Abstract

This thesis investigates the long-term effect of financially constrained takeovers on innovation and operating performance. A large number of M&A deals from 1980 to 2020 are collected and matched with financial data from Compustat and a pre-constructed dataset that estimates the value of patenting activities. I compare firms that complete a merger to firms that withdraw their bid by using a fixed-effects model with an interaction term. The paper contradicts the findings that financially constrained acquisitions increase investments. However, it finds partial evidence for an increase in patent applications after a constrained acquisition. Moreover, the empirical analysis shows that operating cash flows increase for financially constrained firms that perform an acquisition. This evidence is in line with previous research that shows that M&As can relieve financial constraints and produce positive short-term returns. However, the thesis does not find a significant improvement in the value of patent applications following the acquisition. These results indicate that the relief of financial constraints has a positive but weak predictive effect on the firm's productivity in terms of innovations and performance.

Table of Contents

1. Introduction

Mergers and acquisitions are one of the most significant events in the life-cycle of a firm, it can either be the end of a firm's existence for the seller or an expansion of the acquiring firm's activities. Mergers and acquisitions are generally regarded as positive events, the seller shareholders receive a premium whereas the buyer expects to generate synergies by either increasing their market power or improving efficiency. Mergers and acquisitions have increased substantially over the past decades with a record-breaking deal volume of 5 trillion dollars in 2021 (Nishant, 2021). While deal volume increase, the performance effects have been studied extensively by many financial and economic researchers with varying results.

While M&As are generally perceived as positive events by the parties involved, the academic literature is ambiguous about the factors that determine a deal`s success. Many papers find no significant or even negative short-term abnormal returns for the bidders around a takeover deal (Betton et al., 2008). Further, studies that investigate the operational performance over a longer time frame often fail to find any positive effects of M&A transactions (Agrawal & Jaffe, 2000; Malmendier et al., 2018). These negative findings are often explained by behavioural biases, where management is overconfident in its ability to generate synergies (Malmendier & Tate, 2008). While mergers do not seem to generate positive performance in the aggregate some papers explore whether specific determinants can predict takeover success. These factors include whether the bidder and the target operate in related industries, the governance structure of the acquiring firm and whether the bidding firm is a serial acquirer (Renneboog & Vansteenkiste, 2019).

Besides these factors, several more recent papers attempt to investigate whether financial synergies can be generated through the relief of financial constraints in corporate takeovers (Erel et al., 2015; Khatami et al., 2015; Williamson & Yang, 2021). A firm is considered financially constrained if it has a limited ability to access external financing at a competitive rate (Almeida et al., 2004). These firms tend to forgo profitable growth opportunities because they have difficulties accessing external funds. Naturally, financial constraints can have negative implications for a firm's performance as well as its innovation output (Lamont et al., 2001; Savignac, 2008). Erel et al. (2015) provide evidence that acquisitions can relieve these financial constraints for targets, both cash flow sensitivity to investment is decreased and investments are increased after a financially constrained firm is acquired. Moreover, Williamson and Yang (2021) extend these findings by providing evidence that acquirers can also relieve their financial constraints by performing a takeover, of these firms. However, Blomkvist & Felixson (2018) argue that constrained firms can only

perform acquisitions when credit supply is high, and forgo more optimal acquisitions in times with low credit supply. This implies that constrained firms perform less optimal acquisitions. Further, Bena & Li (2014) find financial synergies between acquirers with large patent portfolios and targets with large R&D expenses and smaller portfolios, implying that takeovers can have positive effects on innovation activities. The relief of financial constraints through takeovers could potentially be beneficial for operating performance and innovation output if it allows firm`s to pursue profitable growth opportunities, but it could lead to less optimal acquisitions because constrained firms have less options to finance acquisitions. However, there is a lack of evidence that M&As lead to improved operational performance and innovation output. For example, Seru (2014) finds that a target firm`s innovativeness after takeover tends to decrease even when research and development expenses increase after being acquired. Malmendier et al. (2018) find negative long-term stock and operational performance for acquirers compared to non-acquirers.

In this thesis, I aim to resolve these conflicting findings by studying the long-term operational firm performance after a financially constrained acquisition. Further, this thesis explores how acquisitions affect the value of innovation output. The differentiation with prior research is that I investigate the relationship between financial constraints and the value of a firm's innovation activity, while previous studies are limited to studying the effects on investments. Prior studies on financially constrained acquisitions focus mostly on short-term abnormal market returns, whereas this study aims to capture the long-term operating performance of these M&A events. Following the identified research gap I formulate the following research question: Do financially constrained acquisitions influence the long-term innovation output, innovation performance and operational performance?

Based on the previous literature, several hypotheses are developed and tested to estimate the effect of financially constrained acquisitions on operational performance and innovation output. The first hypothesis tests whether takeovers with financially constrained firms lead to an increase in innovation expenditures. Since prior research shows a general increase in investments for both constrained targets and acquirers after a takeover I expect there should be a positive effect on R&D expenditures post-acquisition.

The second hypothesis tests the effect of financially constrained acquisitions on the value creation of innovation output. I expect that firms improve the value of innovation activities in terms of higher citations and higher market value for financially constrained takeovers. This is based on the findings by Bena and Li (2014) that show that target firms tend to spend more on R&D while acquiring firms tend to have larger patent portfolios, which

implies that there are financial synergies between constrained innovative acquirers and unconstrained targets.

The third hypothesis tests the effect of financially constrained acquisitions on operational performance. Since previous literature finds that constrained acquirers do not make optimal acquisitions because they need to forgo their optimal investment opportunities, I expect negative operational performance for financially constrained acquirers. However, I expect to find positive performance for firms that acquire constrained targets, since they can relieve the target`s constraints and generate financial synergies.

I investigate the effect of financially constrained acquirers on performance and innovation by constructing a large panel dataset of U.S. firms ranging from 1980 to 2020. This dataset contains M&A events identified by Eikon Datastream and merges this with annual financial data from the CRSP/Compustat merged dataset. Further, I match data on patent applications and their value from a pre-constructed dataset by Kogan, Papanikolaou and Seru (2017) to investigate innovation outcomes. I use only bidding firms that have data available for at least three prior and three post-announcement. Further, a treatment and control group is constructed based on completed and withdrawn bids. This allows for a fixed effect specification with an interaction term between treated and untreated firms because I argue that withdrawn bidders and targets do not differ significantly in their financial constrained characteristics.

After constructing the data, several empirical analyses are performed to measure the effect of financially constrained acquisitions on multiple operational performance and innovation outcomes. A fixed-effects regression with firm and year-fixed effects is utilized to estimate these outcomes. The regression accounts for the differences between the treatment and control group by an interaction effect between the treated group and the period postacquisition. The analyses show mixed results, I find that investments decrease following an acquisition by constrained acquirers and I find no significant effect of acquisitions on R&D intensity. Further, the results show that patent applications increase for financially constrained acquirers and firms that acquire a financially constrained target. This implies that firms indeed shift their focus on innovation activities but reduce their investments in other areas. Moreover, I find no significant impact of financially constrained acquisitions on the value of the patent applications. Following this analysis, it can be concluded that innovativeness does not increase post-acquisition. Finally, I find mixed results regarding operating performance. The results show that operating cash flows increase significantly after

a successful takeover by a constrained firm. However, I found no significant effect on return on assets.

Finally, the thesis confirms the findings from the main analysis by conducting several robustness checks. First, I use a propensity score-matched sample and second I use a subsample of firms that only perform one acquisition to better isolate the effect of the takeover. The analysis of the propensity-matched sample shows similar results as the main analysis, however, I do not find a significant increase in cash flows. The subsample shows no negative effect on investments and even a small positive effect on R&D intensity. Moreover, the subsample confirms the findings regarding the increase of patents and the insignificant increase in innovation value. Overall, the results from this thesis lead to the conclusion that financially constrained takeovers influence policies around innovation activities, but these policies have a small effect on the value of innovation. Further, the results show indications of improved operational performance but these indications are by no means conclusive.

The remainder of the thesis is structured as follows. The next section reviews the relevant scientific literature related to financial constraints, takeovers and innovation. Based on the literature review, three hypotheses are formulated. Second, the empirical methodology is explained in detail, this includes the data collection, variable constructions and estimation strategy. Third, the thesis presents and discusses the empirical results. To verify these results, the fourth section conducts several robustness checks. The fourth and final section of this discusses the limitations, conclusions and recommendations for further research. All references and the appendix with additional tables can be found at the end of the paper.

2. Literature Review

The literature review provides an overview of the most relevant scientific literature related to mergers and acquisitions, financial constraints, and corporate innovation activities. I start with exploring the rationale for performing a merger or acquisition, followed by the literature on takeover performance. After reviewing the literature on M&A events in general, I discuss the literature regarding financial constraints and corporate takeovers. Finally, I explore the literature that links M&A events to a firm's innovation activities. The literature review is followed up by the hypotheses that will be tested in the remaining part of the thesis.

2.1 Takeover motives

Prior literature suggests that M&A activity is cyclical and categorizes multiple merger waves, with differing underlying motivations (Betton et al., 2008). The merger wave in the 1960s is typically categorized as the conglomerate wave, while the second wave in the 1980s is labelled as the refocusing wave. The following merger wave in the 1990s focused more on cross-border acquisitions and is typically called the strategic wave. These categories of merger waves indicate the underlying motivation for the typical acquisition. The 1960s consisted mostly of conglomerate mergers where firms were mostly in unrelated industries, while the 1980s takeovers were more hostile and were focused on specializing operations. Betton et al. (2008) show that merger waves usually happen in times of economic expansion, but they also relate merger waves to technological linkages between firms and technological advancements.

Although takeover motives differ between firms and even by merger wave, the general goal of M&A is to increase the combined value of the firms involved. Multiple potential synergistic effects can motivate managers to perform acquisitions. Mukherjee et al. (2005) collected surveys from CFOs about their takeover motives, they found that CFOs perform acquisitions with the aim to gain synergies by either increasing efficiency or increasing market power. Efficiency gains can be created by taking advantage of tax benefits, cost-cutting, economies of scale and various other measures. Value creation by increasing market power is usually achieved by gaining a larger market share which involves an ability to determine prices and generate higher revenues. However, the survey also found that CFOs justified diversification to reduce risk in economic downturns.

Whereas classical theory about M&A explains acquisition motives through a rational lens, Malmendier & Tate (2008) propose a behavioural model to explain acquisition events. Their findings show that overconfidence by the acquirer can lead to higher acquisitiveness,

and also is a large determinant in the takeover premiums that a target receives. These behavioural motives can explain why there seems to be a generally negative abnormal return for acquiring firms. Irrational markets can also explain acquisitions. Here, the managers act rationally to take advantage of mispricing in stock valuations. Shleifer & Vishny (2003) propose a model where bidding firms take advantage of the overvaluation of equity to acquire undervalued firms. This model follows the evidence that merger waves happen in expansionary periods, assuming managers that perform acquisitions time the market.

2.2 Takeover performance and returns

According to a literature survey by Agrawal & Jaffe (2000), the majority of research on longterm stock performance reports negative returns for the acquirer after a corporate event. Argawal and Jaffe (2000) acknowledge that these conclusions are not robust because the identification strategies in older papers where not sufficient. Subsequent research by (Bessembinder & Zhang, 2013) indeed shows that when accounting for a large set of firm characteristics, there is no significant negative long-term performance after acquisitions compared to non-acquiring companies.

A common approach to investigate takeover returns is to measure cumulative abnormal returns around the announcement of a takeover bid (Renneboog & Vansteenkiste, 2019). This approach measures the market response in the short-term and reveals information on how the market interprets the value of the acquisition. This approach is often used because data availability is high and it accurately captures the effect of an M&A announcement. An important shortcoming of this approach is that short-term stock price fluctuation does not accurately display the value creation effect of a corporate takeover. Both mispricing and ambiguity of performance in the years post-acquisition can bias the estimates of short-term event studies. To resolve this issue, long-term returns are measured in empirical analyses by Malmendier, Moretti and Peters (2018) and Eckbo, Betton and Thornburn (2008). However, longer time frames make it less straightforward to isolate the effect of the acquisition on performance. According to Renneboog and Vansteenkiste (2019), the two most common approaches to measuring short and long-term returns are cumulative abnormal returns (CAR) for short-term returns and buy-and-hold abnormal returns (BHAR) for long-term returns. These measures have in common that they regress stock performance against either a set of control firms or against a specific benchmark like CAPM, and Fama-French factor models. While most papers focus on measuring stock market returns, some researchers have also attempted to measure the effect of acquisitions on operating performance (Martynova et al.,

2007). The advantage of this approach is that it is not susceptible to market mispricing or performance ambiguity. Again, a disadvantage of this approach is the difficulty of isolating the effect of a takeover event. Additionally, measuring the change in operating performance presents difficulties because it cannot be readily compared to a performance benchmark.

2.3 Financial constraints and corporate takeovers

A corporate takeover can involve either a financially constrained acquirer, a financially constrained target or both. It might seem to contradict that an acquirer can be financially constrained since acquisitions generally involve large transaction values. It must be noted here that financial constraints are formulated as an inability to access competitive external financing. It is, therefore, possible that a firm is financially constrained but has sufficient internal funds to perform acquisition. This is in line with the definitions of financial constraints from Almeida et al., (2004) and Fazzari et al. (1988) who formulate financial constraints as firms that are cash flow-sensitive in their decision to save cash and invest. One implication of this definition of financial constraints is that a firm might forgo positive NPV projects when it is either too costly to finance these projects or when these firms anticipate future constraints (Fazzari et al., 1988). This might lead to underinvestment and underperformance of firms that are more financially constrained.

Multiple papers investigate the relationship between financial constraints and acquisitions, a majority of these papers investigate whether acquisitions can relieve financial constraints for either the acquirer or the target. Some papers also investigate the returns for the acquirer after the relief of financial constraints in an acquisition. Williamson & Yang (2021) investigate whether acquisitions can relieve financial constraints for the acquirer, while Erel, Jang and Weisbach (2015) investigate whether acquisitions can relieve financial constraints for the target. Williamson & Yang (2021) find that acquirers indeed relieve their financial constraints after performing an acquisition. They show that corporations reduce cash holdings, increase investments and raise debt. They also show that constrained acquirers are more likely to finance deals with undervalued equity, this indicates that these firms indeed lack competitive financing options. To follow up on these findings they also report positive abnormal short-term returns, indicating that these transactions are value-creating for the shareholders. Erel, Jang and Weisbach (2015) show similar findings for financially constrained targets, they report a decrease in cash holdings, a decrease in cash flow sensitivity and an increase in investment for constrained targets. These findings indicate that financially constrained acquisitions have a value-creating potential. However, these papers do

not track long-term performance after the relief of financial constraints. Khatami, Marchica and Mura (2015) perform a more thorough investigation of the value-creating effect of acquiring constrained targets, in their paper, they track the abnormal returns and takeover premiums of constrained targets. The results show that the takeover premium and abnormal returns are higher for constrained targets relative to unconstrained firms. However, the results did not indicate significant positive returns for acquirers.

2.4 Innovation, R&D and corporate takeovers

Innovation can be characterised as the realization of new ideas that provide value through either creating new technologies or new services. According to this definition, many activities of a firm can be characterized as innovations as long as they are novel and provide firm value. However, these innovations are often not observable in terms of assets. Because of this, previous research mainly focuses on types of innovations that are observable like R&D expenses and patent applications (Kogan et al., 2017).

Corporate innovation is regarded as an important marker for both economic and technological progress in society. It is well established that innovation is an important driver of firm productivity and market value (Bloom & Van Reenen, 2002). Companies can innovate through different strategies and are usually characterized as internal versus external innovation strategies (Cassiman & Veugelers, 2006). Internal innovation strategies rely mostly on research and development activities within a company, whereas external strategies rely on acquiring knowledge through purchasing either external patents or acquiring innovative firms. An advantage of internal innovation is that it can lead to large returns if the innovation is successful. However, Hall (2002) describes that there is a funding gap for R&D activities since the upfront costs are high and the returns are uncertain. This leads corporations to rely more on internal funds since they experience difficulties obtaining external funding. These findings show that financial constraints hinder the internal innovation activities of firms.

Besides internal innovation strategies, firms can use external innovation strategies to acquire knowledge. An advantage of this strategy is that it reduces opportunity costs because the innovations are already produced by other firms. Ahuja & Katila (2001) investigate the effect of technological acquisitions, they find that firms can enhance their innovation output by acquiring technology knowledge bases from other firms. Bena and Li (2013) confirm these findings by performing a quasi-experiment on corporate takeovers between firms with technological overlap, they find that the combined innovation output is improved

postacquisition. Further, they investigate which types of companies are acquirers and targets and the relationship to R&D expenses and innovation output. Their paper finds that acquirers are more likely to have a large patent portfolio and low R&D expenses while the target has a relatively small patent portfolio and high R&D expenses. They also find that the likelihood of acquisition increases when there is technological overlap between firms. Their results show that acquiring firms are more likely to be financially constrained and that they perform acquisitions to relieve these constraints.

Besides the innovation strategy, there has been a continuous debate about how corporate structures influence this innovation process. Seru (2014) investigated the influence of conglomerate acquisitions on innovation output. A conglomerate acquisition is defined as a diversifying acquisition between unrelated firms. An advantage of these types of acquisitions is that the target firms can make use of the internal capital market to fund their R&D activities. However, the results of this study show that targets in diversifying mergers become less innovative and apply for fewer patents after a completed acquisition. According to Seru (2014), this can be attributed to the decrease in productivity of individual inventors after being acquired by a conglomeration. Bernstein (2015) investigates the influence of firm structure on innovation by comparing successful to withdrawn IPOs, the results of the study show that going public has a negative influence on the quality of internal innovation by 40% while it has a positive effect on the firm's ability to acquire external innovation.

2.5 Hypothesis development

Based on the literature review I formulate three hypotheses to answer the main research question. This hypothesis investigates the effect of financially constrained acquisitions on innovation activities, the value of innovation activities and operating performance. The literature shows that takeovers can alleviate financial constraints for both parties involved (Erel et al., 2015; Khatami et al., 2015; Williamson & Yang, 2021). These papers show that the joint firms increase their investments after the completion of an M&A deal. Combined with the findings that a financially constrained company's risk increases with R&D intensity, I expect that the relief of financial constraints through acquisitions leads to an improvement in R&D expenditures. Therefore, I formulate the following hypothesis.

Hypothesis 1A: There is a positive effect of acquisitions by a financially constrained firm on R&D intensity

Hypothesis 1B: There is a positive effect of acquisitions of a financially constrained target firm on R&D intensity

A logical conclusion from the first hypothesis might be that firms increase their innovation output as R&D intensity increases. It must be noted that the empirical evidence around takeovers and innovation output shows some conflicting results. Seru (2014) shows that inventiveness decreases even when investments increase after a target firm is acquired. However, Seru (2014) investigates diversifying mergers without taking into account the possible synergistic effects of the relief of financial constraints. Other research by Bena and Li (2014) finds contrasting evidence that patenting increases after a technologically related acquisition. Based on these findings, I predict that financially constrained acquisitions increase patent applications because the relief of constraints allows firms to pursue their best investment opportunities. Based on these predictions I formulate the second hypothesis:
Hypothesis 2A: There is a positive effect of acquisitions by a financially constrained firm on patent applications
Hypothesis 2B: There is a positive effect of acquisitions of a financially constrained target firm on the number of patent applications.
Hypothesis 2C: There is a positive effect of acquisitions by a financially constrained firm on the value of patent applications.
Hypothesis 2D: There is a positive effect of acquisitions of a financially constrained target firm on the value of patent applications.

The literature review shows that financially constrained acquisitions have positive effects on the short-term abnormal stock returns after a takeover announcement (Khatami et al., 2015; Williamson & Yang, 2021). This indicates that these types of deals are ex-ante regarded as value-creating. The research is less conclusive on the long-term performance aspects of financially constrained acquisitions, some theories predict that financially constrained takeovers are less efficient because firms do not make the optimal investments decisions when performing a takeover, whereas other research suggests that financially constrained firms can relieve constraints and profit from the internal capital markets. I predict based on the findings that abnormal returns are positive, and that the long-term operational performance is positive as well. Therefore, the last hypothesis is as follows:
Hypothesis 3A: There is a positive effect of acquisitions by a financially constrained firm on the firm`s operating performance
Hypothesis 3B: There is a positive effect of acquisitions of a financially constrained target firm on the firm`s operating performance

3. Empirical methods

The empirical methods start with a description of the data collection. Followed by a discussion about the estimation strategy. Here, the main variables and measures are constructed and the main estimation strategies are discussed. After this, I present the main regression equation that will be used in the empirical analysis.

3.1 Data collection

To investigate the effect of M&A events on innovation and performance outcomes I collect merger and acquisition data from North American firms between 1980 and 2020. The data on the M&A deals are retrieved from Eikon Refinitiv Deal Scanner, this database is formerly known under the name of Thomson SDC. I require that the acquiring firm is publicly traded because various control variables and dependent variables require the availability of stock price information. I require the deal value to be more than 100 million US dollars and the stake of the bidding to be less than 25% before the takeover event and the stake sought to be more than 50%. Another criterion is that deals must be either completed or withdrawn, pending deals are omitted from the dataset. In the analysis I require that firms do not announce new M&A transactions during the estimation window of three years after a completed or withdrawn transaction, this prevents measurement errors that are caused by subsequent takeover events.

To extend this thesis to patenting and citations I use a pre-constructed dataset by Kogan et al. (2017), this dataset is extended to 2020 and provides data on the number of patents, patent value and patent citations. The advantage of this dataset is that it provides a PERMNO identifier which enables straightforward matching with the financial firm data from Compustat that provides an identical firm identifier. To measure operational performance and financial constraints I use annual data from CRSP/Compustat merged dataset on North American firms. I exclude firm-year observations with missing or negative assets and sales since these entries are likely to be erroneous. Further, I exclude highly regulated firms with SIC codes ranging from 4900 to 4900. All financial variables are winsorized at a 1% cut-off to reduce outliers.

After obtaining all the necessary data, I construct two separate datasets, one which merges the financial and patent data to acquirers and a second dataset that matches the financial data with targets. The dataset on acquiring companies is used to estimate the postacquisition effects because this dataset contains the financial data for bidders postacquisition. I use the target firm`s dataset to construct pre-acquisition financial

constraints measures for the target firm. The target`s financial measures are merged with the main dataset of buying firms. This procedure allows for a separate analysis of the effects of acquiring and selling pre-acquisition financial constraints on innovation and performance outcomes.

3.2 Estimation strategy

One of the major issues with M&A research is selection bias. This means that the likelihood of being involved in an M&A event is not randomly distributed across firms. Therefore, it is likely that these firms have different characteristics than firms that are not involved in M&A events. These unobserved firm characteristics could explain differential outcomes between acquiring and non-acquiring firms. Many researchers have attempted to address this issue by introducing quasi-experimental identification strategies. Papers from Seru (2014), Liu and Ping (2017) and Erel, Jang and Weisbach (2015) have constructed control groups based on withdrawn bids or failed acquisitions. This reduces the selection bias because these firms are more likely to be similar to other firms involved in M&A events. However, it does not resolve the issue completely because it does not account for unobservable differences between successful and withdrawn bids. Malmendier et al. (2018) have attempted to construct a control group based on winners and losers in the same bidding contest, this makes it more likely that the treatment and control group are comparable because it compares firms that attempt to acquire the same target. This identification strategy suffers from other problems, the sample size is naturally smaller since they need to identify bidding contests with multiple bidders, and this makes the results less reliable. Further, firm size is significantly different between winners and losers, this questions the validity of this approach because firm size is a major determinant in post-acquisition performance.

Another approach that is frequently used in studies on mergers and acquisitions is propensity score matching (PSM). This is an algorithmic approach to identifying a set of firms that have similar characteristics as the acquiring firms in the study. Williamson and Yang (2021) use a propensity score matching technique to identify firms that are most likely to be acquirers, these firms are then used as a control group for the actual acquirers. Khatami et al. (2015) use a slightly different propensity scoring technique where the treatment group are bidders that acquire financially constrained targets and the control group are bidders that acquire unconstrained targets. Besides this, the firms are matched on similar characteristics. The propensity score matching approach has an advantage in applicability because there is no need for an experimental design, however, the main disadvantage is that we can only match

firms on observed characteristics. This implies that PSM does not resolve omitted variable bias.

In this thesis, I use a similar identification strategy as Seru (2014) and Liu and Ping (2017), where bidders with withdrawn acquisitions are utilized as a control group for the treated firms with successful acquisitions. However, Liu and Ping (2017) identify withdrawn bids that are exogeneous to firm fundamentals by searching Lexis-Nexis for withdrawal reasons, whereas I choose to use all withdrawn bids. To mitigate the problem of endogeneity of withdrawal reason I require all bids to be friendly since hostile bids are more likely to be withdrawn and differ in characteristics. I also test whether there is a significant difference between completed and withdrawn firms regarding multiple financial constraints measures to confirm that financially constrained characteristics are not endogenous to the likelihood of acquisition completion.

3.2.1 Performance measures

This empirical study uses multiple dependent variables to examine a wide range of outcomes for financially constrained firms in M&A transactions. Accounting-based performance measures are used to examine the operational performance after the relief of financial constraints. Two commonly used measures are the return on assets (ROA) and operating cash flows (CF). ROA is computed by dividing net income (EBITDA) by the firm's total assets. Cash flows are computed by adding back depreciation and amortization to EBITDA and dividing this by total assets.

3.2.2 Innovation and investment measures

As discussed in the literature review, prior studies show that post-acquisition investments increase when financial constraints are relieved, to examine if these increased investments also result in increased innovation output I examine the post-acquisition long-term value of the patent applications and patent citations. To investigate this, both the market value and the citation value of patent applications will be computed inspired by Kogan, Seru and Papanikalou (2017). Further, I use a similar methodology as Seru (2014) to uncover postacquisition innovation performance. The main difference is that this thesis investigates this through the channel of financial constraints, whereas Seru (2014) investigates postacquisition innovation output through the channel of conglomerate mergers. Seru (2014) uses a sample period from 1980 to 1998, because in this study the innovation output of specific firm segments is estimated. In this study, I aim to estimate the innovation output for

the acquiring firm instead of focusing on a segment or subsidiary. Therefore I can use a larger sample period and the patent data is extended to include a period from 1980 to 2020. Seru, Kogan and Papanikalou (2017) constructed a dataset of U.S. patent applications and measures the value of the firm`s patents by the measuring the number of forward-citations of the patent, and they propose a new method of capturing the economic value of the patent by exploiting movement in stock prices following the days a patent was issued. The advantage of this method is that it captures the anticipated economic value of innovations by using stock prices which incorporate the information that is available ex-ante. The dataset that was constructed is publicly available and was recently extended to 2020.

In this study, I will use two measures to estimate the innovation output of firms after making an acquisition. First, I use the market value of the patent application as specified by Kogan et al. (2017) to measure the economic importance of a specific innovation. This measure captures the stock market returns in the days following a patent application and normalizes this by the number of patent applications per firm. Second, I use the forward citations as specified by Kogan et al. (2017) to measure the technological value of innovation. This measure attributes all future citations of innovation to a specific patent. The number of citations is normalized by the number of patent applications by a specific firm. Besides capturing the value of innovation output, I also estimate whether firms increase their innovation spending by measuring research and development intensity.
The following measures are used to estimate the firm`s innovation output:

$CPatent_{it}$: Total forward citations divided by patent application for firm i in year t. Where forward citations are the total number of citations a patent receives after application.
$Patent_{it}$: Total number of patent applications for firm i in year t.
$MVInnovation_{it}$: Total market value of innovations for firm i in year t, adjusted for USD inflation from 1980 using the consumer price index (CPI).
$MVweighted_{it}$: Patent weighted market value of innovation for firm i in year t.
$RDintensity_{it}$: Research and development expenses over total assets for firm i in year t.

3.2.3 Measuring financial constraints

Various measurements proxy financial constraints and the debate on which measurement is the most accurate is not yet settled. One of the first measures was proposed by Fazzari, Hubbard and Petersen (1988). This is a measure of cash flow sensitivity to investments to estimate a firm`s financial constraints. The rationale behind this measure is that financially

constrained firms can only invest if they have the cash flows available, hence when the cash flow sensitivity to investments is higher financial constraints tend to be higher as well. This measure is controversial because empirical evidence does not support this measure as an accurate proxy of financial constraints. More specifically, Chen & Chen (2012) show that cash flow sensitivity to investments has decreased significantly over time while financial constraints have not decreased. Almeida, Campello and Weisbach (2004) use a cash flow measure as well. Their model involves measuring cash saving from incremental cash flows. The rationale behind this model is that when management expects the likelihood of future financial constraints they will save cash from incremental inflows of cash as a precautionary measure.

Besides the constraints measures based on cash flows, other papers use composite measures based on different factors that indicate financial constraints. These papers identify firms that are financially constrained by investigating qualitative reporting on these firms after identification quantitative analyses are employed to identify the common factors that indicate whether a firm is financially constrained. Kaplan & Zingales (1997) were the first researchers that used this approach to construct a factor model to estimate the 'KZ index'. Later on, this approach was followed up by Whited & Wu (2006) who use an Euler equation to estimate the 'WW index' which is based on the optimal investment policy of a firm. However, subsequent analysis by Hadlock & Pierce (2010) shows that a simple index based on age and size better predicts financial constraints than both the WW and KZ index. Whited & Wu (2006) address the issue that the KZ index and WW index are uncorrelated to each other, this challenges the credibility of the KZ index since the WW index is highly correlated to the HPSA index according to Hadlock & Pierce (2010).

This thesis does not aim to investigate which constraints measure is most accurate, therefore multiple constraints measures are used based on the availability of data and the compatibility with the regression models. Williamson & Yang (2021) use a quintile-based ranking system based on the WW index, the HPSA index and the firm`s credit rating. This allows for equal weighting of multiple indices which results in a more robust proxy for financial constraints. Williamson & Yang (2021) include the credit rating of firms since its shown that having a credit rating reduces financial constraints. Since financial constraints are relative, I take a similar approach by ranking the financial constraints by terciles.

I construct the cash flow sensitivity of investments according to the paper of Hovakimian and Hovakimian (2009). The CFSI measure is computed by the following equation.

$$CFSI = \sum^{n}_{t=1}(Iit * CFit/\sum CFit) - \frac{1}{-}\sum_{n}{}^{n}{}_{t=1} Iit \quad (1)$$

CF is the Cash flow defined as earnings before extraordinary items plus depreciation over lagged total assets. *Iit* is the Investments defined as capital expenditures of lagged total assets. The subscript *n* is the number of observations for firm *i* and *t* is the period in years. Since financially constrained firms have a higher cash flow sensitivity, a firm is considered more financially constrained when cash flow sensitivity increases.

I define the WW index as specified in Whited and Wu (2006), which is given by the following equation:

$WWindex$ = - 0.091* CF_{it} - 0.062 * $DivPayment_{it}$+0.021 * $Leverage_{it}$ - 0.044 * $Size_{it}$ + 0.102 * ISG_{it} - 0.035 * $SG_{it,}$ (2)

Where *i* indicates the firm in year *t. CF* is the cash flow defined as total cash flow divided by lagged total assets. *Divpayment* indicates whether a firm pays cash dividends. Leverage is defined as the ratio of long-term debt to total assets. *Size* is the natural logarithm of total assets. *ISG* is the three-digit industry sales growth and *SG* is the firm`s sales growth. One of the features that differentiate the WW index from the KZ index is that the WW index measures relative constraints towards other firms by including industry sales growth relative to individual firm sales growth.

The Kaplan Zingales index was defined by Kaplan and Zingales (1997). The KZ index is given by the following equation:

$KZindex$ = -1.001909 * CF_{it} + 3.139193 * $Leverage_{it}$ - 39.36780 * $Tdiv_{it}$ - 1.314759 * $Cash_{it}$ + 0.2826389 * Q_{it}, (3)

Where *i* indicates the firm in year *t. CF* is the cash flows divided by property, plant and equipment, *Leverage* is defined as long-term debt to property, plant and equipment. Kaplan and Zingales use similar variables for Cash Flows and Leverage as Whited and Wu (2006). It must be noted that these variables use different construction. *Tdiv* is defined as total dividends to total assets, Q is defined as Tobin's Q which is specified in the appendix, and *Cash* is defined as the ratio of liquid assets to total assets.

The HPSA index by Handlock and Pierce (2010) is defined by the following equation:

HPSAindex = - *0.737* * Size + *0.043* * Size^2 - *0.04* * Age, (4)

Where size is defined as the natural logarithm of inflation-adjusted total assets, and age is the

number of years the firm has been on Compustat without missing stock price. The firm age is reduced to 37 for firms with a higher age to normalize the index.

After constructing the variables I rank-order firms into three groups according to their level of financial constraints. In the regression analysis, I use an indicator FC which takes the value 1 if a firm ranks in the top tercile (the highest 33.3%) for either the WW index or the HPSA index in the year before the acquisition. This indicator is based on the approach by Khatami (2015), who also use terciles to rank firms as financially constrained. Another approach by Williamson & Yang (2021) uses a composite measure of the quantiles of multiple financial constraint variables.

3.2.4 Control variables

This study implements a number of control variables to reduce omitted variable bias. The paper follows the control variables used in Seru (2014) for the regressions that estimate the firm`s innovation activities. The first control variable is the firm`s leverage, which is a determinant of the firm`s willingness to take risk and make investments. The second control variable is R&D intensity since this is one of the largest determinants of a firm`s innovation output. Other control variables capture the fundamental firm characteristics that might influence innovation output. These variables are Tobin`s Q which captures the firm's investment opportunity, asset tangibility which captures how much of a firm`s assets are tangible which is inversely related to innovation activities, and firm size.

The regressions that estimate the effect of constrained acquisitions on operating performance use similar control variables such as Tobin's Q leverage, firm size and industryrelatedness.

3.3 Regression model

I use a fixed effects regression with a double interaction-term between financial constraints, completed takeovers and the three years after the takeover. This specification compares the differential outcomes of treated and untreated groups before and after an event. This method allows for an estimation of the average treatment effect on the firms that successfully complete a takeover. In this study, the treated group consists of successful acquisitions and the untreated group consists of withdrawn acquisitions. The main assumption of this specification is the common trend assumption, this implies that treated groups would have followed a common trend as the untreated group if they would not be treated i.e. completing an acquisition. This specification is commonly used in the literature regarding M&As and

innovation. Therefore the regression specification of this thesis is based on the research design of Seru (2014) which is also implemented by Bena and Li (2014).
The baseline regression model has the following specification:

$$\gamma_{it} = \alpha + \beta 1\ After * Treated * FC + \beta 2\ After * Treated + \beta 3\ After * FC + \beta 5\ After + \beta 6\ Treated + \beta 7\ FC + \beta 8\ Control + \mu_{it} \quad (5)$$

This equation measures the impact of financially constrained acquisitions on innovation activities and operational performance. The double interaction term in this equation allows for estimation of the difference between the before and after period, as well as the difference between successful and withdrawn bids. In this equation, Y*it* is the dependent variable for firm *i* in year *t* which can be categorized as variables that measure innovation and variables that measure operational performance. *After* is a dummy variable that takes a value of 0 for all firms before an acquisition is announced and a value of 1 for all firms 1-year postannouncement. Further, *Successful* is a dummy variable that takes a value of 1 if a firm belongs to the treated group that completes an acquisition and 0 otherwise. *FC* is the third indicator that takes a value of 1 if a firm is considered financially constrained, separate regressions are estimated for acquirer financial constraints and target financial constraints. The interaction between *Successful* and *After* captures the average treatment effect of successful acquisitions, whereas the three-way interaction between *Successful, After* and *FC* captures the average treatment effect of successful acquisitions when either the target or acquirer is financially constrained. *Control* denotes a set of control variables that are used to reduce omitted variable bias. In this equation, *β1* is the main coefficient of interest since this captures the treatment effect of financially constrained firms that complete an acquisition.

4. Descriptive Statistics

Table 1 shows the frequency of bids by year and indicated whether the bid was completed or withdrawn on the full sample. A total of 3213 M&A events are included in this study, and

2970 of these events were successful while 243 were withdrawn. The occurrence of withdrawn bids is substantially lower than the occurrence of successful bids. This is in line with expectations since only friendly bids are included in the sample, which increases the likelihood of a completed takeover. It seems to be the case that bid volume increased substantially in 1990 and remains similar afterwards, but this could be due to data availability and sample selection instead of the actual M&A volume.

Table 2 presents the total number of events for the subsample that is used to study the firm`s innovation activities. In this table, only firms are included who do not announce any bids 3 years prior and 3 years post-announcement. Further, I require that there should at least be 1 patent application in the 3 years after a bid is announced. Approximately 50% of the firms in this sample applied for a patent which results in 1678 announcements. From these announcements, 1551 firms successfully completed an acquisition and 127 firms withdraw their bid.

To address the endogeneity of financial constraints, I compare completed to withdrawn bids concerning multiple measures of financial constraints in the year before the announcement. Table 3 shows summary statistics of the financial constraints measures and a t-test of the difference between successful and withdrawn mergers. It can be observed that most financial constraint measures do not differ significantly between the treatment and control groups, since the p-values of the t-test are not significant for any financial constraint measure. The results from the t-test allow for the assumption that withdrawn bids do not differ in terms of financial constraints. The mean values of financial constraints are negative for the HPSA index, KZ index and WW index. This does not mean that firms are unconstrained since these indices display relative values of financial constraints instead of absolute values. This implies that a ranking approach is most suitable for further analyses with these indices.

Table 1
Tabulation of withdrawn and completed bids by year
This table shows the total withdrawn bids by year in the first column and total completed bids in the second column, in the third column the total number of bids by year is displayed.

Year	Deal announcements		
	Withdrawn	**Completed**	**Total**
1980	2	3	5
1981	5	18	23
1982	3	13	16
1983	2	14	16
1984	4	24	28
1985	2	25	27
1986	5	34	39
1987	7	27	34
1988	8	45	53
1989	11	50	61
1990	5	32	37
1991	3	18	21
1992	4	31	35
1993	0	38	38
1994	2	47	49
1995	7	42	49
1996	11	69	80
1997	10	117	127
1998	9	131	140
1999	13	129	142
2000	20	155	175
2001	12	121	133
2002	10	70	80
2003	5	81	86
2004	3	96	99
2005	3	110	113
2006	8	151	159
2007	13	156	169
2008	10	92	102
2009	5	59	64
2010	4	92	96
2011	3	108	111
2012	3	108	111
2013	4	95	99
2014	7	134	141
2015	9	146	155
2016	2	128	130
2017	9	161	170
Total	**243**	**2970**	**3213**

Table 2
Tabulation of withdrawn and completed bids with at least 1 patent

This table shows the total amount of bids where firms apply for at least 1 patent in the 3 years following the announcement. The first column shows the total amount of events with at least 1 patent application and the second column shows the number of completed takeovers and the third column shows the number of withdrawn bids with at least 1 patent application.

	All events	**Successful**	**Withdrawn**
At least 1 patent	1678	1551	127
Total	3213	2970	243

Further, I investigate whether the financial characteristics of a firm influence the likelihood of completing a deal. I employ a Tobit regression where the dependent variable takes a value of 1 if a deal is completed and a value of 0 if a deal is withdrawn. I test whether operating performance and firm characteristics such as size and leverage influence the probability of success. Table 4 reports the results of this Tobit regression. I find that likelihood of a successful deal increases significantly for firms with larger total assets and higher sales growth. However, operating performance measures such as return on assets, and cash flows do not seem to influence deal success significantly. Besides this, the number of patent applications does not influence the deal's success.

Table 5 shows the correlation matrix of the financial constraints measures. Panel A shows a pairwise correlation matrix, while panel B displays a spearman ranked correlation matrix. A disadvantage of the pairwise correlation matrix is that it only captures linear correlations, this requires that the variables are more of similar magnitude. This is resolved by the spearman rank correlation, which also captures non-linear correlations if variables move in similar directions. It stands out that there is KZ index has low a low correlation with both the WW and HPSA index. This is confirmed by Whited and Wu (2006) show that the KZ index and WW index correlate at approximately 0. Hadlock and Pierce (2010) find that the WW index and HPSA index are highly correlated due to the emphasis on firm size in both indices, this is confirmed by the spearman ranked correlation matrix that estimates a correlation coefficient of 0.71. Further, the correlation matrix shows a negative correlation of 0.124 between the CFSI and both the WW and HPSA index, which is in line with prior results that show a negative relationship between CFSI and financial constraints (Chen & Chen, 2012). Since the WW index and HPSA index are most correlated it makes sense to use these measures in further analyses.

Finally, the appendix shows the summary statistics of all remaining dependent and independent variables. It stands out that the amount of observations regarding patent activities is substantially lower than the other variables. Kogan et al. (2017) explain that their dataset does not report observations for firms that did not apply for a patent. This means that missing firm-year patent observations can be interpreted as 0. In further analysis, I transform the missing observations regarding patents to 0. This ensures that the regression analyses do not drop firm-year observations without patent data.

Table 3
Financial constraints of successful and withdrawn bids

This table reports the mean and standard error (between parentheses) for each financial constraint measure for both completed and withdrawn firms. Column 1 reports these estimates for completed bids. Column 2 reports these estimates for withdrawn bids. Column 3 reports the pvalues from a t-test of the difference of means between column 1 and column 2. adjusted for clustering at the industry level.

Panel A: Acquirer financial constraints

	Completed (1)	Withdrawn (2)	P-value of difference (3)
HPSA Index	-2.7459	-2.7244	0.9073
	(0.5882)	(1.0713)	
KZ Index	-6.9634	-6.1361	0.8034
	(1.0550)	(3.1496)	
WW index	-0.1599	-0.1704	0.6142
	(0.0066)	(0.0198)	
Cash Flow Sensitivity to Investments	0.0475	0.0511	0.8681
	(0.0045)	(0.0039)	

Table 4

Probit regression on the likelihood of acquisition completion.

This table reports the coefficients of a probit regression on the likelihood of acquisition completion for the acquiring firm. The table reports various financial variables in the year of bid announcement. *Ln Total Assets* represents the natural logarithm of the total assets of the acquiring firm during the announcement year. *Leverage* represents the ratio of debt to equity for the acquiring firm. *Return on assets* represents the ratio of EBITDA to total assets, and *sales growth* represents the 1year growth in net revenue for the acquiring firm. *Ln patents* measure the natural logarithm of total patent applications. Column 1 presents the likelihood coefficients for these variables with the corresponding standard errors between parentheses.

	Completed *(1)*
Ln Total Assets	0.131***
	(0.044)
Leverage	0.033
	(0.036)
Return On Assets	0.132
	(0.549)
Sales Growth	0.290**
	(0.147)
Ln Patents	0.038
	(0.037)
Cash Flows	-0.097
	(0.380)
Constant	0.349
	(0.313)
Observations	2767

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5

Pairwise correlation matrix of financial constraints.

This correlation table shows the pairwise correlation estimates between all financial constraint measures. The HPSA index in the first column, the KZ index in the second column, the WW index in the third column and the cash flow sensitivity to investments in the fourth column. Panel A displays the correlation coefficients of a pairwise correlation and Panel B displays the correlation coefficients of a Spearman ranked correlation estimate.

Panel A: Pairwise correlation coefficients

	(1)	*(2)*	*(3)*	*(4)*
(1) WW index	1.000			
(2) HPSA index	0.168	1.000		
(3) KZ index	0.050	-0.026	1.000	
(4) CFSI	-0.029	-0.064	0.137	1.000

Panel B: Spearman's rank correlation coefficients

Variables		*(1)*	*(2)*	*(3)*	*(4)*
(1) WWindex	1.000				
(2) HPSAindex	0.701	1.000			
(3) KZindex	0.285	0.062	1.000		
(4) CFSI	-0.425	-0.347	0.041	1.000	

5. Results

The results section of this thesis describes the findings of the empirical analyses that are performed to test the hypotheses. This section is divided into two parts, the first part investigates the effect of financially constrained acquisitions on investments and innovation activities. Several regressions that estimate the effect of both acquirer and target financial constraints on R&D activities, investments and patenting activities are discussed. A firm is considered financially constrained if it scores in the highest centile for either the WW index or the HPSA index 1 year before the bidding announcement, the computation of these indices can be found in the empirical methods. Further, the regressions require that there is at least one patent application in the years following the bid announcement. The second part investigates the effect of financially constrained acquisitions on operating performance. In this part, the specification of financial constraints is similar to the first part. However, I do not require that there is at least one patent application in the years following the bid announcement. This results in a slightly larger number of observations for the second part of the results section.

Further, it must be noted that firm fixed-effects regression would normally omit the coefficient estimate of the treated group since being treated is constant over time. However, in this regression estimate that is not the case because firms can participate in multiple events, this means that the same firm can be treated in one event and untreated in another event. In the robustness check, I take this into account by dropping observations for firms that perform multiple regressions.

5.1 Financial constraints, investments and innovation

First, I investigate whether financially constrained acquirers increase their research and development intensity and investments. Panel A of Table 6 reports the results from a fixedeffects regression on R&D intensity and investments. The main variable of interest in this regression is the three-way interaction term denoted as *After * Succesful * FC.* All regressions are estimated with and without control variables to account for possible omitted variable bias. The table shows a significant decrease in investments for the financially constrained firm`s that successfully complete acquisitions at 10% significance. However, their relative investments are only decreased by approximately 4.2% according to the regression estimates in columns 1 and 2. Moreover, the regression estimates a significant

decrease in investments for all firms post-announcement by approximately 1.2%, this indicates that being involved in a takeover event has a generally negative effect on future investment activities. With regards to R&D intensity, the results show no significant differences pre and post-acquisition for financially constrained firms. This indicates that firms do not alter their research and development policies after making an acquisition. These results indicate that constrained firms do not relieve their constraints by acquisitions since investments decrease on average and R&D investments do not increase post-acquisition. The first hypothesis that predicts that financially constrained firms increase their investments and R&D activities after making a successful acquisition is therefore not supported by the results of this analysis. The null hypothesis that there is no significant change in investments can be rejected because I find that firms decrease their investment post-acquisition. These results contradict the findings by Williamson and Yang (2021) who show that acquisitions tend to relieve financial constraints and increase investments post-acquisition.

Panel B of Table 6 shows the effect on investments and R&D intensity for firms that buy a financially constrained target. The coefficients in this regression show no significant change in investments for firms that acquire a financially constrained target, this implies that firms do not change their investment policies after acquiring a constrained target. This result contradicts the findings by Erel et al. (2015) who show that acquisitions relieve the targets' financial constraints. It must be noted that Erel et al. (2015) is a different dataset that allows for tracking the post-acquisition investments of targets separately, while the results in this study only track the post-acquisition investments of the combined firms. Further, I find a minor increase in R&D intensity ranging between 0.8% and 1% which is not statistically significant. Again, this might be caused by the inability to track the target firm's behaviour post-acquisition. Based on these results it can be concluded that firms do not increase their spending on innovation activities after a financially constrained acquisition.

Table 6

Fixed effects regression on R&D intensity and investments

This table reports the result of a regression on the full sample of M&A transactions. A fixedeffects regression with firm and year-fixed effects is employed to estimate the effects of a financially constrained acquirer on R&D intensity and investments. After is an indicator that takes a value of 1 after an announced bid and 0 otherwise. Treated is an indicator that takes a value of 1 for firms that complete a transaction and 0 when a firm withdraws their transaction bid. FC is an indicator that takes a value of 1 if the acquiring firm is financially constrained 1 year before the transaction. The estimation windows range from 3 years before the announcement bid to three post announcement. The table reports regression results without control variables in columns 1 and 3 and with control variables in columns 2 and 4. The control variables include Leverage, total assets and Tobin's Q. Standard errors are clustered at the three-digit industry level.

Panel 6A: Acquirer financial constraint

	Investments	*Investments*	*R&D intensity*	*R&D intensity*
	(1)	(2)	(4)	(5)
*After * Treated * FC*	-0.042*	-0.043*	-0.015	-0.009
	(0.024)	(0.025)	(0.020)	(0.019)
*After * Treated*	-0.002	-0.003	-0.004*	-0.001
	(0.006)	(0.006)	(0.002)	(0.002)
*After * FC*	0.007	0.006	0.006	0.009
	(0.015)	(0.015)	(0.016)	(0.016)
After	-0.012***	-0.012***	0.007**	0.007***
	(0.004)	(0.004)	(0.003)	(0.003)
Treated	-0.004	-0.003	0.004	-0.000
	(0.008)	(0.009)	(0.004)	(0.004)
FC	0.031	0.030	-0.013	-0.013
	(0.033)	(0.037)	(0.031)	(0.028)
Control Var.	NO	YES	NO	YES
Firm FE	YES	YES	YES	YES
Time FC	YES	YES	YES	YES
Observations	19,264	19,196	11,191	11,154
R-squared	0.484	0.486	0.810	0.829

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.10

Panel 6B: Target Financial constraints

	Investments	*Investments*	*R&D intensity*	*R&D intensity*
	(1)	(2)	(4)	(5)
*After * Treated * target FC*	-0.002	-0.001	0.010	0.008
	(0.009)	(0.010)	(0.008)	(0.007)
*After * Treated*	-0.008	-0.009	-0.009**	-0.004
	(0.009)	(0.010)	(0.004)	(0.004)
*After * target FC*	-0.007	-0.010	0.001	0.001
	(0.016)	(0.017)	(0.007)	(0.009)
*Succesful * target FC*	0.002	0.002	-0.012*	-0.009*
	(0.008)	(0.008)	(0.007)	(0.006)
After	-0.012**	-0.012**	0.010**	0.011**
	(0.005)	(0.005)	(0.004)	(0.004)
Treated	0.001	0.003	0.004	-0.000
	(0.011)	(0.011)	(0.004)	(0.004)
Control Var.	NO	YES	NO	YES
Firm FE	YES	YES	YES	YES
Time FC	YES	YES	YES	YES
Observations	19,264	19,196	11,191	11,154
R-squared	0.482	0.483	0.809	0.829

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

After establishing a significant decrease in investments and no significant difference in R&D intensity, I investigate whether this influences innovation output. Table 7 reports the results for the natural logarithm for patent applications and Table 8 reports the results for the citation and market value of patent applications. In columns 1 and 2 of Table 7, I find a significant increase in patent applications for financially constrained acquirers after completing an acquisition. Without control variables, the table reports an increase of 52.7% at 5% significance. After including a set of control variables, the coefficient drops from 52.7% to 36.2% at a 10% significance level. This implies that financially constrained firms increase

their patenting applications on average by 36.2% after performing an acquisition compared to financially constrained companies that do not complete an acquisition. Columns 3 and 4 report results for firms that acquire a constrained target. After including control variables the table reports a 31.1% increase on average in patent applications for firms that acquire a financially constrained target at 5% significance. These results confirm hypotheses 2a and 2b that predicted an increase in patent applications post-acquisition for both financially constrained acquirers and targets.

The increase in patent applications might be a sign of either increased inventiveness or a shift in innovation strategy towards more patent protection. To investigate this, panel A of Table 8 reports a regression on the number of forward-citations per patent in columns 1 and 2. The results show an increase of 6 to 15 citations per patent application after the takeover, however, these results are not significantly different from 0. Columns 3 and 4 report the estimates of the market value of patent applications, again the table reports a nonsignificant increase in the years following acquisition for financially constrained firms. I find no support for hypothesis 2C which states that the value of patent applications increases. Panel B reports the results for firms that acquire a constrained target, the results show no significant effect of a successful acquisition on citation-weighted innovation and contrary to the results from Panel A the change in citations is negative when the target is constrained. Further, the market value of patents shows no significant change either. Based on these results, hypothesis 2D which predicts an increase in the value of innovation when the target firm is constrained cannot be confirmed.

Table 7
Fixed effects regression on patent applications.

This table reports the result of a regression on the full sample of M&A transactions. A fixedeffects regression with firm and year fixed effects is employed to estimate the effects of financially constrained acquirers and financially constrained targets on the natural logarithm of patent applications in columns 1 and 2 the regression uses financially constrained acquirers and in columns 3 and 4 the regression uses financially constrained targets. After is an indicator that takes a value of 1 after an announced bid and 0 otherwise. Treated is an indicator that takes a value of 1 if a transaction is completed and 0 when a transaction is withdrawn. FC is an indicator that takes a value of 1 if a firm is financially constrained 1 year before the transaction. The table reports regression results without control variables in columns 1 and 3 and with control variables in columns 2 and 4. The set of control variables includes firm leverage, the natural log of total assets, and R&D intensity. Standard errors are clustered at the three-digit industry level.

	Ln Patents		*Ln Patents*	
	(1)	(2)	(3)	(4)
*After * Treated * FC*	0.527**	0.362*	0.093	0.311**
	(0.230)	(0.202)	(0.167)	(0.142)
*After * FC*	-0.471**	-0.509***	0.049	-0.178
	(0.232)	(0.187)	(0.165)	(0.131)
*Treated * FC*	0.040	0.006	0.164**	0.087
	(0.113)	(0.119)	(0.083)	(0.073)
*After * Treated*	-0.095	-0.078	-0.065	-0.119
	(0.078)	(0.087)	(0.091)	(0.095)
After	0.086	-0.022	0.013	-0.052
	(0.073)	(0.076)	(0.086)	(0.088)
Treated	0.145***	0.034	0.089*	0.004
	(0.044)	(0.036)	(0.050)	(0.047)
FC	-0.020	-0.059		
		(0.124)		
	(0.136)			
Control Variables	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes

Year FE	Yes	Yes 8,800	Yes	Yes
Observations	10,624		10,624	8,800
Adjusted R-squared	0.820	0.840	0.820	0.840

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 8

Fixed effects regression on the value of innovation activities.

This table reports the result of a regression on the full sample of M&A transactions. A fixedeffects regression with firm and year fixed effects is employed to estimate the effects of financially constrained acquirers and financially constrained targets on the natural logarithm of patent applications in columns 1 and 2 the regression uses financially constrained acquirers and in columns 3 and 4 the regression uses financially constrained targets. After is an indicator that takes a value of 1 after an announced bid and 0 otherwise. Treated is an indicator that takes a value of 1 if a transaction is completed and 0 when a transaction is withdrawn. FC is an indicator that takes a value of 1 if a firm is financially constrained 1 year before the transaction. The table reports regression results without control variables in columns 1 and 3 and with control variables in columns 2 and 4. The set of control variables includes firm leverage, the natural log of total assets, and R&D intensity. Standard errors are clustered at the three-digit industry level. **Panel 8A: Acquirer Financial constraints**

	Citation Weighted Innovation		*Market Value Weighted Innovation*	
	(1)	(2)	(3)	(4)
*After * Treated * FC*	6.263	15.957	5.695	0.201
	(13.386)	(17.394)	(4.308)	(3.224)
*After * FC*	-12.317	-17.661	-2.730	1.268
	(13.162)	(17.292)	(3.325)	(2.017)
*Treated * FC*	-8.817	-9.248	4.335*	3.722
	(5.577)	(5.680)	(2.263)	(2.264)
*After * Treated*	-5.419	-5.012	-5.295*	-1.188
	(3.507)	(4.215)	(2.850)	(1.516)
After	1.596	1.271	3.825	-0.542
	(3.512)	(4.216)	(2.978)	(1.374)
Treated	-1.132	0.682	-1.670	-1.682
	(0.944)	(1.310)	(1.073)	(1.191)
FC	1.336	10.585	1.729	1.908

	(10.841)	(7.463)	(1.581)	(1.370)
Control Variables	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	10,624	8,800	10,624	8,800
Adjusted R-squared	0.664	0.718	0.643	0.659

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel 8B: Target Financial Constraints

	Citation Weighted Innovation		*Market Value Weighted Innovation*	
	(1)	(2)	(3)	(4)
*After * Treated * Target FC*	-10.262	-13.950	1.904	0.671
	(6.713)	(8.520)	(6.364)	(3.421)
*After * Target FC*	-10.262	-13.950	1.904	0.671
	(6.713)	(8.520)	(6.364)	(3.421)
*Treated * Target FC*	0.640	-0.354	4.266**	4.434***
	(2.237)	(2.411)	(1.655)	(1.645)
*After * Treated*	-2.171	0.191	-4.947*	-0.987
	(4.204)	(4.905)	(2.835)	(1.363)
After	-1.625	-3.032	3.793	-0.303
	(4.645)	(5.646)	(2.957)	(1.292)
Treated	-2.026*	0.319	-2.823***	-3.026**
	(1.142)	(1.380)	(1.053)	(1.164)
Control Variables	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	10,624	8,800	10,624	8,800
Adjusted R-squared	0.664	0.718	0.643	0.659

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.2 Financially constrained acquisitions and operational performance

Prior literature found positive abnormal returns around financially constrained acquisitions. This section of the results discusses whether this also translates into improved operational performance. More specifically, I test the effect of financially constrained

acquisitions on the return on assets and the relative operating cash flows. Table 9 reports the results from the analysis of operational performance. In columns 1 and 2 of panel A, the effect of acquisitions on return on assets is estimated. The results show a non-significant increase of constrained acquisitions on return on assets of 1.2%, this indicates that firms do not produce an economically significant improvement in the return on assets. Columns 3 and 4 of panel A report the estimates for operating cash flows as the dependent variable. These results show a significant average increase of 6.2% at a significance level of 5% when accounted for control variables. This indicates that there is an economically significant improvement in the relative cash flows that are generated post-acquisitions, this is in line with the expectations from previous papers that show positive market sentiment toward constrained acquisitions (Williamson & Yang, 2021). Based on these results hypothesis 3A is partially supported since I find a positive effect for both measures of operational performance and a significant positive effect on operating cash flows. In panel B the same analysis is performed for firms that acquire a financially constrained target. The results show no significant changes in both returns on assets and cash flows and even non-significant decreases in cash flows. However, the average decrease is estimated to be 0.3% for cash flows after including control variables, this does not appear to be economically significant. Based on these results no support is found for hypothesis 3B which estimates a positive effect on the operating performance of acquiring constrained targets. Again, this can be explained by the inability to measure the separate performance of targets. Overall, the results regarding operational performance after financially constrained acquisitions are inconclusive and I only find partial support for hypothesis 3.

Table 9

Fixed effects regression on return on assets and cash flows.

This table reports the results from a fixed-effects regression on the return on assets and cash flows. The full sample of M&A transactions is used and year and firm fixed effects are employed. The first two columns report the regression estimates on return on assets, the last two columns report the estimates on cash flows. Tables 1 and 3 report the estimates without control variables and tables 2 and 4 use multiple control variables. After is an indicator that takes a value of 1 after an announced bid and 0 otherwise. Treated is an indicator that takes a value of 1 if a transaction is completed and 0 when a transaction is withdrawn. FC is an indicator that takes a value of 1 if a firm is financially constrained 1 year before the transaction. The control variables include leverage, Market-to-book ratio, total assets and Tobin's Q. Standard errors are clustered at the three-digit industry level.

Panel 9A: Acquirer Financial constraints

	Return on Assets		*Cash flows*	
	(1)	(2)	(3)	(4)
*After * Treated * FC*	0.012	0.013	0.044*	0.062**
	(0.020)	(0.019)	(0.026)	(0.031)
*After * FC*	-0.008	0.000	0.002	0.001
	(0.019)	(0.016)	(0.017)	(0.017)
*Treated * FC*	0.018*	0.007	-0.012	-0.021
	(0.010)	(0.013)	(0.016)	(0.017)
*After * Treated*	0.006	0.003	0.004	0.002
	(0.006)	(0.005)	(0.006)	(0.005)
After	-0.031***	-0.029***	-0.035***	-0.026***
	(0.007)	(0.006)	(0.006)	(0.006)
Treated	-0.003	-0.008*	0.004	0.001
	(0.003)	(0.004)	(0.004)	(0.005)
FC	-0.005	-0.008	-0.006	-0.014

	(0.015)	(0.017)	(0.015)	(0.016)
Control Variables	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	28,935	19,408	24,964	17,444
Adjusted R-squared	0.348	0.378	0.293	0.280

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Panel 9B: Target financial constraints

	Return on Assets		*Cash Flows*	
	(1)	(2)	(3)	(4)
*After * Treated * target FC*	-0.020	0.010	-0.021	-0.003
	(0.015)	(0.014)	(0.018)	(0.021)
*After * target FC*	0.012*	0.004	0.016*	0.017
	(0.006)	(0.007)	(0.009)	(0.010)
*Treated * target FC*	0.024	0.003	0.021	0.004
	(0.014)	(0.015)	(0.015)	(0.017)
*After * Treated*	-0.000	-0.001	0.003	0.008
	(0.008)	(0.010)	(0.010)	(0.013)
After	-0.037***	-0.030***	-0.039***	-0.027***
	(0.008)	(0.008)	(0.007)	(0.007)
Treated	-0.001	-0.008*	0.000	-0.007
	(0.002)	(0.004)	(0.003)	(0.005)
Control Variables	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	28,935	19,408	24,964	17,444
Adjusted R-squared	0.348	0.378	0.292	0.277

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6. Robustness

There are two main concerns regarding the robustness of the results. First, the control group consisting of withdrawn firms is not entirely equal regarding the observable firm characteristics and the relatively small number of observations makes this estimation more susceptible to outliers. Second, some firms perform multiple acquisitions which means that they can be both treated and untreated in the main regression. The robustness section addresses the first issue by performing a propensity score matching technique to allow for a larger control group that is more similar in observable firm characteristics. The second issue is addressed by holding the treated group constant by including one event for each firm.

6.1 Propensity score matching

Since the descriptive statistics found observable differences in size and cash flows between completed and withdrawn bids, I verify whether the estimations of the regressions still hold with a different control group. I apply a propensity score matching technique which matches a control firm to each acquiring firm on the likelihood of completing an acquisition. This technique matches the firm characteristics in the year before the announcement, this includes the financial constraints measures and other firm characteristics such as size, leverage, sales growth and performance. The appendix shows the full matching specification in equation (7). After matching one-on-one using a Mahalanobis matching algorithm 1624 non-acquiring firms correspond to a firm that completed an acquisition. Table 11 in the appendix reports a Tobit regression on the likelihood of completing an acquisition comparing successful acquisitions to the full Compustat database of North American firms and finds significant

differences for all variables. After matching most observable characteristics do not differ significantly between successful acquirers and matched controls before the acquisition. The only observable variable that is significantly different from 0 is the return on assets, which is higher for the treated group.

After the matching procedure, similar regressions are performed with financially constrained acquirers. The analysis is not performed with constrained targets because the control group are non-acquirers that are not matched to a specific target. Table 12 in the appendix and table 13 in the appendix report the results of these regressions. The same control variables and regression specifications are used as in the main analysis. The results related to R&D intensity and investments are similar to the main analysis, they confirm a significant decrease in investments and a positive non-significant increase in R&D intensity. This implies that the results are robust to the chosen identification strategy. Further, the propensity score-matched regressions fail to show significant effects on operating performance outcomes. This draws into question if the significant increase in cash flows in the main analysis is valid.

6.2 Adjusted sample selection

As discussed in the results some firms perform multiple acquisitions, this leads to a situation where these firms are both treated and untreated depending on the event. I address the issue that some firms perform multiple acquisitions by only keeping one takeover event for each firm. This allows for a constant treatment where each firm is either treated or untreated for the entire period. As a result, the individual coefficients for treated and financial constraints are dropped from the regression because this is a constant over the full regression estimation. After only keeping one takeover event per firm, there are a total of 123 withdrawn bids and 1290 completed bids for a total of 1413 takeover events. The appendix reports the regression results from the subsample in Tables 14, 15 and 16. The same control variables and regression specification is used as in the main analysis. Table 14 reports a fixed regression on investments, R&D intensity and the natural logarithm of patents while using the subsample. The estimates for financially constrained firms post-acquisition are different for investments and R&D intensity. Using the subsample I do not find a significant difference in investments before and after a takeover for financially constrained acquirers and targets. Further, I find a significant average increase of 0.9% in R&D intensity for both constrained targets and acquirers at 10% significance, whereas the main analysis did not find an increase in R&D intensity. However, an increase in R&D investments relative to assets of less than 1% with a

10% significance level does not seem to be economically significant. Further, the increase of patent applications for financially constrained acquirers in the main analysis is confirmed by the subsample with a positive coefficient of 21.6 % at 10% significance. This confirms that the increase in patent applications is robust to the sample that was used. Table 15 in the appendix reports the changes in the citation and market-weighted output of patent applications. Again, the table reports a positive but insignificant increase for citation-weighted innovation. However, the subsample does show a significant increase in the market value of patent applications when the target is financially constrained. This confirms that there indeed is some positive albeit small effect of financially constrained acquisitions on the value of innovation output. However, the lack of significance for the other estimates indicates that it is a rather weak effect. Finally, Table 16 reports the estimated effect of the subsample on operating performance. The regression estimates show no significant changes in both returns on assets and cash flows. This confirms the findings from the propensity score-matched sample and draws into question whether the findings in the main regression are valid. Overall, the robustness checks confirm the findings that patent applications increase significantly after a financially constrained acquisition. Moreover, the positive coefficients for citation and market-weighted innovation indicate that there might be a weak effect of financially constrained acquisitions on the value of innovation.

7. Limitations and conclusion

The final section of this paper starts with the limitations of the empirical analysis. Following, summary and conclusion of the results, and ends with recommendations for further research.

7.1 Limitations

Empirical research on M&A events naturally entails a set of limitations that must be overcome to accurately estimate causal relationships between events and post-acquisition effects. In this paper, I choose to use withdrawn bids as a control group to estimate the treatment effect on successful bids. This approach is limited in at least three different ways. First, the number of observations of withdrawn bids is substantially smaller than completed bids, this reduces the accuracy of the estimations which leads to higher standard errors and less significant results. Second, I assume that withdrawn bids are exogeneous to a firm`s financial constraints, however, there are possible unobservable characteristics related to financial constraints that influence the likelihood of a successful acquisition. Third, I do not investigate whether the withdrawal reason is related to the variables of interest, which increases the probability of endogeneity. I address the issue of observable differences in firm characteristics and the small size of the control group by including robustness checks with a propensity score matching. This gives the advantage of comparing equal-sized groups and firms that are more similar in observable characteristics. Nevertheless, this identification strategy does not control for differences in unobservable characteristics either, and the matching criteria can be arbitrary since not all determinants of M&A outcomes are fully understood as mentioned in Renneboog & Vansteenkiste (2019).

Besides the limitations concerning the causal inference of the regression model, there are several limitations regarding the measurement of the variables in this thesis. First, I use

several proxies to estimate a firm`s financial constraints but an obvious limitation is that I do not qualitatively observe whether a firm is financially constrained in the sense that it has trouble accessing external funds. As discussed in the empirical methods a firm`s financial constraints are not directly observable from the quantitative financial data of a firm. FarreMensa and Ljungqvist (2016) argue that most firm characteristics that are related to financial constraints can also reflect differences in the individual investment policies and the firm`s life-cycle. To accurately capture financial constraints, one would need both qualitative data on the financial policies of individual firms and quantitative data on the firm`s corresponding behaviour, which is beyond the scope of this study. Second, I use a firm's patent activity and forward citations as a proxy for the firm`s innovation activities. As discussed in the literature review these measures do not fully capture the full extent of a firm's innovation activities because not all firms choose to patent their innovations and not all innovations can be protected by patents. A firm may choose to keep its innovation confidential instead of patenting it which entails disclosure of the firm's activities. I attempt to overcome this issue by only including firms that apply for at least one patent post-acquisition since these firms are more likely to use patents to protect their innovation activities.

7.2 Conclusion

The central idea behind financially constrained acquisitions is that companies can benefit from shared capital structures to relieve financial constraints. Multiple papers confirmed this idea by showing that investments increase and cash flow sensitivity decrease post-acquisition. However, there is an understudied effect of the relief of financial constraints on subsequent performance and the outcomes of investments through innovation activities. Therefore, this paper attempts to answer whether financially constrained acquisitions have a positive effect on innovation and operational performance. Innovation activities are considered the driver behind economic growth, yet there is a lack of understanding of how financial constraints influence innovations.

Through an empirical study, multiple hypotheses are tested to answer the main research question. The paper used a sample of North American acquisitions from 1980 to 2020 to investigate a total of 3213 events. In the empirical analysis, the treatment effect of a financially constrained acquisition was estimated using a fixed-effects regression with firm and year fixed effects and a double interaction term to capture the differential effects of financially constrained firms after completing an acquisition. The findings of the main

empirical analysis show that constrained firms decrease investments and do not increase their R&D activities after acquisitions involving a constrained acquirer or a constrained target. This contradicts the findings of previous papers that observe a relief in financial constraints (Erel et al., 2015; Khatami et al., 2015; Williamson & Yang, 2021). However, an alternative explanation is offered by Seru (2014) who shows that acquiring firms shift from internal innovation strategies towards external strategies such as joint ventures and strategic alliances. Resulting, the paper finds no support for the first hypothesis that predicted an increase in R&D investments. Follow-up research could investigate whether the insignificant increase in R&D is due to the change from internal to external innovation strategies.

Further, this thesis estimated the effect of financially constrained acquisitions on innovation output. Although there seems to be a positive effect on patent applications, this does not translate to a higher valuation in stock returns or a higher value of the patents through forward-citations. Therefore, the second thesis that predicted an increase in innovation is only partially supported. A possible explanation for this might be that the negative effect of a changing capital structure on innovation as shown in Bernstein (2015) outweighs the positive effect of relieving financial constraints through an acquisition.

Finally, the empirical analysis estimated the effect of financially constrained acquisitions on operational performance. The results showed a significant increase in operating cash flows but failed to find significant effects on return on assets. Therefore, the third hypothesis that predicted constrained takeovers improve operational performance is only partially supported. After the main analysis, robustness checks were performed with a propensity score-matched sample and a smaller subsample of deals. Overall, the robustness checks support the findings that patent applications increase, as well as the findings that the value of innovation tends to increase. However, the positive increase in operating performance was not confirmed during the robustness checks.

Overall, these results open up possibilities for further exploration of the overall effect of financial constraints on innovation and performance. To this date, the debate about what constitutes a financially constrained firm and how to identify these firms is not yet settled. Besides this, measuring innovation has proven to be an imprecise task due to the difference in innovation strategies across firms. Further, the long-term stock returns of financially constrained acquisitions could add some interesting insight to settle the debate whether the relief of financial constraints leads to improved performance overall.

8. References

Agrawal, A., & Jaffe, J. F. (2000). The post-merger performance puzzle. *Advances in Mergers and Acquisitions*, *1*, 7–41. Scopus. https://doi.org/10.1016/S1479-361X(00)01002-4

Ahuja, G., & Katila, R. (2001). Technological acquisitions and the innovation performance of acquiring firms: A longitudinal study. *Strategic management journal*, *22*(3), 197–220.

Almeida, H., Campello, M., & Weisbach, M. S. (2004). The cash flow sensitivity of cash. *The journal of finance*, *59*(4), 1777–1804.

Bena, J., & Li, K. (2014). Corporate Innovations and Mergers and Acquisitions. *The Journal of Finance*, *69*(5), 1923–1960. https://doi.org/10.1111/jofi.12059

Bernstein, S. (2015). Does Going Public Affect Innovation? *The Journal of Finance*, *70*(4), 1365–1403. https://doi.org/10.1111/jofi.12275

Bessembinder, H., & Zhang, F. (2013). Firm characteristics and long-run stock returns after corporate events. *Journal of Financial Economics*, *109*(1), 83–102. https://doi.org/10.1016/j.jfineco.2013.02.009

Betton, S., Eckbo, B. E., Thorburn, K. S., & Eckbo, B. E. (2008). *Handbook of corporate finance: Empirical corporate finance*.

Blomkvist, M., & Felixson, K. (2018). Credit supply, post-acquisition performance and financial constraints. *Applied Economics Letters*, *25*(20), 1421–1425.

https://doi.org/10.1080/13504851.2017.1422598

Bloom, N., & Van Reenen, J. (2002). Patents, real options and firm performance. *The Economic Journal*, *112*(478), C97–C116.

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.

Chen, H. (Jason), & Chen, S. (Jenny). (2012). Investment-cash flow sensitivity cannot be a good measure of financial constraints: Evidence from the time series. *Journal of Financial Economics*, *103*(2), 393–410. https://doi.org/10.1016/j.jfineco.2011.08.009

Erel, I., Jang, Y., & Weisbach, M. S. (2015). Do acquisitions relieve target firms' financial constraints? *The Journal of Finance*, *70*(1), 289–328.

Farre-Mensa, J., & Ljungqvist, A. (2016). Do Measures of Financial Constraints Measure Financial Constraints? *The Review of Financial Studies*, *29*(2), 271–308. https://doi.org/10.1093/rfs/hhv052

Fazzari, S., Hubbard, R. G., & Petersen, B. (1988). Investment, financing decisions, and tax policy. *The American economic review*, *78*(2), 200–205.

Hadlock, C. J., & Pierce, J. R. (2010). New Evidence on Measuring Financial Constraints: Moving Beyond the KZ Index. *The Review of Financial Studies*, *23*(5), 1909–1940. https://doi.org/10.1093/rfs/hhq009

Hall, B. H. (2002). The financing of research and development. *Oxford review of economic policy*, *18*(1), 35–51.

Hovakimian, A., & Hovakimian, G. (2009). *Cash Flow Sensitivity of Investment* (SSRN Scholarly Paper Nr. 1320678). Social Science Research Network. https://doi.org/10.1111/j.1468-036X.2007.00420.x

Kaplan, S. N., & Zingales, L. (1997). Do investment-cash flow sensitivities provide useful measures of financing constraints? *The quarterly journal of economics*, *112*(1), 169–215.

Khatami, S. H., Marchica, M.-T., & Mura, R. (2015). Corporate acquisitions and financial constraints. *International Review of Financial Analysis*, *40*, 107–121.

Kogan, L., Papanikolaou, D., Seru, A., & Stoffman, N. (2017). Technological innovation, resource allocation, and growth. *The Quarterly Journal of Economics*, *132*(2), 665–712.

Lamont, O., Polk, C., & Saá-Requejo, J. (2001). Financial Constraints and Stock Returns. *The Review of Financial Studies*, *14*(2), 529–554.

Malmendier, U., Moretti, E., & Peters, F. S. (2018). Winning by losing: Evidence on the long-run effects of mergers. *The Review of Financial Studies*, *31*(8), 3212–3264.

Malmendier, U., & Tate, G. (2008). Who makes acquisitions? CEO overconfidence and the market's reaction. *Journal of financial Economics*, *89*(1), 20–43.

Martynova, M., Oosting, S., & Renneboog, L. (2007). The long-term operating performance in European mergers and acquisitions. In *International mergers and acquisitions activity since 1990* (pp. 79–116). Elsevier.

Mukherjee, T. K., Kiymaz, H., & Baker, H. K. (2005). *Merger Motives and Target Valuation: A Survey of Evidence from Cfos* [SSRN Scholarly Paper]. https://papers.ssrn.com/abstract=670383

Nishant, N. (2021, december 31). Global M&A volumes hit record high in 2021, breach $5 trillion for first time. *Reuters*. https://www.reuters.com/markets/us/global-mavolumes-hit-record-high-2021-breach-5-trillion-first-time-2021-12-31/

Renneboog, L., & Vansteenkiste, C. (2019). Failure and success in mergers and acquisitions.

Journal of Corporate Finance, *58*, 650–699. https://doi.org/10.1016/j.jcorpfin.2019.07.010

Savignac, F. (2008). Impact of financial constraints on innovation: What can be learned from a direct measure? *Econ. Innov. New Techn.*, *17*(6), 553–569.

Seru, A. (2014). Firm boundaries matter: Evidence from conglomerates and R&D activity. *Journal of Financial Economics*, *111*(2), 381–405. https://doi.org/10.1016/j.jfineco.2013.11.001

Shleifer, A., & Vishny, R. W. (2003). Stock market driven acquisitions. *Journal of Financial Economics*, *70*(3), 295–311. https://doi.org/10.1016/S0304-405X(03)00211-3

Whited, T. M., & Wu, G. (2006). Financial Constraints Risk. *The Review of Financial Studies*, *19*(2), 531–559. https://doi.org/10.1093/rfs/hhj012

Williamson, R., & Yang, J. (2021). Tapping into financial synergies: Alleviating financial constraints through acquisitions. *Journal of Corporate Finance*, *68*, 101947.

9. Appendix

Table 10

Summary statistics

This table reports the summary statistics of the dependent and independent variables used in the analysis. I select observations for the acquiring firm 3 years prior and 3 years post-acquisition. Data on sales, assets, R&D expenses and equity are all retrieved from Compustat. Data on patents, citations and the market value of patents all come from the pre-constructed dataset from Kogan et al. (2017). The first column presents the number of observations during the estimation window of -3 to +3 years around the acquisitions. The second column reports the mean of these observations and the third column reports the standard deviation.

Variable	N	Mean	Std. Dev.	Min	Max
Return on assets	20888	.021	.131	-1.422	.294
Cash flows	18031	.082	.174	-8.181	4.989
R&D intensity	11213	.047	.069	0	.769
Investments	19275	.06	.112	0	5.599
Citation Weighted innovation	7854	18.358	46.534	0	1350
Market Weighted innovation	7854	17.993	38.482	.004	804.585
Patents	7854	78.691	230.944	1	3522
Total Assets	20888	20689.934	115340.41	2.018	3001251.5
Tobins Q	20861	1.819	1.884	.298	100.807
Market to Book ratio	14292	605.487	1390.176	0	7751.966
Tangibility	19610	.253	.239	0	.903
Leverage	20810	1.116	2.237	0	14.752

Table 11
Logit regression on the matched sample

This table reports a logit regression on the likelihood of being a successful bidder in an M&A transaction. The dependent variable is a dummy that takes the value of 1 for firms that are actual acquirers and a value of 0 otherwise. The regression uses the financial data 1 year before the announcement date to estimate the likelihood of being a successful acquirer. Column 1 reports a logit regression that compares all firms with available data in Compustat that do not acquire another firm to acquirers. Column 2 reports the coefficients for the sample that was matched using a propensity score matching technique. The firms are matched according to equation 7.

	All firm`s logit	*Matched logit*
	(1)	(2)
Market-to-Book Ratio	-0.000**	0.000
	(0.000)	(0.000)
Tangibility	-0.434***	-0.254
	(0.115)	(0.156)
Leverage	0.009	0.008
	(0.012)	(0.019)
Return on assets	0.096*	0.409*
	(0.058)	(0.239)
Sales growth	0.366***	-0.021
	(0.037)	(0.060)
Total assets	0.310***	0.005
	(0.026)	(0.042)
HPSA index	-1.049***	0.044
	(0.041)	(0.064)
WW index	-0.118	-0.080
	(0.314)	(0.375)
Constant	-6.271***	0.169
	(0.098)	(0.165)
Pseudo-R2	0.059	0.001
Observations	79,459	3,248

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 12

Propensity score-matched regression on investments, R&D and patents

This table reports the result of a fixed-effects regression using a propensity score matching technique with firm fixed and year fixed effects. The dependent variables are firm investments, R&D intensity and the natural logarithm of patents. After is an indicator that takes a value of 1 after an announced bid and 0 otherwise. Treated is an indicator that takes a value of 1 if a transaction is completed and 0 when a transaction is withdrawn. FC is an indicator that takes a value of 1 if a firm is financially constrained 1 year before the transaction. The table reports regression estimates with control variables. The set of control variables includes firm leverage, the natural log of total assets, and Tobin's Q. Standard errors are clustered at the three-digit industry level.

	Investments	*R&D intensity*	*Ln Patents*
	(1)	(2)	(3)
*After * Treated * FC*	-0.023***	0.002	0.218**
	(0.007)	(0.004)	(0.110)
*After * FC*	-0.015***	0.001	0.060
	(0.005)	(0.003)	(0.099)
*Treated * FC*	0.032***	0.001	-0.014
	(0.011)	(0.006)	(0.221)
*After * Treated*	-0.012***	0.005**	0.086
	(0.003)	(0.002)	(0.071)
After	-0.001	-0.000	-0.166***
	(0.003)	(0.002)	(0.064)
Treated	0.006	-0.008***	0.130
	(0.005)	(0.003)	(0.135)
FC	0.013	0.020***	0.077

	(0.009)	(0.005)	(0.159)
Control Variables	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	17,945	11,302	8,723
Adjusted R-squared	0.410	0.810	0.834

Standard errors in parentheses ***
p<0.01, ** p<0.05, * p<0.1

Table 13

Propensity score-matched regression on innovation, return on assets and cash flows

This table reports the result of a fixed-effects regression using a propensity score matching technique with firm fixed and year fixed effects. The dependent variables are the citations per patent, the market value per patent, return on assets and operating cash flows. After is an indicator that takes a value of 1 after an announced bid and 0 otherwise. Treated is an indicator that takes a value of 1 if a transaction is completed and 0 when a transaction is withdrawn. FC is an indicator that takes a value of 1 if a firm is financially constrained 1 year before the transaction. The table reports regression estimates with control variables. The set of control variables includes firm leverage, the natural log of total assets, Tobin's Q, and R&D intensity. Standard errors are clustered at the three-digit industry level.

innovation	*innovation*	*Citation weighted*	*Market value-weighted*	*Return on assets*	*Cash flows*
		(1)	(2)	(3)	(4)

*After * Treated * FC*	-2.542	4.724	-0.007	0.024
	(4.905)	(4.061)	(0.013)	(0.023)
*After * Treated*	-0.451	-4.564***	-0.005	-0.008
	(2.044)	(1.530)	(0.005)	(0.006)
*After * FC*	-3.274	-1.911	0.018	0.039***
	(3.389)	(1.683)	(0.011)	(0.011)
*Treated*FC*	-0.901	1.945	0.004	0.007
	(9.600)	(4.811)	(0.035)	(0.033)
After	1.388	0.047	-0.028***	-0.024***
	(1.382)	(1.191)	(0.005)	(0.005)
Treated	-5.818	2.193	-0.011	0.003
	(7.453)	(2.892)	(0.007)	(0.007)
FC	7.455	-3.189	-0.029	-0.069**
	(8.393)	(4.996)	(0.035)	(0.034)
Control Variables	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	8,723	8,723	26,548	26,146
Adjusted R-squared	0.718	0.661	0.435	0.381

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 14

Fixed effects regression on sub-sample of investments, R&D and patents

This table reports the result of a regression on the sub-sample of M&A transactions with one event for each firm. A fixed-effects regression with firm and year-fixed effects is employed to estimate the effects of a financially constrained acquirer on R&D intensity and investments. After is an indicator that takes a value of 1 after an announced bid and 0 otherwise. Treated is an indicator that takes a value of 1 for firms that complete a transaction and 0 for a firm that withdraws their transaction bid. FC is an indicator that takes a value of 1 if the acquiring firm is financially constrained 1 year before the transaction. The estimation window ranges from 3 years before the announcement to three post-announcement. The table reports regression results for investments in columns 1 and 2, R&D intensity in 3 and 4 and the natural log of patents in 5 and 6. Columns 1, 3 and 5 use the acquirer's financial constraints. Columns 2, 4 and 6 use target financial constraints. The control variables include Leverage, total assets and Tobin's Q. Standard errors are clustered at the three-digit industry level.

	Investments		*R&D Intensity*		*Ln Patents*	
	(1)	(2)	(3)	(4)	(5)	(6)
*After * Treated * FC*	0.001		0.009*		0.216*	

	(0.019)		(0.006)		(0.137)	
*After * Treated * Target FC*		0.001		0.009*		0.133
		(0.008)		(0.006)		(0.196)
*After * FC*	-0.011		-0.003		-0.153	
	(0.017)		(0.006)		(0.209)	
*After * Target FC*		-0.003		-0.009		-0.153
		(0.008)		(0.005)		(0.176)
*After * Treated*	-0.004	0.003	-0.001	-0.002	-0.045	-0.043
	(0.005)	(0.004)	(0.003)	(0.003)	(0.087)	(0.100)
After	-0.001	-0.008**	0.004	0.006**	-0.010	-0.007
	(0.006)	(0.004)	(0.003)	(0.003)	(0.092)	(0.086)
Observations	8,847	4,853	5,013	5,013	5,013	5,013
Adjusted R-squared	0.373	0.628	0.871	0.871	0.935	0.935
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Robust standard errors in parentheses		*** p<0.01, ** p<0.05, * p<0.1				

Table 15

Fixed effects regression on sub-sample of innovation value.

This table reports the result of a regression on the sub-sample of M&A transactions with one event for each firm. A fixed-effects regression with firm and year-fixed effects is employed to estimate the effects of a financially constrained acquirer on the citation weighted and market valueweighted value of innovation. After is an indicator that takes a value of 1 after an announced bid and 0 otherwise. Treated is an indicator that takes a value of 1 for firms that complete a transaction and 0 for a firm that withdraws their transaction bid. FC is an indicator that takes a value of 1 if the acquiring firm is financially constrained 1 year before the transaction. The estimation window ranges from 3 years before the announcement to three post announcements. The table reports regression results for citation-weighted innovation in columns 1 and 2 and market-weighted innovation in columns 3 and. Columns 1 and 3 use the acquirer's financial constraints. Columns 2 and 4 use target financial constraints. The control variables include leverage, R&D intensity, total assets and Tobin's Q. Standard errors are clustered at the three-digit industry level.

	Citation weighted innovation		*Market value-weighted innovation*	
	(1)	(3)	(2)	(4)
*After * Treated * FC*	2.570		0.293	
	(6.461)		(1.355)	

*After * Treated * Target FC*		4.388		2.505*
		(5.241)		(1.440)
*After * FC*	0.289		1.960*	
	(5.511)		(1.137)	
*After * Target FC*		0.575		1.976
		(5.215)		(1.289)
*After * Treated*	-5.157	-4.061	-0.024	0.400
	(4.813)	(4.807)	(0.922)	(0.963)
After	4.505	4.327	0.914	0.889
	(3.945)	(4.106)	(0.854)	(0.907)
Observations	5,013	5,013	5,013	5,013
Adjusted R-squared	0.421	0.422	0.801	0.801
Control variables	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 16

Fixed effects regression on sub-sample of operating performance.

This table reports the result of a regression on the sub-sample of M&A transactions with one event for each firm. A fixed-effects regression with firm and year-fixed effects is employed to estimate the effects of a financially constrained acquirer on return on assets and operating cash flows. After is an indicator that takes a value of 1 after an announced bid and 0 otherwise. Treated is an indicator that takes a value of 1 for firms that complete a transaction and 0 for a firm that withdraws their transaction bid. FC is an indicator that takes a value of 1 if the acquiring firm is financially constrained 1 year before the transaction. The estimation window ranges from 3 years before the announcement to three years post-announcements. The table reports regression results to return on assets in columns 1 and 2 and cash flows in columns 3 and 4. Columns 1 and 3 use the acquirer's

financial constraints. Columns 2 and 4 use target financial constraints. The control variables include leverage, Market-to-book ratio, total assets and Tobin's Q. Standard errors are clustered at the threedigit industry level.

	Return on assets		*Cash flows*	
	(1)	(2)	(3)	(4)
*After * Treated * FC*	-0.017		-0.014	
	(0.027)		(0.032)	
*After * Treated * Target FC*		-0.015		0.009
		(0.021)		(0.019)
*After * FC*	-0.008		-0.006	
	(0.024)		(0.023)	
*After * Target FC*		0.011		-0.003
		(0.021)		(0.018)
*After * Treated*	0.004	0.006	0.003	-0.001
	(0.008)	(0.007)	(0.007)	(0.008)
After	-0.016*	-0.020**	-0.020**	-0.021**
	(0.008)	(0.008)	(0.008)	(0.008)
Observations	9,498	9,498	8,401	8,401
Adjusted R-squared	0.418	0.417	0.296	0.296
Control variables	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 17

Variable Definitions

Dependent variables	Variable definitions	Compustat definition
ROA	Net income over total assets	ni/at
Cash Flows	Income before extraordinary items plus depreciation and amortization divided by lagged total assets	$(ibc+dp)/at_{t-1}$
R&D intensity	Research and Development expenses over lagged total assets	xrd/at_{t-1}
Invesments	Capital expenditures over lagged total assets	$capx/at_{t-1}$
Citation weighted innovation	Number of forward citations as defined by Kogan et al. (2017) over the number of patents by year	citation/npatent
Market value-weighted innovation	The market value of innovation as defined by Kogan et al. (2017) over the number of patents by year	xireal/npatent
Patents	Number of patents by firm-year	npatent
Independent variables		
Financially constrained target	Indicates if the target firm is in the highest certile for the WW index or HPSA index 1 year before an acquisition	
Financially constrained acquirer	Indicates if acquiring firm is in the highest certile for the WW index or HPSA index 1 year before an acquisition	
Control variables		
Leverage	Long term debt plus short term debt divided by stockholders equity	(dltt+dlc)/seq
Tobins Q	total assets plus the market value of equity minus book value of equity divided by total assets	(at+(csho*prcc_fceq))/at
ln Assets	Natural logarithm of total assets	ln(at)
Market-to-book	The market value of equity divided by the book value of equity	mkvalt/bkvlps
Sales growth	Change in revenue divided by lagged revenue	$(revt-revt_{t-1})/revt_{t-1}$
Tangibility	Property, plant and equipment divided by total assets	ppent/at