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The Value Creation of Intellectual Property in Mergers and Acquisitions

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Abstract

This thesis examines the shareholder value creation of IP in M&A. Using a unique patent-M&A data set over the period 2006 to 2016, we show that acquirers of companies holding IP gain significantly more shareholder value than acquirers of targets not holding IP. We find that this only holds as a binary relationship, and that the discrete relationship between shareholder value and IP is negative. We also find that potential IP synergies do not increase shareholder value. We conclude that, while IP is a vital part of targets' assets in M&A activities, ambitious valuations and large IP premia may shift future IP-induced value from acquirers to targets.

Keywords: intellectual property; IP; innovation; research and development; R&D; mergers and acquisitions; M&A; patents; value creation; shareholder value

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1 Introduction

During the past decades, a large number of mergers and acquisitions (M&A) have been made because of acquirers' perceived need for targets' intellectual property (IP)[1] including patents, technological know-how, licenses, and media portfolios (Holmström and Roberts, 1998; Kaplan, 2000; Lamb, 2002). Google's acquisition of Motorola Mobility in 2011 illustrates this phenomenon in today's deals. Both Google and Motorola Mobility were active in the market for mobile devices which use the open-source operating system Android, and Motorola Mobility held a large number of Android patents which could "increase competition by strengthening Google's patent portfolio [...] to better protect Android from anti-competitive threats from Microsoft, Apple, and other companies", according to Google's co-founder and former CEO Larry Page (2011). Three years later, Lenovo acquired Motorola Mobility from Google, but Google maintained ownership of Motorola Mobility's Android patents (Lenovo to Acquire Motorola Mobility, 2014).

The Google case is just one of many famous IP heavy deals which have taken place in the past decades[2], and the role of IP in firms' M&A activities has not been overlooked by the academic community. Existing research on IP and related fields such as "innovation" and "R&D" in M&A shows that firms' desire to acquire IP in forms of knowledge (Holmström and Roberts, 1998) and intangible assets (Lamb, 2002) drives a large number of today's M&A deals. This is especially true when firms are learning about new markets, or when new technologies are developing around them (Holmström and Roberts, 1998), which in the Google case would be the development of Android products in the ever emerging mobile devices and tablets market. Outside of the M&A spectrum, existing research points in the same direction when it comes to the general value creation of knowledge and intangible assets in firms, and it is established that IP in itself has a positive impact on firm value (Jaffe, 1986; Bloom and Reenen, 2002; Nicholas; 2008, Pastor and Veronesi, 2005). At a first glance, it therefore seems obvious that IP should be value creating within the M&A spectrum. Yet, most of the literature is in fact rather anecdotal and impressionistic, and is lacking empirical evidence on whether or not, and if so, how IP is value creating in transactions. However, some findings regarding IP's value creation properties are present within the boundaries of IP research, but they are often focused on long-term operational value arising from synergies between firms. For instance, firms with similar technological characteristics participating in IP heavy deals experience strengthened R&D abilities, a more competitive positioning on the market (Cassiman and Veugelers, 2006; Cassiman and Colombo, 2006), and economies of scale benefits from combined R&D activities (Henderson and Cockburn, 1996). These types of operational improvements arising from IP focused M&A have not been ignored by

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[1]See appendix A.1 for a formal definition of IP, and an overview of common types of IP.

[2]See e.g. Citicorp's merger with Travelers Group in 1996; Exxon's acquisition of Mobil in 1998; AOL's merger with Time Warner in 2000; and American Home Products' merger with Warner-Lambert in 2000.

technology intense firms; it has recently been shown that a technological overlap between firms' R&D activities has a positive effect on the likelihood to participate together in a merger or acquisition (Bena and Li, 2014). However, to the best of our knowledge, there exists no empirical evidence on whether or not IP creates value for acquiring firms' shareholders in M&A transactions.

The purpose of this thesis is to fill this gap in the literature and investigate if IP creates shareholder value for acquirers, if the *amount* of IP matters, and if shareholders of acquiring firms benefit from potential synergies due to combined IP. Following Ahuja and Katila (2001), we proxy IP as number of patents granted, and construct a unique patent-M&A data set over the period 2006 to 2016. We conduct an event study over the period to estimate wealth effects of M&A, followed by a set of univariate and multivariate cross-sectional OLS regressions to estimate wealth effects of IP in M&A. Not surprisingly, we show that M&A create more shareholder value for firms which acquire targets with IP. However, surprisingly, we cannot show that the targets' amount of IP has a positive relationship with shareholder value creation for acquiring firms. Based on M&A theory, we speculate that this may be due to systematically high valuations of firms with large IP portfolios, caused by acquirers overestimating their own ability to capitalize on acquired IP. Also surprisingly, we find no evidence that there is a higher increase in shareholder value for acquiring firms the more IP both acquirers *and* targets hold during a transaction. Based on M&A theory, we speculate that this may be due to targets taking the potential synergies into account when deciding on what price to ask for, and hence capturing these benefits for themselves. In addition to these speculations, we recognize that patents is not a flawless proxy for IP, e.g. due to the fact that two patents, per definition, cannot be equal.

This thesis provides, to the best of our knowledge, the first ever thorough mapping out of the relationship between IP and M&A value creation. Our findings can serve as food for thought in M&A decision making; we argue that IP represents an opportunity to increase shareholder value for acquiring firms, but issue a note of caution for overvaluations, especially of targets with large IP portfolios. In addition, this thesis can serve as a platform for future research within this rather underdeveloped field. In particular, we request similar studies on other types of IP (e.g. trademarks and copyrights), as well as a refinement of the patent measurement incorporating the value difference between patents.

The remainder of this thesis is structured as follows: In section 2 we show our hypotheses development, in section 3 we show the methodology used for testing our hypotheses, in section 4 we present and discuss our findings, and in section 5 we conclude the thesis with a summary, implications, and suggestions for future research.

2 Hypotheses Development

In this section, we present the four hypotheses which we test in this thesis, and the literature from which they are developed. Hypothesis 1 concerns value creation in M&A, and states that M&A in general conserve value for acquirers. Hypothesis 2 concerns IP and its relation to M&A, and states that M&A create more value for acquirers if their targets hold IP. Hypothesis 3 concerns the *amount* of IP and its relation to M&A, and states that conditional on targets holding IP, shareholder value for acquiring firms increases with the amount of target firms' IP. Hypothesis 4 concerns IP synergies and their relation to M&A, and states that the more IP target firms *and* acquiring firms possess during a transaction, the higher the increase in shareholder value for acquiring firms.

2.1 Value creation in M&A

M&A, and its effect on firm value is an extensively theorized and researched subject. Several theories attempting to explain the motivation for M&A have been developed, and numerous empirical studies[3] have investigated M&A performance. Implications of theories and previous empirical work are discussed before arriving at our first hypothesis.

Already in 1965, Henry G. Manne described the notion that there exists a market for corporate control. That is, corporate control is a valuable asset which is bought and sold in the equity markets. He argues that there may exist a difference between the market value of a firm as implied by its stock price, and what it could be under efficient management. Koller, Goedhart and Wessels (2010) describe this phenomenon, calling it the best owner principle, and they propose three major reasons why one owner may be better than another, and, maybe more importantly, why this may change over time. Firstly, an owner may have links with other businesses, which they can leverage to, for example, increase the customer base, or share manufacturing infrastructure with. Secondly, an owner may simply be able to access a management team with superior skills, which can enhance performance. Thirdly, an owner may have better insight and foresight regarding how a market and/or industry will develop, and hence take advantage of this. Finally, Koller et al. (2010) proposes that the best owner is a dynamic definition, arguing that different characteristics are favorable during different stages of a firm's life cycle; for example, an enthusiastic, but perhaps inexperienced, entrepreneur may be the best owner during the start-up phase, while a mature firm with high cash flows, and limited investment opportunities may be the best owner during the expansion phase.

The synergy hypothesis suggests that the value of two firms combined is larger than the sum of their values as individual firms (Seth, Song and Pettit, 2000). Looking at the long

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[3]E.g., through a meta-analysis, King, Dalton, Daily and Covin (2004) found more than 90 empirical studies on post-acquisition performance between 1921 and 2002.

term effects on share prices of targets of unsuccessful acquisitions, Bradley, Desai and Kim (1983) investigate the rationale behind acquisitions. Arguing that a permanent increase in target share price would suggest that the increase is due to a discovered undervaluation, while a temporary increase would suggest a discovered potential for synergies, the authors find that synergies seem to be the rationale behind acquisitions. The increases do, however, tend to be semi-permanent, but this is argued to be due to an anticipated second bid after the unsuccessful one. These findings are confirmed by e.g. Berkovitch and Narayanan (1993), and Seth et al. (2000). The source of these synergies is primarily efficiency improvements rather than the consolidated firm leveraging its increased market power (Devos, Kadapakkam and Krishnamurthy, 2009). However, this conclusion does not hold across all industries; airlines generally increase their fairs after mergers (Kim and Singal, 1993), and interest rates on deposits decrease after acquisitions of small banks (Sapienza, 2002).

The hubris hypothesis suggests that the potential for improved ownership or synergies is not enough to justify the large premia in M&A, but instead acquirers overestimate their own ability to create value, and due to this simply pay too much (Roll, 1986). An interesting notion put forth by Roll (1986) is the fact that a positive acquisition premium is necessary for a rational target to accept the bid. This means that, in the absence of the above mentioned improvement of ownership and synergies, M&A will harm acquirers but benefit targets. Since Roll's (1986) article, several studies have shown evidence in support of the hubris hypothesis (e.g. Berkovitch and Narayanan, 1993; Seth et al., 2000).

The agency dilemma suggests that a conflict between owners (the principal) and management (the agent) exists due to their different incentives; owners wish to maximize shareholder value, while management wish to maximize their own compensations (Jensen, 1986). A logical conclusion of the agency dilemma is that acquisitions will occur even in the absence of actual (improved ownership or synergies) or perceived (hubris) potential benefits, simply due to the fact that management has incentives (e.g. Murphy, 1985; Baker, Jensen and Murphy, 1988) to increase the size of their firm. Several studies have shown evidence in support of the agency dilemma in M&A (e.g. Berkovitch and Narayanan, 1993; Seth et al., 2000).

Early empirical work on M&A's effect on shareholder value for the acquirer shows small insignificant gains (e.g. Mandelker, 1974; Langetieg, 1978; Asquith, 1983), or even small significant losses (Dodd, 1980). However, Asquith, Bruner and Mullins (1983) suggest that this may be due to failure in measuring the value effect accurately; in particular, they point out that previous studies have not included the period prior to the merger in their event windows. Doing so themselves, the authors show that shareholders of the acquiring firms actually do benefit from acquisitions. While these findings seem to have

solved the mystery of M&A's effect on firm value, subsequent studies show that this is not the case. Jensen and Ruback (1983) conclude that M&A conserves value for the acquirer, and these results are confirmed by e.g. Bradley, Desai and Kim (1988), Datta, Pinches and Narayanan (1992), Seth et al. (2000), and Bruner (2002). The situation is further complicated when King et al. (2004), after having conducted a thorough meta-analysis of 93 empirical studies with a total of 852 effect sizes, and a total of 206,910 firms studied, find statistically significantly positive abnormal returns on the event day, but statistically significantly negative abnormal returns for event windows between 22 days and 3 years.

Reviewing the theories attempting to explain M&A activity, it is evident that M&A can be viewed either in a benign light as a measure to increase shareholder value (best ownership principle and synergy hypothesis), or in a malign light as a result of management disillusion (hubris hypothesis) or selfishness (agency dilemma). The former would suggest that M&A activity is value creating, while the latter would imply value conservation or even destruction. In line with this, the empirical results are inconsistent, with the largest part of the studies indicating value conservation. Therefore, our first hypothesis is:

Hypothesis 1: Acquiring firms, on average, neither create nor destroy shareholder value through their M&A activity.

2.2 IP and value creation in M&A

In contrast to M&A, and its effect on firm value, which is an extensively theorized and researched subject, IP, and its role within M&A, is not. It is scattered around different fields, such as "innovation", "R&D", and "knowledge transfer", but rarely is the main variable of interest in empirical M&A research. However, the argument that many M&A take place because of technological reasons can be seen as consensus. Holmström and Roberts (1998) argue that knowledge transfer is a common driver of M&A, and horizontal expansions of companies in general, especially when learning about new markets or when new technologies are developing, and that the trend towards business globalization allows for high premia on the knowledge sharing in acquisitions. On this token, Kaplan (2000) concludes, based on a collection of M&A cases, that most of the M&A studied were associated with technological shocks, and that this is true for several industries; e.g. the airline, banking, hospital, and pharmaceutical industries. Lamb (2002) extends this argument, arguing that firms' vital desire to acquire IP even is the major cause of M&A. At a first glance, it therefore seems obvious that IP should be value creating in M&A. Yet, most of the literature is in fact rather anecdotal and impressionistic, and is lacking empirical evidence on whether or not, and if so, how IP is value creating in transactions. However, some findings regarding IP's value creation properties are present within the boundaries of IP-related fields. Jaffe (1986) shows that patents, profits, and market value are systematically related to the technological position of firms' research programs,

indicating the importance and value of IP. Further, Bloom and Reenen (2002) show that patents have a significantly positive impact on market value and firm-level productivity, and because patents provide exclusive rights to innovation, firms can generate valuable real options, and delay investments. Regarding shareholders' direct response to IP related activities, Pastor and Veronesi (2005) show that stock prices of innovative firms increase during technological shocks, and Nicholas (2008) finds that investors also respond to the *quality* of technological innovations, and that the value of IP increases during times in which these innovations occur, causing stock market run ups.

Reviewing existing work on IP and its role within M&A, it is clear that the argument that IP is a key driver of M&A is rather established. Further, the argument that IP in isolation creates firm value seems to be broadly established. Combining these two arguments, our second and third hypotheses are:

Hypothesis 2: M&A create more shareholder value for acquirers if their targets hold IP.

Hypothesis 3: Conditional on targets holding IP, shareholder value for acquiring firms increases with the *amount* of target firms' IP.

According to the classic synergy hypothesis, the value of two firms combined is larger than the sum of their values as individual firms (Seth et al., 2000). This combined value is seen as one of the rationales behind acquisitions (Bradley et al., 1983), and the sources of synergies are primarily efficiency improvements, rather than increased market power (Devos et al., 2009). However, as in the case with the topic of IP and shareholder value creation previously discussed, the topic of synergies arising from IP, and shareholder value creation is not entirely established. Previous empirical work has primarily focused on long-term operational synergies arising from "innovation", "R&D", "similar technological characteristics", and "technological overlaps" in M&A. On this, Higgins and Rodriguez (2006) show that when firms merge with or acquire another firm with similar technological characteristics, information asymmetry coming from uncertainty of valuing IP can be mitigated. In particular, they show that returns for acquirers in the pharmaceutical industry are positively correlated with acquirers pre-transaction access to information about targets' R&D activities. Further, Cassiman and Veugelers (2006), and Cassiman and Colombo (2006) show that firms participating in M&A activities may experience a more competitive positioning on the market, and strengthened R&D abilities, if they are technologically overlapped. For these firms, this experience may not only be strengthening for their R&D departments, but also causing valuable synergy effects from an economies of scale perspective, where firms involved in such transactions can mitigate duplicated R&D departments, and increase efficiency (Henderson and Cockburn, 1996). These types of operational improvements arising from IP focused M&A has not been ignored by

technology intense firms, and Bena and Li (2014) provide empirical evidence to this topic. They show that a technological overlap between firms' R&D activities has a positive and significant impact on the likelihood to participate together in a merger or acquisition, and that firms with high R&D expenses are likely to be targets, indicating that firms realize the potential efficiency improvements coming from combined R&D departments, in line with Henderson and Cockburn (1996). Bena and Li (2014) further conclude that synergies which are obtained from combined innovation capabilites are important drivers of M&A.

Since IP in isolation creates firm value, together with evidence of long-term operational synergy effects arising from overlapping R&D and technology in mergers or acquisitions, and that synergies obtained from combined innovation capabilities are important drivers of M&A, our fourth hypothesis is:

Hypothesis 4: The more IP target firms *and* acquiring firms possess during a transaction, the higher the increase in shareholder value for acquiring firms.

3 Method

In this section, we first present our patent-M&A data set, and how it was constructed. Thereafter, we present our specific modifications of the event study approach in order to capture M&A wealth effects for our sample. Finally, we present the model specifications of the regression analysis we use to estimate wealth effects of IP in M&A.

3.1 Data collection

Given the unique nature of this study with regards to its focus on IP proxied by patents, there exists no precedent on how to properly collect the patent data needed. Due to this, the lion's share of time has been spent collecting data, and making sure this data is correct and reliable. This rigorous scrutiny applies to the data collection in whole, but especially to the collection of patent data. Data has primarily been collected from the three databases Bureau van Dijk's Zephyr, European Patent Office's (EPO) Global Patent Index, and Thomson Reuters Datastream.

Databases

Zephyr provides "Comprehensive M&A data with integrated detailed company information" (Zephyr - Overview, 2016). We have used this data to find our original sample of transactions (see appendix A.2 for a detailed description of how this search was conducted), as well as to identify certain characteristics of the deals and their participants. In particular, Zephyr was used to identify the market value of the acquirer, the acquisition price, the method of payment, and whether the acquisition was focused (same industry or supplier/customer) or not (conglomerate). The former three data types were straightforward to collect as the data was directly given in the search results. The latter, however, was not. Instead, the industries in which the acquirer and target respectively operated were provided. From this information, we concluded whether or not the acquisition was focused. If no strong evidence for a focused acquisition was found, it was assumed to be a conglomerate acquisition.

Global Patent Index provides data on published patents with regards to numerous criteria, the most important one to us being the applicant. We have used this data to identify how many active patents the acquirer and target owned respectively at the transaction announcement day (see appendix A.3 for a detailed description of how this search was conducted). Since each search query was made manually using SQL (Search Query Language), we were particularly careful not to make any errors. As a step to ensure that these counts were accurate, they were compared to figures obtained from the United States Patent and Trademark Office's (USPTO) Patent Assignment Search. USPTO's search engine was not as customizable as EPO's, hence granted patents could not be singled out from all applications. Due to this, we could not determine with absolute certainty that the counts were correct, but rather conclude that they were reasonable with

regards to the number of patent applications the company had filed during the period of interest. Two types of scenarios in particular raised our suspicions of some sort of error: (1) when the number of published patents granted from EPO exceeded the number of patent applications from USPTO, and (2) when the number of patent applications from USPTO greatly exceeded the number of published patents granted from EPO. Scenario (1) only occurred a single time, and was due to an incorrect search query. Regarding scenario (2), it was not uncommon to find the number of patent applications being up to ten times as large as the number of published patents. However, when the ratio exceeded ten, or when there were no published patents but more than ten patent applications, we looked closer at the search results to ensure that there was no error. Usually, these discrepancies were caused by the company having filed a large portion of its patent applications in the near past, resulting in them not yet being granted (or denied). On the odd occasion that the discrepancy was due to an incorrect search query, this error was corrected.

Datastream provides a wide specter of financial data; from bond yields to company sales. For this study, the database has been used to obtain stock price data for the acquirers in the acquisitions of interest, as well as the S&P 500 index. This data was used to estimate normal returns, and calculate abnormal returns (see subsection 3.2). The data is daily prices, and the selected data type is *Price (Adjusted - Default)*, which represents the official closing price for the stock of interest.
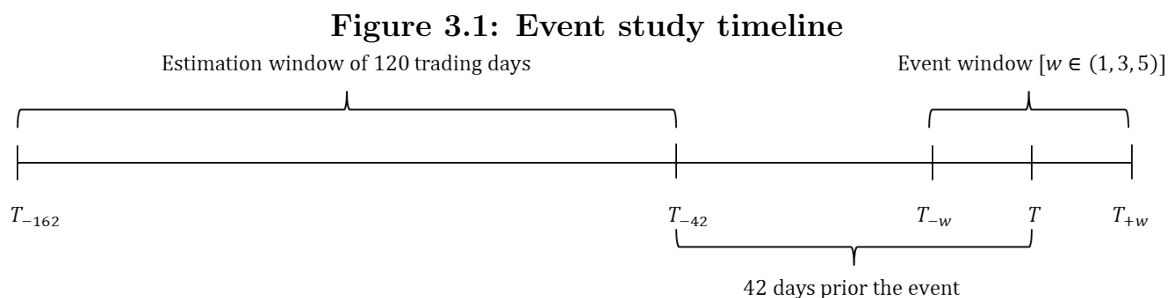
Sample of transactions

The search strategy described in appendix A.2 resulted in an initial sample of 347 transactions. In order to avoid event clustering (see subsection 3.2 for further discussion on this phenomenon), 44 events had to be removed due to having announced transactions during their estimation and/or event windows; 89 events had to be removed due to having completed transactions during their event windows; 2 events had to be removed due to having completed transactions during their estimation windows; and 28 events had to be removed due to occurring before 01/10/2006, meaning it cannot be ensured that no transaction announcement or completion has interfered with the estimation windows. In addition, 2 events had to be removed due to completely lacking stock price data for the acquirer in Datastream, and another 5 events had to be removed due to lacking stock price data in the relevant period for the acquirer in Datastream. After this reduction, an initial event study analysis was conducted on the sample of 177 transactions. However, all these transactions were not suitable for our regressions; 35 of them were acquisitions of parts of a company rather than a whole one, meaning data on patent ownership was unobtainable; and 30 of them lacked data on method of payment in Zephyr. With these transactions removed, we ended up with a final sample of 112 transactions, which we matched with the patent data from the Global Patent Index.

3.2 Estimating wealth effects of M&A

As introduced by Dolley (1933), but developed and made famous by e.g. Fama, Fisher, Jensen and Roll (1969), the event study analysis (see e.g. Brown and Warner, 1980; 1985, and MacKinlay, 1997, for a modern detailed description) is the primary method for studying effects of an economic event on the value of firms, such as wealth effects of M&A. The main idea is that in efficient markets, the instant wealth effects reflect the market's valuation of the present value of future benefits of M&A, including both instant and expected cash flows (Datta et al., 1992). This type of analysis dominates the empirical research within the M&A field, with famous applications of e.g. Manne (1965), Eckbo (1983), Jensen and Ruback (1983), Jarrell, Brickley and Netter (1988), and Jarrell and Poulsen (1989), where wealth effects of M&A are measured as abnormal returns on, and around, the announcement day (MacKinlay, 1997).

Estimation window, event window, and event day

In this event study, the estimation window consists of 120 trading days, which is based on the length of estimation windows in e.g. Schwert (1996) and MacKinlay (1997). In order to avoid event clustering, which is when the effect of a studied event affects the estimated normal return, the estimation window should be separated from the event day. When aggregating abnormal returns, no event clustering is assumed; inference testing is possible even in the presence of event clustering, but certain adjustments have to be made (MacKinlay, 1997). The estimation window ends 42 days prior to the event day in this study[4]. Further, in this study the event windows consist of three, seven, and eleven days, and the event day is the first announcement day of the merger or acquisition, which historically has been the appropriate event day for event studies measuring wealth effects of M&A (Datta et al., 1992). In order to describe our analysis, some notation is needed. We have used MacKinlay's (1997) notation with our own modifications. Returns on individual days during events will be indexed τ. Let $\tau = T$ be the event date and let $\tau = T_{-w}$ to T_{+w} represent an event window.

Figure 3.1: Event study timeline

Estimation window of 120 trading days   _Event window $[w \in (1, 3, 5)]$_

T_{-162} T_{-42} T_{-w} T T_{+w}

42 days prior the event

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[4]Schwert (1996) shows, in his paper examining the relation between premia in takeover bids and pre-announcement stock price run-ups, that cumulative abnormal returns started to rise around 42 days before the first bid announcement.

Market model

When calculating the normal return for a given security, both statistical and economic models can be used (MacKinlay, 1997). Even though both approaches have been evaluated, the market model, which is a statistical model, has been used in this study. We have chosen the market model for two reasons. First, it is one of the most frequently used models when studying wealth effects of M&A (see e.g. Fama, Fisher, Jensen and Roll, 1969 and Asquith et al., 1983). Second, its linear specification provides an opportunity to remove the portion of a given security's return which is related to variation in the market return. MacKinlay (1997) shows that for any security i, the model is specified as:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it} \tag{3.1}$$

$$E(\epsilon_{it} = 0) \qquad var(\epsilon_{it}) = \sigma^2_{\epsilon_i}$$

R_{it} is the arithmetic return for any security i at time t, and R_{mt} is the market return at time t. Given the estimated parameters in (3.1), expected returns for any security i can be calculated as:

$$E[R_{it}] = \hat{\alpha}_i + \hat{\beta}_i R_{mt} \tag{3.2}$$

Abnormal returns

Subtracting (3.2) from the arithmetic return $R_{i\tau}$ gives the abnormal return for security i at any event date τ, which is equivalent to the disturbance term in equation 3.1 and denoted as:

$$\widehat{AR_{i\tau}} = R_{i\tau} - E[R_{i\tau}] \tag{3.3}$$

or equivalently

$$\widehat{AR_{i\tau}} = R_{i\tau} - \hat{\alpha}_i - \hat{\beta}_i R_{m\tau} \tag{3.4}$$

Using the notation in (3.3), we have estimated abnormal returns for each security i during each event date τ included in this study. These abnormal returns have then been aggregated across all securities for each event date τ in the event window(s), allowing us to analyze abnormal returns for any event date τ in isolation. The sample aggregated abnormal returns are denoted as:

$$\overline{AR}_\tau = \frac{1}{N} \sum_{i=1}^{N} \widehat{AR_{i\tau}} \tag{3.5}$$

Cumulative abnormal returns

The abnormal returns have not only been aggregated over securities, but also over time as shown below in (3.6). Further, (3.6) has then been averaged allowing us to analyze an event window $\tau = T_{-w}$ to T_{+w} in isolation, as shown in (3.7).

$$\widehat{CAR}_i(T_{-w}, T_{+w}) = \sum_{T=T_{-w}}^{T_{+w}} \widehat{AR}_{i\tau} \tag{3.6}$$

$$\overline{CAR}(T_{-w}, T_{+w}) = \frac{1}{N} \sum_{T=T_{-w}}^{T_{+w}} \widehat{CAR}_i(T_{-w}, T_{+w}) \tag{3.7}$$

To test our first hypothesis, that acquiring firms, on average, neither create nor destroy shareholder value through their M&A activity, we have applied a one-sample t-test on the estimated cumulative average abnormal returns shown in (3.7) for the samples of 177 and 112 transactions. In order to test whether transactions with targets holding patents granted are statistically different from transactions with targets not holding patents granted, we have performed a two-sample t-test (Welch's test).

3.3 Estimating wealth effects of IP in M&A

Following Ahuja and Katila (2001), we proxy IP as number of patents granted, and in order to test the three hypotheses concerning IP and value creation in M&A, we conducted a set of univariate and multivariate cross-sectional OLS regressions. The univariate regressions measure the overall relationships between the dependent and independent variables. The multivariate regressions, on the other hand, attempt to isolate the effects of the variables of interest by controlling for other variables. The specifications of the univariate and multivariate regressions can be seen below in (3.8) and (3.9) respectively.

$$y_i = \alpha + \beta X_i + \epsilon_i \tag{3.8}$$

$$y_i = \alpha + \beta X_i + \sum_{k=1}^{K} \gamma_k Z_{ik} + \epsilon_i \tag{3.9}$$

where y_i represents the (cumulative) abnormal return for firm i, as calculated in subsection 3.2, X_i represents the independent variable of interest for firm i, and Z_{ik} represent any control variable k for firm i[5]. Note that we have three variables of interest, and regress abnormal returns for three event windows as well as the announcement day, giving us 3x4 regressions for each of the two representations above.

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[5]See appendix A.4 for fully specified regressions.

In order to test our second hypothesis, that M&A create more shareholder value for acquirers if their targets hold IP, we, in addition to performing Welch's test described in subsection 3.2, constructed a dummy variable, denoted as *PatentDummy*. This variable of interest is binary, and takes the value 1 if the target in the acquisition has published a patent within 20 years prior to the deal, and 0 otherwise. Regressions with *PatentDummy* as the variable of interest include all 112 transactions; this in order to test if the estimated abnormal returns are higher in transactions where the target holds patent rights. In line with hypothesis 2, we predict a positive relationship between the *PatentDummy* variable and the estimated abnormal returns.

In order to test our third hypothesis, that conditional on targets holding IP, shareholder value for acquiring firms increases with the amount of target firms' IP, we constructed a discrete variable, denoted as *PatentCount*. This variable of interest takes a value equal to the number of patents the target has published within 20 years prior to the deal, as described in subsection 3.1. Regressions with *PatentCount* as the variable of interest exclude the sub-sample of transactions with targets not holding patent rights; this in order to test if, conditional on the target holding patents, abnormal returns increase with the number of patents granted. In line with hypothesis 3, we predict a positive relationship between the *PatentCount* variable and the estimated abnormal returns.

In order to test our fourth hypothesis, that the more IP target firms *and* acquiring firms possess during a transaction, the higher the increase in shareholder value for acquiring firms, we constructed an interaction term, denoted as *IPSynergies*. This variable of interest is given by the product of the patent counts of the target and the acquirer. That is, the patent count of the target is multiplied with the patent count of the acquirer. Regressions with *IPSynergies* as the variable of interest include all 112 transactions; this in order to test if abnormal returns increase with the target's and acquirer's combined amount of patents granted. In line with hypothesis 4, we predict a positive relationship between the *IPSynergies* variable and the estimated abnormal returns. In addition to the three variables of interest, a vector of control variables is included in (3.9); these control variables are:

- *FirmSize* - The first control variable is a continuous variable given by the natural logarithm of the market value of the acquirer at the time of the acquisition. This variable is included since previous research has shown that the number of patents increases with firm size (Cohen and Levin, 1989; Mansfield, 1986).

- *RelativeSize* - The second control variable is a continuous variable given by the ratio of the acquisition price to the market value of the acquirer at the time of the acquisition. Asquith et al. (1983) investigate wealth effects from merger programs

conducted between 1955 and 1979 by 156 of the Fortune 1,000 of 1979. They find that the abnormal returns from acquisitions of targets with small relative size are smaller than those with large relative size. These results can, however, not be confirmed by Agrawal, Jaffe and Mandelker (1992). Based on this, we predict a positive relationship between *RelativeSize* and abnormal returns, but acknowledge the possibility of no significant relationship.

- *EquityPayment*[6] - Our third control variable is a dummy variable which takes the value 1 if equity has been used to pay for the acquisition, and 0 otherwise. Datta et al. (1992) employ a multivariate framework and regression analysis using observations from 41 studies on wealth creation from M&A. They find that paying for an acquisition using equity destroys value. These results are confirmed by e.g. Bruner (2002), while King et al. (2004) find no significant relationship. Based on this, we predict a negative relationship between *EquityPayment* and abnormal returns, but acknowledge the possibility of no significant relationship.

- *CashPayment*[6] - The fourth control variable is a dummy variable which takes the value 1 if cash has been used to pay for the acquisition, and 0 otherwise. Datta et al. (1992), as mentioned above, also find that paying for an acquisition using cash conserves value. These results are confirmed by e.g. Bruner (2002), and King et al. (2004). Based on this, we predict no relationship between *CashPayment* and abnormal returns.

- *Conglomerate* - The fifth and final control variable is a dummy variable which takes the value 1 if the acquisition is considered unfocused as described in subsection 3.1, and 0 otherwise. Bruner (2002) reviews 14 informal surveys, and 100 scientific studies regarding M&A and its effect on firm value. He finds that conglomerate acquisitions destroy value. These results are confirmed by e.g. King et al. (2004), but contradicted by Agrawal et al. (1992), while Datta et al. (1992) find no significant relationship. Based on this, we predict a negative relationship between *Conglomerate* and abnormal returns, but acknowledge the possibility of no significant, or even a positive, relationship.

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[6]Note that *EquityPayment* and *CashPayment* can simultaneously take the value 1 if both equity and cash has been used to pay for the acquisition.

4 Empirical Results

In this section, we present and discuss the empirical results of our study. In particular, we first present the characteristics of our data, and discuss how we test it to for potential flaws. Thereafter, we present our main results in order of the hypotheses they are related to, and discuss them from the perspective of M&A theories, and previous empirical work. Finally, we present robustness checks, and the results of these.

4.1 Data characteristics

Conducting a Shapiro-Wilk non-normality test shows that, for the announcement day as well as for all event windows, the null hypothesis of the abnormal returns being normally distributed is rejected at the 1% level. Since Welch's test assumes normal distribution, we conduct a Mann-Whitney-Wilcoxon test[7] to challenge the results of Welch's test. In addition, for all regressions, we winsorize the abnormal returns (see Hastings Jr, Mosteller, Tukey and Winsor, 1947) in order to moderate the effect of outliers (see appendix A.5 for the results of the regressions with pre-winsorized ARs). When testing for multicollinearity, we find that the estimated correlation between *PatentCount* and *IPSynergies* is 0.816%, and significantly different from zero at the 1% level. Ignoring this high correlation would lead to multicollinearty if these two variables were included in the same regression. Luckily, they are not, so this is not a problem. Looking at the other correlations between the independent variables, we find several which are significantly different from zero, but none of them have an absolute correlation above 0.5. We run four dependent variables (abnormal returns on the announcement day as well as during the three-, seven-, and eleven-day event windows), against our three variables of interest (*PatentDummy*, *PatentCount*, and *IPSynergies*), both in univariate and multivariate regressions, totaling 24 regressions. We test all regressions for heteroscedasticity using the White test, and find heteroscedasticity in one regression. In order to remedy this, we use heteroscedasticity-consistent standard errors, as proposed by White (1980), for this regression. All other regressions are free from heteroscedasticity. See appendix A.6 for the results of the data characteristics tests discussed in this subsection.

4.2 Value creation in M&A

Table 4.1 presents the estimated average abnormal returns (AARs) and cumulative average abnormal returns (CAARs) from equations 3.5 and 3.7 for the initial sample of 177 transactions, and the final sample of 112 transactions, and the empirical distributions of their standard deviations and T-scores. By applying equations 3.5 and 3.7 on the

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[7]Introduced by Wilcoxon (1945), and developed by Mann and Whitney (1947). However, in this thesis we use Zar's (1999) notation due to its simplicity:

$U_1 = R_1 - \frac{n_1(n_1+1)}{2}; \quad U_2 = R_2 - \frac{n_2(n_2+1)}{2}$
$U_1 + U_2 = R_1 - \frac{n_1(n_1+1)}{2} + R_2 - \frac{n_2(n_2+1)}{2}$

two samples, and performing T-tests, we show that for the initial sample, during all the event windows as well as on the announcement day, the AAR and CAARs are significantly different from zero, with positive returns between 0.5% and 0.9%. In the cases of on the announcement day, during a three-day event window, and during a seven-day event window, the estimated AAR and CAARs are significant at the 5% level. During an eleven-day event window, the CAAR is significant at the 10% level. Figure 4.1 graphically presents the AARs and CAARs of these samples (as well as the two sub-samples of transactions with targets who do or do not hold patent rights; these are discussed further in subsection 4.3). The results of positive abnormal returns on the announcement day are consistent with the implications of the best owner principle (Manne, 1965) and the synergy hypothesis (Bradley et al., 1983), and in line with the results of e.g. Asquith et al. (1983) and King et al. (2004). On the other individual days, the AARs are insignificant; a result which can be interpreted as the non-predictability characteristic of an efficient market (see e.g. Fama, 1965; 1970 for an introduction to the efficient-market hypothesis). Furthermore, all significance is lost when the sample is reduced to 112 transactions. More than half of the transactions dropped were acquisitions of parts of a company rather than a whole one, hence, the loss of significance may be an indicator that acquisitions of parts

Table 4.1: Average abnormal returns

This table reports the AARs and CAARs, standard errors, and T-scores for each individual day in the event windows, as well as for each event window itself. The first column displays over which period the ARs are calculated, where T-x and T+x represent the event day x days prior to or post the announcement day, respectively, and T(-w, w) represents the event window of w days before and after the announcement day. The next three columns display the values for the initial sample, and the last three columns display the values for the final sample. The null hypotheses assume AARs and CAARs equal to zero; hence, significance indicates an AAR or CAAR statistically different from zero.

	AAR (n=177)			AAR (n=112)		
Day	AAR	Std. Error	T-Score	AAR	Std. Error	T-Score
T-5	-0.02%	0.001	-0.228	0.01%	0.001	0.050
T-4	0.03%	0.001	0.266	-0.09%	0.001	-0.598
T-3	0.08%	0.001	0.575	0.08%	0.002	0.503
T-2	0.05%	0.001	0.476	-0.01%	0.001	-0.077
T-1	0.10%	0.001	1.059	0.14%	0.001	1.117
T	0.50%**	0.002	2.016	0.37%	0.003	1.090
T+1	0.12%	0.002	0.605	-0.18%	0.002	-0.876
T+2	-0.05%	0.001	-0.412	-0.01%	0.001	-0.133
T+3	0.08%	0.001	0.669	0.11%	0.001	0.809
T+4	0.00%	0.001	0.002	-0.11%	0.001	-0.852
T+5	0.02%	0.001	0.164	0.09%	0.001	0.805
Days	CAAR	Std. Error	T-score	CAAR	Std. Error	T-score
T(-1, 1)	0.72%**	0.003	2.074	0.33%	0.005	0.726
T(-3, 3)	0.88%**	0.004	2.158	0.50%	0.004	1.143
T(-5, 5)	0.90%*	0.005	1.858	0.40%	0.005	0.784

Significance: *=10%, **=5%, ***=1%

Figure 4.1: Average abnormal returns

This figure displays the AARs for each individual day in the event windows. This data is reported for each sample and sub-sample in a total of four graphs; the samples and sub-samples are the initial sample of 177 transactions, the final sample of 112 transactions, the sub-sample of transactions where the target holds patents, and the sub-sample of transactions where the target does not hold patents. The y-axis displays the AAR, and the x-axis displays for which day the ARs have been calculated, where T-x and T+x represent the event day x days prior to or post the announcement day respectively.
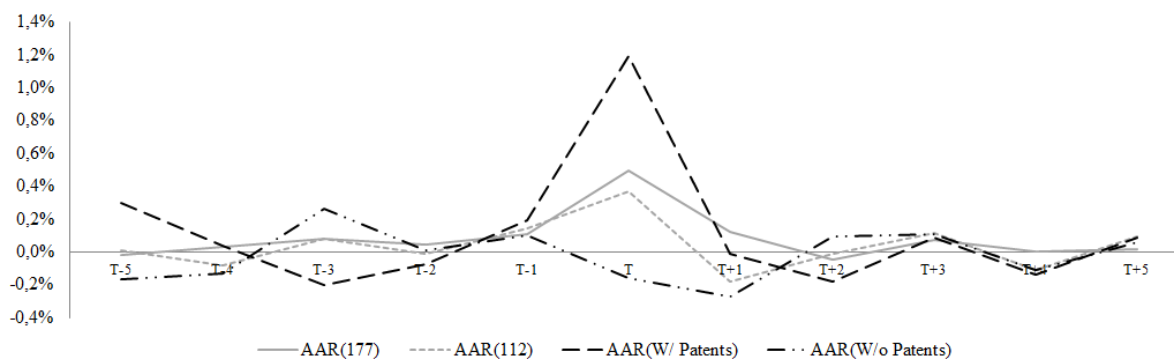
of a company are more value creating than acquisitions of whole companies. The loss of significance is in line with past research being inconclusive (see e.g. Mandelker, 1974; Dodd, 1980 for evidence on value conservation and destruction respectively), and, in line with our first hypothesis that M&A conserve value for acquirers' shareholder, the explanation for our significant results could hence simply be that they are sample specific.

4.3 IP and value creation in M&A

Table 4.2 presents the estimated AARs and CAARs from equation 3.5 and 3.7 for the two sub-samples of transactions *with* and *without* patents granted respectively, and the empirical distributions of their standard deviations and T-scores. By applying equations 3.5 and 3.7 on the two samples, and performing Welch's test, we show that on the announcement day, and during a three-day event window, the AAR and CAAR are significantly higher for acquiring firms when their target firms hold patents granted. In both cases, on the announcement day itself and during a three-day event window, the estimated AAR and CAAR are significant at the 5% level. Because of non-normality findings we perform a Mann-Whitney-Wilcoxon test (table 4.3), and show that the AAR on the announcement day and the CAAR during the three-day event window remain significant at the 5% level. Since the pattern of the AAR and CAARs being insignificant except for on the event day and during a three-day event window is consistent with the pattern in table 4.1, the non-predictability characteristic of an efficient market remains. Table 4.4 presents the coefficient estimates from the OLS regressions in equations 3.8 and 3.9, in which the variable of interest is the *PatentDummy* variable. In the univariate regressions, we show significantly positive coefficients of 0.013 and 0.014 for *PatentDummy* on the announcement day and during the three-day event window respectively. In both

Table 4.2: Average abnormal returns, sub-samples

This table reports the AARs and CAARs, standard errors, and T-scores for each individual day in the event windows, as well as for each event window itself. It shows these values for the two sub-samples where the target does or does not hold patents respectively. In addition, the results of Welch's test, examining if there is a statistical difference between the two sub-samples, is included. The first column displays over which period the ARs are calculated, where T-x and T+x represent the event day x days prior to or post the announcement day, respectively, and T(-w, w) represents the event window of w days before and after the announcement day. The next three columns display the values for the sub-sample of acquisitions where the target holds patents; the three columns thereafter display the values for the sub-sample of acquisitions where the target does not hold patents; and the last column displays the results of Welch's test. The null hypotheses corresponding to the AARs and CAARs assume them to be equal to zero; hence, significance indicates an AAR or CAAR statistically different from zero. The null hypotheses corresponding to Welch's test assume no difference between the sub-samples; hence a significant T-score indicates statistical difference between them.

	AAR (With Patents; n=43)			AAR (No Patents; n=69)			Welch's Test
Day	AAR	Std. Error	T-Score	AAR	Std. Error	T-Score	T-Score
T-5	0.30%**	0.001	2.274	-0.17%	0.002	-1.011	2.201**
T-4	0.03%	0.003	0.122	-0.13%	0.002	-0.879	0.530
T-3	-0.20%	0.002	-1.174	0.26%	0.002	1.160	-1.634
T-2	-0.08%	0.002	-0.478	0.01%	0.002	0.043	-0.379
T-1	0.19%	0.002	1.058	0.10%	0.002	0.589	0.362
T	1.19%**	0.005	2.392	-0.16%	0.004	-0.365	2.033**
T+1	-0.01%	0.003	-0.038	-0.28%	0.003	-0.960	0.653
T+2	-0.18%	0.001	-1.228	0.10%	0.001	0.680	-1.356
T+3	0.08%	0.001	0.564	0.11%	0.002	0.514	-0.092
T+4	-0.14%	0.003	-0.478	-0.11%	0.001	-0.978	-0.073
T+5	0.09%	0.003	0.472	0.06%	0.001	0.429	0.112
Days	CAAR	Std. Error	T-score	CAAR	Std. Error	T-score	T-Score
T(-1, 1)	1.38%**	0.005	2.553	-0.33%	0.006	-0.520	2.038**
T(-3, 3)	1.00%	0.006	1.598	0.13%	0.006	0.230	1.009
T(-5, 5)	1.28%	0.008	1.611	-0.22%	0.006	-0.347	1.471

Significance: *=10%, **=5%, ***=1%

Table 4.3: Mann-Whitney-Wilcoxon test

This table reports the results of the Mann-Whitney-Wilcoxon test of the two sub-samples where the target does or does not hold patents respectively. The first column displays over which period the ARs are calculated, where T(-w, w) represents the event window of w days before and after the announcement day. R1, R2; n1, n2; and U1, U2 represent the ranks, number of observations, and U-scores of the two sub-samples respectively. The U-statistic if given by the lower of the two U-scores. The null hypotheses assume no difference between the sub-samples; hence, a significant U-statistic indicates statistical difference between them.

Day(s)	R1	R2	n1	n2	U1	U2	U-Statistic	Std. Dev.	Z-Score
T	3553	2775	69	43	1138	1829	1138**	167.150	-2.067
T(-1, 1)	3621	2707	69	43	1206	1761	1206**	167.150	-1.660
T(-3, 3)	3812	2516	69	43	1397	1570	1397	167.150	-0.517
T(-5, 5)	3728	2600	69	43	1313	1654	1313	167.150	-1.020

Significance: *=10%, **=5%, ***=1%

Table 4.4: IP possession & value creation

This table reports the results of the regressions where *PatentDummy* is used as the variable of interest. The first column displays which dependent variable has been used. The next six columns display the coefficients for the independent variables, and the last column displays the coefficient of determination for the regression as a whole. The null hypotheses assume coefficients equal to zero; hence, a significant coefficient indicates it being statistically different from zero. Note that the ARs have been winzorized due to non-normality.

Dep. var.	Patent Dummy	Firm Size	Rel. Size	Eq. Paym.	Cash Paym.	Congl.	R^2
AR(T)	0.013**						4.80%
AR(T)	0.012**	0.001	0.008	-0.003	0.002	-0.008	7.79%
CAR(-1, 1)	0.014**						4.34%
CAR(-1, 1)	0.012*	0.002	0.002	0.005	0.012	-0.005	5.93%
CAR(-3, 3)	0.007						0.72%
CAR(-3, 3)	0.005	0.001	-0.007	0.010	-0.002	0.000	1.96%
CAR(-5, 5)	0.014						1.89%
CAR(-5, 5)	0.009	0.007*	0.013	0.002	0.006	-0.012	6.16%
Significance: *=10%, **=5%, ***=1%							

cases, on the announcement day itself and during the three-day event window, the estimated coefficients are significant at the 5% level which is consistent with the AAR and CAAR results (conditional on holding patents) in table 4.2. These results further remain consistent when we include a vector of control variables in the regressions. The estimated coefficients for the announcement day and during the three-day event window drop from 0.013 and 0.014 to 0.012 and 0.012 respectively, and the significance drops from the 5% level to the 10% level for the three-day event window. However, it should be noted that the low R^2 for all of the regressions in table 4.4 can make the models questionable. Overall, our results provide strong support for our second hypothesis, that M&A create more value for acquirers if their targets hold IP. We show that acquiring firms generate significantly more shareholder value if their targets hold patents, compared with transactions in which the target does not hold any patents. We find these results not to be surprising, since they are hypothesized from the facts that IP not only is a key driver of M&A (Holmström and Roberts, 1998; Kaplan, 2000; Lamb, 2002), but also that IP in itself has a positive impact on firm value (Jaffe, 1986; Bloom and Reenen, 2002; Nicholas, 2008; Pastor and Veronesi, 2005). Further, as an extra observation in table 4.4, we show that *FirmSize* is positive and significant at the 10% level.

Table 4.5 presents the coefficient estimates from the OLS regressions in equations 3.8 and 3.9, in which the variable of interest is the *PatentCount* variable. In the univariate regressions, we find no significantly positive coefficient estimates. In fact they are negative and close to zero during all periods investigated. However, R^2 does not exceed 4% in any of the four regressions. These results of negative coefficient estimates remain

when a vector of control variables is included, as shown in the multivariate regressions. In fact, the estimated coefficient for the announcement day becomes significant at the 10% level. In addition, R^2 becomes notably higher ranging from approximately 21% to 48% in all four regressions. Thereby, surprisingly, we find no support for our third hypothesis, that shareholder value for acquiring firms increases with the amount of target firms' IP. The results are surprising in the sense that they are inconsistent with the results from the testing of our second hypothesis where we show that M&A create more value for acquirers if their targets hold IP. The results are also surprising in relation to previous empirical work, which shows that shareholders value IP when it comes to firms' technological position on the market (Jaffe, 1986), that IP has a positive relation with firm value (Bloom and Reenen, 2002), that investors respond to the quality of technological inventions (Nicholas, 2008), and that stock prices of innovative firms increase during technological revolutions (Pastor and Veronesi, 2005). It therefore seems contradictory that shareholders do not respond as positively to the *amount* of IP in today's transactions. In Figure 4.2 we show, to our knowledge, the first-ever empirical relationship between the binary as well as the discrete coefficient estimates of IP and the value creation of M&A. The figure illustrates that for the announcement day as well as during all event windows, there is an initial boost in created shareholder value when the target firm's number of patents granted increases from zero (supporting our second hypothesis); this boost does, however, diminish as the number of patents increases further (disproving our third hypothesis). We believe that the answer to this inconsistency may lie within the boundaries of the hubris hypothesis (Roll, 1986), where today's corporations know that

Table 4.5: IP amount & value creation

This table reports the results of the regressions where *PatentCount* is used as the variable of interest. The first column displays which dependent variable has been used. The next six columns display the coefficients for the independent variables, and the last column displays the coefficient of determination for the regression as a whole. The null hypotheses assume coefficients equal to zero; hence, a significant coefficient indicates it being statistically different from zero. Note that the ARs have been winzorized due to non-normality.

Dep. var.	Patent Count (x1,000)	Firm Size	Rel. Size	Eq. Paym.	Cash Paym.	Congl.	R^2
AR(T)	-0.050						1.92%
AR(T)	-0.081*	0.000	0.117***	-0.035**	-0.007	-0.010	48.14%
CAR(-1, 1)	-0.070						3.56%
CAR(-1, 1)	-0.056	0.004	0.003	0.006	0.016	-0.006	41.45%
CAR(-3, 3)	-0.043						1.01%
CAR(-3, 3)	-0.070	-0.003	0.096***	-0.006	-0.016	0.005	29.70%
CAR(-5, 5)	-0.065						1.29%
CAR(-5, 5)	-0.119	0.002	0.078	0.020	0.033	-0.028	20.93%
Significance: *=10%, **=5%, ***=1%							

Figure 4.2: IP & value creation

This figure displays the relationship between IP and value creation of M&A. We map out this relationship as follows: The abnormal return when the number of patents is zero is given by the constant in the univariate regression with *PatentDummy* as the variable of interest, that is the average abnormal return in transactions where the target had no patents. The abnormal return when the number of patents is larger than zero is given by the constant in the univariate regression with *PatentCount* as the variable of interest, plus the number of patents held by the target times the coefficient estimate of *PatentCount* in the same regression (note that the slope is insignificant). The y-axis displays the AAR, and the x-axis displays the number of patents held by the target.
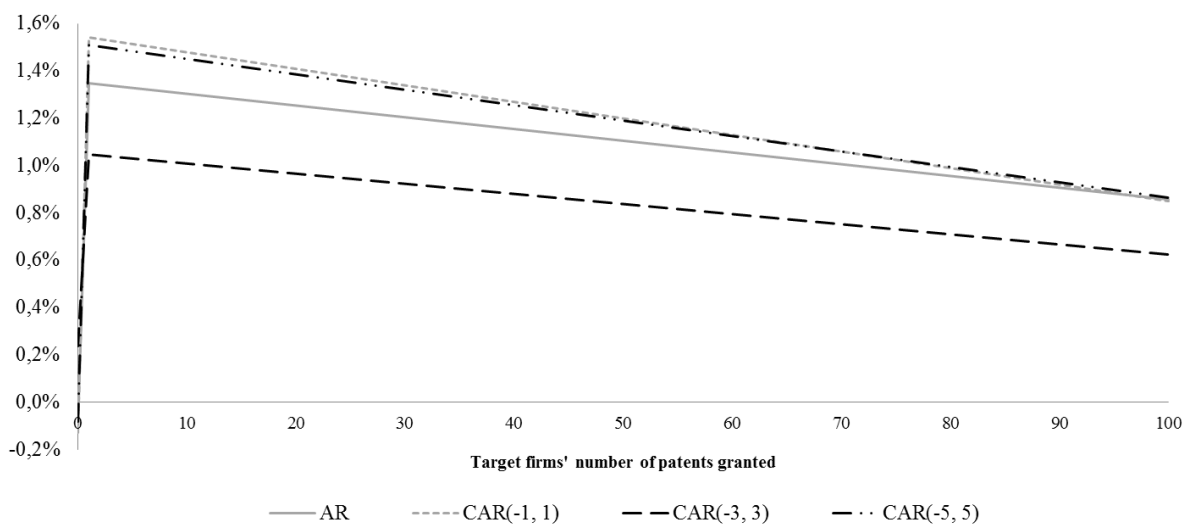
IP is value creating, and want to acquire it in large volumes, but they may overestimate their own ability to create value from acquired IP, driving up valuations, and hence paying large M&A premia. Therefore, from a hubris perspective, figure 4.2 may imply the market's response to potential overvaluations and managerial hubris, showing negative coefficient estimates for number of patents granted. Further, as extra observations in table 4.5, we find that *RelativeSize* is significantly positive at the 1% level on the announcement day and during the seven-day event window, consistent with the findings of Asquith et al. (1983). In addition, we find that *EquityPayment* is significantly negative at the 5% level on the announcement day, consistent with the findings of Datta et al. (1992) and Bruner (2002).

Table 4.6 presents the coefficient estimates from the OLS regressions in equation 3.8 and 3.9, in which the variable of interest is the *IPSynergies* variable. Surprisingly, we find no significantly positive coefficients for *IPSynergies* in neither the univariate nor the multivariate regressions. In fact, the estimated coefficients for *IPSynergies* are negative and very close to zero for the announcement day and during all event windows. However, R^2 does not exceed 8% in any of the eight regressions. Thereby, we find no support for our fourth hypothesis, that the more IP target firms *and* acquiring firms possess during a transaction, the higher the increase in shareholder value for acquiring firms.

We find these results surprising since previous findings does not only show that IP in itself creates firm value (Jaffe, 1986; Bloom and Reenen, 2002; Nicholas; 2008, Pastor and Veronesi, 2005), but also that firms experience a more competitive positioning, and strengthened R&D abilities when they are technologically overlapped in M&A activities (Cassiman and Veugelers, 2006; Cassiman and Colombo, 2006), and that firms in such transactions may avoid information asymmetry coming from uncertainty about valuing IP (Higgins and Rodriguez, 2006), as well as enjoy economies of scale by mitigating duplicated R&D activities (Henderson and Cockburn, 1996). Adding the classic synergy hypothesis (Bradley et al., 1983; Devos et al., 2009) to the analysis makes the results even more surprising; we expected the market to value these potential synergies arising from combined patent portfolios. However, when analyzing these results, one must keep in mind that it is only the acquirers' shareholder value being investigated. Without taking into account the premia paid to the targets, one cannot conclude whether or not the mergers create shareholder value in aggregate through synergies. With synergies being one of the more intuitive reasons why IP would create shareholder value in a merger, it is not unreasonable to assume that targets would take this into account when deciding on how high premia to ask for. Assuming that management overestimates their ability to realize synergies, which is in line with the hubris hypothesis (Roll, 1986), and/or that they have incentives to conduct acquisitions even though they are not value creating, which is in line with the agency hypothesis (Jensen, 1986), it is reasonable to assume that acquisitions will occur even when the premium asked by the target is as large or lar-

Table 4.6: IP synergies & value creation

This table reports the results of the regressions where *IPSynergies* is used as the variable of interest. The first column displays which dependent variable has been used. The next six columns display the coefficients for the independent variables, and the last column displays the coefficient of determination for the regression as a whole. The null hypotheses assume coefficients equal to zero; hence, a significant coefficient indicates it being statistically different from zero. Note that the ARs are winzorized due to non-normality, and that, due to rejection of homoscedasticity, heteroscedasticity-consistent standard errors are used in the multivariate regression with CAR(-5, 5) as the dependent variable.

Dep. var.	IP Synergies (x1,000,000)	Firm Size	Rel. Size	Eq. Paym.	Cash Paym.	Congl.	R^2
AR(T)	-0.005						0.27%
AR(T)	-0.007	0.003	0.008	-0.001	0.006	-0.009	4.52%
CAR(-1, 1)	-0.010						0.61%
CAR(-1, 1)	-0.016	0.004	0.003	0.008	0.017	-0.005	4.84%
CAR(-3, 3)	-0.008						0.35%
CAR(-3, 3)	-0.013	0.003	-0.006	0.012	0.001	0.000	2.43%
CAR(-5, 5)	-0.010						0.64%
CAR(-5, 5)	-0.025	0.009**	0.014	0.006	0.010	-0.012	7.32%

Significance: *=10%, **=5%, ***=1%

ger than the actual synergy gains. As an extra observation in table 4.6, we find that *FirmSize* is positive and significant at the 5% level.

In order to ensure robustness, we run 16 additional regressions where the variables of interest are included in combination with each other. Due to the high correlation between *PatentCount* and *IPSynergies*, these two variables are not combined. Instead, *Patent-Dummy* is combined with them separately. Table 4.7 presents the coefficient estimates of these regressions. With regards to *PatentDummy*, the results are as strong or even stronger than the regressions with only *PatentDummy* as the variable of interest. Hence our finding that M&A create more value for acquirers if their targets hold IP is confirmed and strengthened. With regards to *PatentCount*, we find no statistically significant coefficients in any of the 16 regressions. Hence our general finding that acquirers' value creation in M&A is unrelated to target firms' amount of IP is confirmed. With regards to *IPSynergies*, we find no statistically significant coefficients in any of the 16 regressions. Hence our general finding that acquirers' value creation in M&A is unrelated to target and acquiring firms' combined amount of IP is confirmed.

Table 4.7: IP & value creation, multiple variables of interest

This table reports the results of the regressions where the variable of interest *PatentDummy* has been combined with *PatentCount* or *IPSynergies*. The first column displays which dependent variable has been used. The next eight columns display the coefficients for the independent variables, and the last column displays the coefficient of determination for the regression as a whole. The null hypotheses assume coefficients equal to zero; hence, a significant coefficient indicates it being statistically different from zero. Note that the ARs have been winzorized due to non-normality.

Dep. var.	Patent Dummy	Patent Count (x1,000)	IP Synergies (x1,000,000)	Firm Size	Rel. Size	Eq. Paym.	Cash Paym.	Congl.	R^2
AR(T)	0.014**	-0.050							5.74%
AR(T)	0.014**		-0.010						5.81%
AR(T)	0.014**	-0.057		0.002	0.008	-0.002	0.003	-0.008	9.00%
AR(T)	0.013**		-0.011	0.002	0.008	-0.001	0.003	-0.007	8.88%
CAR(-1, 1)	0.017**	-0.070							5.68%
CAR(-1, 1)	0.016***		-0.015						5.92%
CAR(-1, 1)	0.014**	-0.085		0.003	0.003	0.006	0.013	-0.004	7.83%
CAR(-1, 1)	0.014*		-0.020	0.003	0.003	0.007	0.014	-0.003	8.25%
CAR(-3, 3)	0.008	-0.043							1.10%
CAR(-3, 3)	0.008		-0.011						1.34%
CAR(-3, 3)	0.007	-0.053		0.002	-0.006	0.010	-0.001	0.000	2.53%
CAR(-3, 3)	0.006		-0.015	0.002	-0.006	0.012	-0.000	0.001	3.03%
CAR(-5, 5)	0.016	-0.065							2.44%
CAR(-5, 5)	0.016*		-0.020						3.14%
CAR(-5, 5)	0.012	-0.000		0.008*	0.014	0.003	0.007	-0.012	7.41%
CAR(-5, 5)	0.011		-0.028	0.008**	0.014	0.006	0.008	-0.011	8.43%

Significance: *=10%, **=5%, ***=1%

5   Conclusion

Using a unique patent-M&A data set over the period 2006 to 2016, we investigate if IP creates shareholder value for acquirers, if the *amount* of IP matters, and if shareholders of acquiring firms benefit from potential synergies due to combined IP. We hypothesize that the answer to all three questions is "yes". We show that acquirers of companies holding IP gain significantly more shareholder value than acquirers of targets not holding IP. Furthermore, we uncover an interesting view of IP's role in M&A value creation when we investigate if the amount of IP matters; the increase in shareholder value only holds as a binary relationship. That is, the boost in shareholder value for acquirers of companies holding IP seems to fade as the level of IP increases; this relationship is, however, insignificant. We suggest that this inconsistency with our hypothesis, that the amount of IP matter, may be due to a systematic overvaluation of firms with large IP portfolios, as acquirers may overestimate their own ability to capitalize on the acquired IP. Finally, we find that potential IP synergies do not increase shareholder value for acquiring firms. Surprisingly, our results indicate a negative relationship between acquirers' and targets' combined IP, and shareholder value; this relationship is, however, also insignificant. We speculate that this inconsistency with our hypothesis, that acquirers benefit from potential synergies due to combined IP, may be due to targets taking the potential synergies into account when deciding on how high premia to ask for, and hence mitigate the synergy benefits for the acquirer. In addition to these findings, we find support for our first hypothesis that acquiring firms neither create nor destroy shareholder value through their M&A activity. Our results show some indications of M&A being value creating, but, given the bulk of inconclusive previous research, the results are not strong enough to turn the tide. As a side note, we confirm previous research showing that the relative size of the acquirer and target is positively related to value creation, and that equity payment is negatively related to value creation; we also find some indications that firm size of the acquirer is positively related to value creation.

The implication of our results is that management aiming to maximize the shareholder value of their firm can find an opportunity to do so by acquiring firms which hold IP. They should, however, pay close attention to IP's effect on the premium asked by the target, and beware of paying too much when doing these acquisitions. Based on our results, the risk of doing so seems to be greatest when acquiring firms with large IP portfolios. In addition, management cannot count on being able to reap the rewards of potential IP synergies, since the value of these may be included in the acquisition premium. As a disclaimer to the interpretability of our results, we would shortly like to discuss the viability of patents as a proxy for IP. We mainly have two concerns. First, while a patent definitely constitutes IP, it is not the only form of IP a firm may hold. The term usually refers to e.g. trademarks, copyrights, and design rights as well, hence only looking at patents may be too narrow.

Second, measuring the number of patents, and thereby treating all patents equally, may not be entirely accurate for a number of reasons. The most obvious is that patents must be unique, and hence two patents, per definition, cannot be equal. Furthermore, even though we ensure that all counted patents were active at the announcement day of the acquisition, all else being equal, a patent which was recently granted should be more valuable than one which only has a couple of years left in its patent term. Finally, we find it reasonable to assume that there exists systematic differences between the value of patents in different industries; for example patents for new drugs are likely some of the most valuable. Nevertheless, since the relationships we determine have not been investigated before, we would argue that patents is an as good place as any to start. With these relationships now determined, we propose that future research in the field focus on investigating if these relationships hold for other types of IP, as well as trying to refine the measurement of patents in order to take into account that patents may differ in value amongst themselves. This may be done by incorporating e.g. the number of years left in the patents term, and which industry the patent applies to in the measurement. In addition, our proposed explanations to finding no relationships between neither the amount of IP and value creation, nor potential potential IP synergies and value creation, imply that the hypothesized benefits are seized by the target. By testing the relationships between acquisition premia and targets' amount of IP, and between acquisition premia and potential IP synergies, our proposed explanations could be confirmed or disproved.

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A Appendix

A.1 Overview of IP

Intellectual property refers to "creations of the mind, such as inventions; literary and artistic works; designs; and symbols, names and images used in commerce", and is "protected in law by, for example, patents, copyright and trademarks, which enable people to earn recognition or financial benefit from what they invent or create", according to WIPO[8] (2016). In short, IP rights can be legally equivalent to any other property rights, and are, if capitalized, often accounted for as intangible assets on a firm's balance sheet. This brief overview covers four of the most common forms of IP:

- Patents: According to WIPO (2016), a granted patent application gives an innovator an exclusive right of a product or process, if it offers a new technical solution to a problem or a new way of doing something. "Exclusive right" means that no one, except for the innovator (i.e. a person or a firm), can commercialize on an innovation that is protected by a patent; but this right is usually limited for a 20 year period. However, owners of patent rights can both sell or license the right to third parties.

- Trademarks: According to WIPO (2016), trademarks are a form of IP which give entities exclusive rights to use certain marks, such as corporate slogans or logos, to identify products, processes, or entities themselves. Furthermore, trademarks can also be certification marks for standards; e.g. the "ISO 9000" quality standard. As with patents, owners of trademarks can both sell and license the right to third parties.

- Industrial designs: According to WIPO (2016), industrial designs consist of two- and/or three-dimensional features (e.g. patterns and/or shape) of handcrafts and industrial products, which can be anything from vehicles to leisure goods. Unlike products protected by patents, industrial designs must be non-functional in order to be protected; meaning that it is only the *design* itself that matters.

- Copyright and related rights: According to WIPO (2016), copyright and related rights refer to literary and artistic work; such as novels, poems, musical compositions, advertisement, and films. Creators of literary and artistic work protected by copyright and related rights get exclusive rights to authorize, or prohibit, e.g. reproduction, broadcasting, and translation of their work.

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[8]World Intellectual Property Organization

A.2 Zephyr

When searching for transactions in Zephyr, the following search criteria were used:

- Listed/Unlisted/Delisted companies: listed acquirer

- Deal type: Acquisition

- Percentage of stake: Percentage of initial stake (max: 50 %); Percentage of final stake (min: 50 %)

- Current deal status: Completed - confirmed

- Time period: on and after 01/02/2006 and up to and including 01/02/2016 (announced)

- Country (primary addresses): United States of America (US) (Acquirer AND Target)

- Deal value (EUR): all deals with known value

- Indices: S&P 500 (Acquirer)

A.3 Global Patent Index

When searching for patent counts, using SQL the following search criteria were used:

- Applicant name (APP): [Insert company name]

- Applicant country of residence (APPC): US

- Publication country (PUC): US

- Publication kind (PUK): Granted patent (b1 or b2)

- Publication date (PUD): [Announcement day minus 20 years, Announcement day]

- Is granted (ISG): Yes

APPC ensures that patents owned by a foreign company with the same name as the company of interest are not included in the count. PUC ensures that each patent is only counted once, regardless of how many countries it is published in. PUK and ISG ensures that patent applications which were denied or have not been completed are not included in the count. PUD ensures that the patents are still active, given a patent term of 20 years (USPTO Manual of Patent Examining Procedure - Section 2701, 2015). These search queries resulted in a set of counts of active patents for the selected companies on their corresponding announcement days; see figures A.1-A.3 below.

Figure A.1: SQL search example

Preferences Download Print Help | Home Search Statistics | @gmail.com is using GPI 2016/06

History

ID	Database	Result	Query
$42	GPI 2016/06	0	APP = "conversant inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-09-11, 2014-09-11] and ISG = YES
$41	GPI 2016/06	0	APP = "bank of kentucky financial corporation" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-09-08, 2014-09-08] and ISG = YES
$40	GPI 2016/06	0	APP = "family dollar stores inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-07-28, 2014-07-28] and ISG = YES
$39	GPI 2016/06	0	APP = "integrys energy group inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-06-23, 2014-06-23] and ISG = YES
$38	GPI 2016/06	0	APP = "access midstream partners" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-06-15, 2014-06-15] and ISG = YES
$37	GPI 2016/06	0	APP = "astrotech space operations inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-05-29, 2014-05-29] and ISG = YES
$36	GPI 2016/06	1	APP = "beats electronics llc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-05-28, 2014-05-28] and ISG = YES
$35	GPI 2016/06	10	APP = "amx corporation" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-05-21, 2014-05-21] and ISG = YES
$34	GPI 2016/06	422	APP = "the directv group inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-05-18, 2014-05-18] and ISG = YES
$32	GPI 2016/06	0	APP = "rsg holdings inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-05-06, 2014-05-06] and ISG = YES
$31	GPI 2016/06	11	APP = "accessclosure inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-04-02, 2014-04-02] and ISG = YES
$29	GPI 2016/06	0	APP = "commonwealth laminating and coating inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-03-30, 2014-03-30] and ISG = YES
$28	GPI 2016/06	2	APP = "patient safety technologies" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-12-31, 2013-12-31] and ISG = YES
$27	GPI 2016/06	1	APP = "southern new england telephone company" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-12-17, 2013-12-17] and ISG = YES
$26	GPI 2016/06	0	APP = "mapmyfitness inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-11-14, 2013-11-14] and ISG = YES
$25	GPI 2016/06	0	APP = "dukenet communications llc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-10-07, 2013-10-07] and ISG = YES
$24	GPI 2016/06	0	APP = "the climate corporation" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-10-02, 2013-10-02] and ISG = YES
$23	GPI 2016/06	23	APP = "onyx pharmaceuticals inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-08-25, 2013-08-25] and ISG = YES
$22	GPI 2016/06	24	APP = "arinc inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-08-11, 2013-08-11] and ISG = YES
$21	GPI 2016/06	0	APP = "vanguard health systems inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-06-24, 2013-06-24] and ISG = YES
$20	GPI 2016/06	0	APP = "vanguard health systems inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-06-24, 2013-06-24] and ISG = YES
$19	GPI 2016/06	0	APP = "softlayer technologies inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-06-04, 2013-06-04] and ISG = YES
$18	GPI 2016/06	0	APP = "new mexico gas intermediate inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-05-28, 2013-05-28] and ISG = YES
$17	GPI 2016/06	11	APP = "rae systems inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-04-23, 2013-04-23] and ISG = YES
$16	GPI 2016/06	0	APP = "assuramed holding inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-02-14, 2013-02-14] and ISG = YES
$15	GPI 2016/06	0	APP = "nuco2 inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-02-05, 2013-02-05] and ISG = YES
$14	GPI 2016/06	16	APP = "acme packet inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-02-04, 2013-02-04] and ISG = YES
$13	GPI 2016/06	2	APP = "manageiq inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-12-21, 2012-12-21] and ISG = YES
$11	GPI 2016/06	0	APP = "cloupia inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-11-15, 2012-11-15] and ISG = YES
$10	GPI 2016/06	6	APP = "kayak software corporation" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-11-08, 2012-11-08] and ISG = YES
$9	GPI 2016/06	0	APP = "the board of trade of kansas city missouri inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-10-17, 2012-10-17] and ISG = YES
$8	GPI 2016/06	0	APP = "sunrise senior living" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-08-22, 2012-08-22] and ISG = YES
$7	GPI 2016/06	0	APP = "coventry health care inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-08-20, 2012-08-20] and ISG = YES
$6	GPI 2016/06	0	APP = "william bolthouse farms inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-07-09, 2012-07-09] and ISG = YES
$5	GPI 2016/06	0	APP = "crown imports llc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-06-28, 2012-06-28] and ISG = YES
$4	GPI 2016/06	3	APP = "medtox scientific inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-06-04, 2012-06-04] and ISG = YES
$3	GPI 2016/06	0	APP = "hughes telematics inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-06-01, 2012-06-01] and ISG = YES
$2	GPI 2016/06	3	APP = "kai pharmaceuticals inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-04-10, 2012-04-10] and ISG = YES
$100	GPI 2016/06	8	APP = "kiva systems inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-03-19, 2012-03-19] and ISG = YES
$99	GPI 2016/06	0	APP = "world courier group inc" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-03-06, 2012-03-06] and ISG = YES

Figure A.2: SQL results example: Target firms

Preferences   Download   Print   Help   Home   Search   Result   Statistics   @gmail.com is using GPI 2016/06

History

ID	Database	Result	Query
$55	GPI 2016/06	1	APP = "fidelity national information services" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1995-08-12, 2015-08-12] and ISG = YES
$54	GPI 2016/06	56 066	APP = "international business machines" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1995-08-06, 2015-08-06] and ISG = YES
$53	GPI 2016/06	7	APP = "home depot" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1995-07-22, 2015-07-22] and ISG = YES
$52	GPI 2016/06	50	APP = "cardinal health" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1995-05-28, 2015-05-28] and ISG = YES
$51	GPI 2016/06	2 780	APP = "verizon" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1995-05-12, 2015-05-12] and ISG = YES
$50	GPI 2016/06	0	APP = "ventas" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1995-04-06, 2015-04-06] and ISG = YES
$49	GPI 2016/06	421	APP = "alcoa" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1995-03-09, 2015-03-09] and ISG = YES
$48	GPI 2016/06	0	APP = "macy's" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1995-02-03, 2015-02-03] and ISG = YES
$47	GPI 2016/06	2	APP = "amerisourcebergen" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1995-01-12, 2015-01-12] and ISG = YES
$46	GPI 2016/06	56	APP = "nasdaq" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1995-01-05, 2015-01-05] and ISG = YES
$45	GPI 2016/06	47	APP = "nasdaq omx" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1995-01-05, 2015-01-05] and ISG = YES
$44	GPI 2016/06	802	APP = "becton dickinson" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-10-05, 2015-01-05] and ISG = YES
$43	GPI 2016/06	0	APP = "cognizant technology solutions" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-09-15, 2014-09-15] and ISG = YES
$42	GPI 2016/06	1	APP = "alliance data systems" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-09-11, 2014-09-11] and ISG = YES
$41	GPI 2016/06	0	APP = "dollar tree" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-07-28, 2014-07-28] and ISG = YES
$40	GPI 2016/06	3	APP = "wec" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-06-23, 2014-06-23] and ISG = YES
$38	GPI 2016/06	1	APP = "williams companies" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-06-15, 2014-06-15] and ISG = YES
$37	GPI 2016/06	4 191	APP = "apple" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-05-28, 2014-05-28] and ISG = YES
$36	GPI 2016/06	6 538	APP = "at&t" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-05-18, 2014-05-18] and ISG = YES
$35	GPI 2016/06	50	APP = "cardinal health" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-04-02, 2014-04-02] and ISG = YES
$34	GPI 2016/06	656	APP = "eastman chemical" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1994-03-30, 2014-03-30] and ISG = YES
$33	GPI 2016/06	375	APP = "stryker" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-12-31, 2013-12-31] and ISG = YES
$32	GPI 2016/06	3	APP = "frontier communications" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-12-17, 2013-12-17] and ISG = YES
$31	GPI 2016/06	22	APP = "under armour" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-11-14, 2013-11-14] and ISG = YES
$29	GPI 2016/06	139	APP = "time warner cable" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-10-07, 2013-10-07] and ISG = YES
$28	GPI 2016/06	2 208	APP = "monsanto" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-10-02, 2013-10-02] and ISG = YES
$27	GPI 2016/06	526	APP = "amgen" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-08-25, 2013-08-25] and ISG = YES
$26	GPI 2016/06	0	APP = "tenet healthcare" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-06-24, 2013-06-24] and ISG = YES
$25	GPI 2016/06	44 581	APP = "international business machines" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-06-04, 2013-06-04] and ISG = YES
$24	GPI 2016/06	0	APP = "teco energy" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-05-28, 2013-05-28] and ISG = YES
$23	GPI 2016/06	49	APP = "cardinal health" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-02-14, 2013-02-14] and ISG = YES
$22	GPI 2016/06	573	APP = "praxair" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-02-05, 2013-02-05] and ISG = YES
$21	GPI 2016/06	3 525	APP = "oracle" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1993-02-04, 2013-02-04] and ISG = YES
$20	GPI 2016/06	356	APP = "red hat" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-12-21, 2012-12-21] and ISG = YES
$19	GPI 2016/06	66	APP = "cisco systems" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-11-15, 2012-11-15] and ISG = YES
$18	GPI 2016/06	19	APP = "priceline.com" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-11-08, 2012-11-08] and ISG = YES
$17	GPI 2016/06	0	APP = "health care reit" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-08-22, 2012-08-22] and ISG = YES
$16	GPI 2016/06	6	APP = "aetna" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-08-20, 2012-08-20] and ISG = YES
$15	GPI 2016/06	7	APP = "campbell soup" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-07-09, 2012-07-09] and ISG = YES
$14	GPI 2016/06	5	APP = "laboratory corporation of america" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-06-04, 2012-06-04] and ISG = YES
$13	GPI 2016/06	1 041	APP = "verizon" and PUC = US and APPC = US and PUK = b1 or b2 and PUD [1992-06-01, 2012-06-01] and ISG = YES

Figure A.3: SQL results example: Acquiring firms

A.4 Fully specified regressions

Univariate regressions

$$\widehat{CAR}_i(T_{-w}, T_{+w}) = \alpha + \beta PatentDummy_i + \epsilon_i \tag{A.1}$$

$$\widehat{CAR}_i(T_{-w}, T_{+w}) = \alpha + \beta PatentCount_i + \epsilon_i \tag{A.2}$$

$$\widehat{CAR}_i(T_{-w}, T_{+w}) = \alpha + \beta IPSynergies_i + \epsilon_i \tag{A.3}$$

Multivariate regressions

$$\widehat{CAR}_i(T_{-w}, T_{+w}) = \alpha + \beta_1 PatentDummy_i + \beta_2 FirmSize_i + \beta_3 RelativeSize_i$$
$$+ \beta_4 EquityPayment_i + \beta_5 CashPayment_i + \beta_6 Conglomerate_i + \epsilon_i \tag{A.4}$$

$$\widehat{CAR}_i(T_{-w}, T_{+w}) = \alpha + \beta_1 PatentCount_i + \beta_2 FirmSize_i + \beta_3 RelativeSize_i$$
$$+ \beta_4 EquityPayment_i + \beta_5 CashPayment_i + \beta_6 Conglomerate_i + \epsilon_i \tag{A.5}$$

$$\widehat{CAR}_i(T_{-w}, T_{+w}) = \alpha + \beta_1 IPSynergies_i + \beta_2 FirmSize_i + \beta_3 RelativeSize_i$$
$$+ \beta_4 EquityPayment_i + \beta_5 CashPayment_i + \beta_6 Conglomerate_i + \epsilon_i \tag{A.6}$$

A.5 Empirical results, pre-winsorization

Table A.1: IP possession & value creation, pre-winsorization

This table reports the results of the regressions where *PatentDummy* is used as the variable of interest. The first column displays which dependent variable has been used. The next six columns display the coefficients for the independent variables, and the last column displays the coefficient of determination for the regression as a whole. The null hypotheses assume coefficients equal to zero; hence, a significant coefficient indicates it being statistically different from zero.

Dep. var.	Patent Dummy	Firm Size	Rel. Size	Eq. Paym.	Cash Paym.	Congl.	R^2
AR(T)	0.013*						3.37%
AR(T)	0.012	0.003	0.001	-0.004	0.002	-0.008	6.02%
CAR(-1, 1)	0.017*						3.01%
CAR(-1, 1)	0.013	0.005	0.006	0.006	0.012	-0.004	5.10%
CAR(-3, 3)	0.008						0.75%
CAR(-3, 3)	0.005	0.003	-0.005	0.012	-0.000	-0.001	2.27%
CAR(-5, 5)	0.014						1.73%
CAR(-5, 5)	0.009	0.009*	0.014	0.002	0.005	-0.013	6.29%
Significance: *=10%, **=5%, ***=1%							

Table A.2: IP amount & value creation, pre-winsorization

This table reports the results of the regressions where *PatentCount* is used as the variable of interest. The first column displays which dependent variable has been used. The next six columns display the coefficients for the independent variables, and the last column displays the coefficient of determination for the regression as a whole. The null hypotheses assume coefficients equal to zero; hence, a significant coefficient indicates it being statistically different from zero.

Dep. var.	Patent Count (x1,000)	Firm Size	Rel. Size	Eq. Paym.	Cash Paym.	Congl.	R^2
AR(T)	-0.050						1.89%
AR(T)	-0.081*	0.000	0.118***	-0.035**	-0.007	-0.010	47.50%
CAR(-1, 1)	-0.073						3.47%
CAR(-1, 1)	-0.124**	0.000	0.109***	-0.002	0.016	-0.005	42.62%
CAR(-3, 3)	-0.047						1.08%
CAR(-3, 3)	-0.083	-0.003	0.106***	-0.001	-0.007	0.003	32.93%
CAR(-5, 5)	-0.066						1.27%
CAR(-5, 5)	-0.121	0.003	0.080	0.021	0.035	-0.029	21.48%
Significance: *=10%, **=5%, ***=1%							

Table A.3: IP synergies & value creation, pre-winsorization

This table reports the results of the regressions where *IPSynergies* is used as the variable of interest. The first column displays which dependent variable has been used. The next six columns display the coefficients for the independent variables, and the last column displays the coefficient of determination for the regression as a whole. The null hypotheses assume coefficients equal to zero; hence, a significant coefficient indicates it being statistically different from zero. Note that, due to rejection of homoscedasticity, heteroscedasticity-consistent standard errors are used in the mulitvariate regression with CAR(-5, 5) as the dependent variable.

Dep. var.	IP Synergies (x1,000,000)	Firm Size	Rel. Size	Eq. Paym.	Cash Paym.	Congl.	R^2
AR(T)	-0.005						0.16%
AR(T)	-0.095	0.005	0.010	-0.002	0.006	-0.009	4.24%
CAR(-1, 1)	-0.009						0.26%
CAR(-1, 1)	-0.020	0.008*	0.006	0.010	0.017	-0.005	4.78%
CAR(-3, 3)	-0.008						0.24%
CAR(-3, 3)	-0.016	0.005	-0.004	0.015	0.003	-0.001	2.84%
CAR(-5, 5)	-0.014						0.51%
CAR(-5, 5)	-0.027	0.011**	0.015	0.006	0.010	-0.013	7.45%

Significance: ***=10%, **=5%, ***=1%**

A.6 Data characteristics

Table A.4: Non-normality test

This table reports the result of the Shapiro-Wilk tests of the estimated ARs. The first column displays over which period the ARs are calculated, where T(-w, w) represents the event window of w days before and after the announcement day. The null hypotheses assume normality; hence, a significant W-statistic indicates non-normality.

Day(s)	W-Statistic
T	0.802***
T(-1, 1)	0.780***
T(-3, 3)	0.923***
T(-5, 5)	0.943***

Significance: *=10%, **=5%, ***=1%

Table A.5: Heteroscedasticity detection

This table reports the results of the White tests of the two regressions which showed signs of heteroscedasticity. The null hypotheses assume homoscedasticity; hence, a significant F-statistic indicates heteroscedasticity.

CAR(-5, 5) Multivariate Regression Incl. Patent Count			
F-statistic	3.631***	Prob. F(6,36)	0.006
Obs*R-squared	16.212	Prob. Chi-Square(6)	0.013
Scaled explained SS	9.151	Prob. Chi-Square(6)	0.165
WCAR(-5, 5) Multivariate Regression Incl. Patent Count			
F-statistic	3.496***	Prob. F(6,36)	0.008
Obs*R-squared	15.831	Prob. Chi-Square(6)	0.015
Scaled explained SS	8.946	Prob. Chi-Square(6)	0.177

Significance: *=10%, **=5%, ***=1%

Table A.6: Correlation matrix, independent variables

This table reports the correlations between all variables of interest and control variables. The first column and top row display what variables the correlation corresponds to. The null hypotheses assume zero correlation; hence, significance indicates a correlation statistically different from zero.

	1.	2.	3.	4.	5.	6.	7.	8.
1. Cash Payment	1.000							
2. Conglomerate	0.022	1.000						
3. Equity Payment	-0.351***	-0.115	1.000					
4. Firm Size	0.146	0.234**	-0.055	1.000				
5. Patent Dummy	0.148	-0.052	0.004	0.281***	1.000			
6. Relative Size	-0.358***	-0.150	0.490***	-0.288***	-0.087	1.000		
7. Patent Count	0.066	0.008	0.086	0.241**	0.305***	0.021	1.000	
8. IP Synergies	0.046	0.095	0.168*	0.244***	0.212**	0.042	0.816***	1.000

Significance: *=10%, **=5%, ***=1%