How do *not so visible factors* affect M&A Performance?

Satyam Sharma

Thesis submitted to the University of Ottawa in partial fulfillment of the requirements for the MSc Management – Finance

Telfer School of Management
University of Ottawa

Table of Contents

List of Tables

Abstract

The primary reason for mergers and acquisitions is to achieve synergy and establish competitive advantages. A firms' innovation in form of intangible assets gets accumulated over time depending upon its R&D intensity. Such a strategic bundle of intangible assets that a firm possesses is an indicator of future synergies if the firm were to merge.

The current study examines whether intangible intensive firms more likely to make acquisitions or are more likely to be acquired and how the market reacts to M&A deals involving intangible intensive acquirers and targets. We explore these issues with a sample of U.S. M&A deals over a period of 2001-2017.

We find that intangible assets serve as one of the primary motives for the M&A and are the drivers of M&A activity in recent times. The results from the event study show that target firms' intangible assets have a significant negative effect on target firms' cumulative abnormal returns.

Subsequently, we carry out further analyses to understand various drivers of market reaction to M&A deals. We find that, for target firms, the relation between target firms' intangible assets and market reaction is positively influenced by the use of cash and negatively impacted when the target firm is from high-tech industry.

For the acquiring firms, we find that the relation between acquirer firms' intangible assets and market reaction is negatively impacted when the acquirer is from high-tech industry and positively impacted when a public target is acquired. It appears that market reactions to the acquisition of high intangible targets are primarily driven by investor skepticism about the prospects of the deal.

Lastly, the study does not find any significant effect of (mis)valuation on M&A deals by intangible intensive firms.

1 Introduction

A firms' value is made up of contributions from the various components of its asset portfolios. Intangible assets defined as a strategic bundle of non-physical assets such as knowledge, brands, relationships, organizational culture, and intellectual property that are long term drivers of a firms' growth and lead to benefits such as differentiated products and reduced competition. Nakamura (2001, 2003) estimated that a third of the value of U.S. corporate assets were intangible. The rate of investment in tangible assets fell by 35% while the rate of investment in intangible assets increased by 60% between 1977 and 2014. The larger role of intangibles has led to a decrease in their accounting relevance, measured by decrease in the r-squared regressions of market capitalizations with annual earnings and book values, from over 80% in the 1950's to about 25% in the 2000's (Lev and Gu, 2016).

Past research has shown that firms gradually become narrow or rigid by repeated use of the existing knowledge leading to a competency trap that threatens its mere survival (Cohen and Levinthal, 1989; Levinthal and March, 1993). In such situation an acquisition of innovation can be viewed as a shock to slow this progression, revitalize and enhance the ability of the firm to react to the changing circumstances (Vermeulen and Barkema, 2001).

Firms invest in knowledge or intangible assets in two ways: a) internal creation and b) external purchase. As it is challenging and costly to create intangible assets,

firms often prefer to obtain access to such assets through external purchases (Lev, 2000). Thus, the incentives to purchase or outsource intangible assets could be a motive for M&As (Bhattacharya and Li, 2020). It is often difficult to enforce legal rights over some intangible assets when sharing outcomes between parties, for example, organizational capital cannot be "owned" and transfers along with the ownership of a firm (Lev and Radhakrishnan, 2005; Lev, 2000). The rent seeking opportunities due to knowledge spillovers are minimized when complementary assets are placed under a single owner (Rhodes-Kropf, Robinson, and Viswanathan, 2005). These obstacles provide grounds for firms in need of intangible capital to accumulate such assets by taking over high-intangibles firms. In M&As, the value of intangible capital likely plays an important role, since the proportion of a firms' intangible capital relative to total capital appears to be large (Lev, 2000; Corrado and Hulten, 2010). However, due to the proprietary nature of intangible assets, their post-merger integration is a multifaceted, dynamic, and context-specific process, which involves complexity, unpredictability, uncertainty, and ambiguity. In addition, the failure of intangible investments such as R&D expenditures, software development costs, marketing expenditures etc. to be directly incorporated into the book value of assets under current accounting standards due their uncertain payoffs make it challenging for the investors to determine the potential value of such investments.

As a consequence of the above, the intangible intensive firms are discounted heavily by the investors leading to their undervaluation in comparison to other

firms. However, since most intangible assets are usually expensed in the income statement in contrast to physical assets, which are capitalized on the balance sheet, the firms with high growth opportunities have higher market values relative to book assets.

Thus, small and young R&D intensive firms' continuous investments in future growth opportunities cause the investors to underestimate the payoffs from those investments and leading to the mispricing of their stocks, namely the temporary deviation of a firms' share price from its fundamental value. Rhodes-Kropf et al. (2005), show that the B/M ratio consists of 2 components: i) mispricing and ii) growth or time- varying risk. The residual income valuation (Rhodes-Kropf, Robinson, and Viswanathan, 2005) V/P, filters out growth or time- varying risk factors and has received strong support as an indicator of mispricing. The above discussion suggests that decisions on M&A deals by intangible intensive firms and relevant market reactions could be significantly influenced by information asymmetry and (mis)valuation of acquiring or target firms.

Accordingly, this study focusses on the following research questions: Are intangible intensive firms more likely to make acquisitions or are more likely to be acquired? How the market reacts to M&A deals that involve intangible intensive acquirers and targets? We explore these issues with a sample of U.S. M&A deals over a period of 2001-2017.

The study finds that intangible assets serve as one of the primary motives for the M&A and are the drivers of M&A activity in recent times. The probability of a firm

making an acquisition and the probability of a firm being acquired are both higher for intangible intensive firms. The results from the event study show that target intangible asset has a significant negative effect on targets' cumulative abnormal returns; this result could be attributed to growth opportunities lost because of the merger. For acquiring firms, we do not find any significant direct association between acquiring firm's intangible asset and market reactions.

Subsequently, we carry out further analyses to understand various drivers of market reaction to M&A deals by intangible intensive acquirers and targets. We find that, for target firms, the relation between targets' intangible assets and market reaction is positively influenced by the use of cash. Cash deals signify a greater confidence from acquiring firms and mitigate negative views of target shareholders to a certain extent. We further find that the relation between target firms' intangible assets and market reaction remains negative even when a target is from high-tech industry.

For the acquiring firms, we find that the relation between acquirers' intangible assets and the market reaction is negatively impacted when the acquirer is from high-tech industry. This result implies that acquirer shareholders do not prefer M&A deals when the firms are engaged in high-tech activities and deals with high level of intangibles. Interestingly, we further find that when acquiring firms with high intangibles acquire public targets, the market reacts more positively. This can be attributed to the lower information asymmetry associated with public targets and competitive bidding process which ensures target firms' intangibles are

valued at a premium. Finally, we examine the impact of target attributes on acquiring firms' cumulative abnormal returns surrounding M&A deal announcements. We find that the relation between target intangible asset and acquirer abnormal returns is positively impacted by cash deals. It appears that market reactions to the acquisition of high intangible targets are primarily driven by investor skepticism about the prospects of the deal given complex nature of the intangible assets and the information asymmetry surrounding intangible assets. Use of cash as a payment for the acquisition mitigates this uncertainty and leads to a positive market reaction for the acquirer firms' shareholders. However, we do not find any significant effect of (mis)valuation on M&A deals by intangible intensive firms.

We believe, this study makes some important contributions to the limited but emerging literature on the role of intangible assets in M&A's. Given the increasing importance of intangibles in the economy and market inefficiencies arising from their proprietary nature, the current study presents some new evidence on M&A deals by intangible intensive firms.

2 Background literature

M&A deals are complex and often involve considerations of significant strategic resources such as intangible assets. The following literature discusses the innovation needs of firms in context of intangible assets, the complexities involved in post-merger integration on their acquisition and the market valuation of

intangible intensive firms. To begin with, the following section discusses intangible assets as strategic resources in M&A decisions in light of some relevant theories, such as Resource-Based View (RBV), Dynamic Capability View and Knowledge Based View (KBV).

2.1 Intangible assets as strategic resources

According to Barney (1991), in order to sustain competitive advantages, a company should strategically source resources, which are not available to its competitors, and which aren't imitable or substitutable leading to potential future benefits such as lower costs or superior benefits to consumer (differentiation). The Resource-Based View (RBV) thus defines an organization on the basis of the blend of resources it is composed of and explains that competitive advantage relies on the characteristics of such retained resources and on the firms' capability to exploit them (Barney, 1991; Hall, 1992; Wernerfelt, 1984).

The RBV however has not adequately explained how and why certain firms have competitive advantage in situations of rapid and unpredictable change. Kogut and Zander (1992) defined dynamic capabilities as organizational processes by which firms synthesize and acquire knowledge resources, and generate new applications from those resources, for example product development, strategic decision making, reconfiguration of resources within firms etc. As per this view manipulation of knowledge resources is especially critical to adapt to the changing business environment and maintain competitive advantage (Grant, 1996; Kogut, 1996; Makadok, 2001; Eisenhardt and Martin, 2000).

The knowledge-based theory (Grant, 1996; Hitt, Beamish and Jackson, 2007; Spender and Grant, 1996) and a series of empirical studies such as those by Chen, Cheng and Hwang (2005) and provide the evidence that intangibles are the most appropriable strategic resources that can unleash and sustain the whole potential competitive advantage at the rapid evolution of the market in changing environments. The specific nature of intangible resources characterized by knowledge-based features, such as path dependency, and social complexity allows for the creation of a sustainable competitive advantage but, on the other hand, complicates their practical usage as well as the theoretical investigation of their use.

2.1.1 Effect on standalone performance

There is a vast literature that has examined the effect of standalone intangibles and their effect on firms' performance. Lev and Sougiannis (1996), Eberhart et al. (2004, 2008), and Lev and Radhakrishnan (2005), demonstrate a positive association between R&D investment and future stock returns. The second group of studies, including Gu and Wang (2005), reveal that the outcome of innovations, for example, the patent citations, are positively associated with firms' stock returns and future earnings. Similarly, Hirshleifer et al. (2013) find that innovative efficiency, measured as patents and patent citations per dollar of R&D investment, is positively related to expect returns after controlling firm characteristics and risk. Larkin (2013) shows that credit ratings of firms operating in potentially risky environments (as measured by historical cash flow volatility) improve with

positive brand perception of products. A one standard deviation increase in brand stature allowed for more than 4% of additional debt capacity, thus helping opaque firms with limited access to external capital markets obtain more financial flexibility through strong brands.

2.2 Intangibles and M&A: Merger pair formation and integration complexity

Sourcing innovation vs. in house R&D: Two potential difficulties may be encountered when investing in intangible assets. First, compared with developing intangible assets internally, firms may prefer to purchase them externally due to the high cost of self-investment and the uncertain outcomes of the development process (Lev, 2000). Phillips and Zhdanov (2013) developed a model to examine the effect of active merger and acquisition market on a firms' incentives to innovate. They argued that the large firms might find it optimal to buy small successful innovator firms in order to gain access to their innovations instead of investing in R&D themselves. Thus, small innovative firms face increased incentives to invest in R&D with existence of an active takeover market. They found that firms' incentives to conduct R&D increased with the probability of being acquired and decreased with its size. An important implication of their paper is that instead of interpreting low R&D as a sign of managerial inefficiency or low organizational inertia, a persistent low R&D intensity in large firms could be a signal of their intent to acquire innovation through acquisitions. Similarly, Blonigen and Taylor (2000) found a negative correlation between a firms' R&D intensity and its acquisition activity using the data on US electric and electronic

industry for the period 1985-93. They attributed this result to the differences in a firms' strategy of choosing between an internal growth strategy with relatively higher R&D intensity versus an external growth strategy with acquisitions or in other words, the make vs. buy strategy decisions.

Holmstrom and Roberts (1998) argue that buying innovation is generally not a feasible alternative to an M&A, since establishing an innovation value requires disclosure and a potential buyer of innovation has no incentive to pay once such information has already been revealed. Hart and Holstrom (2010) further show that, when two firms' production functions exhibit externalities—for example, when they need to coordinate their technologies—a merger facilitates coordination that cannot otherwise be achieved. Also, most of the IP assets such as a portfolio of patents or trademarks are unique to a firm (high specificity) and do not have secondary markets where they can be traded. It is difficult to enforce legal rights over some intangible assets share outcomes between parties, for example, organizational capital cannot be "owned" and transfers along with the ownership of a firm (Lev and Radhakrishnan, 2005; Lev, 2000). These obstacles provide grounds for firms in need of intangible capital to accumulate such assets by taking over high-intangibles firms.

The property rights theory of the firm advocated by Grossman and Hart (1986) and Hart and Moore (1994) and extended further by Rhodes-Kropf, Robinson, and Viswanathan (2005) holds that mergers involve redrawing the boundaries of a firm and complementary assets (assets without complementarities can easily be

contained in different firms), should be bound together under common ownership because multi ownership leads to the information spillovers that create opportunities for rent-seeking that are otherwise minimized by allocating decision rights over the use of assets to a single party.

2.2.1 The effect of relatedness

Recent research has found that the components of the targets' intellectual property account for 25% to 33% of total merger value creation (Beneish, Tseng, and Vorst, 2018). The primary reason for mergers and acquisitions is to achieve synergy by integrating two businesses in ways that would provide competitive advantages. Mergers create greater surplus if the partners are a "better match" along one or more dimensions. Such compatibilities could arise along many dimensions: better production, better technology, better organizational culture etc. When there are significant complementarities between assets, then placing the assets under the control of a single firm reduces the hold-up problems and underinvestment that results from the incomplete contracting (Rhodes-Kropf and Robinson, 2008; Beneish, Tseng, and Vorst, 2018). For example, average abnormal returns for target and acquirer are higher in related acquisitions than in diversifying acquisitions (Zhan, 2018). Devos et al. (2009) find that focused mergers offer greater opportunities to realize synergies through elimination of duplicate investments in comparison to diversifying mergers may be undertaken for reasons other than synergies such as empire building or the managers' desire to protect their human capital. Similarly, Guo et al. (2019) find that firms that purchase more intangible

assets reduce R&D expenses at a greater extent in the following years, suggesting that these firms acquire targets with similar competencies, technologies, and or products.

Many studies have examined the effect of relatedness along different dimensions such as technology, product, patents etc., as sources of synergy and lead to formation of merger pairs. One of such sources of synergy is the technological overlap between the merging firms, the background literature on which is summarized below. Higgins and Rodriguez (2006) argue that if the acquirer and the target firm are familiar with each other's technologies, then information asymmetry between merger participants is mitigated. The technological overlap can lead to increase in scope in innovation through reduction in duplicate R&D efforts (Henderson and Cockburn, 1996) and by filling gaps in the other's patent portfolio, resulting in the post-merger firm experiencing strengthened innovation prowess or more competitive positioning (Cassiman and Colombo, 2006; Cassiman and Veugelers, 2006).

Other measures of relatedness that have been examined in prior literature include product similarity, vertical relatedness, patents are briefly described in the following paragraph.

Hoberg and Phillips (2010) find that products developed using technology from similar targets with complementary (similar) assets are more likely to succeed. Fan and Goyal (2006) use industrial commodity flow data between pair of 500 firms as a proxy for vertical relatedness of two firms and find the related firms have

positive announcement wealth effects in the stock market. Bena and Li (2004) using textual analysis and patent data find greater patent output post-merger when merging firms had technological overlap in form of patent citations.

2.2.2 Acquisition of intangible assets and integration complexity

As mentioned previously, in the case of high-tech industries, the acquisitions are motivated mainly by acquirers' need to have access to critical and idiosyncratic knowledge-based resources of the target and to avoid the "time-consuming, path-dependent and uncertain process" of internally accumulating technologies and capabilities (Puranam and Srikanth, 2007; Dierickx and Cool, 1989; Leonard-Barton, 1995; Steensma and Fairbank, 1999). Acquisitions can therefore bring into a company, the capabilities it finds hard to develop and can provide the opportunity to leverage existing capabilities to improve its strategic flexibility and enhance its competitive position (Ranft and Lord, 2002). Moreover, the desire to obtain valuable resources, including know-how, technologies, and capabilities possessed by target firms, has been a driver of M&A activities (Ahuja and Katila, 2001; Chaudhuri and Tabrizi, 1999; Rau and Vermaelen, 1998).

However, the acquisition of intangibles through M&A's presents multifold challenges due to the inherent complexity, which poses a challenge in post-merger integration. Firstly, many technology firms are young start-ups without any current revenues and whose value lies heavily on the future development and commercial success of a new technology (Benou and Madura, 2005). Therefore,

investors may face difficulties in understanding the technology and to adequately evaluate its future outcomes.

Secondly, the recognition and accurate measurement of intangible assets are more vulnerable to subjectivity than are tangible investments. Wyatt (2005) argues since intangible information presents a challenge to the investors in disentangling their motives; debt contracting to reduce leverage vs. signaling growth opportunities. Information asymmetry will, ceteris paribus, be greater in firms with high intangible intensity, given that intangible assets are, by definition, more complex to value, and that estimates of their fair values are rarely disclosed.

Lastly, substantial resources must be devoted to assimilate, adapt, and improve upon the original technology. As Cutler (1991, 12) comments, "Technology is not necessarily a discrete deliverable that can be neatly packaged and forwarded. Technology transfer is a continuous, complex process of human interactions—ideas travel best in the minds of people."

Graebner and Heimeriks (2017) argue that integration is a multifaceted, dynamic, and context-specific process which involves complexity, unpredictability, uncertainty, and ambiguity. Many studies have found that inherent technological complexity level and uncertainty in the high-tech sector leads to risk of integration failure of target firms (Graebner, 2004; Chaudhuri and Tabrizi, 1999; Larsson and Lubatkin, 1990). The integration of a target firm in the R&D sector is more challenging due to the co-involvement of intangible assets and critical human capital. As noted by Ranft and Lord (2002), the acquisition implementation seems

to be particularly challenging in the high-tech industries where "valuable knowledge-based resources reside in human and social capital, that is difficult to measure and extract value from". (Barney, 1986; Teece, 2000) show that these capabilities are very context specific. A stream of subsequent work has built on the knowledge-based view of the firm (Kogut and Zander 1992, 1996) to argue that knowledge-based resources have specific properties that not only create value but also risks during the post-merger integration process. Kogut and Zander (1992) note that the knowledge-based resources can be classified into two types: " know-how" refers to tacit research capabilities that form the basis for their innovative research results, capabilities, and technologies and "knowledge" is the final, explicit findings i.e., codified knowledge. Schweizer (2005) finds the latter type of knowledge is usually transferred to pharmaceutical companies when they acquire new Biotech companies. The transfer of know-how is however complex and difficult under the transitional organizational conditions created by acquisitions (Ranft and Lord, 2002).

2.3 Information asymmetry, accounting treatment and investor perception of intangible assets

The following section discusses the specific characteristics of intangible intensive firms, the accounting treatment of intangibles and how these factors influence the investor perception about intangible intensive firms.

2.3.1 Undervaluation, mispricing due to information asymmetry

The ability of investors to incorporate the fair value of a firms' R&D capital into its market value is hindered by the uncertain payoffs of the R&D investment and by the fact that most information that is needed to estimate the fair value of such assets is held privately−i.e., "information asymmetry" (Kimbrough, 2007).

There are many manifestations of this information asymmetry, example the marketplace for lending based on intangibles looks like the "lemons" market modelled by Akerlof (1970). In this setting, the borrower needs to offer a higher return (lower price) as hedge against the risk of adverse selection caused by targets' private information. Strahan (1999) found that loans to borrowers that exhibit larger information asymmetry are generally more likely to be smaller in size, secured by collateral and have stricter covenants and shorter maturities. Dennis and Mullineaux (2000) showed that lenders are less likely to syndicate a loan when information borrower is less transparent. Boone and Raman (2001) report a significant positive relationship between R&D expenditures and stock bid-ask spreads.

The market value approach, which combines accounting data of firms with their valuation in financial markets (Lindenberg and Ross, 1981; Montgomery and Wernerfelt, 1988), has frequently been employed to assess returns to innovation and the economic value of intangible assets. According to this approach, in financial markets, investors estimate a company's value according to the prospective returns that they expect from its assets. Expectations about the future

performance of a company are embodied in its stock price. The market value can therefore be viewed as a forward-looking measure of firm performance (Hall, 1999).

It is widely understood that the organizational processes such as R&D conducted by private firms is an investment the output of which is an intangible asset that can be labeled as the firms' "knowledge asset". The value of such knowledge assets is considered to be the hidden value that escapes financial statements (Chen, Cheng and Hwang, 2005; Edvinsson and Malone, 1997; Lev and Radhakrishnan, 2003; Lev and Zarowin, 1999; Lev, 2001; Ruta, 2009; Fincham and Roslender, 2003). As per the market value approach, since the knowledge assets are known to contribute positively to the firms' future net cash flows, then the firms' knowledge stock should be reflected in the observed market value (Hall, 2005).

Many studies have argued that "market to book puzzle[1] arises because the market consistently puts a higher value on shareholder equity than the value appearing on corporate balance sheets. These excluded assets and appear significant in explaining the market-to book-value puzzle. Numerous observers, including Lev (2001), have pointed to absence of intangible assets from corporate balance sheets as an important source of the puzzle. Lev (2001) noted that the billions of dollars companies spent on R&D and brand development never enters books and is treated as an expense by their accountants largely because there are no market

[1] increasing gap observed between market value and book values

transactions to measure the fair value of potential benefits generated by those investments.

Lev et al. (2005) find that investors systematically undervalue young, intangible-intensive firms with high R&D expenditures and relatively low earnings growth rate. Firms with high R&D growth but low earnings growth indicate poor capital market performance; therefore, investors are likely to discount the future profitability of such firms' R&D significantly. As a result, such firms are likely to be undervalued.

Zhan (2018) argues that target firms with excess risk aversion are likely to suffer from underinvestment and undervaluation and are therefore more valuable to acquirers that can restructure them. They find acquirers with a relatively low proportion of intangible capital acquire targets with a high proportion of intangible capital create value for acquirers' shareholders. A one standard deviation increase in intangible capital transfer[2] from target to the acquirer led to a 47 basis points increase in acquirer abnormal announcement returns because of the redeployment of assets and the mitigation of underinvestment and undervaluation.

Celik et al. (2019), however documents a robust inverted-U relationship between firm innovation and takeover exposure. They suggest that as a firm becomes more innovative, its potential value as a target increases, which increases its exposure to

[2] defined as difference in proportion of intangible assets to totals assets of target and the acquirer

takeovers. Meanwhile, its stand-alone value is also increasing in innovativeness, reducing the likelihood of accepting an offer since the acquirers are less willing to pay a higher price to the target firm due to an increase in the adverse selection risk.

2.3.2 Market reaction and mispricing

In an efficient market, a tangible variable such as profits that is unambiguously beneficial to firm value are easier to incorporate into traditional valuation methodologies. There is vast evidence in literature that intangibles are not incorporated because the market lacks information on their value (the ''lack-of-information'' hypothesis). Firms with high R&D (Lev and Sougiannis, 1996; Chan, Lakonishok, and Sougiannis, 2001), advertising (Chan, Lakonishok, and Sougiannis, 2001), patent citations (Deng, Lev, and Narin, 1999), and software development costs (Aboody and Lev, 1998) are underpriced and earn abnormal long-run returns.

Eberhart et al 2004 following Daniel and Titman (2001) examine the market reaction to R&D increases and find that that the market is slow to recognize the full benefit of R&D increases for all their subsamples, but the market appeared to be particularly slow in recognizing the relatively greater benefit to high-tech firms. Edmans (2011) finds high levels of employee satisfaction, a highly visible intangible asset generates superior long-horizon returns, even when controlling for industries, factor risk, or a broad set of observable characteristics and posits that investor sophistication may play a role in apparent mispricing. He argues that under a mispricing channel, intangibles will only affect the stock price when they

subsequently manifest in tangible outcomes that are valued by the market. Intangibles thus can lead higher inherent firm value, but the market may fail to capitalize it immediately leading to a valuation gap or underpricing. Further, even if investors were aware of a firms' intangibles, they may have been unable to value them accurately using traditional valuation approaches commonly used for physical assets leading to underpricing. Thus, the firms with high growth opportunities, typically have higher market values relative to book value of assets (Doukas, Kim, and Pantzalis, 2010).

2.3.3 Improper accounting treatment

It is well known that current accounting does not include intangible asset values, does not attempt to reflect growth opportunities, and emphasizes a single performance measure, namely earnings. The amounts related to intangible assets, growth opportunities, and alternative performance measures that were barely noticeable in the 1970s, now explain a large portion of equity value. Even though intangibles may contribute to the market values of service and technology-based companies that invest heavily in intangibles (e.g., research and development, human capital, and brand development), current accounting rules only record intangible assets in limited circumstances (i.e., purchased intangibles). Consequently, financial accounting information may not be very useful when assessing the values of companies with large amounts of unrecorded intangibles. This has led to the decreased relevance of earnings over intangibles in recent years (Amir and Lev, 1996; Lev, 1996).

The information asymmetry of intangible assets and their exclusion from financial statements has potential consequences for their valuation.

Edmans (2011) argues that a firms' intangibles may be only partially incorporated in its market value versus a firm whose all assets are tangible (tangible intensive firm) leading to lower market value for the intangible intensive firm. On the other hand, since the many of intangibles such as R&D expenditure, SGA, marketing and software development costs are only expensed without any addition to the book value of assets, the book value of assets for the intangible intensive firm would also be significantly lower than the tangible intensive firm of similar size[3]. So, the efficiency of pricing of intangibles would determine whether the intangible intensive firms would trade at a premium or discount to a similar sized tangible intensive firm.

2.3.4 (Mis)valuation hypothesis and Q Theory

The (mis)valuation hypothesis rests upon the assumption that the market is inefficient whereas managers are rational, thus managers can exploit mispricing of the market thus having important effects on takeover activity. These effects stem from the efforts of bidders to profit by buying undervalued targets for cash at a price below fundamental value, or by paying equity for targets that, even if overvalued, are less overvalued than the bidder (Shleifer and Vishny, 2003). An alternative theory, which we call the Q hypothesis of takeovers, focuses on how

[3] as measured by their market values

acquisitions redeploy target assets. High market value is an indicator that a firm is well run or has good business opportunities. Thus, market valuations are proxies for growth opportunities of the bidder and target. Both the (mis)valuation and Q approaches imply that market valuations are related to the characteristics of takeover transactions. RRV (2005) have found evidence that valuation levels drive merger activity. They show that the B/M ratio consists of 2 components: i) mispricing and ii) growth or time- varying risk. The residual income valuation, V/P, filters-out growth, or time- varying risk factors and has received strong support as an indicator of mispricing. The residual M/V component, as RRV (2005) argue, reflects deviations from fundamental values caused either by (mis)valuation or the firm specific growth opportunities that are orthogonal to the firms' current fundamentals suggesting that many deals are motivated by mispricing of firm valuations as opposed to their long-run fundamentals. Since, high-intangible mergers are more likely to be motivated by "mispricing", takeover announcement returns of large intangible targets allows for more focused test for the effect of the (mis)valuation on the market reactions to such acquisitions in the current study.

3 Research Questions and Hypothesis

This study examines two primary research questions:

1) Are intangible intensive firms more likely to make acquisitions or are more likely to be acquired?

2) How the market reacts to M&A deals that involve intangible intensive acquirers and targets?

Research Question 1: Is the acquisition of intangible assets a motive for M&A?

As mentioned previously, there are three reasons for firms to seek intangible intensive targets trough M&A. First, the acquisition of intangible assets enables the acquiring firms to access and leverage targets' knowledgebase and capabilities to achieve competitive advantage. Second, compared with developing intangible assets internally, firms sometime prefer to purchase them externally due to the high cost of self-investment and the uncertain outcomes of the development process (Lev, 2000).

Third, the information spillovers that create opportunities for rent-seeking are minimized by allocating decision rights over the use of assets to a single party Grossman and Hart (1986); Hart and Moore (1994). For example, the organizational capital cannot be "owned" and transfers along with the ownership of a firm (Lev and Radhakrishnan, 2005; Lev, 2000). The current study runs an OLS regression on acquisition probability and probability of being acquired (target) as a dummy variable against a firms' intangible assets. A sign and significance

coefficient of the variable, intangible assets would show that whether intangible assets are drivers of M&A deals.

Following are the testable hypotheses based on the above research question:

Hypothesis 1a) Firms having higher intangible assets are likely to make more acquisitions.

Hypothesis 1b) Intangible intensive firms are attractive targets and have higher likelihood of being acquired.

Research Questions 2: How does market reacts to the M&A deals involving intangible intensive acquirer and target firms?

As mentioned previously, although information asymmetry related to innovation results in intangible intensive firms having high capital costs and lower market valuations, it also enables acquirers of intangible intensive firms to capture synergistic benefits at low cost by acquisition of these undervalued firms. Zhan (2018) estimated the stocks of knowledge and organizational capital and found that "intangible capital transfer" from a target to an acquirer during acquisitions has a significantly positive impact on acquirers' and targets' abnormal returns around the announcement day.

Following are the testable hypotheses based on the above research question:

Hypothesis 2) In an M&A, acquisitions of intangible intensive target firms are viewed negatively by the market and their shareholders experience positive announcement returns.

Hypothesis 3) In an M&A, acquisitions by intangible intensive acquirer firms are viewed favourably by the market and their shareholders experience positive and significant announcement returns.

Hypothesis 4) In an M&A, acquisitions by Intangible intensive targets are viewed favourably by the market and the acquiring firm shareholders experience positive and significant announcement returns.

Additional questions related to Research Question 2

As stated previously, there is an evidence of systematic undervaluation of intangible intensive firms with low earnings growth (Lev et al., 2005). Intangibles thus can lead higher inherent firm value, but the market may fail to capitalize it immediately leading to underpricing. Further, retail investors may not be able to value the intangibles accurately using traditional valuation approaches commonly used for physical assets leading to underpricing. As a result, the intangible intensive firms are likely to be undervalued and earn abnormal long-run returns. (Lev and Sougiannis, 1996; Chan, Lakonishok, and Sougiannis, 2001), advertising (Chan, Lakonishok, and Sougiannis, 2001).

Further, the results of Griffin and Lemmon (2002) indicate that in spite of their poor current earnings, small young firms continue to invest heavily in future growth opportunities causing variability in the investors' expectation about the payoffs from future growth opportunities, which may lead to the mispricing of the stocks. Thus, it is worthwhile to examine whether the market reaction to deals involving intangible intensive acquirers and or targets is due to (mis)pricing of their stocks.

a) Are the acquirer and/or target announcement returns driven by their respective (mis)valuation?

Following are the testable hypotheses based on the above research question:

Hypothesis 2 a) For intangible intensive target firms, the announcement returns are positively driven by their respective (mis)valuation.

Hypothesis 3 a) For intangible intensive acquirer firms, the announcement returns are positively driven by their respective (mis)valuation.

Hypothesis 4 a) The announcement returns of the acquirer firms when they acquire intangible intensive target firms are positively driven by the latter's (mis)valuation.

Theoretical work by Eckbo, Giammarino, and Heinkel (1990) showed that the payment method was used to send a "signal" to market about acquirers' valuation of the target and to hedge the adverse selection risk caused by targets' private information. Many studies have provided evidence that in presence of the adverse selection risk, overvalued acquirers are more likely to use "equity" as cheap currency to purchase real assets from targets (Shleifer and Vishny, 2003; RRV, 2005; Bhagat, Dong, Hirshleifer, and Noah, 2005). Celik et al. (2019) documents a positive association between equity usage and target innovativeness.

Given the existing information asymmetry around firms with higher intangibles, it is interesting to examine, how market perceives the M&A transaction when acquirer firm uses cash as a method of payment instead of equity, which brings the following research question:

b) Does the market favorably perceive intangible intensive deals with cash as method of payment?

Following are the testable hypotheses based on the above research question:

Hypothesis 2 c) The shareholders of intangible intensive target firms experience positive and significant announcement returns in an M&A, when those target firms are acquired using cash as a method of payment.

Hypothesis 3 c) The shareholders of intangible intensive acquirer firms experience positive and significant announcement returns in an M&A, when the acquirer firm uses cash as a method of payment.

Hypothesis 4 b) The acquirer firms' shareholders experience positive and significant announcement returns in an M&A, when they acquire intangible intensive firms using cash as a method of payment.

Prior literature has shown that the deals involving public targets generate the negative returns for the acquirer firms' shareholders implying that the market puts lower weight on the synergy benefits from acquisition of public targets (Moeller, Schlingemann, and Stulz (2004); Masulis, Wang, and Xie, 2007). In an efficient market, if the target is equally valuable to potential acquirers, the competitive bidding process will result in zero returns for the acquiring firm since any expected synergies estimated on the basis of public information are unlikely to benefit the acquiring firm. Thus, through the competitive bidding process this excess value usually goes to the target firm. We examine the relation between acquirers' CAR and acquisition of public targets in the context of intangible intensive acquirers leading to the following research questions:

c) Does the market favorably perceive the M&A deals where intangible intensive acquirers acquiring public targets?

Following is the testable hypothesis based on the above research question:

Hypothesis 3 f) The shareholders of intangible intensive acquirer firms experience positive and significant announcement returns in an M&A, when acquiring acquires a publicly listed target.

Lastly, the past decades have witnessed an increased acquisition activity in high-tech sector where firms are usually intangible intensive driven by opportunities to access tacit and complex knowledge and to avoid the uncertain process of developing the technology internally (Desyllas and Hughes, 2010; Phillips and Zhdanov, 2012). Similarly, mergers create greater surplus if the firms are a "better match" along one or more dimensions. Such compatibilities could arise along many dimensions: better production, better technology, better organizational culture etc. Many studies show that private synergies exist when the acquirer is more technologically proximate to the target as compared to other potential acquirers (Chondrakis, 2016; Bena and Li, 2014). In view of the above, we examine the relation between announcement returns and intangible assets of the acquirer or target firms being from high technology sector and operating in same industry as per the SIC code. This leads to the following research questions:

d) Does the market react positively to the M&A deals where target or the acquirer firm is from the high-tech sector?

Following are the testable hypotheses based on the above research question:

Hypothesis 2 d) The shareholders of intangible intensive target firms experience negative and significant announcement returns in an M&A, when the target firm belongs to the high-tech sector.

Hypothesis 3 d) The shareholders of intangible intensive acquirer firms experience negative and significant announcement returns in an M&A, when the acquiring firm belongs to the high-tech sector.

Hypothesis 4 d) The shareholders of acquirer firms experience positive and significant announcement returns in an M&A, when they are in a high-tech industry and acquire intangible intensive targets.

e) Does the market react positively to the M&A deals where target or the acquirer firm operate in the same industry i.e., related acquisition?

Following are the testable hypotheses based on the above research question:

Hypothesis 2 e) The shareholders of intangible intensive target firms experience positive and significant announcement returns in an M&A, when target firm and the acquiring firm have the same SIC code i.e., related acquisition.

Hypothesis 3 d) The shareholders of intangible intensive acquirer firms experience positive and significant announcement returns in an M&A, when acquiring firm and the target firm have the same SIC code i.e., related acquisition.

Hypothesis 4 e) The shareholders of acquirer firms experience positive and significant announcement returns in an M&A, when acquire intangible intensive firm having same SIC code. i.e., related acquisition.

4 Data and Methodology

Sections 4.1 and 4.2, describe the data and methodology used in the study.

4.1 Data

The deal data for M&A deals is obtained from the SDC Platinum database. The financial information and stock return data for the acquirers and targets is obtained from Standard and Poor's COMPUSTAT and Center for Research in Security Prices (CRSP) respectively. Stock price and accounting data were then merged with SDC deals data by CUSIP field. Following filters were applied to the deal data:

- Both target and acquirer are registered in the U.S.
- Deal date is between 2001 to 2017
- Deal results in transfer of ownership i.e., atleast 50% of the target shares are acquired
- Deal value is greater than or equal to $1 million
- Deal status is completed

The event study analysis for market reaction to announcement was carried out using Wharton Research Data Services (WRDS) event study application. The abnormal returns were calculated using a market model with cumulative abnormal returns (CARs) over the event window [-2,2] as a main dependent variable. We assess statistical significance with heteroskedasticity-robust standard errors clustered by industry using the Fama-French 12-industry classification.

4.2 Methodology

The following section lists the OLS models used to test each of the hypotheses from section 3.

Research Question 1: Intangible assets and probability of acquisition and probability of being acquired.

Hypothesis 1a), that the firms having higher intangible assets are likely to make more acquisitions is estimated from the following model.

$$acquisition\_dummy = a + \beta\_1*intan + \beta\_2*size + \beta\_3*sales\_growth + \beta\_4*firm\_risk + \beta\_5* rnd\_sales + \beta\_6*inst\_own + \beta\_7\ ind\_fixed + \beta\_8*\ year\_fixed + \varepsilon$$

Hypothesis 1b), that the intangible intensive firms are attractive targets and have higher likelihood of being acquired is estimated from the following model.

$$target\_dummy = a + \beta\_1*intan + \beta\_2*size + \beta\_3*sales\_growth + \beta\_4*firm\_risk + \beta\_5* rnd\_sales + \beta\_6*inst\_own + \beta\_7*\ ind\_fixed + \beta\_8*\ year\_fixed + \varepsilon$$

Research Question 2: Target intangible assets and their abnormal returns: Effect of (mis)valuation RQ-2a), cash payment RQ-2b), high tech industry RQ-2d) and related deals RQ-2e).

Hypothesis 2), that the acquisitions of intangible intensive target firms are viewed negatively by the market and their shareholders experience positive announcement returns is estimated from the following model.

$$tar\_CAR = a + \beta\_1*tar\_intan + \beta\_2*tar\_leverage + \beta\_3*tar\_sales\_growth + \beta\_4*tar\_size + \beta\_5*\ tar\_inst\_own + \beta\_6*tar\_firm\_risk + \beta\_7*\ percent\_cash + \beta\_8*related\_dummy + \beta\_9*\ tar\_hightech\_dummy + \beta\_10*\ ind\_fixed + \beta\_11*\ year\_fixed + \varepsilon$$

Hypothesis 2 a), that the announcement returns intangible intensive target firms are positively driven by their respective (mis)valuation is estimated from the following model.

tar_CAR = a + β_1 tar_misvaluation + firm specific controls + deal controls+ industry and year specific controls + ε*

Hypothesis 2 b), that the announcement returns intangible intensive target firms are positively driven by (mis)valuation of the intangible assets is estimated from the following model.

*tar_CAR = a + β_1*tar_intan*tar_misvaluation + firm specific controls + deal controls+ industry and year specific controls+ ε*

Hypothesis 2 c), that the shareholders of intangible intensive target firms experience positive and significant announcement returns in an M&A, when those target firms are acquired using cash as a method of payment is estimated from the following model.

tar_CAR = a + β_1 tar_intan*percent_cash + firm specific controls + deal controls + industry and year specific controls + ε*

Hypothesis 2 d), that the shareholders of intangible intensive target firms experience negative and significant announcement returns in an M&A, when the target firm belongs to the high-tech sector is estimated from the following model.

tar_CAR = a + β_1 tar_intan*tar_high_tech + firm specific controls + deal controls + industry and year specific controls + ε*

Hypothesis 2 e), that the shareholders of intangible intensive target firms experience positive and significant announcement returns in an M&A, when target firm and the acquiring firm have the same SIC code i.e., related acquisition is estimated from the following model.

$tar\_CAR = a + \beta\_1 * tar\_intan * related\_dummy + firm\ specific\ controls + deal\ controls + industry\ and\ year\ specific\ controls + \varepsilon$

Research Question 2: Acquirer intangible assets and its abnormal returns: Effect of (mis)valuation-RQ 2a), cash payment-RQ 2b), high tech industry RQ 2e), public targets-RQ 2c) and related deals-RQ 2e).

Hypothesis 3), that acquisitions by intangible intensive acquirer firms are viewed favourably by the market and their shareholders experience positive and significant announcement returns is estimated from the following model.

$acq\_CAR = a + \beta\_1 * acq\_intan + \beta\_2 * acq\_leverage + \beta\_3 * acq\_sales\_growth + \beta\_4 * acq\_size + \beta\_5 * acq\_inst\_own + \beta\_6 * acq\_firm\_risk + \beta\_7 * percent\_cash + \beta\_8 * related\_dummy + \beta\_9 * acq\_hightech\_dummy + \beta\_9 * ind\_fixed + \beta\_10 * year\_fixed + \varepsilon$

Hypothesis 3 a), that the announcement returns for intangible intensive acquirer firms are positively driven by their respective (mis)valuation is estimated from the following model.

$acq\_CAR = a + \beta\_1 * acq\_misvaluation + firm\ specific\ controls + deal\ controls + industry\ and\ year\ specific\ controls + \varepsilon$

Hypothesis 3 b), that the announcement returns for intangible intensive acquirer firms are positively driven by (mis)valuation of the intangible assets is estimated from the following model.

$$acq\_CAR = a + \beta\_1 * acq\_intan * acq\_misvaluation + firm\ specific\ controls + deal\ controls + industry\ and\ year\ specific\ controls + \varepsilon$$

Hypothesis 3 c), that the shareholders of intangible intensive acquirer firms experience positive and significant announcement returns in an M&A, when the acquirer firm uses cash as a method of payment is estimated from the following model.

$$acq\_CAR = a + \beta\_1 * acq\_intan * percent\_cash + firm\ specific\ controls + deal\ controls + industry\ and\ year\ specific\ controls + \varepsilon$$

Hypothesis 3 d), that the shareholders of intangible intensive acquirer firms experience negative and significant announcement returns in an M&A, when the acquiring firm belongs to the high-tech sector is estimated from the following model.

$$acq\_CAR = a + \beta\_1 * acq\_intan * high\_tech + firm\ specific\ controls + deal\ controls + industry\ and\ year\ specific\ controls + \varepsilon$$

Hypothesis 3 e), that the shareholders of intangible intensive acquirer firms experience positive and significant announcement returns in an M&A, when acquiring firm and the target firm have the same SIC code i.e., related acquisition is estimated from the following model.

acq_CAR = a + β_1 acq_intan*related_dummy + firm specific controls + deal controls + industry and year specific controls + ε*

Hypothesis 3 f), that the shareholders of intangible intensive acquirer firms experience positive and significant announcement returns in an M&A, when acquiring acquires a publicly listed target is estimated from the following model.

acq_CAR = a + β_1 acq_intan*public_target_dummy + firm specific controls + deal controls + industry and year specific controls + ε*

Research Question 2: Target intangible assets and acquirer abnormal returns: Effect of (mis)valuation-RQ 2a), cash payment-RQ 2b), high tech industry-RQ 2d), and related deals-RQ 2e).

Hypothesis 4), that the acquisitions of intangible intensive targets are viewed favourably by the market and the acquiring firm shareholders experience positive and significant announcement returns target is estimated from the following model.

*acq_CAR = a + β_1*tar_intan+ β_2*acq_leverage + β_3*acq_sales_growth + β_4*acq_size +β_5*acq_inst_own+β_6*acq_firm_risk+ β_7*percent_cash + β_8* related_dummy+β_9* acq_hightech_dummy + β_10* ind_fixed + β_11* year_fixed + ε*

Hypothesis 4 a), that the announcement returns of the acquirer firms when they acquire intangible intensive target firms are positively driven by the latter's (mis)valuation target is estimated from the following model.

acq_CAR = a +β_1 acq_misvaluation + firm specific controls + deal controls + industry and year specific controls+ ε*

Hypothesis 4b), that the acquirer firms' shareholders experience positive and significant announcement returns in an M&A, when they acquire intangible intensive firms using cash as a method of payment target is estimated from the following model.

acq_CAR = a + β_1 tar_intan*percent_cash + firm specific controls + deal control s+ industry and year specific controls+ ε*

Hypothesis 4 c), that the acquisition of intangible intensive target firms by intangible intensive acquirer firms leads to positive and significant announcement returns for the shareholders of acquirer firms target is estimated from the following model.

acq_CAR = a + β_1 tar_intan*acq_intan + firm specific controls + deal controls + industry and year specific controls + ε*

Hypothesis 4 d), that the shareholders of acquirer firms experience positive and significant announcement returns in an M&A, when they are in a high-tech industry and acquire intangible intensive targets target is estimated from the following model.

acq_CAR = a + β_1 tar_intan*acq__high_tech + firm specific controls + deal controls + industry and year specific controls + ε*

Hypothesis 4 e), that the shareholders of acquirer firms experience positive and significant announcement returns in an M&A, when acquire intangible intensive firm having same SIC code. i.e., related acquisition target is estimated from the following model.

acq_CAR = a + β_1 tar_intan*related_deal_dummy + firm specific controls + deal controls + industry and year specific controls + ε*

5 Results and Findings

The descriptive statistics of the main variables in the study are presented in panel A's of Tables 1 and 2 with the number of observations, minimum, maximum, mean, and standard deviation measures.

Insert Tables 1 and 2 here

The average size of a firm as measured by its number of employees in the sample approximately 9. The average values in the sample for a firms' intangibles as a percentage of total assets, long term debt as a percentage of total assets, firm risk, annual sales growth, R&D expenditure as a percentage of sales, and institutional ownership are 13.75%, 17.39%, 13.85%, 16.79%, 53.89% respectively. The panel B's of Tables 1 and 2 report the pairwise Pearson Correlation among main variables of interest.

Hypothesis 1a) and 1b) Intangible assets and probability of acquisition and probability of being acquired.

Insert Table 3 here

Table 3 presents the results of the logistic regression for hypothesis 1 a) with firm-fixed and year fixed effects as controls. The coefficients of the variable, intan are significant at 1 percent confidence interval for both model 1 and model 2 (includes rnd_sales as a control variable).

As expected, the results clearly show that there is a positive and significant causal relationship between a firms' probability to make acquisitions and its intangible assets i.e., intangible assets are the drivers of a firms' acquisition activity.

Insert Table 4 here

Table 4 presents the results of the logistic regression for hypothesis 1 b) with firm-fixed and year fixed effects as controls. The coefficients of the variable, intan are significant at 1 percent confidence interval for both model 1 and model 2 (includes rnd_sales as a control variable).

As expected, the results show that there is a positive and significant causal relationship between a firms' probability of being acquired and its intangible assets i.e., firms having higher intangible assets are more likely to get acquired.

Hypothesis 2) Target intangible assets and its abnormal returns: Effect of (mis)valuation, cash payment, high tech industry and related deals.

Insert Table 5 here

Table 5 presents the results of hypothesis 2, with deal specific, firm-fixed and year fixed effects controls.

It can be seen from Table 5 that the coefficient of tar_intan is negative and significant at 5 percent confidence level showing that the shareholders of intangible intensive target firms experience negative announcement returns when such firms are acquired.

Additionally, it can be seen from model 2 (hypothesis 2a) that the coefficient of tar_misvaluation is insignificant showing that there is no evidence that

that market reaction to the acquisition of intangible intensive targets is driven by mispricing instead of their intrinsic value.

The models 3 through 6 (hypothesis 2b, 2c, 2d and 2e) are the results for the additional analysis when tar_intan variable is interacted with tar_misvaluation, percent_cash and tar_high_tech and related_dummy. The following paragraph presents the important findings from this analysis.

The coefficient of interaction variable, tar_intan*percent_cash in model 4 is positive and significant at 10 percent confidence level indicating when acquirers are more certain about the prospects of the deal and signal to market by paying cash for acquisition, such deals lead to positive announcement returns for the target shareholders. From model 5, the coefficient of interaction variable, tar_intan*tar_high_tech is negative and significant at 1 percent confidence level showing that the market negatively views the acquisition of high-tech target firms with high intangibles leading to value destruction for target firm shareholders. This is consistent with market skepticism of the benefits from the merger i.e., synergies and high risk of integration failure due to complex nature of the intangible assets.

The coefficient of variable tar_intan*related_dummy is negative but insignificant hence, the study doesn't find any significant relationship between relatedness i.e., acquisition of intangible intensive target firms operating in the same industry as the acquirer firm and target firms' announcement returns.

Thus, from above results, hypotheses; 2, 2 c) and 2 d) are supported while the study fails to reject hypotheses; 2 a) and 2 e).

Hypothesis 3) Acquirer intangible assets and its abnormal returns: Effect of (mis)valuation, cash payment, high tech industry, public targets and related deals.

Insert Table 6 here

Table 6 shows the results for hypothesis 3. The coefficient of variable acq_intan is positive but insignificant showing that acquirer firms' intangibles do not have any significant effect on its announcement returns as proxied by CAR. Also, the coefficient of acq_misvaluation in model 2 is insignificant showing that acquirer firms' (mis)valuation at announcement doesn't drive its announcement returns.

The models 3 through 7 (hypothesis 3a, 3b, 3c, 3d, 3e and 3f) are the results for the additional analysis when acq_intan variable is interacted with acq_misvaluation, , acq_intan* acq_(mis)valuation, percent_cash and acq_high_tech, related_dummy and public_target. The following paragraph presents the important findings from this analysis.

In model 5, coefficient of variable acq_intan*acq_high_tech is negative and significant at 5 percent confidence level showing that the market negatively views high tech acquirer firms having higher intangible assets and such deals end up destroying value for the acquirer firm shareholders. Further in model 7, the coefficient of variable, acq_intan*public_target is positive and significant at 5 percent confidence level in agreement with the prior literature about acquisition

of public targets The results of model 7 show that when acquiring firms with high intangibles acquire public targets, the market reacts positively can be attributed to the lower information asymmetry associated with public targets which allows the market participants to fairly access the prospects of the deal. Further in a competitive bidding process, the target firms' intangibles have different values for different acquirers which increases the target firms' bargaining power as acquirers are willing to pay a premium for acquisition which leads to positive gains for the target firms' shareholders (Masulis, Wang, and Xie, 2007; Moeller, Schlingemann, and Stulz, 2004).

In model 6, the coefficient of variable acq_intan*related_dummy is positive but insignificant. Hence, the study doesn't find any significant relationship between the intangible intensive acquirer firms' propensity to acquire related firms and their respective announcement returns.

Thus, from above results, hypotheses; 3 c) and 3 e) are supported while the study fails to reject hypotheses; 3, 3 a), 3 b), and 3 c).

Hypothesis 4) Target intangible assets and acquirer abnormal returns: Effect of (mis)valuation, cash payment, high tech industry, and related deals.

Insert Table 7 here

Table 7 shows the results of hypothesis 4. The positive but insignificant coefficient of variable, tar_intan implies that target firms' intangibles does not have any significant effect on acquirers' announcement returns as proxied by CAR. Similarly, the coefficient of variable tar_misvaluation in model 3 is insignificant

indicating the acquirer announcement returns aren't driven by target firms' (mis)valuation.

The models 4 through 7 (hypothesis 4b, 4c, 4d, 4e) are the results for the additional analysis when tar_intan variable is interacted with percent_cash, acq_intan, acq_high_tech, related_dummy. The following are the major findings from this analysis.

In model 3, coefficient of variable tar_intan*percent_cash is positive and significant at 5 percent confidence level showing that the market positively views intangible intensive acquirer firms in deals where they use cash as a method of payment leading to positive announcement returns for the acquirer firms' shareholders.

The coefficients of variables, tar_intan*acq_intan and tar_intan*related_dummy in models 4 and 6 are insignificant. Hence, the study doesn't find any significant effect on the acquirers' CAR in deals where both target and acquirer firms are intangible intensive or deals where intangible intensive targets operating in the same industry as the acquirer

Thus, from above results, hypotheses; 4 b) is supported while the study fails to reject hypotheses; 4, 4 a), 4 c), 4 d) and 4 e).

6 Robustness Tests

In order-to examine the robustness of our results, we re-run the regressions in Table 5, 6 and 7 with where both target firm and the acquirer firm are both

operating in the high technology sector. Since, the acquirers and targets firms in the high technology sector, in general have higher proportion of intangibles, these tests serve as a test of our previous results about the effect of intangibles on cumulative abnormal returns. The average acquirers' intangible assets to total assets ratio in a high technology deal is 0.2737 vs 0.1981 for the overall sample. Similarly, the average targets' intangible assets to total assets ratio is 0.2101 vs 0.1421 for the overall sample.

Insert Table 8 here

The panels A, B and C of Table 8, show the results of the regressions. It can be seen from Table 8 that the previous results remain robust and unchanged.

Summary of the results

	Hypothesis	Result
1 a)	***Firms having higher intangible assets are likely to make more acquisitions.***	supported
1 b)	***Intangible intensive firms are attractive targets and have higher likelihood of being acquired***	supported
2:	***Acquisitions of intangible intensive target firms are viewed negatively by the market and their shareholders experience positive announcement returns.***	supported
2 a)	***For intangible intensive target firms, the announcement returns are positively driven by their respective (mis)valuation.***	Not supported
2 b)	***For intangible intensive target firms, the announcement returns are positively driven by (mis)valuation of the intangible assets.***	Not supported
2 c)	***The shareholders of intangible intensive target firms experience positive and significant announcement returns in an M&A, when those target firms are acquired using cash as a method of payment.***	supported
2 d)	***The shareholders of intangible intensive target firms experience negative and significant announcement returns in an M&A, when the target firm belongs to the high-tech sector.***	supported
2 e)	***The shareholders of intangible intensive target firms experience positive and significant announcement returns in an M&A, when target firm and the acquiring firm have the same SIC code i.e. related acquisition.***	Not supported
3:	***In an M&A, acquisitions by intangible intensive acquirer firms are viewed favourably by the market and their shareholders experience positive and significant announcement returns.***	Not supported

3 a)	***For intangible intensive acquirer firms, the announcement returns are positively driven by their respective (mis)valuation.***	Not supported
3 b)	***For intangible intensive acquirer firms, the announcement returns are positively driven by (mis)valuation of their intangibles.***	Not supported
3 c)	***The shareholders of intangible intensive acquirer firms experience positive and significant announcement returns in an M&A, when the acquirer firm uses cash as a method of payment.***	Not supported
3 d)	***The shareholders of intangible intensive acquirer firms experience negative and significant announcement returns in an M&A, when the acquiring firm belongs to the high-tech sector.***	supported
3 e)	***The shareholders of intangible intensive acquirer firms experience positive and significant announcement returns in an M&A, when acquiring firm and the target firm have the same SIC code i.e. related acquisition.***	Not supported
3 f)	***The shareholders of intangible intensive acquirer firms experience positive and significant announcement returns in an M&A, when acquiring acquires a publicly listed target.***	supported
4:	***In an M&A, acquisitions by Intangible intensive targets are viewed favourably by the market and the acquiring firm shareholders experience positive and significant announcement***	Not supported
4 a)	***The announcement returns of the acquirer firms when they acquire intangible intensive target firms are positively driven by the latter's (mis)valuation.***	Not supported
4 b)	***The acquirer firms' shareholders experience positive and significant announcement returns in an M&A, when they acquire intangible intensive firms using cash as a method of payment***	supported
4 c)	***In an M&A, acquisition of intangible intensive target firms by intangible intensive acquirer firms leads to positive and significant announcement returns for the shareholders of acquirer***	Not supported
4 d)	***The shareholders of acquirer firms experience positive and significant announcement returns in an M&A, when they are in a high-tech industry and acquire intangible intensive targets.***	Not supported
4 e)	***The shareholders of acquirer firms experience positive and significant announcement returns in an M&A, when acquire intangible intensive firm having same SIC code. i.e. related acquisition.***	Not supported

7 Discussion, conclusion, and future research

The results of this study clearly show that there is a positive and significant i.e., causal relationship between a firms' probability to make acquisitions and its intangible assets i.e. intangible assets are the drivers of a firms' acquisition activity. Similarly, the results also show that there is a positive and significant causal relationship between a firms' probability of being acquired and its intangible assets i.e., firms having higher intangible assets are more likely to get acquired.

The findings support the Q Theory of mergers, which states that acquisitions redeploy target assets and target firms with high market value compared to book values via intangible assets offer such growth opportunities for the acquirer firms. Given the increasing proportion of intangible assets in the economy Nakamura (2001, 2003), the result also clearly indicate that intangible assets are indeed a strategic bundle of non-physical assets for the acquirers which are necessary for their growth and providing them competitive advantage in changing environments.

The results also support the property rights theory, property rights theory of the firm advocated by Grossman and Hart (1986) and Hart and Moore (1990) and extended further by Rhodes-Kropf, Robinson, and Viswanathan (2005), which states that single ownership of such complementary assets is preferable than multiple ownership due to benefits of reduction in information spillovers which otherwise create opportunities for rent-seeking.

For targets, the result that firms with higher intangibles have a higher probability of being acquired even when controlling for firms' R&D, clearly extends the R&D and acquisition probability relationship. Thus, with an existence of an active takeover market, target firms have increased incentives to invest in R&D and accumulate intangibles to signal potential acquirers, especially in the high technology sector. The results mentioned above have important implications for M&A. Since intangibles increase the probability of a firm making an acquisition and probability of a firm getting acquired, firms may accumulate specific intangibles in order to be active in the M&A market.

The following paragraphs discuss the results for the market reaction to the intangible intensive deals for both acquirer and target shareholders. First, the study does not find any evidence for the role of mispricing channel in the market reactions to intangible assets acquisition.

Second, as mentioned previously, in the case of deals involving high intangible acquirers or targets including those operating in the high technology industries, there are two factors for investors to consider. On one hand, the acquirers' need to have access to critical and idiosyncratic knowledge-based resources of the target and to avoid the "time-consuming, path-dependent and uncertain process" of internally accumulating technologies and capabilities (Puranam and Srikanth, 2007; Dierickx and Cool, 1989; Leonard-Barton, 1995; Steensma and Fairbank, 1999). On the other hand, the firms with high intangible intensity have higher information asymmetry, since intangible assets are more complex to value, and

that estimates of their fair values are rarely disclosed. Further, in M&A deals where the acquirer or the target firm has a higher proportion of such assets, there is a consistent market scepticism of the benefits from the merger i.e., synergies, due to complex nature of the intangible assets that may pose challenges for post merger integration.

The significance of negative market reaction for acquirers' shareholders to the acquisition of intangible intensive target firms operating in the high technology sector shows that this effect is primarily driven market scepticism.

The fact that above results hold true even when the acquirer is from a high technology sector is surprising given large volume of M&A in the high technology sector. Hence, the investor scepticism still dominates in market evaluation of such deals even though where there is an increasing need to acquire such assets in order to remain competitive.

In further analysis of the above results, it is interesting to note in the above case (acquisition of intangible intensive target firms which are operating in the high technology sector), when cash is used as a method of payment the market reacts positively leading to positive announcement returns for the acquirer firms' shareholders. This shows that even though the market is sceptical about the targets, cash mitigates some of the uncertainty and increases investor confidence.

The above result holds true even when the target and acquirer both are in the high technology sector but with less significance. This agrees with prior literature that the market is particularly slow in recognizing the benefit of R&D increases for high

technology firms (Eberhart, Maxwell, and Siddique, 2004 and 2008; Daniel and Titman, 2001 and 2006).

Lastly, the results show that when acquiring firms with high intangibles acquire public targets, the market reacts positively. This can be attributed to the lower information asymmetry associated with public targets, which allows the market participants to fairly access the prospects of the deal. Further, the competitive bidding process, the bidders place different values on a target firms' intangibles due to different expectations about the synergies, which increases the target firms' bargaining power resulting in positive gains for the target firms' shareholders (Masulis, Wang, and Xie, 2007; Moeller, Schlingemann, and Stulz, 2004).

For target shareholders of intangible intensive target firms experience negative announcement returns when such firms are acquired. Growth opportunities lost as result of the merger. The market reaction remains negative and significant when either the target firm or the target and acquirer firms are operating in the high technology sector

As the proportion of such assets increase in the economy (Lev, 2000; Corrado and Hulten, 2010), the results imply that most of the due diligence aspects of the deal would revolve around their valuation, integration, complementarity etc.

Appendix

Variable Name	Description
acquisition_dummy	Dummy variable which takes the value 1 if a firm makes an acquisition in any given year and 0 otherwise

target_dummy	Dummy variable which takes the value 1 if a firm is acquired in any given year and 0 otherwise
tar_CAR	The cumulative abnormal returns around announcement period (-2,+2) for the target firm, estimated using the market model based on the Centre for Research in Stock Prices (CRSP) equally weighted index
acq_CAR	The cumulative abnormal returns around announcement period (-2,+2) for the acquirer firm, estimated using the market model based on the Centre for Research in Stock Prices (CRSP) equally weighted index
intan	Ratio of a intangible assets to total assets of a COMPUSTAT firm
leverage	*Long term debt to total assets* of a COMPUSTAT firm
firm_size	Size of COMPUSTAT firm as measured by number of employees
sales_growth	Annual growth of sales as measured by ΔSALE / SALEt-1 of a COMPUSTAT firm
rnd_sales	Target firms' R&D expenditure a year before the acquisition year
inst_own	The percentage of a COMPUSTAT firms' shares outstanding owned by institutions
acq_intan	Acquirer firm intangible assets scaled by total assets
acq_leverage	Acquirer firms' long-term debt to total assets
acq_firm_size	Acquirer firms' size as measured by number of employees
acq_firm_risk	Acquirer firms' risk as measured by annualized buy-and-hold stock returns (BHRET) for past 60 month
acq_sales_growth	Acquirer firms' annual growth of sales as measured by ΔSALE / SALEt-1
acq_inst_own	The percentage of acquirer firms' shares outstanding owned by institutions
acq_(mis)valuation	Acquirer firm specific relative overvaluation measure winsorized at 1% (Rhodes-Kropf, Robinson, and Viswanathan, 2005). A high RKRV mispricing value indicates high valuation
acq_high_tech	Dummy variable equals to 1 if the acquirer firm is from the high-tech industries, see Loughran and Ritter (2004)
tar_intan	Target firm intangible assets scaled by total assets
tar_leverage	Target firms' long-term debt to total assets
tar_firm_size	Target firms' size as measured by number of employees,
tar_firm_risk	Target firms' risk as measured by annualized buy-and-hold stock returns (BHRET) for past 60 month
tar_sales_growth	Target firms' annual growth of sales as measured by ΔSALE / SALEt-1
tar_inst_own	The percentage of target firms' shares outstanding owned by institutions

tar_(mis)valuation	Target firms' specific relative overvaluation measure (Rhodes-Kropf, Robinson, and Viswanathan, 2005). A high RKRV mispricing value indicates high valuation
tar_high_tech	Dummy variable equals to 1 if the target firm is from the high-tech industries, see Loughran and Ritter (2004)
related_dummy	Dummy variable that takes the value 1 if acquiring and target firms are from the same industry as determined by the SIC 4digits industry classification, and 0 otherwise
percent_cash	The percentage of the total deal value that is paid with cash.
public_target	Dummy variable that takes value 1 if the target firm is public, and 0 otherwise
ind_fixed	Variable that controls for industry specific effects
year_fixed	Variable that controls for year specific effects

References

Aboody, D., Lev, B., 1998. The value relevance of intangibles: the case of software capitalization. Journal of Accounting Research 36, 161–191.

Ahuja, G. and Katila, R. (2001), "Technological acquisitions and the innovation performance of acquiring firms: a longitudinal study", Strategic Management Journal,Vol. 22No. 3,pp. 197-220.

Akerlof, G. A. (1970). The market for "lemons": Quality uncertainty and the market mechanism. The Quarterly Journal of Economics, 84(3), 488.

Ali, A., Kravet, T. D., & Li, B. (2016). Accounting profitability and takeover likelihood. Available at SSRN 2538902.

Amir, E., & Lev, B. (1996). Value-relevance of nonfinancial information: The wireless communications industry. Journal of accounting and economics, 22(1-3), 3-30.

Barney, J. (1991). Firm resources and sustained competitive advantage. Journal of management, 17(1), 99-120.

Barney, J. B. (1986). Organizational culture: can it be a source of sustained competitive advantage? Academy of management review, 11(3), 656-665.

Bena, J., & Li, K. (2014). Corporate innovations and mergers and acquisitions. The Journal of Finance, 69(5), 1923-1960.

Beneish, M. D., Tseng, A., & Vorst, P. (2018). Identifying the Nature and Value of Expected Merger Synergies. Kelley School of Business Research Paper, (18-24).

Benou, G., & Madura, J. (2005). High-tech acquisitions, firm specific characteristics and the role of investment bank advisors. The Journal of High Technology Management Research, 16(1), 101-120.

Bhattacharya, D., & Li, W. H. (2020). Wealth effects of relative firm value in M&A deals: reallocation of physical versus intangible assets. *Review of Quantitative Finance and Accounting*, *55*(4), 1513-1548.

Bhagat, S., Dong, M., Hirshleifer, D., & Noah, R. (2005). Do tender offers create value? New methods and evidence. *Journal of Financial Economics*, *76*(1), 3-60.

Blonigen, B. A., & Taylor, C. T. (2000). R&D intensity and acquisitions in high-technology industries: evidence from the US electronic and electrical equipment industries. The Journal of Industrial Economics, 48(1), 47-70.

Chen, M. C., Cheng, S. J., & Hwang, Y. (2005). An empirical investigation of the relationship between intellectual capital and firms' market value and financial performance. *Journal of intellectual capital*.

Boone, J. P., & Raman, K. K. (2001). Off-balance sheet R&D assets and market liquidity. Journal of accounting and public policy, 20(2), 97-128.

Cassiman, B., & Colombo, M. G. (Eds.). (2006). Mergers & acquisitions: The Innovation Impact. Edward Elgar Publishing.

Cassiman, B., & Veugelers, R. (2006). In search of complementarity in innovation strategy: Internal R&D and external knowledge acquisition. Management science, 52(1), 68-82.

Celik, M. A., Tian, X., & Wang, W. (2019). Acquiring Innovation Under Information Frictions. Available at SSRN 3475698.

Chan, L., Lakonishok, J., Sougiannis, T., 2001. The stock market valuation of research and development expenditures. Journal of Finance 56, 2431–2456.

Chaudhuri, S., & Tabrizi, B. (1999). Capturing the real value in high-tech acquisitions. Harvard business review, 77(5), 123-123.

Chen, M.C., Cheng, S.J. and Hwang, Y. (2005), "An empirical investigation of the relationship between intellectual capital and firms' market value and

financial performance", Journal of Intellectual Capital, Vol. 6 No. 2, pp. 159-76.

Cohen, W. M., & Levinthal, D. A. (1989). Innovation and learning: the two faces of R & D. The Economic Journal, 99(397), 569-596.

Chondrakis, G. (2016). Unique synergies in technology acquisitions. *Research Policy*, *45*(9), 1873-1889.

Corrado, C. A., & Hulten, C. R. (2010). How do you measure a" technological revolution"? American Economic Review, 100(2), 99-104.

Cutler, W. G. (1991). Acquiring technology from outside. Research-Technology Management, 34(3), 11-18.

Daniel, K., & Titman, S. (2006). Market reactions to tangible and intangible information. The Journal of Finance, 61(4), 1605-1643.

Daniel, K., Titman, S., & Wei, K. J. (2001). Explaining the cross-section of stock returns in Japan: factors or characteristics?. *The Journal of Finance*, *56*(2), 743-766.

Deng, Z., Lev, B., Narin, F., 1999. Science and technology as predictors of stock performance. Financial Analysts Journal 55, 20–32

Dennis, S. A., & Mullineaux, D. J. (2000). Syndicated loans. Journal of financial intermediation, 9(4), 404-426.

Desyllas, P., Hughes, A., 2010. Do high technology acquirers become more innovative? Res. Policy 39 (8), 1105–1121.

Devos, E., Kadapakkam, P. R., & Krishnamurthy, S. (2009). How do mergers create value? A comparison of taxes, market power, and efficiency improvements as explanations for synergies. The Review of Financial Studies, 22(3), 1179-1211.

Dierickx, I., & Cool, K. (1989). Asset Stock Accumulation and Sustainability of Competitive Advantage: Reply. Management Science, 35(12).

Dong, M., Hirshleifer, D., Richardson, S., & Teoh, S. H. (2006). Does investor misvaluation drive the takeover market?. The Journal of Finance, 61(2), 725-762.

Doukas, J. A., Chansog (Francis) Kim, & Pantzalis, C. (2010). Arbitrage risk and stock mispricing. Journal of Financial and Quantitative Analysis, 907-934.

Eberhart, A. C., Maxwell, W. F., & Siddique, A. R. (2004). An examination of long-term abnormal stock returns and operating performance following R&D increases. The Journal of Finance, 59(2), 623-650.

Eberhart, A., Maxwell, W., & Siddique, A. (2008). A reexamination of the tradeoff between the future benefit and riskiness of R&D increases. Journal of Accounting Research, 46(1), 27-52.

Eckbo, B. E., Giammarino, R. M., & Heinkel, R. L. (1990). Asymmetric information and the medium of exchange in takeovers: Theory and tests. *The Review of Financial Studies*, *3*(4), 651-675.

Edmans, A. (2011). Does the stock market fully value intangibles? Employee satisfaction and equity prices. Journal of Financial economics, 101(3), 621-640.

Edvinsson, L. and Malone, M.S. (1997), Intellectual Capital: Realizing Your Company's True Value by Finding Its Hidden Brainpower, Harper Business, New York, NY.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: what are they?. Strategic management journal, 21(10-11), 1105-1121.

Fama, E., French, K., 2008. Dissecting anomalies. Journal of Finance 63, 1653–1678.

Fan, J. P., & Goyal, V. K. (2006). On the patterns and wealth effects of vertical mergers. The Journal of Business, 79(2), 877-902.

Fincham, R. and Roslender, R. (2003), "Intellectual capital accounting as management fashion: a review and critique", European Accounting Review, Vol. 12 No. 4, pp. 781-95.

Fu, F., Lin, L., & Officer, M. S. (2013). Acquisitions driven by stock overvaluation: Are they good deals?. Journal of Financial Economics, 109(1), 24-39.

Graebner, M. E. 2004. Momentum and serendipity: How acquired leaders create value in the integration of technology firms. Strategic Management Journal, 25: 751–777.

Graebner, M. E., Heimeriks, K. H., Huy, Q. N., & Vaara, E. (2017). The process of postmerger integration: A review and agenda for future research. Academy of Management Annals, 11(1), 1-32.

Grant, R. M. (1996). Toward a knowledge-based theory of the firm. Strategic management journal, 17(S2), 109-122.

Grossman, S. J., & Hart, O. D. (1986). The costs and benefits of ownership: A theory of vertical and lateral integration. Journal of political economy, 94(4), 691-719.

Griffin, J. M., & Lemmon, M. L. (2002). Book-to-market equity, distress risk, and stock returns. *The Journal of Finance*, *57*(5), 2317-2336.

Guo, R., Mann, W., & Reza, S. W. (2019). Are Acquisitions of Intangibles Less Subject to Agency Problems? Available at SSRN 3427176.

Hall, B. H., Jaffe, A., & Trajtenberg, M. (2005). Market value and patent citations. RAND Journal of economics, 16-38.

Hall, B. H. (1999). Innovation and market value (No. w6984). National Bureau of Economic Research.

Hall, R. (1992). The strategic analysis of intangible resources. Strategic management journal, 13(2), 135-144.

Hart, O., & Holmstrom, B. (2010). A theory of firm scope. The quarterly journal of economics, 125(2), 483-513.

Hart, O., & Moore, J. (1994). Debt and seniority: An analysis of the role of hard claims in constraining management (No. w4886). National Bureau of Economic Research.

Henderson, R., & Cockburn, I. (1996). Scale, scope, and spillovers: The determinants of research productivity in drug discovery. *The Rand journal of economics*, 32-59.

Higgins, M. J., & Rodriguez, D. (2006). The outsourcing of R&D through acquisitions in the pharmaceutical industry. Journal of financial economics, 80(2), 351-383.

Hitt, M. A., Beamish, P. W., Jackson, S. E., & Mathieu, J. E. (2007). Building theoretical and empirical bridges across levels: Multilevel research in management. Academy of Management journal, 50(6), 1385-1399.

Hoberg, G., & Phillips, G. (2010). Product market synergies and competition in mergers and acquisitions: A text-based analysis. The Review of Financial Studies, 23(10), 3773-3811.

Holmstrom, B., & Roberts, J. (1998). The boundaries of the firm revisited. Journal of Economic perspectives, 12(4), 73-94.

Kimbrough, M. 2007. The influences of financial statement recognition and analyst coverage on the market's valuation of R&D capital. Accounting Review 82(5): 1995–1225.

Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. Organization science, 3(3), 383-397.

Kogut, B., & Zander, U. (1996). What firms do? Coordination, identity, and learning. Organization science, 7(5), 502-518.

Larkin, T., 2013. Brand perception, cash flow stability, and financial policy. Journal of Financial Economics 100, 232-253.

Larsson, R., & Lubatkin, M. 2001. Achieving acculturation in mergers and acquisitions: An international case survey. Human Relations, 54: 1573–1607

Leonard-Barton, D. 1995. *Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation.* Boston, Massachusetts.: Harvard Business School Press.

Lev, B. (2001), *Intangibles: Management, and Reporting*, Brookings Institution Press, Washington, DC.

Lev, B. and Radhakrishnan, S. (2003), "The measurement of firm-specific organization capital", NBER Working Paper Series No. 9581, available at: www.cib.espol.edu.ec/Digipath/D_ Papers/47205.pdf (accessed 4 April 2010).

Lev, B. and Zarowin, P. (1999), "The boundaries of financial reporting and how to extend them", Journal of Accounting Research, Vol. 37, Autumn, pp. 353-85.

Lev, B., & Gu, F. (2016). *The end of accounting and the path forward for investors and managers.* John Wiley & Sons.

Lev, B., & Radhakrishnan, S. (2005). *The valuation of organization capital. In Measuring capital in the new economy* (pp. 73-110). University of Chicago Press.

Lev, B., & Sougiannis, T. (1996). The capitalization, amortization, and value-relevance of R&D. Journal of accounting and economics, 21(1), 107-138.

Lev, Baruch Itamar, Baruch Lev, *Intangibles: Management, Measurement and Reporting,* Bookings Institution Press, 2001. Available at SSRN: https://ssrn.com/abstract=254345

Levinthal, D. A., & March, J. G. (1993). The myopia of learning. Strategic management journal, 14(S2), 95-112.

Lindenberg, E.B., Ross, S.A., 1981. Tobin's q ratio and industrial organization. Journal of Business 54 (1), 1–32

Makadok, R. (2001). Toward a synthesis of the resource-based and dynamic-capability views of rent creation. Strategic management journal, 22(5), 387-401.

Masulis, R. W., Wang, C., & Xie, F. (2007). Corporate governance and acquirer returns. *The Journal of Finance*, *62*(4), 1851-1889.

Moeller, S. B., Schlingemann, F. P., & Stulz, R. M. (2004). Firm size and the gains from acquisitions. *Journal of financial economics*, *73*(2), 201-228.

Montgomery, C.A. and B. Wernerfelt (1988), "Diversification, Ricardian Rents, and Tobin's q." Rand Journal of Economics 19(4): 623-32.

Nakamura, L. 2001. Investing in intangibles: Is a trillion dollars missing from GDP? Business Review, Federal Reserve Bank of Philadelphia, 27-37.

Nakamura, L. 2003. A trillion dollars a year in intangible investment and the new economy. In:Hand, J., Lev, B. (editors). Intangible assets. Oxford University Press.

Phillips, G. M., & Zhdanov, A. (2013). R&D and the Incentives from Merger and Acquisition Activity. The Review of Financial Studies, 26(1), 34-78.

Puranam, P., & Srikanth, K. (2007). What they know vs. what they do: How acquirers leverage technology acquisitions. Strategic management journal, 28(8), 805-825.

Ranft, A. L., & Lord, M. D. 2002. Acquiring new technologies and capabilities: A grounded model of acquisition implementation. Organization Science, 13: 420–441.

Rau, P. R., & Vermaelen, T. (1998). Glamour, value and the post-acquisition performance of acquiring firms. Journal of financial economics, 49(2), 223-253.

Rhodes-Kropf, M., & Robinson, D. T. (2008). The market for mergers and the boundaries of the firm. The Journal of Finance, 63(3), 1169-1211.

Rhodes–Kropf, M., Robinson, D. T., & Viswanathan, S. (2005). Valuation waves and merger activity: The empirical evidence. Journal of Financial Economics, 77(3), 561-603.

Ruta, C.D. (2009), "HR portal alignment for the creation and development of intellectual capital", International Journal of Human Resource Management, Vol. 20 No. 3, pp. 562-77.

Schweizer, L. (2005). Knowledge transfer and R&D in pharmaceutical companies: A case study. *Journal of Engineering and Technology Management*, *22*(4), 315-331.

Shleifer, A., & Vishny, R. W. (2003). Stock market driven acquisitions. *Journal of financial Economics*, *70*(3), 295-311.

Spender, J.C.; Grant, R.M. Knowledge and the firm: Overview. Strategic Management Journal 1996, 17, 5–9.

Steensma, H. K., & Fairbank, J. F. (1999). Internalizing external technology: A model of governance mode choice and an empirical assessment. The Journal of High Technology Management Research, 10(1), 1-35.

Strahan, P. E. (1999). *Borrower risk and the price and nonprice terms of bank loans.* FRB of New York staff report, (90).

Teece, D. J. (2000). *Managing intellectual capital: Organizational, strategic, and policy dimensions.* OUP Oxford.

Vermeulen, F., Barkema, H., 2001. Learning through acquisitions. Academy of Management Journal 44, 457–476.

Wagner, M. (2011), "To explore or to exploit? An empirical investigation of acquisitions by large incumbents", Research Policy, Vol. 40 No. 9, pp. 1217-25

Wernerfelt, B. (1984). A resource-based view of the firm. Strategic management journal, 5(2), 171-180.

Wernerfelt, B. (1988). Umbrella branding as a signal of new product quality: An example of signalling by posting a bond. The RAND Journal of Economics, 458-466.

Wyatt, A. (2005). Accounting recognition of intangible assets: theory and evidence on economic determinants. The accounting review, 80(3), 967-1003.

Zhan, L. (2018). The Value of Intangible Capital and its Components in Mergers (Doctoral dissertation, University of Saskatchewan).

Table 1. Descriptive Statistics and Correlation Matrix for Acquisition Probability data

Panel A reports summary statistics for variables of interest. Panel B reports pairwise Pearson correlations. * indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level. *The sample includes all publicly listed firms in the COMPUSTAT Universe for period 2001-2017. The variable acquisition_dummy takes a value 1 if a firm makes an acquisition in a given year and 0 otherwise. See the Appendix for other variable definitions.*

Panel A

VARIABLE	Mean	Standard Deviation	Min	Max	Count
intan	0.1375	0.1815	0.0000	0.7457	58779
acquistion_dummy	0.2315	0.4218	0.0000	1.0000	58779
leverage	0.1739	0.1950	0.0000	0.8794	58779
size	9.6006	24.2517	0.0000	151.0000	58779
sales_growth	0.1234	0.4291	-0.7797	3.6292	58779
firm_risk	0.1385	0.0787	0.0116	0.4751	58779
rnd_sales	0.1679	0.9876	0.0000	10.7246	58779
inst_own	0.5389	0.3328	0.0007	1.1092	58779

Panel B

VARIABLES	intan	acquisition_ dummy	leverage	size	sales_ growth	firm_ risk	rnd_ sales	inst_ own
intan	1							
acquisition_dummy	0.202***	1						
leverage	0.164***	0.0365***	1					
size	0.0998***	0.0827***	0.0610***	1				
sales_growth	0.0342***	0.0242***	0.00451	-0.0457***	1			
firm_risk	-0.0160***	-0.0888***	-0.0662***	-0.178***	0.0877***	1		
rnd_sales	-0.0447***	-0.0603***	-0.0463***	-0.0583***	0.0668***	0.198***	1	
inst_own	0.242***	0.254***	0.155***	0.0593***	0.00923*	-0.196***	-0.0354***	1

Table 2. Descriptive Statistics and Correlation Matrix for the Target Probability data

Panel A reports summary statistics for variables of interest. Panel B reports pairwise Pearson correlations. * indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level. *The sample includes all publicly listed firms in the COMPUSTAT Universe for period 2001-2017. The variable target_dummy takes a value 1 if a firm is target in a given year and 0 otherwise. See the Appendix for other variable definitions.*

Panel A

VARIABLE	Mean	Standard Deviation	Min	Max	Count
intan	0.1244	0.1725	0.0000	0.7280	78798
target_dummy	0.0518	0.2216	0.0000	1.0000	78798
leverage	0.1761	0.1950	0.0000	0.8794	78798
size	8.7150	22.7701	0.0000	151.0000	78798
sales_growth	0.1539	0.4696	-0.7797	3.6292	78798
firm_risk	0.1397	0.0785	0.0116	0.4751	78798
rnd_sales	0.1615	0.9589	0.0000	10.7246	78798
inst_own	0.4905	0.3271	0.0007	1.1092	78798

Panel B

VARIABLES	intan	target_ dummy	leverage	size	sales_ growth	firm_ risk	rnd_ sales	inst_ own
intan	1							
target_dummy	0.0117**	1						
leverage	0.164***	-0.0121**	1					
size	0.0997***	-0.00392	0.0609***	1				
sales_growth	0.0342***	-0.0104*	0.00452	-0.0458***	1			
firm_risk	-0.0160***	0.000567	-0.0662***	-0.178***	0.0877***	1		
rnd_sales	-0.0447***	0.000722	-0.0463***	-0.0583***	0.0668***	0.198***	1	
inst_own	0.242***	0.0390***	0.155***	0.0592***	0.00925*	-0.196***	-0.0354***	1

Table 3. Firm's Intangible Asset and Acquisition Probability

The table reports the regression estimates for the dependence of a firm's probability of making an acquisition on its intangible assets. The predicted variable acquisition_dummy, takes the value of 1 when a firm makes acquisition in any given year and 0 otherwise.
Panel A. Logistic Regression (with Robust Standard Errors)
Panel B. Logistic Regression (with Robust Standard Errors Clustered by Firms in parenthesis)
Panel C. Panel Data Logistic Regression (with Robust Standard Errors Clustered by Firms)
*`All models include intercept, industry- and year-fixed effects clustered by target industry and announcement year. The last two rows report the pseudo R-squared, and the number of observations in each regression. The model is estimated using the sample of all publicly listed firms in the COMPUSTAT Universe for the period 2001-Corresponding p-values calculated using Eicker–Huber–White–Sandwich heteroskedastic-robust standard errors are reported in brackets. Model 2 includes rnd_sales as a control variable. * indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level. See the Appendix for other variable definitions.*

Panel A

VARIABLES	(1) acquisition_dummy	(2) acquisition_dummy
intan	1.7612***	1.7250***
	(0.056)	(0.056)
leverage	-0.2142***	-0.2241***
	(0.053)	(0.054)
size	0.0072***	0.0072***
	(0.000)	(0.000)
sales_growth	0.2338***	0.2431***
	(0.019)	(0.020)
firm_risk	-2.4804***	-2.2842***
	(0.167)	(0.168)
inst_own	1.9649***	1.9634***
	(0.032)	(0.032)
rnd_sales		-0.2000***
		(0.032)
Constant	-1.5075***	-1.5180***
	(0.173)	(0.172)
Year fixed-effect	Yes	Yes
Industry fixed-effect	Yes	Yes
Pseudo R square	0.1115	0.1112

Panel B

VARIABLES	(1) acquisition_dummy	(2) acquisition_dummy
intan	1.7612***	1.7250***
	(0.093)	(0.093)
leverage	-0.2142**	-0.2241***
	(0.085)	(0.085)
size	0.0072***	0.0072***
	(0.001)	(0.001)
sales_growth	0.2338***	0.2431***
	(0.020)	(0.021)
firm_risk	-2.4804***	-2.2842***
	(0.245)	(0.244)
rnd_sales		-0.2000***
		(0.035)
inst_own	1.9649***	1.9634***
	(0.054)	(0.054)
Constant	-1.5075***	-1.5180***
	(0.246)	(0.246)
Year fixed-effect	Yes	Yes
Industry fixed-effect	Yes	Yes
Pseudo R square	0.1115	0.1122

Observations	78,928	78,796	Observations	78,928	78,796

Panel C

VARIABLES	(1) acquisition_dummy	(2) acquisition_dummy
intan	0.8388***	0.8017***
	(0.105)	(0.105)
leverage	-0.6955***	-0.7023***
	(0.089)	(0.089)
size	0.0052***	0.0052***
	(0.001)	(0.001)
sales_growth	0.2456***	0.2442***
	(0.024)	(0.024)
firm_risk	-1.9508***	-1.7856***
	(0.253)	(0.253)
inst_own	2.1452***	2.1385***
	(0.059)	(0.059)
rnd_sales		-0.1981***
		(0.034)
Constant	-1.5707***	-1.5688***
	(0.276)	(0.277)
Year fixed-effect	Yes	Yes
Industry fixed-effect	Yes	Yes
Wald Chi-squared Statistics	0.0000	0.0000
Probability > Chi-squared	2919.36	2883.24
Observations	78,928	78,796
Number of unique firms	11,268	11,231

Table 4. Firm's Intangible Asset and Probability of being Acquired

The table reports the regression estimates for the dependence of a firm's probability of being acquired on its intangible assets. The predicted variable target_dummy, takes the value of 1 if a firm is acquired in any given year and 0 otherwise.
Panel A. Logistic Regression (with Robust Standard Errors)
Panel B. Logistic Regression (with Robust Standard Errors Clustered by Firms in parenthesis)
Panel C. Panel Data Logistic Regression (with Robust Standard Errors Clustered by Firms)
*All models include intercept, industry- and year-fixed effects clustered by target industry and announcement year. The last two rows report the pseudo R-squared, and the number of observations in each regression. The model is estimated using the sample of all publicly listed firms in the COMPUSTAT Universe for the period 2001-2017. Corresponding p-values calculated using Eicker–Huber–White–Sandwich heteroskedastic-robust standard errors are reported in brackets. Model 2 includes rnd_sales as a control variable. * indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level. See the Appendix for other variable definitions.*

Panel A

	(1)	(2)
VARIABLES	target_ dummy	target_ dummy
intan	0.3534***	0.3611***
	(0.111)	(0.111)
leverage	-0.1945**	-0.1924**
	(0.097)	(0.097)
size	-0.0009	-0.0009
	(0.001)	(0.001)
sales_growth	-0.1008***	-0.1012***
	(0.039)	(0.039)
firm_risk	1.0591***	1.0145***
	(0.248)	(0.251)
rnd_sales		0.0225
		(0.019)
inst_own	0.9150***	0.9151***
	(0.055)	(0.055)
Constant	-2.6182***	-2.6131***
	(0.293)	(0.293)
Year fixed-effect	Yes	Yes

Panel B

	(1)	(2)
VARIABLES	target_ dummy	target_ dummy
intan	0.3534***	0.3611***
	(0.118)	(0.118)
leverage	-0.1945*	-0.1924*
	(0.101)	(0.101)
size	-0.0009	-0.0009
	(0.001)	(0.001)
sales_growth	-0.1008***	-0.1012***
	(0.039)	(0.039)
firm_risk	1.0591***	1.0145***
	(0.262)	(0.264)
rnd_sales		0.0225
		(0.020)
inst_own	0.9150***	0.9151***
	(0.061)	(0.061)
Constant	-2.6182***	-2.6131***
	(0.325)	(0.325)
Year fixed-effect	Yes	Yes

Industry fixed-effect	Yes	Yes	Industry fixed-effect	Yes	Yes
Pseudo R square	0.0388	0.0388	Pseudo R square	0.0388	0.0388
Observations	78,930	78,798	Observations	78,930	78,798

Panel C

	(1)	(2)
VARIABLES	target_dummy	target_dummy
intan	0.3825***	0.3905***
	(0.126)	(0.126)
leverage	-0.2367**	-0.2349**
	(0.108)	(0.108)
size	-0.0020*	-0.0020*
	(0.001)	(0.001)
sales_growth	-0.1249***	-0.1258***
	(0.040)	(0.040)
firm_risk	0.9805***	0.9363***
	(0.279)	(0.282)
inst_own	1.0326***	1.0333***
	(0.066)	(0.066)
rnd_sales		0.0224
		(0.021)
Constant	-2.8474***	-2.8435***
	(0.366)	(0.366)
Year fixed-effect	Yes	Yes
Industry fixed-effect	Yes	Yes
Wald Chi-sqaured Statistics	1053.98	1057.81
Probability > Chi-squared	0	0
Observations	78,930	78,798
Number of unique firms	11,269	11,232

Table 5. Target Intangible Assets and Target Abnormal Returns

*The table presents OLS estimates for relation between target firm's intangible assets and the target average cumulative abnormal returns (CARs). The sample consists of publicly listed target firms in the SDC M&As database for deals in the period between 2001-2017. The abnormal returns were calculated using a market with cumulative abnormal returns (CARs) over the event window [-2,2] as a main dependent variable. The dependent variable is tar_intan. Model 1 reports the baseline model result. Model 2 examines the effect of the degree of (mis)valuation as measured using price-to-residual income value, P/V, defined as the stock price at the end of the month immediately preceding the effective date of the acquisition over residual income valuation [RRV], Models 3 through 7 report the interaction of primary dependent variable tar_intan with tar_misvaluation (model 3), and other deal specific variables; percent_cash (model 4), tar_high_tech (model 5) and related_dummy (model 6). * indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level. See the Appendix for other variable definitions.*

VARIABLES	(1) target CAR (-2 to +2)	(2) target CAR (-2 to +2)	(3) target CAR (-2 to +2)	(4) target CAR (-2 to +2)	(5) target CAR (-2 to +2)	(6) target CAR (-2 to +2)
tar_intan	-0.0731**		-0.0826**	-0.1879**	0.0137	-0.0160
	(0.033)		(0.034)	(0.075)	(0.047)	(0.061)
tar_leverage	0.0222	-0.0035	0.0066	0.0083	0.0081	0.0045
	(0.036)	(0.040)	(0.040)	(0.041)	(0.041)	(0.040)
tar_size	-0.0009***	-0.0011***	-0.0011***	-0.0011***	-0.0011***	-0.0011***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
tar_sales_growth	-0.0294*	-0.0262	-0.0284	-0.0286	-0.0277	-0.0289*
	(0.017)	(0.018)	(0.018)	(0.018)	(0.018)	(0.017)
tar_inst_own	-0.0937***	-0.0927***	-0.0802***	-0.0800***	-0.0821***	-0.0824***
	(0.023)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
tar_percent_cash	0.0000	0.0000	0.0001	-0.0001	0.0000	0.0000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
tar_high_tech	0.0148	0.0011	0.0163	0.0135	0.0416*	0.0157
	(0.020)	(0.020)	(0.021)	(0.021)	(0.024)	(0.021)
related_dummy	-0.1274***	-0.1300***	-0.1287***	-0.1275***	-0.1269***	-0.1130***
	(0.013)	(0.014)	(0.014)	(0.014)	(0.014)	(0.018)
tar_firm_risk	0.2624***	0.3039***	0.2989***	0.3043***	0.2889***	0.2839***
	(0.090)	(0.098)	(0.097)	(0.097)	(0.096)	(0.097)

tar_misvaluation		0.0056	-0.0006	0.0056	0.0063	0.0058
		(0.008)	(0.012)	(0.008)	(0.008)	(0.008)
tar_intan * tar_misvaluation			0.0321			
			(0.033)			
tar_intan * percent_cash				0.0014*		
				(0.001)		
tar_intan * tar_hightech					-0.1444**	
					(0.066)	
tar_intan * related_dummy						-0.0953
						(0.063)
Constant	0.1972***	0.1448***	0.1308***	0.1412***	0.1226***	0.1263***
	(0.046)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)
Year fixed-effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed-effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,565	1,337	1,305	1,305	1,305	1,305
R-squared	0.234	0.236	0.242	0.243	0.244	0.243

Table 6. Acquirer Intangible Assets and Acquirer Abnormal Returns (includes all targets - private, public and subsidiaries)

*The table presents OLS estimates for relation between acquirer firm's intangible assets and its average cumulative abnormal returns (CARs). The sample consists of publicly listed target firms in the SDC M&As database for deals between 2001-2007. The abnormal returns were calculated using a market model with cumulative abnormal returns (CARs) over the event window [-2,2] as a main dependent variable. The dependent variable is acq_CAR. Model 1 reports the baseline model result. Model 2 examines the effect of the degree of (mis)valuation as measured using price-to-residual income value, P/V, defined as the stock price at the end of the month immediately preceding the effective date of the acquisition over residual income valuation[RRV], Models 3 through 7 report the interaction of primary independent variable, acq_intan with acq_misvaluation (model 3), and other deal specific variables; percent_cash (model 4), acq_high_tech (model 5), related_dummy (model 6) and public_target (model7). * indicates significance. at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level.*

See the Appendix for other variable definitions.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	acq CAR (-2 to +2)	acq CAR (-2 to +2)	acq CAR (-2 to +2)	acq CAR (-2 to +2)	acq CAR (-2 to +2)	acq CAR (-2 to +2)	acq CAR (-2 to +2)
acq_intan	0.0035		0.0034	0.0036	0.0132**	0.0011	-0.0012
	(0.004)		(0.005)	(0.008)	(0.007)	(0.005)	(0.005)
acq_leverage	0.0034	0.0049	0.0044	0.0045	0.0054	0.0044	0.0042
	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
acq_size	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
acq_sales_growth	-0.0051**	-0.0052**	-0.0052**	-0.0052**	-0.0052**	-0.0052**	-0.0053**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
acq_inst_own	-0.0135***	-0.0130***	-0.0127***	-0.0127***	-0.0129***	-0.0126***	-0.0125***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
percent_cash	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
acq_hightech	-0.0034	-0.0024	-0.0026	-0.0026	0.0018	-0.0026	-0.0029
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)
related_dummy	0.0043***	0.0043**	0.0039**	0.0039**	0.0040**	0.0026	0.0040**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
public_target	-0.0071***	-0.0068***	-0.0063***	-0.0063***	-0.0062***	-0.0063***	-0.0111***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
acq_firm_risk	0.0726***	0.0692***	0.0702***	0.0703***	0.0675***	0.0704***	0.0706***

	(0.015)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
acq_misvaluation		0.0002	0.0003	0.0002	0.0003	0.0002	0.0002
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
acq_intan * acq_misvaluation			-0.0001				
			(0.000)				
acq_intan * percent_cash				-0.0000			
				(0.000)			
acq_intan * acq_high_tech					-0.0168**		
					(0.009)		
acq_intan * related_dummy						0.0059	
						(0.007)	
acq_intan * public_target							0.0237**
							(0.009)
Constant	0.0138	0.0275**	0.0250*	0.0250*	0.0242*	0.0254*	0.0259*
	(0.011)	(0.013)	(0.013)	(0.013)	(0.014)	(0.013)	(0.013)
Year fixed-effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed-effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,546	7,794	7,634	7,634	7,634	7,634	7,634
R-squared	0.041	0.041	0.041	0.041	0.041	0.041	0.042

Table 7. Target Intangible Assets and Acquirer Abnormal Returns (includes only public targets due to data limitation)

*The table presents OLS estimates for relation between target firms' intangible assets and the acquirer firms' average cumulative abnormal returns (CARs). The sample consists of publicly listed target firms in the SDC M&As database for deals in the period between 2001-2017. The abnormal returns were calculated using a market with cumulative abnormal returns (CARs) over the event window [-2,2] as a main dependent variable. The dependent variable is acq_CAR. Model 1 reports the baseline model result. Model 2 examines the effect of the degree of (mis)valuation as measured using price-to-residual income value, P/V, defined as the stock price at the end of the month immediately preceding the effective date of the acquisition over residual income valuation[RRV], Models 3 through 7 report the interaction of primary independent variable, tar_intan with acq_misvaluation (model 2), acq_intan (model 3) and other deal specific variables; percent_cash (model 4), acq_high_tech (model 5), related_dummy (model 6). * indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level. See the Appendix for other variable definitions.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	acq_CAR	acq_CAR	acq_CAR	acq_CAR	acq_CAR	acq_CAR	acq_CAR
acq_intan	-0.0030			-0.0088	-0.0178	-0.0081	-0.0082
	(0.014)			(0.014)	(0.017)	(0.015)	(0.015)
tar_intan	0.0076	0.0077	0.0077	-0.0268	-0.0082	0.0275	0.0010
	(0.013)	(0.011)	(0.011)	(0.029)	(0.025)	(0.020)	(0.019)
acq_leverage	0.0174	0.0167	0.0167	0.0169	0.0169	0.0160	0.0167
	(0.012)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
acq_size	-0.0001**	-0.0001**	-0.0001**	-0.0001**	-0.0001**	-0.0001**	-0.0001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
acq_sales_growth	-0.0070	-0.0065	-0.0065	-0.0068	-0.0066	-0.0062	-0.0066
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
acq_inst_own	-0.0058	-0.0090	-0.0090	-0.0085	-0.0081	-0.0093	-0.0088
	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
percent_cash	0.0003***	0.0004***	0.0004***	0.0003***	0.0004***	0.0004***	0.0004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
acq_high_tech	-0.0077	-0.0067	-0.0067	-0.0061	-0.0053	-0.0015	-0.0059
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.008)
related_dummy	0.0112***	0.0101**	0.0101**	0.0100**	0.0092**	0.0101**	0.0070
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
acq_firm_risk	0.0014	-0.0079	-0.0079	-0.0033	-0.0063	-0.0119	-0.0081
	(0.041)	(0.043)	(0.043)	(0.044)	(0.044)	(0.044)	(0.044)

tar_misvaluation		-0.0011	-0.0011	-0.0005	-0.0007	-0.0005	-0.0007
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
tar_intan*percent_cash				0.0005*			
				(0.000)			
tar_intan*acq_intan					0.0565		
					(0.054)		
tar_intan*acq_high_tech						-0.0244	
						(0.024)	
tar_intan*related_dummy							0.0181
							(0.023)
Constant	-0.0085	-0.0167	-0.0167	-0.0118	-0.0128	-0.0156	-0.0141
	(0.018)	(0.019)	(0.019)	(0.020)	(0.020)	(0.020)	(0.020)
Observations	1,522	1,290	1,290	1,269	1,269	1,269	1,269
R-squared	0.134	0.134	0.134	0.136	0.135	0.135	0.134

Table 8. Robustness Tests: Abnormal Returns in High Technology Deals

The table presents estimates for Table 5 (panel A), 6 (panel B) and 7(panel C) when the acquirer firm and target firm both are in the high technology sector.
The predicted variables are tar_CAR (panel A), acq_CAR (panel B and C) denote cumulative abnormal returns (CARs) for the target and acquirer firm respectively.
Panel A: Target Intangible Assets and Target Abnormal Returns
Panel B: Acquirer Intangible Assets and Acquirer Abnormal Returns (includes all targets - private, public and subsidiaries
Panel C: Target Intangible Assets and Acquirer Abnormal Returns
*The sample consists of publicly listed target firms in the SDC M&As database for deals in the period between 2001-2017. The abnormal returns were calculated using a market with cumulative abnormal returns (CARs) over the event window [-2,2] as a main dependent variable. * indicates significance at the 10% level, ** indicates significance at the 5% level, and *** indicates significance at the 1% level. See the Appendix for other variable definitions.*

Panel A

	(1)	(2)	(3)	(4)	(5)
VARIABLES	tar_CAR	tar_CAR	tar_CAR	tar_CAR	tar_CAR
tar_intan	-0.0745**	-0.0772**	-0.0844**	-0.1939**	-0.1437*
	(0.033)	(0.034)	(0.034)	(0.076)	(0.082)
tar_leverage	0.0222	0.0070	0.0058	0.0063	0.0022
	(0.036)	(0.041)	(0.040)	(0.040)	(0.040)
tar_size	-0.0009***	-0.0011***	-0.0011***	-0.0011***	-0.0011***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
tar_sales_growth	-0.0298*	-0.0296*	-0.0288	-0.0283	-0.0278
	(0.017)	(0.018)	(0.018)	(0.018)	(0.017)
tar_inst_own	-0.0959***	-0.0840***	-0.0829***	-0.0818***	-0.0829***
	(0.023)	(0.024)	(0.024)	(0.024)	(0.024)
percent_cash	0.0000	0.0001	0.0001	-0.0001	-0.0002
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
tar_high_tech	-0.0031	-0.0054	-0.0045	-0.0065	-0.0067
	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)
acq_high_tech	0.0306	0.0359	0.0360	0.0362	0.0365
	(0.027)	(0.028)	(0.028)	(0.028)	(0.028)
related_dummy	-0.1268***	-0.1274***	-0.1276***	-0.1267***	-0.1069***
	(0.013)	(0.015)	(0.014)	(0.014)	(0.019)
tar_firm_risk	0.2617***	0.2987***	0.2995***	0.3055***	0.2888***

	(0.089)	(0.097)	(0.097)	(0.097)	(0.097)
tar_misvaluation		0.0057	-0.0005	0.0001	0.0005
		(0.008)	(0.012)	(0.012)	(0.012)
tar_intan*tar_misvaluation			0.0322	0.0295	0.0298
			(0.033)	(0.032)	(0.032)
tar_intan*percent_cash				0.0014*	0.0017*
				(0.001)	(0.001)
tar_intan*related_dummy					-0.1208*
					(0.066)
Constant	0.1973***	0.1281***	0.1295***	0.1409***	0.1394***
	(0.046)	(0.043)	(0.043)	(0.043)	(0.043)
Observations	1,565	1,305	1,305	1,305	1,305
R-squared	0.235	0.243	0.243	0.245	0.247

Panel B

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	acq_CAR	acq_CAR	acq_CAR	acq_CAR	acq_CAR	acq_CAR
acq_intan	0.0037	0.0035	0.0037	0.0039	0.0021	0.0004
	(0.004)	(0.005)	(0.005)	(0.008)	(0.008)	(0.008)
acq_leverage	0.0029	0.0038	0.0038	0.0038	0.0037	0.0035
	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
acq_size	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
acq_sales_growth	-0.0051**	-0.0052**	-0.0052**	-0.0052**	-0.0052**	-0.0053**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
acq_inst_own	-0.0134***	-0.0125***	-0.0126***	-0.0126***	-0.0126***	-0.0124***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
percent_cash	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

acq_high_tech	-0.0015	-0.0004	-0.0004	-0.0004	-0.0004	-0.0006
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
tar_high_tech	-0.0042*	-0.0049*	-0.0049*	-0.0049*	-0.0049*	-0.0053**
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
related_dummy	0.0044***	0.0040**	0.0040**	0.0040**	0.0026	0.0037
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
public_target	-0.0069***	-0.0060***	-0.0060***	-0.0060***	-0.0059***	-0.0110***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
acq_firm_risk	0.0743***	0.0724***	0.0724***	0.0724***	0.0725***	0.0728***
	(0.015)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
acq_misvaluation		0.0003	0.0004	0.0004	0.0003	0.0003
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
acq_intan*acq_misvaluation			-0.0001	-0.0001	-0.0001	-0.0001
			(0.000)	(0.000)	(0.000)	(0.000)
acq_intan*percent_cash				-0.0000	-0.0000	-0.0000
				(0.000)	(0.000)	(0.000)
acq_intan*related_dummy					0.0063	0.0021
					(0.007)	(0.008)
acq_intan*public_target						0.0247**
						(0.010)
Constant	0.0144	0.0259**	0.0259**	0.0259**	0.0262**	0.0267**
	(0.011)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Observations	8,545	7,634	7,634	7,634	7,634	7,634
R-squared	0.042	0.041	0.041	0.041	0.041	0.042

Panel C

	(1)	(2)	(3)	(4)	(5)
VARIABLES	acq_CAR	acq_CAR	acq_CAR	acq_CAR	acq_CAR

acq_intan	-0.0022	-0.0045	-0.0081	-0.0161	-0.0168
	(0.014)	(0.014)	(0.014)	(0.018)	(0.018)
tar_intan	0.0086	0.0119	-0.0262	-0.0355	-0.0380
	(0.013)	(0.014)	(0.029)	(0.034)	(0.035)
acq_leverage	0.0166	0.0157	0.0161	0.0163	0.0164
	(0.012)	(0.013)	(0.013)	(0.013)	(0.013)
acq_size	-0.0001**	-0.0001**	-0.0001**	-0.0001**	-0.0001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
acq_sales_growth	-0.0070	-0.0067	-0.0069	-0.0069	-0.0068
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
acq_inst_own	-0.0059	-0.0087	-0.0085	-0.0081	-0.0081
	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)
percent_cash	0.0003***	0.0004***	0.0003***	0.0003***	0.0003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
acq_high_tech	-0.0023	-0.0011	-0.0009	-0.0007	-0.0008
	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)
tar_high_tech	-0.0083	-0.0077	-0.0080	-0.0076	-0.0076
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
related_dummy	0.0109***	0.0097**	0.0098**	0.0092**	0.0078
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
acq_firm_risk	0.0032	-0.0063	-0.0013	-0.0006	-0.0009
	(0.041)	(0.044)	(0.044)	(0.044)	(0.044)
tar_misvaluation		-0.0007	-0.0006	-0.0006	-0.0007
		(0.003)	(0.003)	(0.003)	(0.003)
tar_intan*percent_cash			0.0005*	0.0005	0.0004
			(0.000)	(0.000)	(0.000)
tar_intan*acq_intan				0.0373	0.0349
				(0.053)	(0.054)
tar_intan*related_dummy					0.0088
					(0.024)
Constant	-0.0094	-0.0165	-0.0127	-0.0111	-0.0106

	(0.018)	(0.020)	(0.020)	(0.020)	(0.020)
Observations	1,521	1,269	1,269	1,269	1,269
R-squared	0.134	0.135	0.137	0.137	0.137