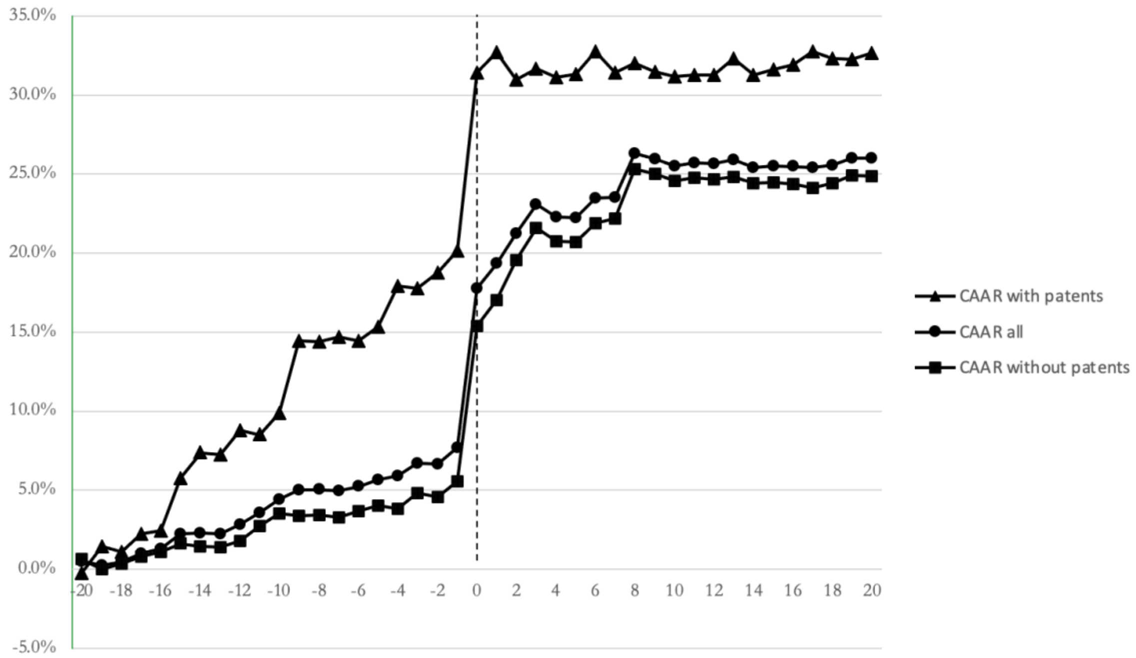

Figure 7. 2: Target CAAR event window [-20→20]

Presents the target´s CAAR in the event window [-20→20]. The lines summarize the CAAR when the target has a patent (triangle), the CAAR when the target does not have a patent (square), and the overall CAAR for the targets in our sample (circle)

As mentioned, the premium is a primary determinant of target shareholder returns upon merger announcement. Due to missing synergy data in the sample, it was impossible to conduct a regression of patents on premium as synergies determine premium again; thus, the assumption regarding the analysis would be violated. Therefore, a two-sided t-test to evaluate if patents in the deal affect the target shareholder returns.

Event Window	*t-value*	*p-value*	*95 percent confidence interval*
[1→20]	1.053	0.3059	[-0.080076, 0.24173142]
[1→10]	1.3534	0.1914	[-0.05362704, 0.25087266]
[-2→2]	0.15146	0.8812	[-0.1337099, 0.1545503]
[-1→1]	-0.41701	0.681	[-0.1400468, 0.0932935]
[0]	-0.29664	0.7695	[-0.12357319, 0.09264651]

[-10→-1]	-1.5876	0.1387	[-0.23939655, 0.03774934]
[-20→-1]	-1.9468	0.07494	[-0.3883397, 0.0214746]

Table 7.7: T-test on differences in CAR for targets (patent vs. non-patent

Summarizes the t-test, p-value, and 95 percent confidence interval for the seven event windows [1→20], [1→10], [-2→2], [-1→1], [0], [-10→-1], and [-20→-1].

Table 7.7 Summarizes the t-tests done for seven different event windows. The event windows in focus are [-2→2],[-1→1], and [0], all of which include the M&A announcement date. The p-values for the event windows are 0.8812, 0.681, and 0.7695, showing very little evidence for a significant relationship between the two variables. The 95 percent confidence interval for the three event windows also points to a negative relationship between the target having a granted patent and the acquirer´s return around the M&A announcement. The only significant find in table 7.7 is the p-value of 0.07494 in the event window [-20→-1]. A negative relationship significant at 10 percent is weak evidence for a significant relationship and only includes the event window leading up to the M&A announcement. Thus, the relationship between the target shareholders and if the target has granted patents is not significant in our sample; the sample does not provide evidence for a relationship between a target´s granted patents and the premium.

8.0 Discussion and conclusion

8.1 Summary and contributions

This thesis uses the event study methodology to calculate the CAR of a sample including acquirers and targets with and without patents to check if granted patents significantly affect M&A transactions. We follow MacKinlay´s (1997) approach for event studies in economics and finance and the market model explained in his studies. The sample in this thesis consists of 103 acquirers and 74 targets from Sweden, Norway, and Denmark. We have focused on the event windows [-2→2], [-1→1], and [0] to look for results regarding the M&A announcement. Additionally, we control for effects in event windows [-20→-1] and [1→20] to check for significant effects around M&A announcements and also check for information leakage.

For acquirers, previous research found a significant relationship between multiple control variables used in this thesis, e.g., a significant relationship between the size of the acquiring party and the return in the M&A announcement (Moeller, Schlingemann, & Stulz, 2004). However, there was little significance for our control variables in the OLS regression on the acquirer´s CAR. For the event windows in focus, the only significant effect found for the control variables was a positive effect between cross-industry and the acquirer´s CAR. The relationship was evident at a 10 percent significance value, which is as strong as Megginson, Morgan, and Nail (2004) findings, which found a significant effect and an average 4.39 percent fall in acquirer´s price on cross-industry M&A announcement. The cross-industry deals from both Megginson, Morgan Nail´s sample, and our sample are identified by the two first digits in the SIC matching. Other than the 10 percent significant effect in cross-industry deals, there is no significant effect between the acquirer´s CAR and other control variables in the event windows [-2→2], [-1→1], and [0].

Further, we include patents in the OLS regression to see if patents significantly affect the acquirer´s CAR in an M&A announcement. We include all the control variables when regressing for patents. The OLS regressions use the natural logarithm of patents as the determinant variable. We performed the OLS for all five of the event windows included in the thesis, and there are six models for each event window. The six models are (1) the effect of acquirer´s patent, (2) the effect of target´s patents, (3) the effect of total patents in the deal, (4) the effect of only the acquirer having a patent, (5) the effect of only the target having a patent, and (6) combines models 1 and 2. We include only granted patents in the sample.

The effect on acquirer shareholder return is positive and significant for all event windows [-2→2], [-1→1], and [0], when the acquirer has granted patents. The findings support hypotheses 2 and 4, which are the only hypothesis supported by the findings in this thesis. The most significant effect occurs for event windows [-2→2] and [-1→1] with a 5% significance level and at a 10 percent level for event window [0]. For event window [0], patents have weaker evidence for the acquirer´s CAR. According to MacKinlay´s (1997) research, one should always include a wider time horizon than just the official announcement day. The time horizon should be wider to account for information leakage, but most important, including the day following the M&A announcement. One should include the day after the announcement date to account for effect on the market if the M&A announcement is released after the market closes on the official announcement day.

After that, we studied the effect of patents on targets´ CAAR by looking at the effect of patents on the targets´ return. For acquisitions, synergies are an absolute determinant of premium, which further determines target shareholder returns. Due to synergy data missing on Bloomberg Terminal and SDC Platinum for a substantial amount of the sample, we do not implement an OLS regression for targets. Omitting synergies as a variable would lead to substantial omitted variable bias. Hence, we have done a t-test for each of the event windows. The t-test is done between the target's return in the event window and whether or not the target has a granted patent. To better suit a t-test, we use a dummy variable for patents. The t-test indicates no significant evidence between premium and patents. The t-test for [-2→2], [-1→1], and [0] show high p-values for patents, and we conclude that there is no significant relationship between the premium paid and granted patents.

8.2 Limitations and future avenues of research

Our thesis includes control variables to try to minimize omitted variable bias. However, the study does not include a variable for R&D spendings, which likely will capture some CAR effects for acquirers. R&D spendings are highly correlated with the number of patents, as patents are the most frequently used indicator for technological output (Danguy, de Rassenfosse, & van Pottelsberghe de la Potterie, 2009). Using R&D spendings instead of patents could be another approach to our thesis.

Another limitation to our model is including multiple industries and later controlling for cross-industry. Looking at the effect of patents in a single industry may lead to other results. An example of such an industry is the pharmaceutical industry, where the M&A activity is highly driven by patents (Ascher, Bansal, Dhankhar, & Kim, 2020). We prioritized looking at the effect of patents in Scandinavia. If we restricted our research to a single industry, the sample size would shrink. The small sample would lead to immense standard errors. Therefore, including a broader geographical area and singling in on a specific industry would be a new approach to this thesis.

This thesis uses a [-20→20] event window with a 250 day estimation period. We solely look at the short-term effect patents have on shareholder value and do not consider a long-term approach for patents´ effect. Looking at how acquirers and targets perform on a long-term horizon could be just as interesting as the short-term effect. A long time horizon could include one, two, and three years. However, the complications with a long-term view are a considerably higher amount of factors to consider. Even though the market model (MacKinlay, 1997) takes the systematic risk of the market into account, there may still arise fluctuations in stock price because of company-specific events. Unsystematic risk is always present, and other events affecting the price might occur in the post-event window, leading to biased results. Examples of such events are other M&As and changes in management.

Researchers have so far found less evidence on long-term CAR to shareholders of acquirers compared to short-term returns. Lubatkin (1987) used a 1-year post-event window and found a slight positive CAR for acquirers, while Laughran and Vilj (1997) found a significant effect for tender offers. Other studies found a negative return for acquirers (Gregory & McCorriston, 2005; Sudarsanam & Mahate, 2003). Asquith, Bruner, and Mullins (1983) elaborate how different samples and methodologies greatly vary findings in research. To study a patent´s effect over a long-term horizon would be an interesting future avenue of research to this study.

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