The impact of competition and time-to-finance on corporate cash holdings

Raun Moritzen, Mark ; Schandlbauer, Alexander

Published in:
Journal of Corporate Finance

DOI:
10.1016/j.jcorpfin.2019.101502

Publication date:
2020

Document version:
Accepted manuscript

Citation for pulished version (APA):
Raun Moritzen, M., & Schandlbauer, A. (2020). The impact of competition and time-to-finance on corporate cash holdings. *Journal of Corporate Finance*, *65*, Article 101502. https://doi.org/10.1016/j.jcorpfin.2019.101502

The Impact of Competition and Time-to-Finance on Corporate Cash Holdings*

Mark Raun Moritzen‡ Alexander Schandlbauer§

First Version: July 1, 2015

This Version: August 18, 2019

Abstract

This paper empirically documents how the interaction between competition and time frictions in capital markets impacts firms' cash management decisions. Using the introduction of the U.S. Securities Offering Reform in 2005 as a quasi-natural experiment, we show that a shorter time-to-finance leads to a reduction in corporate cash holdings. This effect is significantly stronger for firms that are exposed to preemption risk. Furthermore, patents mitigate the risk of preemption and the effect of a reduction in time-to-finance on cash holdings is strongest for unconstrained firms.

JEL classification: G30, G32, G35

Keywords: cash holdings; time-to-finance; competition; real investment; capital market frictions

*We would like to thank Marc Arnold, Patrick Bolton, András Danis, Kristian Debrabant, Christian Riis Flor, Andrea Gamba, Gerard Hoberg, Evgeny Lyandres, Florian Nagler, Thiago de Oliveira Souza, Charlotte Ostergaard, Mikkel Hasse Pedersen, Daniel Rettl, Xunhua Su, Toni Whited, and Youchang Wu for helpful comments and suggestions. We also thank the seminar participants at the MFA 2017, NFN Workshop 2017, SGF 2016, EFMA 2016, World Finance 2016, and the seminar participants at Columbia Business School, the University of Southern Denmark and Moody's Analytics. We thank Adrian Profir for excellent research assistance.

‡Bain & Company, Industriens Hus, H. C. Andersens Blvd. 18, 1787 Kopenhagen, Denmark.

§University of Southern Denmark and Danish Finance Institute, Campusvej 55, 5230 Odense M, Denmark. Phone: (+45) 93507001. Email: alsc@sam.sdu.dk

1 Introduction

Why do firms hold cash? Most explanations are based on the notion that financial frictions create a precautionary motive to either avoid illiquidity induced default (e.g., Anderson and Carverhill, 2012; Bolton et al., 2014) or to mitigate underinvestment problems (e.g., Boyle and Guthrie, 2003; Acharya et al., 2007). The main friction used to explain this is the cost of external financing caused by asymmetric information between firms' insiders and investors (Myers and Majluf, 1984), and a substantial part of the literature focuses on these costs as the key motivation for having internal cash buffers (e.g., Gryglewicz, 2011; Kisser, 2013; Harford et al., 2014). In this paper, we document one additional aspect that influences firms' optimal cash management policy: Time frictions, that is, the time it takes to raise money when funds are needed. Using the U.S. Securities Offering Reform (SOR) of 2005 as a quasi-natural experiment, we show that when external financing cannot be obtained instantly, firms optimally hold cash to avoid underinvestment problems.[1]

Raising external capital involves several steps, such as dealing with investment banks, lawyers, and the Securities and Exchange Commission (SEC), all of which place constraints on firms. The importance of these frictions is well-established among both regulators and practitioners. For instance, Nelson Mullins Scarborough LLP, a leading U.S. law firm, points out that "filing a registration statement is a complex process that can result in a long and costly review by the SEC". Bethel and Krigman (2008) document an average waiting time in SEC reviews of public offerings of about 1.5 months, and notice that firms might risk waiting as long as six months for a SEC clearance. In line with this, a recent CFO survey by Lins et al. (2010) documents that out of 22 factors, managers rank time frictions as the fourth most important reason for holding cash.

Time-to-finance considerations are especially important for firms facing higher levels of competition. While various channels through which competition may affect corporate cash holdings exist, this paper focuses on competition in the form of preemption risk. That is, firms compete for mutually exclusive investment opportunities that are associated with a high winner's advantage. In

[1]Throughout the paper, we rely on the term *time-to-finance*, introduced to the literature by Ma et al. (2015, 2018), to denote the time associated with obtaining external financing.

this case, investment opportunities are no longer perpetual, and firms have to take into account the short-lived nature of their growth options. Thus, when firms face time delay in external financing it becomes increasingly important to hold cash. The reason is that having internal financing available allows firms to take advantage of investment opportunities whenever they arise. On the contrary, if firms do not have sufficient cash at hand when an investment opportunity presents itself, they face the risk of a competitor seizing that same investment opportunity before external financing can be secured. Thus, holding cash can help lower the risk of preemption and ensure continued growth at the expense of less financially strong competitors (e.g., Garlappi, 2004; Fresard, 2010).

We examine how a large sample of U.S. firms reacted to the SOR of 2005. This reform allowed a group of firms known as Well-Known Seasoned Issuers (WKSIs) to issue unspecified amounts of securities (any class) through the so-called Automatic Shelf Registration (ASR). The main advantage of ASR is that any SEC pre-issuance review is no longer required, which effectively reduces the time-to-finance. In general, we can think of a firm's time-to-finance as being comprised of two parts: A systematic part (the SEC review process) and an idiosyncratic part. The latter consists of the time spent with lawyers and underwriters, as well as finding investors in the capital market and is likely to vary with different firm characteristics, such as size and asymmetric information. In our empirical analysis, however, we focus on a change in the systematic part of the time-to-finance that arises prior to taking securities to the market. Before 2005, all firms were equally exposed to the systematic part of time-to-finance. By introducing ASR, the reform effectively eliminated this part for WKSIs, as these firms no longer faced the risk of delay due to a SEC review. Importantly, only firms with a public float above $700 million qualified for such an accelerated process. Thus, we compare firms eligible for ASR (treatment group) with firms that are not (control group) and conduct a difference-in-differences analysis.

To test whether firms, that are subject to preemption risk, hold more cash to mitigate the risk of underinvestment, we face the empirical challenge that the risk of preemption is unobservable. Motivated by papers focusing on acquisitions in research and development (R&D) intense industries (e.g., Granstrand and Sjölander, 1990; Blonigen and Taylor, 2000; Phillips and Zhdanov, 2013), we rely on industry levels of R&D expenditures as a measure of preemption risk. To analyse the interaction between time-to-finance and preemption risk we split the sample into different percentiles and define the top (bottom) quartile as high (low) preemption risk industries and perform a difference-in-difference-in-differences analysis.

Our main analysis yields two distinct sets of findings. First, we show that the average treated firm significantly reduced its cash-to-asset ratio by 2.4 percentage points subsequent to the reform. Given the pre-treatment levels of cash of 19.7% in 2004, this corresponds to a decrease of 12.2%. Second, we show that the reduction of cash holdings following the reform was significantly larger for firms facing preemption risk. Specifically, treated firms in the top quartile reduced their cash holdings by an additional 4.8 percentage points. The intuition behind these results is that a shorter time-to-finance enables firms to reduce the cash buffers held to mitigate preemption risk. As firms in high preemption risk industries hold more cash to hedge this risk (their cash to asset ratio is 0.38 vs. 0.16 for firms that are subject to low preemption risk), they respond more strongly to the decrease in time-to-finance.

To help validate our measure of preemption risk and to get a better understanding what impacts the overall results, we conduct several sample splits. First, we show that firms in industries with a higher acquisition intensity, measured by the number of acquisitions that occurred in the pre-reform years relative to the number of firms, react stronger to the reform. Second, in line with this, we document that firms in industries with a higher takeover probability reduce their cash holdings more, since in such instances the risk of preemption increases. Third, we examine the in how far firms' own amount of R&D spending, in comparison to the industry wide spending, affects their response to reform. In line with the results of Phillips and Zhdanov (2013) we find evidence that firms with below mean R&D spendings reduce their cash holdings more, as these firms are likely to focus on acquiring other firms rather than develop internally. Fourth, we find that firms with shorter projects respond stronger to the reform, as the timing of investment opportunities matters more for them. Last, we provide evidence on whether patents can help mitigate the risk of preemption. We show that firms active in patent intensive industries reduce their cash less subsequent to the reform.

We further extend our analysis to shed light on the components of competition by including two common measures of competitive pressure - the fluidity measure of Hoberg et al. (2014) and the concept of economics of scope (Baik et al., 2017). While these alternatives help to capture other aspects of competition, such as the number and distribution of firms competing (i.e., the intensity of competition), they only serve as noisy proxies for preemption risk. Our results highlight that the common measures of competition provides directional similar results, however, R&D expenditures help capture a specific characteristic of competition, namely the degree of preemption risk. Specifically, we show that competition intensity only impacts the effect of time-to-finance on corporate cash holdings within high preemption risk industries.

Moreover we examine the role of direct issuance costs, financial constraints, and credit lines. We start off by showing that direct costs, such as the offering yield or treasury spread, do not change around the SOR. Next, we categorize firms prior to the reform as either financially constrained or unconstrained by using three alternative measures that are commonly used in the literature. We find that the effect of a reduction in the time-to-finance on cash holdings is strongest for unconstrained firms, implying that firms with low financing costs were more likely to benefit from the reform. Last, we examine the role of credit lines, which are not subject to time-to-finance concerns. We document that only firms with more credit lines reduce their cash holdings, indicating that firms with such alternative source of financing are able to rely less on cash.

The empirical results hold for a large number of robustness checks: First, we examine the potential endogeneity of the treatment status by using the control function approach of Heckman (1978, 1979) and an instrumental variable approach. Second, we ensure that two potential confounding events are not driving the results: the Sarbanes-Oxley provisions, which reduces the time to file the annual report, and the 2004 Homeland Investment Act, where firms were given a one-time deduction of taxable income for repatriations from foreign subsidiaries. For the latter, we examine a subset of firms that are not directly affected. To do so, we look at those firms for which the post-treatment observations fall outside the tax holiday period. The results remain similar. Third, we discuss whether control firms react strategically. A concern could be that having easier access to external financing may provide treated firms with a competitive advantage, which in turn could increase the preemption risk of the control group and thereby lead control firms to increase cash holdings. To ensure that our results are not driven by such strategic considerations, we analyze control firms that do not directly compete with any of the treated firms, as these firms should have no incentives to respond strategically. Fourth, we examine the role of innovation in connection to our proxy for preemption risk. Finally, we verify that our results are not driven by size differences between the treatment and control group. A potential concern of the difference-in-differences setup is that larger (smaller) firms tend to have a larger (smaller) public float. By implicitly comparing firms of a different size, we face the risk of unobservable omitted variables influencing our results. To mitigate this concern, we include a comprehensive set of control variables throughout all analyses, and to account for time-invariant unobservable variation, we add both firm and year fixed effects, allowing us to exploit the within firm variation in cash. We further perform a matched sample analysis, focusing on a subset of firms with very comparable characteristics, which confirms the results of the main analysis, and conduct several placebo tests to ensure that the results are not driven by the difference in size.

1.1 Related literature

At its core, this paper contributes to the empirical literature that analyzes the effect of competition on corporate cash holdings (e.g., Schroth and Szalay, 2010; Hoberg et al., 2014; Morellec et al., 2014). Lyandres and Palazzo (2015) argue that the relation between cash holdings and competition in future output markets depends on the level of financial constraints. Their paper focuses on the effect of firms' cash holdings on their rivals' cash choices and shows how the relationship between product market competition and cash holdings is influenced by financial constraints. A key contribution of our paper is to provide novel evidence on the interplay between competition for mutually exclusive investment opportunities and firms' time-to-finance constraints. Specifically, we show that the effect of preemption risk on corporate cash is not uniform across firms, but increases with a firm's time-to-finance.

Furthermore, our paper relates to the large empirical literature on corporate cash holdings and financial frictions (e.g., Almeida et al., 2004; Denis and Sibilkov, 2010). The important difference is that only few papers have focused on time frictions as a determinant of corporate cash policies. Fenn (2000) uses the introduction of the 144A private placement rule to show how firms shift towards faster types of issuance. The recent literature has added to these findings using the 2005 SOR as a quasi-natural experiment to document that firms value faster issuances (e.g., Wirz and Kulak, 2014) and are willing to pay for a lower time-to-finance (Gustafson, 2018). Most closely related is Kulak (2011), a working paper, that corroborate our main results. We differ in a number of crucial aspects: We show that the effect of the reform is not uniform across industries but depends on the characteristics of competition. We highlight that firms reduce their cash only in industries with high levels of preemption risk and that this effect goes beyond traditional measures of competition that focus on the intensity of competition. Additionally, we supplement the previous findings by showing that patents reduce the risk of preemption and by showing that the reduction in time-to-finance primarily affects credit line intensive and unconstrained firms.

Our paper is also related to the literature focusing on the determinants of the financing decision in corporate takeovers (e.g., Faccio and Masulis, 2005; Betton et al., 2008). Martynova and Renneboog (2009) show that the need for flexibility in managing corporate funds explains the M&A financing decision. Alshwer et al. (2011), and more recently Gorbenko and Malenko (2017), show that financially constrained bidders are more likely to use stocks in acquisitions. We add to this discussion by documenting that a firm's choice of payment for acquisitions is influenced by time-to-finance and competition.

Last, our paper builds on a large theoretical literature that focuses on analyzing firms' financial flexibility and the determinants of corporate cash holdings (e.g., Gamba and Triantis, 2008; Bonaimé et al., 2014; Hugonnier et al., 2015). Our contribution is twofold: First, we show how the direct interaction between the time-to-finance and corporate cash depends on the firms' risk of preemption. Second, we highlight how the role of corporate cash holdings changes from primarily hedging default risk to providing financial flexibility for investment purposes when the risk of preemption increases. In a recent paper Ma et al. (2018) use a general equilibrium model to analyze how cash plays a strategic role when there is a significant winner's advantage in innovations and outside financing takes time. A novel contribution of our paper is that we provide in-depth empirical evidence on the effect of time-to-finance on cash holdings and its interaction with preemption risk, alternative measures of competition, and financial constraints.

2 Theoretical implications and the empirical identification

2.1 Theoretical implications

To guide our empirical analysis, we outline the insights from a cash model in the spirit of Hugonnier et al. (2015). The Internet Appendix presents a stylized model that examines how both time frictions in capital markets and preemption risk affect a firm's cash management decision.

The basic insight is that competition and time-to-finance impact corporate cash holdings through two channels: First, firms retain cash to fund investments and to hedge illiquidity if it takes time to secure financing (Ma et al., 2018). Second, the threat of preemption further increases firms' incentives to retain earnings and to use internal cash to fund investments. The latter effect arises because as the level of preemption risk increases, the role of cash shifts away from hedging illiquidity risk to hedging the risk of not being able to invest (i.e., underinvestment). Stated differently, by holding cash, a firm can lower the probability of one of its project being preempted before financing can be secured. The longer time a firm has to wait, the more an investment project is exposed to the possibility that a competitor ceases the opportunity and invests first. Thus, preemption risk makes cash holdings valuable for investments. The relative degree of importance between the two channels depends on a firm's financial constraints and its exposure to (the specific type of) competition.

Implication 1: *An increase in time-to-finance leads to an increase in corporate cash holdings.*

Implication 2: *The effect of time-to-finance on corporate cash holdings increases with preemption risk.*

2.2 Identification: The Securities Offering Reform of 2005

To empirically test the model's implications and to identify the causal effects of changes in firms' time-to-finance, we rely on a quasi-natural experiment. The SOR of 2005 allowed a group of firms known as Well-Known Seasoned Issuers to issue securities through Automatic Shelf Registration. Prior to the reform, firms could issue public equity or debt either using standard public offerings or via shelf offerings, both of which are subject to a pre-issuance review by the SEC. The introduction of ASR allowed WKSIs to completely forgo such reviews, which effectively reduced their time-to-finance.[2] The main goal of the reform was to "eliminate unnecessary and outmoded restrictions on offerings" and to remove "delays in the offering process that [. . .] would be inconsistent with the needs of issuers for timely access to the securities markets and capital", as argued by the SEC (Release No. 33-8491).[3]

To be eligible, within 60 days of the determination date, firms are required to have a public float of more than \$700 million. Alternatively, at least \$1 billion aggregate principal amount of non-convertible securities, other than common equity, in primary offerings for cash, needs to have been issued over the past three years.[4]

While firms voluntarily chose whether to use ASR or not, eligible firms rapidly switched from traditional shelf offerings to ASRs. This can be seen from Panel (a) of Figure 1, which illustrates the fraction of issuances conducted using ASR.[5] In fact, more than 41% of all eligible firms issued securities through ASR between 2005 and 2008. Moreover, several commentators, especially law

[2]While the usage of accelerated seasoned equity offerings had been increasing prior to the reform (Bortolotti et al., 2008), according to the SEC's final ruling, "the modifications [of the SOR] will facilitate immediate market access and promote efficient capital formation [. . .]. Most significantly, the new rules will provide the flexibility to take advantage of market windows [and] to structure securities on a real-time basis to accommodate issuer needs".

[3]Besides allowing WKSIs to issue securities faster, the reform also relaxed reporting requirements. Importantly, however, the SEC itself did not believe that the information environment of WKSIs would be materially affected (Gustafson, 2018). Moreover, Shroff et al. (2013) find no differences in disclosure for WKSIs and non-WKSIs. surrounding the passage of the reform. Hence, the reform constitutes a valid natural experiment to discuss how changes in time-to-finance affect firms' cash.

[4]Moreover, firms are required to file reports pursuant to Section 13(a) or 15(d) of the Exchange Act and they need to satisfy the shelf registration registrant requirements of Form S-3 (or F-3 for foreign issuers), which include being current and timely in all reporting requirements for the preceding 12 months. Firms must not be an "ineligible issuer", i.e., not being a limited partnership, a penny stock issuer or having filed for bankruptcy in the preceding three years.

[5]The reason why some control firms issue ASRs after 2005 is that the treatment status is based on firms' public float in 2005. Hence, firms may use ASR if their public float rises above the cut-off in subsequent years.

firms, positively welcomed the change to the public offering process by highlighting the issuance acceleration (e.g., Latham & Watkins LLP described the July ruling as "Christmas in July").[6]

Prior to a security issuance, a firm needs to file a registration statement with the SEC. Subsequently the SEC determines, usually within two to five business days, whether the registration statement is reviewed. WKSIs filing for ASR are automatically exempt and are not required to wait for the SEC. In contrast, the SEC may choose to review filings for public offerings and shelf offerings. In such case, an initial comment letter is generally issued within 30 days of the date of the initial submission, after which the firm needs to resolve and respond to any issues raised. The review may involve several rounds of comments from the SEC and responses from the company. As the exact number, and the respective time frame, of non-WKSI offerings that are reviewed prior to the reform is unavailable, we approximate this by looking at the amendments that occur within the first 60 days after the initial filing. 44% of the offerings were amended 1.9 times, and the average time between the initial filing and the first (last) amendment was 32 (65) days. These findings are consistent with the documented average waiting time in SEC reviews of public offerings.[7]

3 Data description and empirical approach

3.1 Sample and variable construction

The firms' public float is retrieved from the annual 10-K filings (via the SEC EDGAR database) using a dedicated text-search algorithm.[8] We subsequently merge the public float data with annual

[6]Firms risk losing their WKSI status as a result of certain violations of the federal securities laws. Recently, in December 2016, Deutsche Bank faced the risk of becoming an "ineligible issuer" after being convicted of market manipulations in South Korea. In an attempt to get a waiver, the bank highlighted in a letter to the SEC that if its WKSI status were to be withdrawn (and as such the possibility to use ASR), it "would lose significant flexibility". Section 1 of the Internet Appendix provides a detailed description of the SEC registration and review process.

[7]To test the internal validity and to ensure that SEC reviews are not systematically different between larger and smaller firms, we examine firms' pre-issuance behavior prior to the reform. We calculate the probability of amending a shelf offering within the first two months after an offering as a proxy for being reviewed. We then compare the average time between a shelf offering and its first amendment. In the years before the ASR introduction, the fraction of amended issuances within 60 days was very comparable among treated (45%) and control firms (44%). Similarly the initial amendment length: 32.2 (32.8) days for the treatment (control) group.

[8]This is necessary as standard databases do not report the public float. The algorithm identifies the relevant paragraph by searching for keywords such as "aggregate market value" and "non-affiliates" in different variations. The

accounting data from Compustat over the period 2002-2008 based on the Central Index Key, the date of the reported public float, and the reporting year in Compustat. We exclude financials, utilities, and governmental firms (SIC codes 6000-6999, 4900-4999, and 9000-9999), as they are subject to different regulations, all firm-year observations exhibiting negative cash holdings, R&D expenses, sales or dividends, and all firm-year observations with total assets below one million or a cash-to-asset ratio above one. To limit concerns of firm heterogeneity we restrict our sample to include only firms with a public float of between $50 million and $5 billion. Further, to reduce the effect of outliers caused by mergers and restructurings, we truncate all control variables at the 99th percentile and drop all firms with less than three years of observations in Compustat, one-year asset growth of more than 100%, and one-year sales growth of more than 500%. The results are robust to including these observations. Our main variable of interest is cash, which we define as "cash and short-term investments" *(che)* over total-assets *(at)*. The final sample comprises of 6521 firm-year observations and 1645 unique firms.

3.2 Empirical model

To understand whether a decrease in the time-to-finance leads to a decrease in corporate cash holdings we start by looking at the evolution in cash holdings of treated and control firms before and after the reform. Panel (b) of Figure 1 depicts that prior to the reform in 2005 cash holdings of treated and untreated firms exhibit a parallel trend.[9] However, following the SOR of 2005 and the introduction of ASR, there is a clear reduction in the cash holdings of the treatment group, while the cash holdings of the control group remain stable.[10]

public float is found by searching for indicators such as "$", "USD", and different variations of the words "million", "billion", and "thousand". We search for multiple numbers in the paragraph. In case of multiple values we evaluate the validity of each by looking for wordings such as "revenue" and "per share" in different variations in the near proximity, to avoid extracting false values. All type one errors are manually checked to ensure consistency. To reduce concerns about type two errors we hand check a cross-section of the year 2005, and verify that our code has a higher than 99% success rate.

[9]Using a test of difference, a Wilcoxon rank-sum test, and a Kolmogorov-Smirnov test, undisclosed results confirm that the cash holdings of treated and control firms exhibit a common trend prior to the SOR.

[10]The drop in 2008 coincides with the financial crisis and with changes to forms S-3 and F-3 and could potentially distort our results. Yet, excluding these observations leads to quantitatively and qualitatively similar results.

To formally test the model's implications, we perform a difference-in-differences analysis.[11] The main coefficient of interest is γ in the following specification:

$$Cash_{i,t} = \theta_0 + \gamma\ (treat \times post)_{t,i} + \beta\ X_{i,t} + \alpha_i + \alpha_t + \varepsilon_{i,t}, \tag{1}$$

where $treat_i$ is an indicator variable that is equal to one for firms whose public float is larger than \$800 million (treatment group) and zero for firms whose public float is smaller than \$700 million (control group), $post_t$ is an indicator variable defining post reform years 2006-2008, and $X_{i,t}$ is a comprehensive set of control variables.[12] Following the literature, we include Tobin's Q and the ratio of R&D expenses over total assets to control for investment opportunities. For firms with greater investment opportunities, underinvestment is more costly, and these firms are expected to accumulate more cash (Chen et al., 2017). To control for the relation between investments and cash, we include capital expenditures and firms' acquisition intensity; to capture the precautionary savings motive for cash, we include the cash flow risk (Bates et al., 2009). Moreover, including firms' acquisition intensity allows us to control for potential agency costs of free cash, as documented by Harford (1999). Last, we include firm (α_i) and year (α_t) fixed effects and allow for heteroskedastic error terms clustered at the firm level ($\varepsilon_{i,t}$).[13]

Preemption risk

To test the main implication of the model, a measure of a firm's exposure to preemption risk is needed. Unfortunately, this is empirically challenging, as the (precise) level of that risk is un-

[11] Our empirical specification, similar to, e.g., Gustafson and Iliev (2017), relies on a difference-in-differences analysis rather than a regression discontinuity design. The main reason is that the public float fluctuates over time since it is determined by stock market prices. Hence, firms that are just above the \$700 million threshold take into consideration the probability of being below the threshold in the future whenever liquidity is needed. As firms just above and below the threshold have almost similar probabilities of ASR eligibility, one would not observe a discontinuity around the threshold. Therefore, we use a difference-in-differences analysis to test whether treated firms altered their liquidity management policies differently than the untreated firms following the reform.

[12] The vector X includes 15 firm-specific control variables following the cash literature. These are: 1) log of public float; 2) R&D expenses; 3) sales; 4) sales growth; 5) leverage; 6) Tobin's Q; 7) investment; 8) working capital; 9) log of firm age; 10) profit; 11) acquisition intensity; 12) tangibility; 13) dividends; 14) log of the Herfindahl-Hirschmann Index (HHI); and 15) cash flow risk ("industry sigma"). All variables used in the analysis are defined in the Internet Appendix 4.

[13] $treat_i$ and $post_t$ are not included in the regression since they are captured by firm and year fixed effects.

observable. In this paper, we therefore rely on the average industry R&D expenses to capture the risk of being preempted. There are a number of reasons for this choice: First, R&D expenses have been shown to be largely driven by time-invariant characteristics, such as competition (Hirschey et al., 2012). Second, firms and industries that are characterized by a high level of preemption risk are more likely to have high R&D expenses (e.g., Fudenberg et al., 1983; Garlappi, 2004).[14] Third, Granstrand and Sjölander (1990), and more recently Phillips and Zhdanov (2013), document that large firms in R&D intensive industries conduct less R&D than their smaller counterparts and are more likely to grow through the acquisition of smaller R&D intensive rivals. Phillips and Zhdanov (2013) further show that firms' R&D is related to measures of industry acquisition activity and the probability of being an acquisition target. This is supported by Blonigen and Taylor (2000) who show that the acquisition activity is higher in high-technology industries compared to other manufacturing industries. Since growth opportunities such as acquisitions are mutually exclusive in nature, firms in such industries are likely to face preemption risk. Thus, firms in R&D intense industries are likely to face preemption risk.

We therefore sort industries by their annual average R&D expenditures and define the top quantile as high preemption risk industries.[15] To formally test whether the reform had a stronger impact on firms in high preemption risk industries we first estimate our baseline specification using a sub-sample of high preemption risk industries, and subsequently conduct a difference-in-difference-in-differences (diff-in-diff-in-diff) analysis. The main coefficient of interest of the latter is δ_2:

$$\begin{aligned} Cash_{i,t} = \theta_0 + \beta\, X_{i,t} + \alpha_i + \alpha_t + \gamma\, (treat \times post)_{t,i} + \delta_1\, (high \times post)_{t,i} \\ + \delta_2\, (high \times treat \times post)_{t,i} + \varepsilon_{i,t}, \end{aligned} \tag{2}$$

[14]R&D expenditures have also been argued to capture the tangibility of a firm, as they lead to the creation of intangible assets with lower collateral value, which increases firms' cash holdings (Bates et al., 2009; Clausen and Hirth, 2016). To mitigate concerns about our measure of preemption risk capturing this effect, we include two direct measures of tangibility, Tobin's Q and property, plant and equipment, as controls. This ensures that the effect we capture is over and above that of firms' tangibility.

[15]The yearly industry average R&D expenditures are calculated using the Fixed Industry Classification (FIC 100) developed by Hoberg and Phillips (2010, 2016).

where $high_i$ is an indicator variable that is $1(0)$ for firms in the top (bottom) quartile.

Examples of high preemption risk

While it is intuitive that firms in general face the risk of preemption, documenting specific examples can be hard. Takeovers or acquisitions are instances when firms compete for mutually exclusive investment opportunities that are associated with a high winner's advantage. However, even if the supply of targets is limited, the due diligence process of a potential target may take some time, during which firms can already secure financing. Yet certain acquisitions are likely to occur more instantaneously, for instance the purchase of pledgeable assets, especially when sellers dispose equipment, machinery, buildings, or property following foreclosure. Other examples, of where preemption risk occurs, are airwave license / spectrum auctions[16] or the auctioning of patents, where individuals or other firms sell their patent rights. Recently, a patent portfolio entitled "Document Processing System" was sold to an undisclosed buyer for a seven digit figure in 10 days via a platform called Ocean Tomo Bid-Ask.[17] In such cases, faster access to the capital market, i.e. a lower time-to-finance, reduces the need for holding cash to be able to react quickly.

Potential endogeneity of the treatment status

Our empirical analysis relies on the firms' public float to determine if they qualify for the WKSI status. This choice is supported by the Office of Economic Analysis, which found that "very few issuers that [...] did not meet the $700 million public float threshold would meet the $1 billion non-convertible securities threshold". The SEC further notes in its official ruling that it "believe[s] that public float of a reporting issuer can be used as a proxy".

The public float is the aggregate market value of common equity outstanding to non-affiliates. Non-affiliates are typically defined as any shareholder who is not part of management and who

[16] In recent months, telecommunication companies competed in a sale of licenses to operate in the different GHz band that is suitable for new and faster 5G wireless networks.

[17] The patent portfolio consisted of four issued U.S. patents, four non-provisional patent applications, and software code. Odasso et al. (2014) examines 535 patent lots that were sold on the same platform between 2006 and 2008 and shows that the average patent lot was sold for over $330.000. Currently, Intel is looking to divest around 8,500 patents.

owns less than 10% of any class of equity securities. However, there is legal uncertainty regarding the definition of an "affiliate" and hence about the exact the definition of a firm's public float (Iliev, 2010).[18] One concern could thus be that firms may try to alter/manipulate their public float. To mitigate such concerns we consider two alternative methods.

First, we employ the control function approach of Heckman (1978, 1979). This approach comprises of two steps. The potentially endogenous treatment variable is first regressed on a set of firm characteristics. Similar to above, we fix the treatment and control groups in 2005. Subsequently, the fitted values are used to obtain estimates of the control function, $\hat{\lambda}_i$.[19] In a second stage of the control function method, we re-run the differences-in-differences estimation adjusted by the interaction term $treat \times post \times \hat{\lambda}_i$. Intuitively, λ of the first stage regression accounts for unobservable, confounding, effects. If the empirical model is specified correctly in the first place, then the coefficient of the interaction term should be insignificant. The results in Section 5.1 show that this is the case.

Second, a related way to account for potential public float manipulation, is to use an instrumental variable approach. The SEC introduced the proposal for the SOR on November 3, 2004 and on June 29, 2005 it adopted the final rules (SEC Release No. 33-8501 and 33-8591) that got effective on December 1, 2005. Hence, in e.g., 2003, firms were unable to foresee the (details of the) reform. Inspired by Iliev (2010), we thus instrument for the treatment status in 2005 with the help of the public float of 2003 and subsequently estimate a two-stage regression model that provides quantitatively similar results as the baseline specification.[20]

[18] A SEC release of 1997 (No. 33-7391) defined an affiliates as "a person shall be deemed not to be an affiliate for purposes of this section if the person: (i) is not the beneficial owner, directly or indirectly, of more than 10% of any class of equity securities of the issuer; (ii) is not an officer of the issuer; and (iii) is not a director of the issuer". However, "members of one or more of these classes may contend, nevertheless, that they are not affiliates because they are not in a 'control' position. For such persons, the determination of affiliate status would be a 'facts and circumstances' test." See Iliev (2010) for details.

[19] Our approach follows Nagler (2019): $\hat{\lambda}_i = (1 - treat)(-\phi(Z_j)/\Phi(-Z_j)) + treat_j(\phi(-Z_j)7(1 - \Phi(-Z_j)))$ where $\phi(.)$ and $\Phi(.)$ are the probability density and cumulative distribution functions of the standard normal distribution.

[20] As an instrument for being treated in 2005 ($treat_i$), we use an indicator variable that is equal to one if a firm had a public float above the \$700 million threshold in year 2003 and zero otherwise, $PF700_{2003}$. The first-stage regressions include the same control variables and fixed effects as the second stage regression. The second stage is: $Cash_{i,t} = \theta_0 + \gamma\ (\widehat{PF700_{2003}\ \times\ post})_i + \beta\ X_{i,t} + \alpha_i + \alpha_t + \varepsilon_{i,t}$. $\widehat{PF700_{2003}\ \times\ post}$ is the predicted value of $(treat \times post)$.

An additional concern could arise due to the public float only being available as of the second fiscal quarter.[21] Firms close to the threshold could change treatment status over the year. While the SEC states that "the eligibility requirements for being a well-known seasoned issuer generally will be determined on an approximately annual basis", we further ensure that this concern does not drive our results by defining the treatment group as firms having a public float of more than $800 million and the control group as firms having a public float of less than $700 million. Moreover, we fix the treatment and control groups in 2005, meaning that changes in the eligibility of a firm, intentionally or unintentionally, bias us against finding a result. The reason behind this is that a treated firm moving into the control group will be subject to a longer time-to-finance and should therefore hold more cash, and vice versa.[22]

3.3 Descriptive statistics

Table 1 compares the firm characteristics and the key variables in the pre- and post-offering reform periods for treated and control firms. In total, our treatment group is comprised of 469 firms that are eligible for ASR and the control group covers 1176 firms. Unsurprisingly, treated firms are bigger; the average public float is $1.72 billion, while it is $232 million in the control group prior to the reform. However, the two groups of firms are more comparable, economically speaking, for a wide range of other variables including investments, leverage, and dividends in the pre- and post-security offering reform periods. While most variables are statistically different from each other (untabulated results), we mitigate the potential concern that this drives the analysis by including 15 control variables, as well as firm and year fixed effects, in all regression specifications.[23]

[21] Since the introduction of the Sarbanes-Oxley Act in 2002, firms are required to state their public float as of the second fiscal quarter in the header of their annual 10-K filings.

[22] Since the public float is largely determined by the stock price, one would expect the treatment status to be exogenously determined. To further reduce concerns about firms self-selecting into the treatment group, Section 5.7 shows that our results are robust to various treatment definitions between $700 and $900 million. Moreover, using a symmetric threshold of above $750 and below $650 million does not change the results.

[23] Moreover, as Section 5.7 describes, we perform a matched sample analysis, we conduct several placebo tests, and we consider a restricted sample including only firms having a public float between $250 million and $2.5 billion, to mitigate concerns about the similarity of the treatment and the control groups. Additionally, untabulated results show that restricting the sample further to having a public float e.g., between $400 million and $1.5 billion leads to similar results. In this case, the control variables (except profit, tangibility and R&D) of the treatment and control groups are

4 Empirical results

Before discussing the effects of a change in firms' time-to-finance, let us briefly review some of the other determinants of cash holdings. Echoing the previous literature, the results in column 1 in Table 2 show that firms with more investment opportunities are associated with higher levels of cash. Acquisition intensity, i.e., the outflow of funds used for an acquisition of a company, is negatively related to cash. Moreover, consistent with Bates et al. (2009), firms with higher R&D expenditures hold more cash. The coefficient for firm size, measured by the public float, is negative, though not statistically significant. Leverage is negatively related to cash, as interest payments decrease the ability of firms to hoard cash (Chen et al., 2017).

4.1 All firms vs. high preemption risk firms

The main focus is to test whether firms reduced their reliance on corporate cash holdings subsequent to the introduction of the SOR. Table 2 compares the cash holdings of treated and control firms three years before and after December 31^{st}, 2005. Column 1 highlights an average treatment effect of -2.4%, which is statistically significant at the 1% level. Given a cash-to-asset ratio of treated firms of 0.197 in 2004, this corresponds to an average reduction of 12.2% of the treated firms' cash holdings. In column 2, we further include industry times year fixed effects to address the possibility that treated firms may be better represented in industries that were affected by the reform. Given the modest change in the coefficient of interest, it seems unlikely that random industry distribution is driving our results. Therefore, consistent with Implication 1, firms significantly reduced their cash holdings in response to a reduction in their time-to-finance.

Next, we discuss the effect preemption risk has on corporate cash holdings and the interaction with time-to-finance. Consistent with the implication of the model, we start of by noting that firms within the high preemption risk sub-sample hold more cash: The average cash-to-asset ratio of treated firms in high preemption risk industries was 0.38, while the cash-to-asset ratio for treated

also statistically not different from each other.

firms in low preemption risk industries was only 0.16 in the year prior to the reform. Additionally, while treated firms in this sub-sample are, on average, older, bigger and spend less on R&D, we ensure that these observable differences do not drive our results by including such firm characteristics, as well as firm-fixed effects, as control variables in the regression specifications.

To test the second implication of the model, we analyze whether firms in high and low preemption risk industries altered their cash holdings differently following the reform. Columns 3-4 in Table 2 highlight that treated firms in high preemption risk industries indeed reduced their cash-to-asset ratio significantly more. Column 3 looks at the subset of high preemption risk firms only and shows that the average treatment effect is much larger for firms subject to preemption risk compared to the overall sample. The point estimate of -0.066 corresponds to a reduction of 17.4% of the treated firms' cash holdings. Hence, compared to all firms, high preemption risk firms decrease their cash-to-asset ratio significantly more. Additionally, column 4 depicts the diff-in-diff-in-diff regression results by comparing firms whose R&D expenses are higher than the top quartile of their industry average to those firms whose R&D expenses lie within the lowest quartile. The triple interaction term thus represents the post-treatment effect of firms in high preemption risk industries and it is -4.8% and again highly significant. Thus, consistent with Implication 2, we can conclude that firms subject to preemption risk are more exposed to time frictions in the capital market.[24]

To further support the implication that the effect of a change in time-to-finance on corporate cash holdings is increasing with preemption risk, we vary the degree of preemption risk. Table 3 reports the estimates of the diff-in-diff-in-diff regression using the top tercile, quartile, quintile, and 15^{th} percentile of R&D intensive industries. The results still remain significant and a pattern emerges. The higher the exposure to preemption risk, the stronger is the relation between a firm's cash holdings and its time-to-finance. The estimates decrease from an additional -2.9% to -5.9% as the overall level of preemption risk increases and remain statistically highly significant.

[24]Undisclosed results show that our results are not driven by younger, R&D intensive, firms.

4.2 Cross-sectional variations

To better understand what the R&D intensity of a firm within its industry proxies for, we conduct several cross-sectional sample splits with two further goals: The sample splits serve as an indirect test of validity for our proxy of preemption risk and they help us get a better understanding of which firms are driving the overall results. Table 4 presents the results.

Acquisition activity

First, we examine how the industry wide acquisition intensity influences firms' reaction to a reduction in time-to-finance. To do so, we differentiate between firms that are active in industries with higher or lower number of acquisitions during the pre-reform period (2002-2004).[25] If firms operate in industries where growth tend to occur through acquisitions we expect the reduction in time-to-finance to play a bigger role, as the risk of preemption should be higher in these industries. Hence, the acquisition intensity may serve as an alternative proxy for preemption risk.

Columns 1 and 2 in Panel A show that firms in the overall sample, that are active in more acquisition intensive industries, reduce their cash more. Columns 3 and 4 focus on high preemption risk firms and confirm this pattern, indicating that firms in acquisition intensive industries that are also subject to high preemption risk are more likely to face competition for (short lived) acquisition targets. Even though the differences in the coefficients are statistically not too pronounced, they are economically more different: Given the pre-reform cash levels, firms in more acquisition intensive industries reduce their cash by 8.2% whereas firms in less acquisition intensive industries reduce it only by 6.1% (14.4% and 9.7% in high-preemption risk industries).[26] Hence, these findings confirm our intuition that the acquisition intensity and the industry wide R&D spendings can both help identify the unobservable preemption risk that firms face. By holding cash, a firm can lower

[25]All data are derived from the Thomson Reuters SDC database and no restriction is imposed on a target's country of incorporation or its listing status. After the initial screening and merging to balance sheet data, we have complete information for 5,260 M&As between 2002 and 2008. After merging the data to our public float data, the sample is reduced to 2,454 M&As, out of which 1,720 are acquisitions by 729 firms. We split the sample according to the median fraction of number of acquisitions prior to the reform divided by the number of firms in an industry.

[26]The 2004 cash levels are 0.28 (0.30) for firms in more (less) acquisition intensive industries, and 0.45 (0.58) for firms subject to high preemption risk.

the probability of one of its project being preempted before financing can be secured, it can thus invest faster, and this effect is more pronounced in industries where acquisitions are more common.

Takeover probability

In line with the above results, firms face higher preemption risk if they are active in industries where takeovers are more likely. To proxy for the industry wide takeover probability, we again look at the pre-reform years and use the takeover index that was recently developed by Cain et al. (2017). This index measures the likelihood of a hostile takeover by looking at a number of court decisions and state anti-takeover laws, as well as macroeconomic conditions and firm characteristics. Panel B splits the sample according to industry median.

Columns 1 and 3 show that firms that are active in industries with a higher probability of a takeover indeed react stronger to the reform. While the differences in the coefficients in the overall sample are again low, firms that face both high levels of preemption risk and a higher takeover probability significantly reduce their cash significantly by 8.3%, whereas no effect is found for those firms with a lower takeover probability.

Within industry R&D position

Next, we examine in how far firms' own amount of R&D spendings, in comparison to the industry wide spendings, affect their reaction to the 2005 reform. We expect that firms, where R&D matters less, reduce their cash holdings more, as such firms might rather acquire other firms than develop knowledge internally.

Columns 1 and 2 of Panel C show that firms, with below industry median levels of R&D in 2004, indeed reduce their cash holdings more. Undisclosed results show that these firms grow faster and spend more on acquisitions, both when looking at the actual number of acquisitions that were conducted in the pre-reform period and at the balance sheet fraction of acquisitions to total assets. Hence, they are more likely to acquire in order to grow. In the high preemption risk sub-sample, however, contrary to our intuition, we do not find a significant difference in the coefficient estimates. However, firms with relatively more R&D start off with much higher pre-reform cash levels (0.58 vs. 0.44). This implies that the ones with relatively less R&D reduce their cash by 14.7% whereas the ones with more R&D reduce it by only 11.2%.

Project length

A further aspect that may influence the firms' exposure to preemption risk is the time that projects typically take. Firms that with shorter project lengths may be more exposed to preemption risk, as the timing of investment opportunities matters more for these firms. To examine the validity of this conjecture, we follow Dudley (2012) and calculate a proxy for the time it takes firms to conduct their projects.[27] We subsequently differentiate between firms whose projects take longer/shorter than the industry median.

Columns 1 and 2 in Panel D show that there is no difference for the overall sample. However, columns 3 and 4 highlight that firms that are subject to high preemption risk reduce their cash only if they their project length is shorter, whereas they do not react if their projects are more long-term. Thus, in light of the risk of preemption, the timing of investment opportunities matters for firms' cash management decisions.

Patents

Last, one way to mitigate the risk of preemption for firms in R&D intensive industries is the usage of patents, which are frequently applied for early on in the development process (Freilich, 2018).[28] We examine this channel by differentiating between firms that are active in more or in less patent intensive industries.[29]

[27]A firm's annual investment rate is $\frac{CAPX_t+XRD_t+\Delta WCO_t}{AT_{t-1}-CHE_{t-1}}$ where $WCO = (ACT - CHE) - (LCT - DLC)$. According to Dudley (2012), investment (project) years are when the firms' annual investment rates exceed 1.5 times the median rate in their industry. The investment length is then defined as the number of consecutive investment years.

[28]Examples of high preemption risk industries are SIC codes 367 or 283, which represent firms within the electronic components & accessories and the drugs industries. These firms have an average 567 and 219 patents and an average R&D to total asset ratio of 11.7% and 22.9%, respectively, in 2005. In contrast, firms in low preemption risk industries such as in SIC code 504 (professional and commercial equipment and supplies) have on average only 31 patents and an average R&D to total asset ratio of 1.0%, in 2005.

[29]Patent data is retrieved via the NBER Patent Citations Data Project, which contains data on all utility patents granted by the U.S. Patent and Trademark Office. We combine this with supplementary patent data provided by Kogan

Panel E documents that the reaction to the SOR is diminished for firms that are active in patent intensive industries. Columns 1 and 2 display the results for overall sample. Firms in industries with less patents reduce their cash by 3.0% whereas their counterparts in more patent intensive industries reduce their cash only by 2.4%. This difference is more pronounced when looking at the high preemption risk sub-sample. Column 4 documents a significant reduction in cash for the low patent intensive industries - firms reduce their cash by 5.8% - whereas no statically significant effect is found for high patent intensive industries that are also subject to high preemption risk (column 3). Hence, for firms, where R&D is more appropriable, e.g., patentable, the risk of preemption is reduced. Stated differently, patents may provide some protection against the risk of preemption. Instead, treated firms that are active in less patent intensive industries face the risk of preemption. These firms have higher cash levels and spend more on R&D, and thus react significantly to the 2005 reform.

4.3 Issuance costs, financial constraints, and credit lines

Direct issuance costs

One popular explanation for why firms hold cash is provided by the precautionary demand for cash theory. Under this theory, firms hold cash as a buffer to protect themselves against adverse cash flow shocks to avoid incurring the costs of external financing (e.g., Hennessy and Whited, 2007; Bolton et al., 2014). These costs consist of several parts such as direct issuance costs associated with explicit fees or costs related to asymmetric information. An additional component is the consideration of time, i.e., the time it takes to secure financing (Fenn, 2000; Ma et al., 2018), which may result in further indirect costs of potentially foregoing an investment opportunity.

We examine whether direct cost of issuances change around the SOR by comparing first WKSIs

et al. (2012). The sample comprises of the number of patents between 1926 and 2008. We match the patent data with Compustat which leaves 1016 firms with an average (median) patent stock of 133 (17) in 2004. 352 firms are eligible for the ASR (treatment group) and 828 are not. Undisclosed results show that firms in the patent sample are broadly similar to the overall sample of firms, though they have more cash and are a bit older than firms where no patent data is available. We split the sample according to the industries' overall median patent stock. Due to sample size restrictions, we define high preemption risk firms as having R&D expenditures in the top industry tercile.

to non-WKSIs, and second, firms in high to low preemption risk industries. The 2005 reform affected all security issuances, i.e., both debt and equity, however, due to data restrictions, we focus on bond issuances only.[30] Following the literature, several variables are used a proxies for direct issuance costs: the yield to maturity, the Treasury spread, and the gross underwriting spread (e.g., Wirz and Kulak, 2014; Davis et al., 2018).[31]

Column 1 of Panel A of Table 5 shows that the offering yield actually increases for WKSI firms relative to non-WKSI firms - thus WKSIs actually incur higher costs in exchange for the faster issuance. Yet for a more limited sample, columns 2 and 3 show that the change in the Treasury spread and the gross underwriter spread is the same for WKSIs and non-WKSIs. When differentiating between high and low preemption risk, column 4 shows that there is no significant difference.[32] These findings are consistent with Shroff et al. (2013) who examine the indirect issuance costs related to seasoned equity offerings and find no evidence of a difference in announcement period returns for WKSIs and non-WKSIs surrounding the 2005 SOR. Similarly, Gustafson (2018) finds no significant change in the gross spreads or total discounts of WKSIs and non-WKSIs following the reform. These results suggest that our findings are not driven by changes in direct issuances costs but rather the change in the time-to-finance.[33]

Panel B examines whether our proxy for preemption risk (industry R&D expenses) is correlated with the direct cost of external financing (e.g., the offering yield). Stated differently, to isolate the effect of time-to-finance it is important to ensure that the reform did not lead to a systematic

[30]The bond issuances data is retrieved from the Mergent Fixed Income Securities Database. We focus on bonds with a positive coupon. In case a firm issues more than one bond per year, the yearly average of the offering yield, the treasury spread, the gross spread, and of the maturity is used. The sample consists of 457 (327) bond issuance years from 204 (189) treated (control) firms. We employ a differences-in-differences regression set up, which includes year and industry fixed effects (due to the small sample size, the usage of firm fixed effects is not possible).

[31]While the Treasury spread measures the costs incurred by secondary market traders, Butler (2008) proposes to use the gross underwriting spread to capture revenues to underwriters. The Treasury spread is the difference between the yield of a duration-matched benchmark Treasury security and the issue's yield to maturity. The gross spread consists of fees paid to the lead underwriter, the syndicate and the selling group and consists of the selling concession plus the underwriting and management fees.

[32]However, one caveat is the low number of treated firms that are subject to preemption risk in the diff-in-diff-in-diff specification, 20.

[33]The SOR could potentially reduce issuance costs as the risk of incuring additional legal fees caused by SEC review is no longer present. However, since firms face significant indirect issuance costs (Hennessy and Whited, 2007) and underwriter fees by far constitutes the largest component of direct costs (Joffe, 2015), the impact on total costs of this would be negligible and unlikely to drive our results.

difference in the evolution of direct issuance costs between firms in high and low preemption risk industries. Columns 1-3 show no difference in the evolution of issuance costs for each of the three measures. Column 4 ensures that we see no difference even when focusing only on WKSIs.

Financial constraints

We supplement the above results by analyzing the interaction between financial constrains and time-to-finance. Intuitively, a reduction in the time-to-finance is likely to be more relevant for financially unconstrained firms; that is, firms with low costs of external financing.[34] The reason is that firms balance the cost of holding cash with the potential future costs of issuing securities. Thus, when external financing costs are high, firms are less inclined to reduce their cash buffers as the reduction in the cost-of-carry is dominated by the future costs of external financing. However, when financing costs are low, firms can utilize the flexibility of a shorter time-to-finance to reduce their cash buffers and thereby the cost-of-carry.

Thus, we predict that the negative relation between a reduction in the time-to-finance and cash holdings is more pronounced when firms face lower issuance costs. To test this, we split our sample into constrained and unconstrained firms, similar to Ghaly et al. (2017). We measure the degree of financial constraints using three different proxies: The size and age (SA) index (Hadlock and Pierce, 2010), the Kaplan-Zingales (KZ) index (Kaplan and Zingales, 1997), and the Whited-Wu (WW) index (Whited and Wu, 2006). We define firms with above-median scores on these indices as constrained and those with below-median scores as unconstrained.[35]

Table 6 shows how the relation between time-to-finance and firms' cash holdings varies with their degree of financial constraint. Columns 1 and 2 report the results for the two sub-samples of constrained and unconstrained firms according to the SA index. In line with the idea that firms

[34] Hennessy and Whited (2007) show that the cost of issuing securities is higher for firms identified as constrained by the Whited-Wu index. Further, the empirical literature suggests, that financially constrained firms face higher adjustment costs (Almeida and Campello, 2010). For example, Altınkılıç and Hansen (2000) find that smaller and riskier firms face higher adjustment costs for both debt and equity.

[35] One potential concern may be that time-to-finance is correlated with the precautionary savings motive. Section 3 in the Internet Appendix shows that the SOR of 2005 itself does not change those traditional measures of financial constraints.

only lower their cash holdings if the cost of being able to raise cash again in the future is low, we find a significant effect for unconstrained firms and no effect for constrained firms. Hence, a reduction in the time-to-finance mainly allows unconstrained firms to rely less on cash. This is primarily the case for firms that are subject to high preemption risk.[36] Columns 3 through 6 reveal similar patterns when we proxy for financial constraints using the WW or KZ indices.[37] Hence, we highlight that the benefits from a reduction in the time component is larger when the costs of external financing is low. Moreover, this pattern also rejects that direct issuance cost reductions are the driving source behind the main results. As a result, time-to-finance and direct issuance costs can be seen as complements rather than substitutes.

Credit lines

An alternative source of external financing that does not lead to time-to-finance concerns is a credit line, which gives firms access to pre-committed financing.[38] We therefore examine the role and availability of credit lines in connection to the firms' reduction in cash holdings subsequent to the Securities Offering Reform.[39]

Table 7 splits the sample according to the median credit line to total asset ratio that firms had prior to the reform in 2004. Columns 1 and 3 of show that only those firms that rely more credit lines reduce their cash, whereas those with fewer credit lines do not. While firms with more

[36]This result highlights that contrary to intuition unconstrained firms, which are more likely to be able to obtain bridge financing such as a short-term loan to mitigate time frictions in capital markets, respond stronger to the reduction in time-to-finance offered by the reform. This therefore serves as an indirect test of the importance of time-to-finance considerations over such alternatives.

[37]Notice that the difference-in-differences estimator in Column 5 is significant for constrained firms as measured by KZ Index. This is counter-intuitive, however, Farre-Mensa and Ljungqvist (2013) document that while the SA and WW index often agree, lower agreement exists with the KZ index.

[38]The literature discussing credit lines (and the differences with cash) is large: They can help firms with their liquidity management by mitigating financial market frictions (Lins et al., 2010), provided firms with liquidity during the recent financial crisis (Campello et al., 2012), or allow firms to sustain investments after having experienced an idiosyncratic liquidity shock (Berrospide and Meisenzahl, 2015).

[39]All credit line data is retrieved from the Capital IQ Capital Structure database. In general, credit line data is available for fewer (and larger) firms; data is available for 1,246 firms and 6,087 firm year observations. In 2004, the average outstanding amount on the credit lines was $154,000. Firms with credit lines have significantly less cash: 16.6% vs. 40.3% for those that did not have credit lines. Treated firms had higher credit lines then the control firms ($288,000 vs. $73,000), which is not surprising given the firms' size. Moreover, treated (control) firms draw 11.1% (14.2%) and firms that are subject to high preemption risk have lower credit lines to total assets ratios, 8.6% vs. 15.9%.

credit lines are more profitable and have higher net income (consistent with e.g., Sufi (2007)), they actually have lower cash holdings (0.11 vs. 0.22). Therefore, for these firms, credit lines constitute an alternative source of financing, which allows them to rely less on cash when being subject to the SOR of 2005.[40] Stated differently, firms with more credit lines reduce their cash holdings following the reform since these firms already have alternative financing in place. As in the main specification, it can be seen that firms in high preemption risk industries respond stronger. Conditional on being in the high credit lines sub-sample, firms in high- or low-preemption risk industries have very similar lines of credit (22.0% and 23.4% of total assets) prior to the reform, but high preemption risk firms start off with significantly higher cash levels (0.30 vs 0.08), which partly explains the large different in coefficients.

4.4 Further results

4.4.1 Different measures of competition

It is well established that firms face multiple forms of competition.[41] We extend our analysis to shed light on the components of competition by including two measures of competitive pressure: the fluidity measure of Hoberg et al. (2014) and the concept of economics of scope (Baik et al., 2017). We show that while these alternatives help to capture other aspects of competition, such as the number and distribution of firms competing (i.e., the intensity of competition), they only serve as noisy proxies for preemption risk, while our measure helps us get a more refined estimate of the effect of preemption risk.[42]

[40] We also examine if credit line draw-downs change subsequent to the introduction the reform. While positive, we do not find a consistently statistically significant relationship, which we constitute to credit lines being sticky.

[41] Examples include the competition from existing oligopoly firms that produce identical, undifferentiated products (the Cournot oligopoly model directly gives rise to the Hirschman-Herfindahl Index (HHI)), competition in the form of product differentiation (the Chamberlin or Hotelling model) or competition from firms that have not even entered yet but can enter at a low cost (economies of scope). We thank Gerard Hoberg for helpful suggestions.

[42] Other papers have relied on the HHI as a measure of competitive pressure (e.g., Morellec et al., 2014). However, the HHI is not suitable to capture preemption risk. The reason is that HHI only measures the dispersion of market shares in an industry and that it is unclear whether preemption risk is larger in industries consisting of a small group of large firms competing for the acquisition of small firms, or in industries with a lot of smaller firms competing for mutually exclusive investment opportunities.

Fluidity measure

We first consider the product market fluidity measure of Hoberg et al. (2014), which estimates the likelihood with which firms are able to move into a firm's current product space with little viscosity. Thus, this measure captures the potential disruption of the current product market by competitors. Panel A in Table 8 first splits the sample according to the mean fluidity measure (columns 1-2) and subsequently combines the fluidity measure with the above described proxy for preemption risk that is based on industry level R&D expenditures (columns 3-6).

Columns 1-2 indicate that firms in the high fluidity sub-sample do react more strongly than firms in the low fluidity sub-sample. However, this effect is amplified when the fluidity measure is combined with preemption risk. Importantly, Column 3 highlights that firms reduce their cash holdings subsequent to a reduction in their time-to-finance only if they both operate in high preemption risk industries and face competitors who can easily move into their product space. No effect is found for firms subject to low preemption risk. Thus, when preemption is more likely to lead to a shift in market shares, firms have stronger hedging needs and are therefore more exposed to changes in the time-to-finance.[43]

Economics of scope

Another measure of competitive threats is the concept of economies of scope. In a recent paper, Baik et al. (2017) create a measure that is akin to that concept by identifying "close" peers and more "distant" peers.[44] A higher density of more "distant" peers indicates that a larger number of "moderately similar firms" are near a firm's product market and that they are likely to be able to enter at a lower cost than a de-novo start up. Thus, the more "distant" peers a firm has, the larger is the potential competitive threat faced by such a firm.

[43]This result is in accordance with the model described in the Internet Appendix, in which a lower level of future expected earnings after preemption, μ_p, leads to a stronger effect of a change in the time-to-finance on cash holdings.

[44]The authors use the Text Based Network Industry Classification (TNIC) of Hoberg and Phillips (2010, 2016) and define closely related industry peers (TNIC-3) and more distant industry peers (TNIC-2) via a textual similarity of their product descriptions. "Close" peers have a textual similarity in the highest 2% among all firm pairs in each year, whereas "distant" peer firms include the broader set of closest peers using firm pairs with a textual similarity in the top 5%. The latter firms are located within TNIC-2 ("outer circle") but outside of TNIC-3 ("inner circle").

Columns 1-2 of Panel B in Table 8 show that firms with more “distant" peers indeed reduce their cash holdings more subsequent to the reform. However, from column 3 it can be seen that the effect is reinforced considerably once we focus on high preemption risk industries (5.3% vs. 2.8%). This further underlines that our measure of preemption risk captures something more than competition intensity. Stated differently, R&D expenditures capture the characteristics of competition, while the economics of scope measure describes how many firms actually engage in the competition.

4.4.2 Payment method of acquisitions

Given the above finding that treated firms reduced their cash holdings subsequent to the reform, we next examine whether the reform also had an effect the financing behavior of acquisitions. The intuition is that the reform allowed treated firms to access the capital markets faster to raise either debt or equity. The issuance proceeds could subsequently be used as cash to pay for their M&A activities.[45] To do so, we look at both public and private acquisitions conducted by U.S. firms between 2003 and 2008.[46]

We first notice that firms within the high preemption risk sub-sample do more cash-only financed acquisitions compared to firms in the low preemption risk sub-sample (52.2% vs. 43.6%). Hence, a higher level of competition makes firms rely more on cash financing. Next, the top part of Table 9 differentiates between the pre-offering reform period and the post-offering reform period. Consistent with the main results, firms seek to avoid time delays and thus finance more deals with cash subsequent to the reform if they are active in more competitive industries. Last, we differentiate those firms that were affected by the reform (treatment group) from those that were not. Treated firms increase the usage of cash-only financing of acquisitions, while there is no effect for the control group. Hence, this analysis shows that, on the one hand, firms in high preemption risk industries use more cash to finance their acquisitions, and, on the other hand, that faster access to

[45] In line with this, Martynova and Renneboog (2009) examine European acquisitions between 1993 and 2001 and show that out of those acquisitions that are entirely paid with cash, one-third is financed with external funds.

[46] All data are derived from the Thomson Reuters SDC database. See footnote 29 for details. We focus on cash-only deals (49% of all deals). To proxy the source of financing, the method of payment in the acquisition is used. Using the consideration offered leads to similar results.

external financing also induces firms to rely more on cash financing.

4.4.3 How do firms reduce their cash holdings?

Last, we examine how the change in the firms' cash balance comes along. Broadly speaking, a cash balance change may be accompanied by a change in payout or issuance policy. If a firm is paying out prior to the reform, then one could expect a spike in payout among treated firms as they move to their new optimal cash balance. If a firm is not paying out but is instead an active issuer, cash balances should decline because those firms conduct more frequent smaller equity offerings, instead of one larger offering that they burn through over a longer period of time. We thus split the sample into firms that payed out equity in the year prior to the reform and those that did not.[47]

Columns 1 and 2 of Table 10 first show that only those firms that did not pay out equity prior to the reform adjusted their cash balances.[48] We subsequently focus on no-payout firms. Column 3 shows that these firms significantly increased their share repurchases whereas no significant difference in the dividend payments is found. Interestingly, however, this picture changes when looking at the sub-sample of firms that belongs to the high preemption risk sub-sample: The last column highlights that these firms significantly increased their dividends whereas we do not find an effect for share repurchases.

5 Robustness checks and alternative interpretations

5.1 Potential endogeneity of the treatment status

Two explicit approaches are used to alleviate concerns that firms could be able to select the treatment status and that the ASR may thus not have been randomly assigned across firms. First, we use the control function method of Heckman (1978, 1979). Column 1 of Table 11 shows the first stage result, i.e., we estimate the probability of being treated. Consistent with e.g., Gustafson

[47]The equity payout ratio is (cash dividends + share repurchases - stock issuance) / total assets.

[48]These firms issued equity and did not repurchase their shares prior to the reform. Undisclosed results show that firms, which did not pay out equity, are not constrained (see Section 4.3 for further details).

(2012), the most important explanatory variable is the size of firm and the coefficient of 2.74 for size can be interpreted as follows: A one standard deviation increase in the public float leads to an increase in the probability of being treated by 29.6%.[49] Moreover, firms, whose sales grow faster, that have a higher Tobin's Q, and that have more acquisitions are also more likely to be treated.[50] The pseudo R^2 of 78% indicates that the fit of the model is high.[51] The fitted values are subsequently used to obtain the estimates of the control function. Column 2 confirms our main results by showing that the estimate of the coefficient of the interaction term of $Post \times Treat \times \hat{\lambda}_i$ is insignificant while the coefficient of $Post \times Treat$ remains significant and of similar magnitude. Focusing on the subset of firms that are subject to high preemption risk, columns 3 and 4 show that the potential endogeneity does not influence the results for these firms either.

To further alleviate concerns about firms manipulating the public float, we instrument the treatment status with a dummy variable measuring whether the public float is above the $700 million threshold in 2003. At that time, firms were unaware of the 2005 SOR and about which firms would qualify for a WKSI status. In line with previous findings (e.g., Iliev, 2010), the public float of 2003 is a valid predictor for the 2005 value. Columns 5 and 6 repeat the difference-in-differences estimations with the instrumented $post \ \times \ treatment$ status for the full sample and the high preemption risk sub-sample. The second stage instrumental variable estimations depict similar results as the in the main results above, suggesting that firms did not manipulate the public float to receive the WKSI status.

5.2 Similarity of treatment and control groups

To mitigate the potential concern that treatment and control firms differ in terms of unobservables and that our findings are driven by omitted variables related to firm size we conduct a series

[49]To ensure that the public float does not explain the first stage treatment decision perfectly, the lagged value of the public float is chosen. Using the two year lagged value gives similar results.

[50]A one standard deviation increase in sales growth, Tobin's Q, and acquisitions leads to an increase in the probability of being treated of 3.1%, 3.8%, and 1.8%, respectively. For the high preemption risk sub-sample, a one standard deviation increase in the public float, profit, sales growth, and sales lead to an increase in the probability of being treated of 20.0%, 10.9%, 9.4%, and -7.6%, respectively.

[51]Not surprisingly, not controlling for the lagged public float is would decrease the pseudo R^2 to 18%.

of robustness tests. First, we tighten the sample restriction criteria both at the upper and the lower boundaries to reduce differences between firms within the sample specification. Table 12 presents the results of our main specification for both the full sample (Panel A) and the high preemption risk sample (Panel B) for various cut-off levels. Columns 1-3 present the results of imposing an upper boundary of $5 billion and a lower bound of $50, $150, and $250 million, respectively. Hence, column 1 corresponds to our baseline specification and can be used as a benchmark. Columns 4-6 present the results of imposing an upper boundary of $2.5 billion and a lower bound of $50, $150, and $250 million.[52] From Panel A we see that the average treatment effect remains similar to the main analysis, ranging from -2.0% to -2.4% and remains significant across the different specifications. Similarly, Panel B reports diff-in-diff-in-diff results for the high preemption firms that range from -4.2% to -4.8% and shows that the estimates remain significant.

Second, we perform a matched sample analysis focusing on a subset of firms with a public float between $250 million and $2 billion. Section 3.1 of the Internet Appendix provides further details on the matching procedure. Columns 5 and 6 in Table 13 show that the matched sample analysis leads to quantitatively and qualitatively similar results.

Finally, we rerun our main specification using a wide range of arbitrary thresholds to define the "treatment status" within the existing treatment and control group. Since firms in these groups do not differ with respect to their actual treatment status, splitting them by an arbitrary threshold allows us to analyze whether size impacted the evolution of cash holdings during our sample period. For example, we examine firms with a public float between $700 million and $5 billion, using a random threshold of $1.2 billion to assign the treatment status; that is firms above $1.2 billion are placebo treated and firms below serve as our placebo control group. If our results are driven by omitted variables related to size, we would expect to find that firms with higher public float, i.e. our placebo treatment group, would react more strongly to the reform.

Figure 2 presents the point estimates and the confidence intervals for each of the placebo thresholds. The left-hand side presents the estimates of the within variation in the initial control group,

[52] Table A7 in the Internet Appendix shows that treated and control firms are indeed more similar for e.g., the $250 million and $2.5 billion sub-sample.

while the right-hand side represents the estimates of the initial treatment group. For example, it can be seen that the point estimate for the post-treatment interaction term using a $1.2 billion placebo threshold is not significantly different from zero. Similarly, non-significant point estimates are found for all placebo thresholds within the treatment and control group, in both the full sample and in the high-preemption risk sub-sample.

All of the above results strongly suggest that there is no systematic relation between firm size and corporate cash holdings in our sample period that drives the results of our main analysis.

5.3 Confounding events

Sarbanes-Oxley provisions

In a series of rule changes that were part of the Sarbanes-Oxley provisions of 2002, the SEC accelerated filing deadlines.[53] One of the amendments provides a potential caveat of our above described quasi-natural experiment, i.e., the SOR reform: SEC Regulation 33-8644, that was passed on December 21, 2005 and that got effective after December 15, 2006. For large firms, with a public float above $700 million, the time to file the annual report was reduced from 75 days to 60 days.[54, 55] If auditing firms reacted to this by charging higher fees, the above documented cash reduction could be a result of this. However, the accounting literature, which has analyzed this reform, does not find evidence that the accelerated deadline was associated with increased duties imposed on auditors or management (e.g., Impink et al., 2012). Moreover, Lambert et al. (2017) show that auditors did not increase fees or hired additional staff but rather rescheduled audits of non-public companies to better allocate human resources to accelerated filers. This came at the expense of a decrease in the audit quality (Bryant-Kutcher et al., 2013; Lambert et al., 2017).

[53] See e.g., Iliev (2010), who provides a detailed overview of which rule changes applied to what sort of firms at what time.

[54] In a previous rule change, the statutory filing deadline was reduced from 90 days to 75 days by December 2003, indicating that firms had some experiences with a reduction in reporting deadlines.

[55] Munsif et al. (2012) document that the audit effort of firms that have accelerated deadlines (bigger firms) is different to that of non-accelerated filers (e.g., smaller firms are not required to have auditor attestation on internal controls).

2004 Homeland Investment Act

Under the 2004 Homeland Investment Act, which was part of the American Job Creations Act, firms were given a one-time deduction of 85% of U.S. taxable incomes for extraordinary dividends received from their controlled foreign corporations. The tax holiday led to an increase in repatriations from an average of around \$60 billion per year in 2000-2004 to almost \$300 billion in 2005. Dharmapala et al. (2011) show that repatriations were primarily used in 2005 to increase payouts, thereby reducing corporate cash holdings. The Act targeted multinational enterprises, which are likely to be large. Since large firms are more likely to have a high public float, they are also more likely to be eligible for ASR. We therefore risk that treated firms in our sample have lower cash holdings in the post period due to the introduction of the Homeland Investment Act.[56] To rule out this potential confounding effect we perform two different robustness tests.

We start by analyzing the results of our baseline specification using a sub-sample of firms. The one-time deduction of repatriated earnings had to be claimed in the first fiscal year beginning on or after October 22^{nd}, 2004. By reducing our sample to firms whose fiscal year ends after October 22^{nd} we ensure that none of the post-period observations are directly affected by the Homeland Investment Act. Further, we restrict our sample to only include observations from 2005 and 2006. This helps us to eliminate the concern that pre-period averages may be artificially high due to observations in 2003 and 2004, thereby mechanically creating our results. Table 14 shows that the firms' reaction to the ASR reform remains similar.

Moreover, we perform a placebo test using the year 2004 as the intervention year. If treated and control firms reacted differently to the tax holiday, we would expect to see a significant effect in a placebo year. However, columns 3 and 4 in Table 13 confirm that there is no statistically nor economically significant effect when using the placebo year of 2004 as the intervention year, which confirms that our results are not driven by the Homeland Investment Act.

These findings mitigate concerns about confounding effects from the Homeland Investment

[56]However, Faulkender and Petersen (2012) show that the increase in the payments to shareholders is not a robust finding and highlight that firms did not change their leverage and equity payouts subsequent to the act.

Act and further support the identifying assumption that treatment and control firms would exhibit similar cash dynamics in the absence of regulatory changes.

5.4 Do control firms respond strategically?

For the difference-in-differences analysis, it is crucial that the parallel trends assumption holds. Absent an intervention, the treatment group is assumed to have evolved similarly to the control group, the underlying reason being that this group serves as the counterfactual. While cash exhibits a similar pattern for both treatment and control firms in the years prior to the reform (as examined in Section 3.3 above), one might additionally worry that a decrease in the time-to-finance of the treatment firms would trigger a strategic response among the control firms. One potential argument could be that having easier access to external financing may provide the treated firms with a competitive advantage. This, in turn, could increase the preemption risk of the control group and thereby lead the control firms to increase cash holdings. If they do so, we would risk overestimating our results. Therefore, to mitigate concerns about whether the above described results are driven by a strategic response in the control group, we perform a robustness test using only a limited sub-sample of control firms. More specifically, we use a set of control firms that do not directly compete with any of the treated firms, as these firms should have no incentives to respond strategically.

We construct our control group by focusing exclusively on control firms that are active in industries with zero treated firms. If no firm within an industry has been treated, preemption risk should remain unchanged. Hence, there should be no incentive for the control firms to alter their cash holdings in response to the reform. We rerun our main specification using the new control group, and columns 1 and 2 of Table 13 depict the results. The coefficients remain statistically significant for both the overall and the high preemption risk samples. Therefore, it is unlikely that our results are driven by a strategic response in the control group.[57]

[57] To ensure that our general control group is indeed valid, we test and verify that the control firms in industries with treated firms did not respond differently than the control firms in industries with no treated firms.

5.5 The level of cash vs. the risk of preemption

Since our measure of preemption risk is correlated with cash holdings, one potential worry is that our measure may capture another determinant of cash. Specifically, time-to-finance may create a precautionary motive for cash through a different channel than preemption risk. If this is the case, one would expect firms with higher cash holdings to react stronger to the reform, independent of the level of preemption risk.

To mitigate this concern we split the sample according to the firms' mean industry cash-to-asset ratio. The two subgroups are subsequently divided further into a high- and a low-preemption risk sub-sample. Columns 1 and 2 of Table 15 confirm our basic intuition that only firms with high cash holdings respond to the SOR. Importantly, however, Columns 3-6 highlight that this result is driven by firms that are subject to high preemption risk. Only those firms alter their cash holdings significantly, whereas no effect is found for firms that are subject to low preemption risk. It can also be seen that the response of firms in high preemption risk industries still exists for those firms with less cash (albeit less significant). This result supports that the change in time-to-finance affects cash holding trough preemption risk, rather than through another channel.

5.6 Innovation

The firms' R&D intensity might also be related to their level of innovation. While difficult to measure empirically, one proxy used by Frésard et al. (2019) is the number of granted patents divided by total assets which they refer to as unrealized innovation. Columns 1 and 2 of Table 16 first split the sample according to the median innovation measure, and Columns 3 and 4 subsequently focus on the subset of high-preemption risk firms. Neither the overall sample split, nor the high preemption risk sup-sample split, show a clear pattern as the coefficients of "Post x Treat" are of comparable size and magnitude, indicating that our analysis is unlikely to be driven by innovation.

An increase in competition may also affect firms' innovation (Aghion et al., 2005), and as a reaction, firms are likely to increase their R&D spending which could lead to a reduction in cash holdings. To rule out this alternative channel, which is more likely to occur for large and innovative firms, we examine whether such firms reacted to the decrease in time-to-finance by increasing their R&D spending. We thus focus on treated firms, that have high levels of either unrealized or of realized innovation (the R&D to sales ratio), and examine how R&D changed around the 2005 reform. We thus look at the variable "post" only, which is zero in the pre-reform period and one afterwards. Panel B shows that R&D spending did not increase in the post-reform years.[58]

5.7 Different treatment and sample-selection boundaries

In the main specification treated firms are defined as firms with a public float of more than $800 million. This criterion can be relaxed. As shown in the Internet Appendix, cut-off values of $700, $800, and $900 million lead to consistent estimates. Hence, it is highly unlikely that the results are driven by a specific treatment definition or by a systematic self-selection process.

6 Conclusion

This paper analyzes a setting in which firms face both competition and time frictions in capital markets. We show that when external financing cannot be obtained on the spot; that is, when there is a "time-to-finance", firms optimally hold cash to avoid underinvestment problems and potential future default. In particular, by using the U.S. Securities Offering Reform of 2005 as a quasi-natural experiment, we provide novel empirical evidence on the relation between the time-to-finance and corporate cash holdings. Using a difference-in-differences analysis, we show that the average firm reduces its cash-to-asset ratio by 2.4 percentage points subsequent to the reform, while firms facing higher preemption risk reduce their cash holdings by an additional 4.8 percentage points. The stronger the risk of preemption, the stronger is the relation between the firms' cash holdings and their time-to-finance. A number of cross-sectional sample splits help us validate our measure of preemption risk. Moreover, we provide additional insights by showing that patents

[58] One caveat is, however, that the sub-sample analysis of high-preemption risk firms that were subject to high innovation is relatively small, which may explain the decrease in R&D.

mitigate the risk of preemption and that the effect of a reduction in time-to-finance on cash holdings is strongest for unconstrained firms.

To summarize, this paper establishes that time frictions in capital markets have a significant impact on firms' cash management policies, and that the time-to-finance becomes an increasingly important concern when competition intensifies.

References

Acharya, V. V., H. Almeida, and M. Campello (2007). Is cash negative debt? A hedging perspective on corporate financial policies. *Journal of Financial Intermediation 16*(4), 515–554.

Aghion, P., N. Bloom, R. Blundell, R. Griffith, and P. Howitt (2005, May). Competition and Innovation: an Inverted-U Relationship. *The Quarterly Journal of Economics 120*(2), 701–728.

Almeida, H. and M. Campello (2010). Financing frictions and the substitution between internal and external funds. *Journal of Financial and Quantitative Analysis 45*(3), 589–622.

Almeida, H., M. Campello, and M. S. Weisbach (2004). The cash flow sensitivity of cash. *Journal of Finance 59*(4), 1777–1804.

Alshwer, A. A., V. Sibilkov, and N. S. Zaiats (2011). Financial constraints and the method of payment in mergers and acquisitions. *Working Paper*.

Altınkılıç, O. and R. S. Hansen (2000). Are there economies of scale in underwriting fees? evidence of rising external financing costs. *The Review of Financial Studies 13*(1), 191–218.

Anderson, R. W. and A. Carverhill (2012). Corporate liquidity and capital structure. *Review of Financial Studies 25*(3), 797–837.

Baik, B., G. Hoberg, J. Kim, and P. Oh (2017). Shocks to product networks and post-earnings announcement drift. *Working Paper*.

Bates, T. W., K. M. Kahle, and R. M. Stulz (2009). Why do us firms hold so much more cash than they used to? *Journal of Finance 64*(5), 1985–2021.

Berrospide, J. M. and R. R. Meisenzahl (2015). The real effects of credit line drawdowns. *Working Paper*.

Bethel, J. E. and L. Krigman (2008). Managing the costs of issuing common equity: The role of registration choice. *Quarterly Journal of Finance and Accounting*, 57–85.

Betton, S., B. E. Eckbo, and K. S. Thorburn (2008). Corporate takeovers. *Handbook of corporate finance: Empirical corporate finance 2*, 291–430.

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

Bolton, P., H. Chen, and N. Wang (2014). Debt, taxes, and liquidity. *Working Paper*.

Bonaimé, A. A., K. W. Hankins, and J. Harford (2014). Financial flexibility, risk management, and payout choice. *Review of Financial Studies 27*(4), 1074–1101.

Bortolotti, B., W. Megginson, and S. Smart (2008, 06). The rise of accelerated seasoned equity underwritings. *Journal of Applied Corporate Finance 20*, 35–57.

Boyle, G. W. and G. A. Guthrie (2003). Investment, uncertainty, and liquidity. *Journal of Finance 58*(5), 2143–2166.

Bryant-Kutcher, L., E. Y. Peng, and D. P. Weber (2013). Regulating the timing of disclosure: Insights from the acceleration of 10-K filing deadlines. *Journal of Accounting and Public Policy 32*(6), 475–494.

Butler, A. W. (2008). Distance still matters: Evidence from municipal bond underwriting. *The Review of Financial Studies 21*(2), 763–784.

Cain, M. D., S. B. McKeon, and S. D. Solomon (2017). Do takeover laws matter? Evidence from five decades of hostile takeovers. *Journal of Financial Economics 124*(3), 464–485.

Campello, M., E. Giambona, J. R. Graham, and C. R. Harvey (2012). Access to liquidity and corporate investment in Europe during the financial crisis. *Review of Finance 16*(2), 323–346.

Chen, T., J. Harford, and C. Lin (2017). Financial flexibility and corporate cash policy. *Working Paper*.

Clausen, S. and S. Hirth (2016). Measuring the value of intangibles. *Journal of Corporate Finance 40*, 110–127.

Davis, R., D. A. Maslar, and B. Roseman (2018). Secondary market trading and the cost of new debt issuance. *Working Paper*.

Denis, D. J. and V. Sibilkov (2010). Financial constraints, investment, and the value of cash holdings. *Review of Financial Studies 23*(1), 247–269.

Dharmapala, D., C. F. Foley, and K. J. Forbes (2011). Watch what I do, not what I say: The unintended consequences of the Homeland Investment Act. *Journal of Finance 66*(3), 753–787.

Dudley, E. (2012). Capital structure and large investment projects. *Journal of Corporate Finance 18*(5), 1168 – 1192.

Faccio, M. and R. W. Masulis (2005). The choice of payment method in European mergers and acquisitions. *The Journal of Finance 60*(3), 1345–1388.

Farre-Mensa, J. and A. Ljungqvist (2013). Do measures of financial constraints measure financial constraints? Technical report, National Bureau of Economic Research.

Faulkender, M. and M. Petersen (2012). Investment and capital constraints: Repatriations under the American Jobs Creation Act. *Review of Financial Studies 25*(11), 3351–3388.

Fenn, G. W. (2000). Speed of issuance and the adequacy of disclosure in the 144A high-yield debt market. *Journal of Financial Economics 56*(3), 383–405.

Freilich, J. (2018). Prophetic patents. *Working Paper*.

Fresard, L. (2010). Financial strength and product market behavior: The real effects of corporate cash holdings. *Journal of Finance 65*(3), 1097–1122.

Frésard, L., G. Hoberg, and G. Phillips (2019). Innovation activities and the incentives for vertical acquisitions and integration. *Working Paper*.

Fudenberg, D., R. Gilbert, J. Stiglitz, and J. Tirole (1983). Preemption, leapfrogging and competition in patent races. *European Economic Review 22*(1), 3–31.

Gamba, A. and A. Triantis (2008). The value of financial flexibility. *Journal of Finance 63*(5), 2263–2296.

Garlappi, L. (2004). Risk premia and preemption in R&D ventures. *Journal of Financial and Quantitative Analysis 39*(4), 843–872.

Ghaly, M., V. Anh Dang, and K. Stathopoulos (2017). Cash holdings and labor heterogeneity: The role of skilled labor. *The Review of Financial Studies 30*(10), 3636–3668.

Gorbenko, A. S. and A. Malenko (2017). The timing and method of payment in mergers when acquirers are financially constrained. *Review of Financial Studies*.

Granstrand, O. and S. Sjölander (1990). The acquisition of technology and small firms by large firms. *Journal of Economic Behavior & Organization 13*(3), 367–386.

Gryglewicz, S. (2011). A theory of corporate financial decisions with liquidity and solvency concerns. *Journal of Financial Economics 99*(2), 365–384.

Gustafson, M. (2012). Issuance costs in today's equity market: The causal effect of accelerating seasoned equity. *Working Paper*.

Gustafson, M. (2018). Price pressure and overnight seasoned equity offerings. *Journal of Financial and Quantitative Analysis 53*, 837–856.

Gustafson, M. T. and P. Iliev (2017). The effects of removing barriers to equity issuance. *Journal of Financial Economics*.

Hadlock, C. J. and J. R. Pierce (2010). New evidence on measuring financial constraints: Moving beyond the KZ index. *The Review of Financial Studies 23*(5), 1909–1940.

Harford, J. (1999). Corporate cash reserves and acquisitions. *The Journal of Finance 54(6)*, 1969–1997.

Harford, J., S. Klasa, and W. F. Maxwell (2014). Refinancing risk and cash holdings. *Journal of Finance 69*(3), 975–1012.

Heckman, J. J. (1978). Dummy endogenous variables in a simultaneous equation system. *Econometrica 46*(4), 931–959.

Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica 47*(1), 153–161.

Hennessy, C. A. and T. M. Whited (2007). How costly is external financing? Evidence from a structural estimation. *Journal of Finance 62*(4), 1705–1745.

Hirschey, M., H. Skiba, and M. B. Wintoki (2012). The size, concentration and evolution of corporate R&D spending in U.S. firms from 1976 to 2010: Evidence and implications. *Journal of Corporate Finance 18*(3), 496–518.

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

Hoberg, G. and G. Phillips (2016). Text-based network industries and endogenous product differentiation. *Journal of Political Economy 124*(5), 1423–1465.

Hoberg, G., G. Phillips, and N. Prabhala (2014). Product market threats, payouts, and financial flexibility. *Journal of Finance 69*(1), 293–324.

Hugonnier, J., S. Malamud, and E. Morellec (2015). Capital supply uncertainty, cash holdings, and investment. *Review of Financial Studies 28 (2)*, 392–445.

Iliev, P. (2010). The effect of SOX Section 404: Costs, earnings quality, and stock prices. *The Journal of Finance 65*(3), 1163–1196.

Impink, J., M. Lubberink, B. van Praag, and D. Veenman (2012). Did accelerated filing requirements and SOX Section 404 affect the timeliness of 10-K filings? *Review of Accounting Studies 17*(2), 227–253.

Joffe, M. D. (2015). Municipal bond costs of issuance. *Working Paper*.

Kaplan, S. N. and L. Zingales (1997). Do investment-cash flow sensitivities provide useful measures of financing constraints? *The Quarterly Journal of Economics*, 169–215.

Kisser, M. (2013). The real option value of cash. *Review of Finance 17*, 1649–1697.

Kogan, L., D. Papanikolaou, A. Seru, and N. Stoffman (2012). Technological innovation, resource allocation, and growth. *NBER Working Paper*.

Kulak, J. P. (2011). Time delay in raising outside capital and cash holdings: Evidence from a quasi-natural experiment. *Working Paper*.

Lambert, T. A., K. L. Jones, J. F. Brazel, and D. S. Showalter (2017). Audit time pressure and earnings quality: An examination of accelerated filings. *Accounting, Organizations and Society 58*, 50 – 66.

Lins, K. V., H. Servaes, and P. Tufano (2010). What drives corporate liquidity? An international survey of cash holdings and lines of credit. *Journal of Financial Economics 98*(1), 160–176.

Lyandres, E. and B. Palazzo (2015). Cash holdings, competition, and innovation. *Journal of Financial and Quantitative Analysis (forthcoming)*.

Ma, L., A. S. Mello, and Y. Wu (2015). Industry competition, winner's advantage, and cash holdings. *Working Paper*.

Ma, L., A. S. Mello, and Y. Wu (2018). First mover advantage, time to finance, and cash holdings. *Working Paper*.

Martynova, M. and L. Renneboog (2009). What determines the financing decision in corporate takeovers: Cost of capital, agency problems, or the means of payment? *Journal of Corporate Finance 15*(3), 290–315.

Morellec, E., B. Nikolov, and F. Zucchi (2014). Competition, cash holdings, and financing decisions. *Working Paper*.

Munsif, V., K. Raghunandan, and D. V. Rama (2012). Internal control reporting and audit report lags: Further evidence. *Auditing: A Journal of Practice & Theory 31*(3), 203–218.

Myers, S. C. and N. S. Majluf (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics 13*(2), 187–221.

Nagler, F. (2019, 03). Yield spreads and the corporate bond rollover channel. *Review of Finance*.

Odasso, C., G. Scellato, and E. Ughetto (2014, 06). Selling patents at auction: an empirical analysis of patent value. *Industrial and Corporate Change 24*(2), 417–438.

Phillips, G. M. and A. Zhdanov (2013). R&D and the incentives from merger and acquisition activity. *Review of Financial Studies 26*(1), 34–78.

Schroth, E. and D. Szalay (2010). Cash breeds success: The role of financing constraints in patent races. *Review of Finance 14*(1), 73–118.

Shroff, N., A. X. Sun, D. White, Hal, and W. Zhang (2013). Voluntary disclosure and information asymmetry: Evidence from the 2005 securities offering reform. *Journal of Accounting Research 51*(5), 1299–1345.

Sufi, A. (2007). Bank lines of credit in corporate finance: An empirical analysis. *The Review of Financial Studies 22*(3), 1057–1088.

Whited, T. M. and G. Wu (2006). Financial constraints risk. *Review of Financial Studies 19*(2), 531–559.

Wirz, M. J. and J. P. Kulak (2014). Delay as a financing friction: Evidence from the 2005 Securities Offering Reform. *Working Paper*.

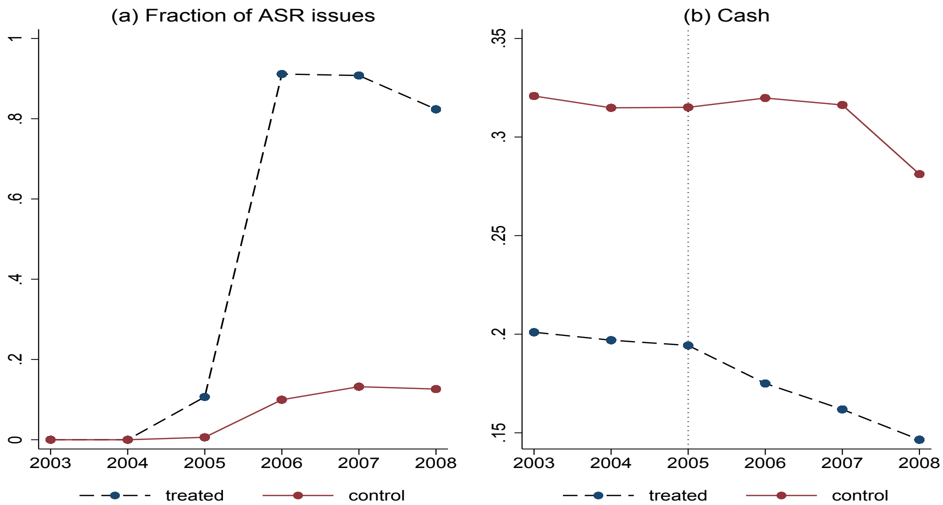

Figure 1. Treated and control firms: ASR issues and cash holdings
This figure depicts the fraction of ASR issuances in panel (a) as well as the cash holdings of both treated and control firms in panel (b) between 2003 and 2008. Treated firms are those firms with a public float higher than \$800 million in 2005, and control firms are firms with a public float below \$700 million in 2005.

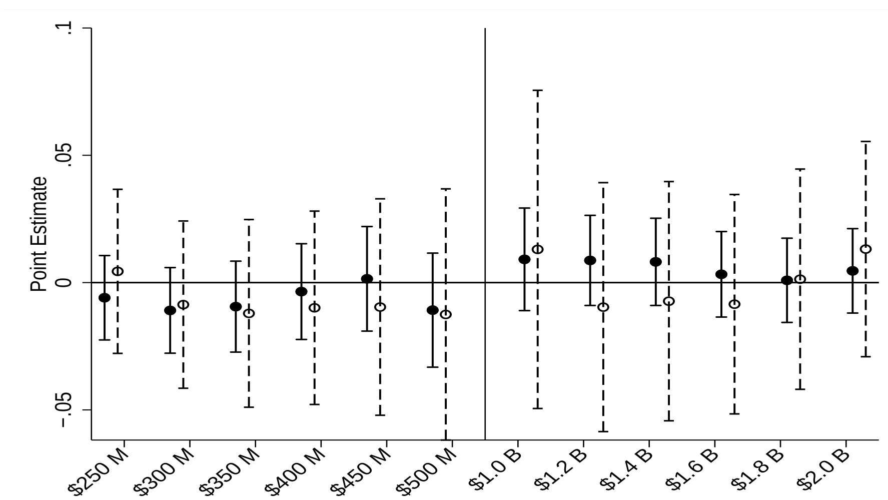

Figure 2. Robustness checks: Placebo tests
This figure depicts arbitrary lower and upper treatment thresholds and the corresponding point estimates for the Post $\times$ Treat interaction term and the confidence interval for the estimates of the Fixed-Effect regressions. For an arbitrary cut-off of, e.g., \$300 million, treated firms are those whose public float is between \$300 and \$700 million, and control firms are those whose public float is below \$300 million. Similarly, for a cut-off of, e.g., \$1.2 billion, control firms are those whose public float is between \$700 million and \$1.2 billion, and treated firms are those whose public float is above \$1.2 billion. The solid lines represent the full sample specifications and the dashed lines represent the high preemption sample specifications that is based on the top tercile of the industry distribution R&D expenses.

Table 1. Comparison of firm characteristics

This table presents key firm characteristics and outcome variables split by treatment status. We summarize these variables in the pre- and post-rule periods. There are 1041 (945) firm-year observations of treated firms in the pre- (post-) period and 2310 (2225) firm-year observations of nontreated firms in the pre- (post-) period. All variables are defined in the Internet Appendix.

	Pre-deregulation (2002-2005)				*Post-deregulation (2006-2008)*			
	Treated		Control		Treated		Control	
	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.
Independent variable								
Cash	0.21	0.20	0.33	0.26	0.17	0.17	0.33	0.27
Size measures								
Public Float	1721	1136	232	200	2497	2185	345	418
Total Assets	1751	1756	277	400	2430	2548	370	650
Market Capitalization	2186	1447	343	327	2570	2304	413	486
Other control variables								
R&D Expenses	0.05	0.06	0.10	0.12	0.05	0.06	0.11	0.14
Sales	1.03	0.60	0.94	0.65	1.06	0.60	0.97	0.67
Sales growth	0.11	0.14	0.09	0.21	0.07	0.16	0.06	0.24
Long-Term Debt	0.19	0.18	0.14	0.21	0.20	0.19	0.15	0.24
Dividends	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.02
EBITDA	0.14	0.09	0.01	0.22	0.13	0.10	-0.02	0.26
Tobin's Q	2.05	1.32	2.32	2.12	1.63	1.07	1.93	1.85
Age	18.66	12.13	13.78	9.58	21.68	12.70	15.36	10.11
Working Capital	0.37	0.15	0.42	0.19	0.36	0.15	0.41	0.19
HHI	9.12	1.71	8.86	1.69	9.38	1.59	8.99	1.68
Capital Expenditures	0.05	0.04	0.03	0.03	0.05	0.04	0.04	0.04
Tangibility	0.22	0.16	0.17	0.16	0.22	0.17	0.16	0.15
Acquisitions	0.04	0.08	0.02	0.06	0.04	0.08	0.03	0.08
Industry Sigma	1.00	4.50	0.98	3.61	0.89	2.73	0.97	2.43

Table 2. Effect of reduced time-to-finance on corporate cash holdings

This table presents the fixed-effect regression estimates of the full sample (columns 2 and 3) and of the high preemption risk firms (columns 4 and 5). The dependent variable is the cash-to-asset ratio measured as cash and short-term investment (che) over total assets (at). Treat is an indicator variable equal to one if the firm has a public float higher than $800 million. The variable high, is an indicator variable that is one for firms whose R&D expenditures are in the top industry quartile and zero for those in the lowest quartile. Post is an indicator variable equal to one in the three fiscal years following Dec. 31st, 2005. All other variables are defined in Appendix B. Standard errors are robust and clustered at the firm level. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Full Sample		*High Preemption Risk*	
	Cash	Cash	Cash	Cash
Post × Treat	-0.024^{***}	-0.023^{***}	-0.066^{***}	-0.018^{**}
	(0.006)	(0.007)	(0.021)	(0.008)
Post × Treat × High				-0.048^{**}
				(0.023)
R&D	0.098^{**}	0.089^{*}	0.235^{***}	0.112^{**}
	(0.048)	(0.052)	(0.072)	(0.056)
Sales	-0.085^{***}	-0.089^{***}	-0.174^{***}	-0.091^{***}
	(0.012)	(0.012)	(0.039)	(0.015)
Sales growth	-0.063^{***}	-0.062^{***}	-0.093^{***}	-0.053^{***}
	(0.009)	(0.009)	(0.030)	(0.013)
Leverage	-0.070^{***}	-0.072^{***}	-0.096^{***}	-0.088^{***}
	(0.021)	(0.022)	(0.035)	(0.028)
Dividends	-0.187	-0.166	-0.439^{**}	-0.257^{**}
	(0.129)	(0.136)	(0.208)	(0.105)
Profit	0.099^{***}	0.103^{***}	0.177^{***}	0.103^{***}
	(0.028)	(0.030)	(0.055)	(0.039)
Tobin's Q	0.014^{***}	0.014^{***}	0.013^{***}	0.015^{***}
	(0.002)	(0.002)	(0.003)	(0.002)
Size	-0.003	-0.005	-0.009	-0.002
	(0.004)	(0.004)	(0.008)	(0.005)
Age	-0.073^{***}	-0.048^{**}	-0.032	-0.028
	(0.020)	(0.023)	(0.051)	(0.028)
Working Capital	0.174^{***}	0.176^{***}	0.139^{***}	0.113^{***}
	(0.023)	(0.023)	(0.034)	(0.030)
HHI	0.005^{***}	-	0.006	0.003
	(0.002)	(-)	(0.004)	(0.002)
Capital Expenditures	-0.110^{*}	-0.132^{*}	-0.188	-0.156^{*}
	(0.067)	(0.071)	(0.166)	(0.087)
Tangibility	-0.612^{***}	-0.626^{***}	-0.844^{***}	-0.632^{***}
	(0.052)	(0.055)	(0.140)	(0.073)
Acquisitions	-0.338^{***}	-0.346^{***}	-0.551^{***}	-0.383^{***}
	(0.023)	(0.024)	(0.059)	(0.039)
Industry Sigma	0.001^{**}	(-)	-0.007	-0.002^{**}
	(0.000)	-	(0.004)	(0.001)
Year FE	Yes	No	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Industry x Year FE	No	Yes	No	No
N	6440	6368	1387	2967
adj. R^2	0.89	0.89	0.85	0.92

Table 3. Effect of reduced time-to-finance on corporate cash holdings for high preemption risk firms
This table presents the estimates of the fixed-effect regression for various levels of preemption risk. Columns 1 through 4 report the result using the top 33rd, 25th, 20th, and 15th percentiles of the industry R&D distribution. The dependent variable is the cash-to-asset ratio measured as cash and short-term investment (che) over total assets (at). Treat is an indicator variable equal to one if the firm has a public float higher than $800 million. To save space, the variable high, which is an indicator variable that is one for firms whose R&D expenditures are in the top percentiles and zero for those in the lowest percentile, is not reported. Post is an indicator variable equal to one in the three fiscal years following December 31st, 2005. All other variables are defined in the Internet Appendix. Standard errors are robust and clustered at the firm level. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	33^{rd} *percentile*	25^{th} *percentile*	20^{th} *percentile*	15^{th} *percentile*
	Cash	Cash	Cash	Cash
Post × Treat	-0.019^{***}	-0.018^{**}	-0.019^{**}	-0.007
	(0.007)	(0.008)	(0.009)	(0.010)
Post × Treat × High	-0.029^{*}	-0.048^{**}	-0.048^{**}	-0.059^{**}
	(0.017)	(0.023)	(0.024)	(0.026)
Controls	Yes	Yes	Yes	Yes
Year & Firm FE	Yes	Yes	Yes	Yes
N	4080	2967	2437	1882
adj. R^2	0.91	0.92	0.93	0.93

Table 4. Cross-sectional splits

This table presents the impact of a change in the time-to-finance on cash holdings. Columns 1 and 2 show the results for the overall sample, and Columns 3 and 4 focus on the subset of firms that are subject to high preemption risk. See Section 4.2 for details. Panel A) looks at firms that are active in industries with more/less acquisitions (number of acquisitions / number of firms in an industry). Panel B) splits the sample according to the median industry takeover index developed by Cain et al. (2017). Panel C) differentiates between firms whose R&D to total assets ratio is below/above the the industry median. Panel D) differentiates between firms that have longer/shorter projects compared to the industry median (Dudley, 2012). Panel E) splits the sample according to the median amount of patents that an industry has. Treat is an indicator variable equal to one if the firm has a public float higher than $800 million. Post is an indicator variable equal to one in the three fiscal years following December 31st, 2005. Standard errors are robust and clustered at the firm level. Besides the usual controls, all regressions include firm and year fixed effects. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Full Sample		*High Preemption Risk*	
	Cash	Cash	Cash	Cash
Panel A)				
	more acquisitions	*less acquisitions*	*more acquisitions*	*less acquisitions*
Post × Treat	-0.023**	-0.018**	-0.064*	-0.056**
	(0.009)	(0.009)	(0.039)	(0.026)
N	3329	2996	614	765
adj. R^2	0.85	0.92	0.78	0.86
Panel B)				
	higher takeover probability	*lower takeover probability*	*higher takeover probability*	*lower takeover probability*
Post × Treat	-0.028***	-0.025***	-0.083***	0.004
	(0.007)	(0.011)	(0.025)	(0.049)
N	2860	3488	986	388
adj. R^2	0.85	0.87	0.86	0.77

Panel C)				
	relatively more R&D	*relatively less R&D*	*relatively more R&D*	*relatively less R&D*
Post × Treat	-0.018**	-0.027***	-0.066**	-0.065**
	(0.010)	(0.008)	(0.030)	(0.030)
N	2953	3214	761	520
adj. R^2	0.90	0.87	0.84	0.85

Panel D)				
	longer projects	*shorter projects*	*longer projects*	*shorter projects*
Post × Treat	-0.024**	-0.023***	-0.046	-0.060**
	(0.011)	(0.008)	(0.044)	(0.024)
N	2549	3865	586	799
adj. R^2	0.90	0.86	0.79	0.83

Panel E)				
	more patents	*less patents*	*more patents*	*less patents*
Post × Treat	-0.024**	-0.030***	-0.036	-0.058***
	(0.011)	(0.011)	(0.021)	(0.021)
N	2064	2640	495	1206
adj. R^2	0.85	0.89	0.80	0.84

Table 5. Cost of security issuances
This table presents the estimates of the fixed-effect regression for which bond issuance data is available. The dependent variable is the offering yield, Treasury spread, and gross spread (yearly average if more than one bond was issued). The Treasury spread is the difference between the yield of a duration-matched benchmark Treasury security and the issue's yield to maturity. The gross spread consists of fees paid to the lead underwriter, the syndicate and the selling group and consists of the selling concession plus the underwriting and management fees. Treat is an indicator variable equal to one if the firm has a public float higher than \$800 million. Post is an indicator variable equal to one in the three fiscal years following December 31st, 2005. The variable high, which is an indicator variable that is one for firms whose R&D expenditures are in the top industry tercile and zero for those in the lowest industry tercile. All regressions include the following control variables: average bond maturity, firm age, leverage, profit, size, Tobin's Q, and cash. Standard errors are robust and clustered at the firm level. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Time-to-finance

	Offering yield	Treasury spread	Gross spread	Offering yield
Post × Treat	1.216**	-17.367	3.338	1.583
	(0.509)	(49.734)	(5.645)	(1.058)
Post × Treat × High				-1.056
				(1.218)
Treat	-0.118	-45.935	-6.795	-0.197
	(0.485)	(49.002)	(6.027)	(0.770)
Controls	Yes	Yes	Yes	Yes
Year & Industry FE	Yes	Yes	Yes	Yes
N	452	176	103	315
adj. R^2	0.44	0.41	0.53	0.42

Panel B: High/Low Preemption Risk

	Offering yield	Treasury spread	Gross spread	Offering yield
		All firms		*Public float > \$700m*
Post × High	-0.252	-15.301	-1.458	-0.442
	(0.428)	(29.431)	(2.542)	(0.488)
Controls	Yes	Yes	Yes	Yes
Year & Industry FE	Yes	Yes	Yes	Yes
N	568	334	251	410
adj. R^2	0.31	0.49	0.60	0.25

Table 6. Time-to-finance and corporate cash holdings: The effect of financial constraints

This table presents the impact of a change in the time-to-finance on cash holdings for constrained (Const.) versus unconstrained (Unconst.) firms. We measure the degree of financial constraints using three different proxies: the Size and Age (SA) index (Hadlock and Pierce 2010), the Kaplan and Zingales (1997) (KZ) index, and the Whited and Wu (2006) (WW) index. The SA index is defined as -0.737 x Size + 0.043 x Size^2 - 0.040 x Age. The KZ index is defined as -1.002 x Cash flow + 0.283 x Tobin's Q + 3.139 x Debt - 39.368 x Dividends - 1.315 x Cash holdings. The WW index is defined as -0.091 x Cash flow - 0.062 x Dividend indicator + 0.021 x Long-term debt - 0.044 x Size + 0.102 x Industry sales growth - 0.035 x Sales growth. Industry sales growth is the average sales growth of firms belonging to the same icode 100 industry. For each year, we define firms with above (below)-median scores on the SA, KZ, and WW indices as constrained (unconstrained). The dependent variable is the cash-to-asset ratio measured as cash and short-term investment (che) over total assets (at). Treat is an indicator variable equal to one if the firm has a public float higher than $800 million. Post is an indicator variable equal to one in the three fiscal years following December 31st, 2005. All other variables are defined in Appendix B. Standard errors are robust and clustered at the firm level. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	SA Index		*WW Index*		*KZ Index*	
	Const.	*Unconst.*	*Const.*	*Unconst.*	*Const.*	*Unconst.*
	Cash	Cash	Cash	Cash	Cash	Cash
Post × Treat	−0.023	−0.015*	−0.018	−0.000	−0.022***	0.014
	(0.020)	(0.008)	(0.011)	(0.013)	(0.008)	(0.021)
Post × Treat × High	0.020	−0.102***	−0.037	−0.072***	0.015	−0.085**
	(0.048)	(0.037)	(0.030)	(0.026)	(0.033)	(0.033)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
N	1337	1588	1217	1305	1351	1296
adj. R^2	0.91	0.89	0.93	0.92	0.89	0.91

Table 7. Credit lines

This table presents the estimates of the fixed-effect regression where the sample is split according to the median credit lines to total asset ratio that prevailed prior to the reform. Columns 2 and 4 focus on those firms whose R&D expenditures belong to the top quartile of all firms. The dependent variable is the cash-to-asset ratio measured as cash and short-term investment (che) over total assets (at). Treat is an indicator variable equal to one if the firm has a public float higher than $800 million. Post is an indicator variable equal to one in the three fiscal years following December 31st, 2005. All other variables are defined in Appendix B. Standard errors are robust and clustered at the firm level. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Less credit lines		*More credit lines*	
	Cash	Cash	Cash	Cash
Post × Treat	-0.014	-0.007	-0.023^{**}	-0.019^{**}
	(0.010)	(0.013)	(0.008)	(0.009)
Post × Treat × High		-0.033		-0.167^{**}
		(0.044)		(0.068)
Controls	Yes	Yes	Yes	Yes
Year & Firm FE	Yes	Yes	Yes	Yes
N	2022	889	1903	900
adj. R^2	0.83	0.88	0.80	0.88

Table 8. Alternative measures of competition and preemption risk

This table presents the estimates of the fixed-effect regression for two alternative measures of competition. Columns 1 and 2 split the sample according to the mean fluidity measure (panel a) and the mean economics of scope measure that is based on the Text Based Industry Classification of Hoberg and Phillips (2010, 2016) (panel b). Columns 3 and 4 as well as 5 and 6 additionally differentiate between those firms whose R&D expenditures belong to the top tercile of all firms and those that that belong to the bottom tercile. The dependent variable is the cash-to-asset ratio measured as cash and short-term investment (che) over total assets (at). Treat is an indicator variable equal to one if the firm has a public float higher than $800 million. Post is an indicator variable equal to one in the three fiscal years following December 31st, 2005. All other variables are defined in Appendix B. Standard errors are robust and clustered at the firm level. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Full Sample		*High Preemption Risk*		*Low Preemption Risk*	
	High Comp.	*Low Comp.*	*High Comp.*	*Low Comp.*	*High Comp.*	*Low Comp.*
	Cash	Cash	Cash	Cash	Cash	Cash
Panel A: Fluidity						
Post × Treat	-0.028^{**}	-0.018^{**}	-0.047^{***}	-0.014	-0.026	-0.011
	(0.011)	(0.007)	(0.018)	(0.035)	(0.019)	(0.007)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
N	3217	2806	1680	393	377	1403
adj. R^2	0.87	0.86	0.85	0.78	0.83	0.86
Panel B: Econ. of Scope						
Post × Treat	-0.028^{***}	-0.011^{*}	-0.053^{***}	0.071	-0.019	-0.010
	(0.010)	(0.006)	(0.016)	(0.044)	(0.016)	(0.007)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
N	3378	2886	1798	292	342	1535
adj. R^2	0.87	0.85	0.85	0.77	0.87	0.83

Table 9. Cash-only financing of M&As
This table depicts the fraction of cash-only acquisitions conducted by U.S. firms between 2003 and 2008. All data are derived from the Thomson Reuters SDC database.

Pre Offering Reform 2003-2005		*Post Offering Reform 2006-2008*		*pre-post difference*	
High-preemption Risk	Low-preemption Risk	High-preemption Risk	Low-preemption Risk	High	Low
0.494	0.433	0.553	0.439	0.059	0.006
Treatment Group	Control Group	Treatment Group	Control Group	Treat	Control
0.504	0.477	0.558	0.482	0.054	-0.005

Table 10. Uses of cash
This table presents the impact of a change in the time-to-finance on cash holdings, equity issuances, share repurchases, and dividends. Columns 1-4 depict the overall sample, whereas columns 5-7 focus on high preemption risk firms. The sample is also split according to the payout ratio (dividends+share repurchase-sale of stock) divided by total assets) in 2004: Column 1 focuses on firms that had a positive payout ratio just prior to the reform, whereas columns 2-7 focus on firms with a negative payout ratio. Treat is an indicator variable equal to one if the firm has a public float higher than $800 million. Post is an indicator variable equal to one in the three fiscal years following December 31st, 2005. The variable high, is an indicator variable that is one for firms whose R&D expenditures are in the top industry quartile and zero for those in the lowest quartile. Standard errors are robust and clustered at the firm level. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Overall sample				*High risk sample*		
	High payout	*Low payout*					
	cash	cash	repurchase	dividend	cash	repurchase	dividend
Post × Treat	0.004	-0.029***	0.018***	0.001	-0.067***	-0.001	0.004**
	(0.011)	(0.008)	(0.004)	(0.001)	(0.023)	(0.007)	(0.002)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1635	4805	4805	4805	1138	1138	1138
adj. R^2	0.89	0.88	0.18	0.50	0.84	0.20	0.35

Table 11. Robustness checks: Control function and instrumental variable approaches

This table presents the results of the control function approach (columns 1-4) and the instrumental variable approach (columns 5-6). In the control function approach, the first stage corresponds, a Probit regression is run where the dependent variable is one if a firm is treated in 2005 and zero if it is not treated in 2005. The fitted values are then used to obtain estimates of the control function, $\hat{\lambda}_i$ (Heckman, 1978, 1979). In the second stage, the main differences-in-differences estimation is adjusted by interaction term $Post \times Treat \times \hat{\lambda}_i$. Treat is an indicator variable equal to one if the firm has a public float higher than $800 million. Firms whose R&D expenditures are in the top industry quartile are part of the high preemption risk sub-sample. Post is an indicator variable equal to one in the three fiscal years following Dec. 31st, 2005. To ensure that the public float does not explain the (2005) first stage treatment decision perfectly, we use the one year lagged value of the public float as a control variable. In the instrumental variable approach, the treatment status is instrumented via a dummy variable that is equal to one if a firm had a public float above the $700 million threshold in year 2003 and zero otherwise. All variables similar to the main regression specification and are defined in the Internet Appendix. Standard errors are robust and clustered at the firm level. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Control Function Approach				*Instrumental Variable Approach*	
	Full Sample		*High Preemption Risk Sample*		*Full Sample*	*High Preemption Risk Sample*
	P(Treat=1)	Second stage	P(Treat=1)	Second stage	Second stage	Second stage
Post × Treat	-	-0.016***	-	-0.060**	-	-
	-	(0.007)	-	(0.026)	-	-
Post × Treat × $\hat{\lambda}$	-	-0.011	-	0.056	-	-
	-	(0.011)	-	(0.043)	-	-
$\widehat{Post \times Treat}$	-	-	-	-	-0.025***	-0.075***
	-	-	-	-	(0.007)	(0.022)
R&D	-3.284*	0.113*	-1.303	0.307**	0.109***	0.273***
	(1.723)	(0.058)	(4.425)	(0.129)	(0.033)	(0.059)
Sales	-0.229	-0.085***	-4.903***	-0.211**	-0.088***	-0.189***
	(0.176)	(0.013)	(1.583)	(0.054)	(0.008)	(0.031)
Sales growth	2.123***	-0.062***	13.972***	-0.175***	-0.058***	-0.099***
	(0.634)	(0.011)	(4.226)	(0.039)	(0.008)	(0.028)
Leverage	0.233	-0.077***	1.029	-0.108**	-0.070***	-0.098***
	(0.484)	(0.022)	(1.135)	(0.043)	(0.013)	(0.024)
Dividends	-2.263	-0.246	-26.256**	-0.804*	-0.240**	-0.378
	(4.989)	(0.179)	(12.635)	(0.484)	(0.097)	(0.236)
Profit	1.775	0.107***	7.533***	0.268**	0.098***	0.208***
	(1.103)	(0.033)	(2.892)	(0.117)	(0.018)	(0.040)
Tobin's Q	0.266***	0.014***	0.209	0.013**	0.014***	0.012***
	(0.082)	(0.002)	(0.153)	(0.006)	(0.001)	(0.002)
Size	2.742***	-0.005	3.522***	-0.027***	-0.003	-0.008
	(0.235)	(0.004)	(0.698)	(0.010)	(0.003)	(0.007)
Age	0.296**	-0.064***	1.077*	-0.008	-0.083***	-0.023
	(0.138)	(0.025)	(0.566)	(0.089)	(0.016)	(0.043)
Working Capital	-0.264	0.193***	5.287***	0.218***	0.185***	0.143***
	(0.696)	(0.026)	(1.802)	(0.046)	(0.013)	(0.026)
HHI	0.022	0.004**	0.090	0.007	0.005***	0.005
	(0.041)	(0.002)	(0.104)	(0.005)	(0.001)	(0.003)
Capital Expenditures	-1.487	-0.145**	2.383	-0.035	-0.105	-0.231
	(3.680)	(0.074)	(11.486)	(0.203)	(0.066)	(0.171)
Tangibility	1.135	-0.630***	2.786	-0.890***	-0.623***	-0.831***
	(0.921)	(0.062)	(2.813)	(0.187)	(0.035)	(0.085)
Acquisitions	3.291***	-0.336***	4.837	-0.488***	-0.338***	-0.549***
	(1.042)	(0.024)	(4.078)	(0.064)	(0.019)	(0.055)
Industry Sigma	-0.005	0.001*	0.307***	-0.013	0.001**	-0.007
	(0.022)	(0.000)	(0.113)	(0.008)	(0.000)	(0.006)
Year FE	No	Yes	No	Yes	Yes	Yes
Firm FE	No	Yes	No	Yes	Yes	Yes
Observations	1137	5409	234	870	5839	1268
Pseudo / Adjusted R^2	0.78	0.89	0.84	0.88	0.88	0.84

Table 12. Robustness checks: Different sample selection criteria

This table presents the estimates of the Fixed-Effect regression for different sample restriction criteria based on public float. Columns 1 through 3 report the result for an upper boundary of $5 billion, and a lower boundary of $50, $150, and $250 million. Columns 4 through 6 report the result for an upper boundary of $2.5 billion, and a lower boundary of $50, $150, and $250 million. Panel A presents the results using the full sample. Panel B reports the results for the high preemption risk firms. To save space, the variable high, which is an indicator variable that is one for firms whose R&D expenditures are in the top quartile and zero for those in the lowest quartile, is not reported. The dependent variable is the cash-to-asset ratio measured as cash and short-term investment (che) over total assets (at). Treat is an indicator variable equal to one if the firm has a public float higher than $800 million. Post is an indicator variable equal to one in the three fiscal years following December 31st, 2005. All other variables are defined in Appendix B. Standard errors are robust and clustered at the firm level. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	$5 Billion			*$2.5 Billion*		
	$50 Million	*$150 Million*	*$250 Million*	*$50 Million*	*$150 Million*	*$250 Million*
Panel A: Full Sample						
Post × Treat	−0.024***	−0.021***	−0.020***	−0.024***	−0.022***	−0.021**
	(0.006)	(0.007)	(0.008)	(0.007)	(0.008)	(0.008)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
N	6440	4681	3757	5924	4162	3238
adj. R^2	0.89	0.88	0.89	0.88	0.88	0.89
Panel B: High Preemption Risk						
Post × Treat	−0.018**	−0.020**	−0.019**	−0.019**	−0.022**	−0.021**
	(0.008)	(0.009)	(0.010)	(0.009)	(0.010)	(0.010)
Post × Treat × High	−0.048**	−0.043*	−0.046*	−0.048*	−0.042*	−0.045
	(0.023)	(0.025)	(0.027)	(0.025)	(0.027)	(0.029)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
N	2967	2170	1746	2736	1939	1515
adj. R^2	0.92	0.92	0.92	0.92	0.92	0.92

Table 13. Robustness checks: Strategic response, matched sample, and placebo test
This table presents the estimates of the Fixed-Effect regressions for four different robustness checks. Columns 1 and 2 show the result of the full sample and for the high preemption sample (firms whose R&D expenses are in the top tercile of the industry distribution) when we limit the control group to FIC 100 industries that have no treated firms. Columns 3 and 4 show the result of the full and high preemption sample using 2004 as the treatment year. Columns 5 and 6 show the results when treated firms are matched to control firms based on their size in the year 2004. All other variables are defined in Appendix B. Standard errors are robust and clustered at the firm level. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Strategic Response		*Placebo Year = 2004*		*Matched Sample*	
	Full Sample	*High Risk*	*Full Sample*	*High Risk*	*Full Sample*	*High Risk*
	Cash	*Cash*	*Cash*	*Cash*	*Cash*	*Cash*
Post × Treat	-0.046**	-0.097*	-0.008	-0.023	-0.021***	-0.078**
	(0.020)	(0.056)	(0.006)	(0.015)	(0.010)	(0.036)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
N	2054	733	4225	1249	1832	269
adj. R^2	0.88	0.83	0.91	0.86	0.89	0.87

Table 14. Robustness checks: Homeland investment act
This table presents the estimates of the fixed-effect regression when we exclude all firms with fiscal end prior to October 22nd, 2005. The high preemption risk sub-sample consists of firms whose R&D expenses are in the top decile of the industry distribution. The dependent variable is the cash-to-asset ratio measured as cash and short-term investment (che) over total assets (at). Treat is an indicator variable equal to one if the firm has a public float higher than $800 million. Post is an indicator variable equal to one in the three fiscal years following December 31st, 2005. All other variables are defined in Appendix B. Standard errors are robust and clustered at the firm level. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Full Sample	33^{rd} *percentile*	25^{th} *percentile*	20^{th} *percentile*
	Cash	Cash	Cash	Cash
Post × Treat	-0.016**	-0.020	-0.049*	-0.046*
	(0.008)	(0.019)	(0.026)	(0.027)
Controls	Yes	Yes	Yes	Yes
Year & Firm FE	Yes	Yes	Yes	Yes
N	1282	426	222	220
adj. R^2	0.93	0.90	0.91	0.91

Table 15. Robustness checks: The level of cash vs. the risk of preemption

This table presents the estimates of the fixed-effect regression where columns 1 and 2 split the sample according to the industry mean cash holdings. Columns 3 and 4 as well as 5 and 6 additionally differentiate between those firms whose R&D expenditures belong to the top quartile of all firms and those that that belong to the bottom quartile. The dependent variable is the cash-to-asset ratio measured as cash and short-term investment (che) over total assets (at). Treat is an indicator variable equal to one if the firm has a public float higher than $800 million. Post is an indicator variable equal to one in the three fiscal years following December 31st, 2005. All other variables are defined in Appendix B. Standard errors are robust and clustered at the firm level. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Full Sample		*High Preemption Risk*		*Low Preemption Risk*	
	High Cash	*Low Cash*	*High Cash*	*Low Cash*	*High Cash*	*Low Cash*
	Cash	Cash	Cash	Cash	Cash	Cash
Post × Treat	-0.037^{***}	-0.002	-0.046^{**}	-0.037^{*}	0.024	0.002
	(0.011)	(0.003)	(0.021)	(0.020)	(0.022)	(0.005)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
N	3357	2829	1441	113	194	1187
adj. R^2	0.82	0.62	0.83	0.72	0.82	0.63

Table 16. Robustness checks: Innovation
This table presents the impact of a change in the time-to-finance on cash holdings and on R&D. Columns 1 and 2 show the results for the overall sample, and Columns 3 and 4 focus on the subset of firms that are subject to high preemption risk. Panel A) examines unrealized innovation, as measured by the number of granted patents divided by total assets (Frésard et al., 2019). Firms whose R&D expenditures are in the top industry quartile are subject to high preemption risk. Panel B) examines if firms change their R&D spending by focusing on treated firms (public float above $800 million) whose innovation measure is above the median. Realized innovation is the ratio of R&D to sales (Frésard et al., 2019). Firms whose R&D expenditures are in the top industry tercile are subject to high preemption risk. Treat is an indicator variable equal to one if the firm has a public float higher than $800 million. Post is an indicator variable equal to one in the three fiscal years following December 31st, 2005. Standard errors are robust and clustered at the firm level. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Overall sample		*High risk sample*	
	Cash	Cash	Cash	Cash
Panel A): Unrealized Innovation				
	more innovation	*less innovation*	*more innovation*	*less innovation*
Post × Treat	-0.033***	-0.029***	-0.078***	-0.086**
	(0.012)	(0.010)	(0.028)	(0.034)
Controls	Yes	Yes	Yes	Yes
Year & Firm FE	Yes	Yes	Yes	Yes
N	2251	2003	528	525
adj. R^2	0.88	0.89	0.85	0.83
Panel B): Treated & innovative firms only:				
	R&D	R&D	R&D	R&D
	more realized innovation	*more unrealized innovation*	*more realized innovation*	*more unrealized innovation*
Post	-0.004	-0.002	-0.003	-0.016**
	(0.003)	(0.003)	(0.005)	(0.007)
Controls	Yes	Yes	Yes	Yes
Year & Firm FE	Yes	Yes	Yes	Yes
N	733	964	171	210
adj. R^2	0.89	0.85	0.86	0.79

Internet Appendix for:

The Impact of Competition and Time-to-Finance on Corporate Cash Holdings

(not for publication)

Contents

1 SEC registration and the review process[1]

Prior to issuing securities on the primary market, the SEC requires an issuer to file a registration statement covering the securities to be sold. The registration statement must be declared effective before the securities may be sold. It typically consists of two parts: A prospectus and any supplemental information. The former informs the investing public about the terms and conditions of the offering, whereas the latter contains information about the securities which is not required to be contained in the prospectus, such as exhibit information and certain issuer undertakings. A registration statement filed by an issuer for an offering of securities is subject to review by the SEC before the offering can be completed. The goal of the review is to ensure adequate disclosure in compliance with the Securities Act of 1933 and applicable accounting principles. Importantly, the goal is not to determine the merits of the offering, but rather, the focus is on whether investors are being provided enough information to make an informed investment decision.

Submitting an incomplete or poorly-written registration statement for review should be avoided. If the registration statement is roughly drafted, the SEC may decline to review it or, more drastically, institute a formal stop order or other enforcement proceedings if the deficiencies appear to reflect carelessness towards compliance with the disclosure rules.[2]

1.1 Timing of the review

The registration statement is reviewed both by an SEC examiner and a staff accountant. The examiner reviews all content of the registration statement other than the accounting aspects, whereas the staff accountant reviews the financial statements and accounting-related issues. Approximately 30 days after the initial submission, the examiner delivers the SEC staff's comments on the registration statement.

[1] Further information regarding the registration and review process can be found in the Thomson Reuters Practical Law Practice Notes, on which this description is based.

[2] Even if the SEC does not discover the deficiencies in a poorly drafted registration statement, there is a risk that the issuer and the working group may expose themselves to potential liability for material misstatements and omissions.

In general, the overall time required to complete the review of a registration statement depends on many different factors. Reviews can range from full review to no review at all. The SEC staff usually determines within two to five business days after the date of the initial filing whether a registration statement will be reviewed.

No Review: There are some registration statements that automatically become effective and the issuer is not required to wait for the SEC to determine whether it will be reviewed: Examples are automatic shelf registration statements filed by Well-Known Seasoned Issuers on Form S-3ASR. For other registration statements, such as standard public offerings (Form S-1) or regular shelf offerings (Form S-3), the SEC staff may decide not to launch a review. In this case the registration form becomes effective within 48 hours. One reason for a non-review is that the SEC is already engaging in an ongoing review of the Exchange Act periodic reports, such as the 10-K and 10-Q filings, or of other registration statements filed by the issuer.

Full Review: If a registration statement is selected for full review, the SEC staff generally try to issue an initial comment letter within 30 days of the date of the initial submission. Circumstances affecting the timeliness of the first SEC comment letter can include both external reasons, e.g., a large backlog of confidential submissions and filings, and internal reasons, which include the following: The quality of the draft registration statement, the need to consult other branches of the Division of Corporation Finance, whether the issuer is in a troubled industry, in which case the SEC may subject the issuer to a more intense review, and whether the issuer is involved in a complex business combination that requires more time to analyze.

Importantly, the Securities Act does not set a definite time-frame in which the overall review process must be completed. Rather, the timing is affected by factors such as:

- The time it takes for the issuer to amend the registration statement and prepare its response letters.

- The number of rounds of comment letters and response letters required.
- The extent of revisions to the disclosure and supplemental information that the staff request and have to review.

The SEC staff try to review amendments to draft registration statements under review within seven to ten days of the date the amendment was submitted. After all comments have been satisfactorily resolved, the issuer can request that the SEC declare the registration statement effective so that the offering can be completed. The Division of Corporation Finance gives notice on the SEC's EDGAR system when a registration statement becomes effective.

1.2 Time between a security offering and the first amendment

To gain some insights into the timing of a review process, we calculate the time it takes between an initial security offering and the first amendment. On average, between 2002 and 2004, 41% (25%) of all non-WKSIs were amended within the first 60(30) days of a security issuance and the average time that elapsed between the initial filing and the first amendment was 32 (18) days.[3,4] Figure A1 depicts the histogram of when the first amendment was conducted. Moreover, to make sure the review times are not systematically different between larger and smaller firms, we compare the average length that elapsed between a shelf offering and its first amendment. In the years before the ASR introduction, the length was very similar; the first amendment occurred after 32.2 (32.8) days for the treatment (control) group.

[3] We only looked at those amendments that hat took longer than 7 days. Including shorter amendments reduces the time to 31 (17) days, respectively.

[4] The average time that elapsed between the initial filing and the last amendment was 65 days.

2 Simplified theoretical framework

2.1 Model set-up

To guide our empirical analysis, we set up a stylized model that examines the impact of both time frictions in capital markets and preemption risk on a firm's cash management decision.

We consider a firm with assets-in-place generating stochastic earnings and a growth option to expand existing operations. Denote the cumulative earnings at time t as Y_t and the instantaneous earnings as dY_t. The cumulative earnings evolve according to the following process:

$$dY_t = \mu_0 dt + \sigma dZ_t, \tag{1}$$

where μ_0 is the expected earnings rate, σ represents earnings volatility, and Z_t is a standard Brownian motion under the risk-neutral probability measure. The investment opportunity, which represents, for example, a takeover or an acquisition, can be realized by incurring a lump-sum investment cost, I. Investing in the project increases the future expected earnings rate to μ_1, where $\mu_1 > \mu_0$. We assume that the investment opportunity is not perpetual. Rather, the firm is subject to competition and faces the risk of being preempted by a competitor. If the firm is preempted, the real investment opportunity disappears and the future expected earnings are given by μ_p, where $\mu_p \leq \mu_0$.[5]

To describe the short-lived nature of the growth option, we follow the reduced form modeling of Li and Mauer (2014). We model preemption risk as a Poisson process with a constant exogenous mean arrival rate, λ. Denote the time at which the firm is preempted as τ_p. Hence, λ can be seen as the aggregate probability of any competitor discovering the same investment opportunity and of obtaining sufficient cash to fund it.[6] When $\lambda = 0$, the firm

[5]This assumption allows us to analyze settings in which preemption is likely to be associated not only with a significant "winner's advantage" but also with a loss in earnings for the preempted firm. This is likely to be the case in industries where investments in, for example, new technologies may create significant shifts in market shares.

[6]Modeling competition in a more complex way; for example, by introducing a duopoly setting, would

has a perpetual growth option, which it may choose to exercise at an optimal point in time - it faces a classic real options problem. As the firm faces more competitors, λ increases. Thus, when $\lambda \to \infty$, the firm faces a now-or-never decision of investment upon receiving the growth option.[7]

The firm can fund the investment either internally or externally. Internal funds can be accumulated by retaining earnings, which are subsequently invested in a liquid, risk-free, security ("cash") earning the risk-free rate, r. We assume that there is a cost associated with managing the internal funds accumulated (i.e., a cost of carry) denoted δ, and cash holdings at time t are denoted as c_t. The firm can obtain external financing by issuing an amount of equity, f, which is sold to investors in the capital market. However, we assume that the firm is not able to obtain an unlimited amount of financing at any point in time. In addition to dealing with underwriters and the marketing of new securities (Gao and Ritter, 2010), security offerings are subject to inspections by the SEC. Thus, there is a “time-to-finance” (Ma, Mello, and Wu, 2018). Our modeling of time frictions follows that of Hugonnier, Malamud, and Morellec (2015), where firms are subject to capital supply uncertainty and need to search for investors in the capital market.[8] Outside investors who are capable of providing the financing needed arrive according to a Poisson process, N, with a constant exogenous arrival rate, $\Phi \geq 0$.[9]

require us to make additional assumptions about both the level of cash of each of the competing firms and the probability that they discover the same investment opportunity, similar to Lyandres and Palazzo (2015). Given the optimal payout strategy, the level of cash, and the probability of discovery of each firm, one could then determine the probability of preemption, λ. Since such a setting adds significantly to the complexity of the model without qualitatively impacting the main results, we rely on a reduced form approach as in Li and Mauer (2014).

[7]Note that λ is the unconditional probability of preemption and is unrelated to cash. Yet, the conditional probability of a competitor beating the firm to invest (i.e., of preemption occurring prior to an actual investment) is decreasing with cash. Thus, the model captures the fact that holding more cash reduces the risk of preemption.

[8]Capital supply uncertainty introduces both a delay in financing and uncertainty about whether the firm will be able to raise outside funds. Yet, in expected terms, these two parts are equivalent. Moreover, in our theoretical setting, the term “searching for investors” should be interpreted in a broad sense as the aggregate time-to-finance; i.e., the time spent with lawyers, underwriters, and the SEC as well as the actual time in the selling process.

[9]Hence, the probability of meeting an investor in $[t, t + dt]$ is Φdt and the expected time-to-finance is $1/\Phi$.

We assume that investors in the capital market face a zero net present value investment decision about whether to inject capital into the firm or not, and that there is no direct cost associated with obtaining external financing. Hence, all value gains from the equity issuance accrue to the existing shareholders implying that it is always optimal for the firm to pursue external financing.[10] The firm immediately invests when investors arrive and issues as much equity as needed to cover the investment cost and to reach the post-investment optimal level of cash, C_1^*. Finally, to keep the model tractable, the firm does not contract on an exact issuance amount prior to searching. Rather, it is able to continuously adjust the issuance amount, f, in response to changes in its cash holdings.

The firm may at any time choose to pay out earnings or cash to its shareholders. There is no tax on capital income, implying that payouts are valued at par by investors. All of the above assumptions yield the evolution of the firm's stock of cash as

$$\begin{aligned} dc_t =& ((r-\delta)c_t + \mu_0)dt + \sigma dZ_t - dD_t + f_t dN_t - 1_{\{t=T\}} I + 1_{\{t\wedge\tau_p \geq T\}}(\mu_1 - \mu_0)dt \\ &+ 1_{\{t\wedge T \geq \tau_p\}}(\mu_p - \mu_0)dt, \end{aligned} \tag{2}$$

where D_t represents the cumulative payouts to shareholders, f is a non-negative process mirroring the financing raised by the firm, and T denotes the time of investment. The firm's cash holdings are thus increasing with interest earned on the current cash (net of the cost-of-carry) and with outside financing, and are decreasing with payouts to shareholders and with the investment cost. Realized earnings may be both positive and negative, which in turn increases or decreases cash holdings.

The firm is liquidated if it is unable to cover its current obligations (i.e., if cash is depleted).[11] In this case, shareholders are left with a fraction, α, of the risk free value of

[10] The zero NPV assumption corresponds to a Nash bargaining game in which existing shareholders have all the bargaining power. This assumption can be relaxed to introduce a cost of external financing by letting new investors obtain a fraction of the NPV. However, as shown by Hugonnier et al. (2015), allowing for a different distribution of bargaining power only leads to a modification of the jump probability and hence does not provide further insights.

[11] The assumption can be relaxed without qualitatively altering the predictions of the model. Allowing the firm to get costly short-term liquidity would lead to an optimal lower bound as in, e.g., Anderson and Carverhill (2012).

assets-in-place. Thus, the liquidation value is $l_i = \frac{\alpha \mu_i}{r}$, where $i \in \{0, I, P\}$. l_0 denotes the liquidation value prior to preemption or investment, whereas l_I and l_P denote the liquidation value after investment or preemption, respectively. Finally, the time of liquidation is τ_l.

The life of the firm can be separated into two stages, as illustrated in Figure A2. In the first stage, the firm is in possession of a real investment opportunity, which can be financed either internally or externally. The firm is subject to time-to-finance and investment is secured with probability Φ. If the firm successfully invests, it enters the second stage and continues its operations with future expected earnings, μ_1. During the first stage, the firm faces the risk of its investment opportunity being preempted (i.e., lost), which occurs with probability λ. If that happens, it enters the second stage with future expected earnings, μ_p. Last, the firm faces the risk of liquidation due to insufficient cash (i.e., $c_t = 0$) in both the first and second stages.

The firm chooses the optimal investment, T, financing, f, and payout policy, dD_t, to maximize the value of incumbent shareholders. The value of the firm is $V_i(c)$ for $i \in \{0, I, P\}$. $V_0(c)$ represents the ex-ante firm value as a function of cash, whereas $V_P(c)$ and $V_I(c)$ denote the firm value conditioning on either being preempted or on having successfully invested:

$$V_i(c) = \sup_{dD_t, f, T} \mathbb{E}_c \left[\int_0^{\tau_l} e^{-rt}(dD_t - f_t dN_t) + e^{-r\tau_l} \left(l_0 + 1_{\{\tau_l \wedge T > \tau_p\}}(l_P - l_0) + 1_{\{\tau_l \wedge \tau_p > T\}}(l_I - l_0) \right) \right]. \tag{3}$$

The first term represents the present value of dividend payments made to incumbent shareholders until the liquidation time, τ_l, net of new investors' claims on the future earnings. The second term represents the value accruing to shareholders in liquidation, which is dependent on whether the firm has successfully invested or if preemption has occurred.

2.2 Model solution

The above described optimization problem is solved by backwards induction. We start by deriving the optimal payout policy and the corresponding firm value after either investment or preemption has occurred (i.e., for the firm with no growth option). We subsequently use these results to determine the optimal policies of the firm with a growth option in place.

Without a growth option in place, the firm only needs to determine its optimal payout, financing, and liquidation policies. Cash purely serves as a hedge against default. Since the probability of default decreases with the level of cash, so does the marginal value of retaining one extra dollar. As the firm can always pay out cash as dividends valued at par (due to the no-taxes assumption), it is only optimal to retain cash if the marginal value of cash exceeds one. Appendix A.1 in Section 2.4 shows that there exists a threshold, C_i^*, below which the marginal value of cash is larger than one and above which it is equal to one. Thus, it is optimal for the firm to retain cash and to search for investors when $c < C_i^*$ to bring cash holdings back to the target and to pay out any excess cash above C_i^* as dividends. Further, since the marginal value of cash is always larger than one below the threshold, the firm is only liquidated if its cash holdings reach zero.

Consider now the case in which the firm has a growth option in place. The firm may choose both internal and external financing to cover the investment cost. If the firm solely uses external financing, the optimal payout and financing policy is similar to that of the firm with no growth option, and the firm only invests if external financing is obtained prior to preemption. Hence, there exists an optimal level of cash, C_W^*, below (above) which the marginal value of cash is larger than (equal to) one (Appendix A.2). As before, the firm is liquidated if cash is depleted.

If the firm chooses to rely on both internal and external financing, the optimal investment strategy needs to be derived. Since there is a risk of illiquidity default after investing, we conjecture that there exists an optimal investment threshold, $C_H^* \geq I$, at which the firm has enough cash to cover the investment cost and to avoid post-investment default. When cash holdings are below the threshold, it is optimal for the firm to retain cash and search for investors. Thus, the marginal value is no longer strictly decreasing as in the case of no growth option, but rather, it is U-shaped. The intuition is that since the firm faces the risk of preemption, an additional unit of cash increases the conditional probability of financing the project internally prior to preemption. This effect is particularly strong when cash holdings approach the investment threshold, C_H^*, as the firm becomes less constrained by the time-to-finance. Yet, if cash holdings are far from the investment threshold, the benefits from a small increase in the conditional investment probability may be outweighed by the cost-of-carry. Hence, if the investment threshold is very high, the marginal value of cash may be less than one. The intuition is that one additional unit of cash neither reduces the risk of default nor significantly increases the probability of internally financing the investment before preemption occurs.

Since the optimal investment threshold is increasing with the investment cost, such a situation occurs when this cost is high. In this case, if the firm's cash holdings are hit by a series of negative shocks, it is optimal to pay out a lump-sum dividend and to rely only on external financing to fund the investment. We denote the point at which the firm switches to rely on external financing only as C_L^*. Figure A3 illustrates the marginal value of cash, which exhibits a clear U-shape. When cash holdings reach C_L^* from above, the marginal value of cash drops to one. At this point it is optimal for the firm to pay out a lump-sum dividend bringing cash holdings down to C_W^* and switch to only relying on external financing to cover the investment cost. In contrast, when the investment cost is low, the combined benefit from a reduction in default risk and from an increase in the conditional investment probability is large enough to outweigh the cost-of-carry. Intermediate dividends are then never optimal and the optimal strategy is always to rely on both internal and external financing.

Intuitively, there must therefore exist a cut-off, I^* (see Appendix A5. for details), such that for $I < I^*$ it is optimal for the firm to always rely on internal financing. If the investment cost is above the cut-off, the optimal strategy of the firm is to rely on both internal and external financing for cash holdings above some cut-off, C_L^*, and only to pay out a lump-sum dividend and rely only on external financing to cover the investment cost if the firm's cash holdings reach C_L^*. When $I < I^*$, the optimal payout policy follows a standard barrier strategy under which the firm always retains earnings and searches for investors when cash holdings are below the optimal investment threshold, C_H^*. Denote the value function of the firm with a growth option in place as $V_0(c)$. The investment threshold and the corresponding firm value are determined by the following boundary conditions:

$$V_0(0) = l_0 \tag{4}$$

$$V_0(C_H^*) = V_I(C_H^* - I) \tag{5}$$

$$V_0'(C_H^*) = V_I'(C_H^* - I), \tag{6}$$

where condition (4) ensures that the value at default is equal to the liquidation value, and conditions (5) and (6) represent the value matching and smooth-pasting condition at the investment threshold. The solution to the problem is described in Appendix A.3.

Consider now a firm facing $I > I^*$. In this case, it chooses to rely only on external financing to cover the these costs when $c \leq C_L^*$ and is valued according to $V_0(c) = W(c)$ (see Appendix A2 for a derivation of $W(c)$). For $c \geq C_H^*$ the firm invests, and its value equals the post-investment value, $V_0(c) = V_I(c - I)$. When $C_L^* \leq c \leq C_H^*$, both internal and external financing is used and the value function satisfies the following ordinary differential equation (ODE):

$$\begin{aligned} rV_0(c) &= ((r-\delta)C_t + \mu_0)\, V_0'(c) + \frac{\sigma^2}{2} V_0''(c) \\ &\quad + \Phi\left[V_I(C_1^*) + c - C_1^* - I - V_0(c)\right] + \lambda\left[V_P(c) - V_0(c)\right]. \end{aligned} \tag{7}$$

C_L^* and C_H^* are determined via the value matching and smooth-pasting conditions:

$$V_0(C_L^*) = W(C_L^*) \qquad \text{and} \qquad V_0(C_H^*) = V_I(C_H^* - I) \tag{8}$$

$$V_0'(C_L^*) = W'(C_L^*) \qquad \text{and} \qquad V_0'(C_H^*) = V_I'(C_H^* - I). \tag{9}$$

The solution is characterized by Proposition 4.

2.3 Empirical predictions

Figures A6 and A7 illustrate the model's solution and its dependence on time-to-finance and preemption risk. We first analyze the firm's optimal financing strategy. Figure A6 shows that I^* increases with preemption risk and decreases with time-to-finance. Recall that when the investment cost is lower than I^*, firms always find it optimal to rely on internal financing. Thus, firms in high preemption risk industries and with a longer time-to-finance are more likely to use cash to finance their growth opportunities internally for a larger set of investment opportunities.

Next, we consider what happens if the investment cost is larger than I^*. Figure A7 illustrates the optimal thresholds and the value of the firm for two cases: First, if the firm faces no preemption risk, Panels (a) and (b), and second, the case of an expected time-to-preemption of two years, $\lambda = 0.5$, Panels (c) and (d).[12] In case of no preemption, Panel (a) illustrates that the region in which a firm retains cash to fund an investment internally is relatively small, implying that there is a low probability of a firm existing in that region. Combining this with the result that firms facing no risk of preemption have a lower I^* (Figure A6), this indicates that these firms are more likely to rely only on external financing to fund the growth option, and therefore hold less cash.[13] Moreover, Panel (b) shows that the retention regions are increasing moderately with time-to-finance. Hence, even absent any preemption risk, the model predicts a small positive relation between time-to-finance and cash, leading to the first empirical prediction:

Prediction 1: *An increase in time-to-finance leads to an increase in corporate cash*

[12] The interpretation of the figure is as follows: When cash holdings reach C_H^*, the firm invests and covers the cost with internal cash. For cash between C_W^* and C_L^*, the firm both retains earnings and searches for investors to fund the investment. If cash holdings are hit by a series of negative shocks bringing them into the region between C_W^* and C_L^*, it is optimal to pay out a lump-sum dividend until C_W^* is reached. Finally, when cash is below C_W^*, the firm retains cash to avoid illiquidity-induced default and searches for external financing to fund the investment opportunity. Thus, the retention region below C_W^* can be interpreted as the cash held for hedging the risk of liquidation, while the region between C_L^* and C_H^* can be interpreted as the cash held for investment purposes.

[13] This result supports the large strand of literature arguing that firms primarily use cash holdings to hedge illiquidity risk (e.g., Anderson and Carverhill, 2012; Gryglewicz, 2011; Hugonnier et al., 2015). Yet, previous results are based on the assumption that firms have infinite time to wait for external financing.

holdings.

If the assumption of no preemption risk is relaxed, a key result of our paper emerges: The threat of preemption increases a firm's incentive to retain earnings and to use internal cash to fund investments. Panel (c) shows how the risk of preemption shifts the optimal boundaries. Most noticeable is the large increase in the upper retention region between C_L^* and C_H^*. Additionally, from Panel (d) it is clear that the upper retention region increases more compared to the case of no preemption risk. A larger upper retention region implies a higher probability of firms prevailing in that region. Firms existing in this region have higher cash holdings as they also rely on internal financing. Thus, an increase in the size of the upper retention region is likely to lead to an increase in the average level of corporate cash holdings. This implies that even when investment costs are high, firms are more likely to hold cash to finance their growth option internally when they face preemption risk. Thus, the model predicts that firms in high preemption risk industries should react more strongly to changes in the time-to-finance.

Prediction 2: *The effect of time-to-finance on corporate cash holdings is increasing with preemption risk.*

The intuition behind this result is as follows: In case the level of preemption risk increases, the role of cash shifts away from hedging illiquidity risk to hedging the risk of not being able to invest (i.e., underinvestment). Stated differently, by holding cash, the firm lowers its probability of being preempted before financing can be secured, and it can invest faster. The longer time a firm has to wait, the more an investment project is exposed to the possibility of being preempted. Thus, preemption risk makes cash holdings valuable for investments (e.g., Acharya, Almeida, and Campello, 2007; Kisser, 2013). This is in contrast to the results of Hugonnier et al. (2015), who argue that cash is primarily held for hedging illiquidity when investment costs are high. Instead, we argue that cash may be valuable for hedging illiquidity as well as for hedging underinvestment. The relative degree of importance between the two hedging motives depends on the firm's financial constraints and its exposure to preemption risk.

Further implications

Figure A4 depicts the optimal payout and investment thresholds as a function of preemption risk. Panel (a) shows the effect for a shorter time-to-finance ($\Phi = 3$), while Panel (b) provides results for a longer time-to-finance ($\Phi = 1.5$). This figure highlights several interesting results: Firstly, the optimal investment threshold is decreasing with preemption risk, which is in line with the standard result that preemption risk leads to over-investment (e.g., Lambrecht and Perraudin, 2003; Mason and Weeds, 2010). Secondly, the area between C_L^* and C_H^* (i.e., the upper retention region) increases significantly when the firm faces preemption risk. Thus, even very low levels of competition are likely to have a substantial impact. The fact that one does not need arbitrarily high levels of preemption risk to significantly affect the liquidity management policy indicates that our results are very robust and not only driven by a specific choice of parameters. Therefore, an increase in preemption risk should lead to an increase in cash holdings. Thirdly, it can be seen that the upper retention region in Panel (b) increases more than that of Panel (a). Hence, an increase in preemption risk has a stronger effect on cash holdings for financially constrained firms. This further supports our second empirical prediction and the notion that both the effect of preemption risk and of time-to-finance are not uniform across firms. Rather, the two effects reinforce each other, meaning that the effect of preemption risk on corporate cash holdings is increasing with the time-to-finance, and vice versa. Finally, we see that the lower region is reduced as preemption risk increases. This is due to the fact that preemption risk decreases the value of the growth option and thereby of the firm. As the firm value decreases, shareholders are less willing to hold cash for hedging illiquidity risk. This result is in line with e.g., Gryglewicz (2011).

Panel (a) in Figure A8 depicts two further results of the model. First, cash holdings are increasing with earnings volatility. The intuition is that a higher earnings volatility increases the risk of illiquidity default and delays investment, thereby leading firms to have higher levels of cash before actually investing. This prediction is in line with the results of Han and Qiu (2007), who show that financially constrained firms increase their cash holdings in response to an increase in cash flow volatility. Second, cash holdings are decreasing with the cost-of-carry. The simple intuition is that for a given level of cash, the benefits of holding an additional dollar is constant. As the cost of holding cash increases, the firm should optimally choose to reduce its cash holdings, which is consistent with the recent findings of Azar, Kagy, and Schmalz (2016). Hence, firms that are suffering from higher levels of agency problems should optimally hold less cash. This result is also in line with the evidence from the literature on mitigating managerial agency costs (e.g., Harvey, Lins, and Roper, 2004; Kalcheva and Lins, 2007). Panel (b) depicts how a change in the time-to-finance affects cash holdings for different levels of those two variables.[14] Two interesting results emerge: Firstly, the effect of time-to-finance is increasing with earnings volatility. This result is driven by a change in both the upper and lower regions. As earnings become more volatile, both the risk of underinvestment and the risk of default due to illiquidity increase. When these risks are high, firms are more sensitive to a change in the time-to-finance. Hence, changes in the time-to-finance have a larger effect on corporate cash holdings when earnings volatility is high. Secondly, we see that the effect of time-to-finance is decreasing with the cost-of-carry. The cost of holding cash is high when there are significant agency costs of free cash flow; that is, when the firm is poorly governed (Jensen, 1986). Hence, a change in the time-to-finance will only have a minor impact on cash holdings when corporate managerial agency costs are high. One explanation for this could be that managers in poorly governed firms are likely to use the financial flexibility that arises from a reduction in the time-to-finance to extract private benefits, rather than paying out cash to shareholders (Dittmar and Mahrt-Smith, 2007).

[14] The effect of time-to-finance is measured as the aggregate change in the retention regions. The solid (dashed) line represents the case of high (no) preemption risk ($\lambda = 0.5$ and $\lambda = 0$, respectively).

2.4 Model solution

A1. The value of the firm with no growth option

With no growth option in place, cash only serves as a hedge against illiquidity default. Since the probability of illiquidity decreases with the level of cash, so does the marginal value of retaining one extra dollar. The firm can always pay out cash as dividends valued at par because of the no-taxes assumption. Hence, it is only optimal to retain cash within the firm as long as the marginal value of cash exceeds one. We therefore conjecture that there exists an optimal level of cash, C_i^*. At this point, the value of an additional dollar of cash is exactly equal to that of an additional dollar of payouts from the perspective of the shareholders. Since the marginal value of cash is decreasing with the level of cash, it is optimal for the firm to pay out all cash above this threshold. Thus: [15]

$$V_i(c) = c - C_i^* + V_i(C_i^*), \text{ for } c \geq C_i^*, \text{where } i \in \{1, P\}. \tag{10}$$

The value function of the firm satisfies the following ODE over the interval $c \in [0, C_1^*)$:

$$rV_i(c) = ((r-\delta)c + \mu_i)\, V_i'(c) + \frac{\sigma^2}{2} V_i''(c) + \Phi\left[V_i(C_i^*) + c - C_i^* - V_i(c)\right]. \tag{11}$$

Equation (11) is solved subject to the boundary conditions, which leads to Proposition 1:

$$V_i(0) = l_i \tag{12}$$

$$V_i(c) = V_i(C_i^*) + c - C_i^*, \text{ for } c \geq C_i^* \tag{13}$$

$$\lim_{c \uparrow C_i^*} V_i'(c) = 1 \tag{14}$$

$$\lim_{c \uparrow C_i^*} V_i''(c) = 0. \tag{15}$$

[15] Hence, if the firm has an initial level of cash above the target, it should optimally distribute all cash holdings above C_i^* as dividends to shareholders. When cash holdings are below C_i^* it is optimal for the firm to retain all earnings and search for investors in the capital market to bring the cash holdings to a level of C_i^*.

Proposition 1: *The optimal target level of cash, C_i^*, which maximizes the value of the firm with no future growth option, V_i, is the solution to*

$$\gamma_i(C_i^*)F_i(0) + \omega_i(C_i^*)G_i(0) + \frac{\Phi}{\Phi + r}\left(\frac{\delta C_i^* + \mu_i}{r} + \frac{\mu_i + (r-\delta)c}{\Phi + \delta}\right) = l_i, \tag{16}$$

where $i \in \{1, P\}$, and the functions $\gamma_i(c)$ and $\omega_i(c)$ are defined in below. For any level of cash $c < C_i^*$, the value function of a firm with no growth option is

$$V_i(c) = \gamma_i(C_i^*)F_i(c) + \omega_i(C_i^*)G_i(c) + \frac{\Phi}{\Phi + r}\left(V_i(C_i^*) + c - C_i^* + \frac{\mu_i + (r-\delta)c}{\Phi + \delta}\right), \tag{17}$$

where the firm value at the optimal cash target, C_i^*, satisfies $V_i(C_i^*) = \frac{(r-\delta)C_i^* + \mu_i}{r}$.

Figure A3 plots the value of the firm after investment and the corresponding marginal value of cash. [16] In line with the literature on liquidity management (e.g., Anderson and Carverhill, 2012), the firm sets an optimal target level of cash and retains all earnings when cash falls below the target, and pays out all earnings when cash is at, or above.

A2. The value of the firm with external financing only

If the firm relies on external financing only, the role of internal cash is reduced to a hedging tool against illiquidity risk.[17] The solution is similar to that of the firm with no growth option. Since the marginal benefit of cash is decreasing and the marginal cost of holding cash is constant, we assume that there exists an optimal level of cash, C_W^*, at which the marginal cost and benefit of holding cash is equalized. Above this, it is optimal for the firm to pay out all earnings to shareholders in the form of dividends. Hence, if $c \geq C_W^*$, the firm value can be written as

[16] The parameters are similar to Morellec, Nikolov, and Zucchi (2014) and Hugonnier et al. (2015) and are listed in Table A1.

[17] Firms finance themselves with equity only. The model can be extended to include both debt and equity issuances. Yet, a simple debt contract would only lead to a scaling of the expected earnings from μ_0 to $\mu_0 - coupon$. We refrain from such extension, as it does not have any qualitative effect: The results carry over for any type of security that is subject to time-to-finance.

$$W(c) = c - C_W^* + W(C_W^*), \text{ for } c \geq C_W^*. \tag{18}$$

For $c \in [0; C_W^*)$ the value of the firm and the optimal payout policy is given by the solution to:

$$\begin{aligned} rW(c) = ((r-\delta)C_t + \mu_0)\, W'(c) + \frac{\sigma^2}{2} W''(c) \\ + \Phi\left[V_I(C_1^*) + c - C_1^* - I - W(c)\right] + \lambda\left[V_P(c) - W(c)\right]. \end{aligned} \tag{19}$$

When investors arrive, the firm issues sufficient capital to cover the investment cost and to reach the optimal post-investment level of cash, C_1^*. Thus, the incumbent shareholders receive an increase in value equal to the value gain of investing minus the claim of the new investor. Equation (19) is solved subject to the appropriate boundary conditions, which leads to:

Proposition 2: *The value of the firm relying only on external financing can be written as*

$$W(c) = \begin{cases} \gamma_w(C_W^*)F_0(c) + \omega_w(C_W^*)G_0(c), & c \leq C_W^* \\ c - C_W^* + W(C_W^*), & c > C_W^*. \end{cases} \tag{20}$$

The constant C_W^* is the unique solution to: $\gamma_w(C_W^*)F_0(0) + \omega_w(C_W^*)G_0(0) = l_0 - \Theta(0)$.

A3. The value of the firm always relying on internal financing

The firm relying on internal financing must determine its optimal investment threshold C_H^* by solving the following ODE:

$$\begin{aligned} rU(c) = ((r-\delta)C_t + \mu_0)\, U'(c) + \frac{\sigma^2}{2} U''(c) \\ + \Phi\left[V_1(C_1^*) + c - C_1^* - I - U(c)\right] + \lambda\left[V_p(c) - U(c)\right]. \end{aligned} \tag{21}$$

Notice that the terms in (21) and (19) are the same, however, the boundary conditions differ. The value of the firm with cash holdings above the optimal investment threshold, C_H^*, is equal to the value of the firm after investing at a level of cash equal to $c - I$. We can express this as

$$U(c) = V_1(c - I), \text{ for } c \geq C_H^*. \tag{22}$$

The investment policy C_U^* and the corresponding firm value can therefore be found as the solution to equation (21) subject to the boundary conditions, which leads to the below proposition:

$$U(0) = l_0 \tag{23}$$

$$U(c) = V_1(c - I), \text{ for } c \geq C_H^* \tag{24}$$

$$U'(C_U^*) = V_1'(C_H^* - I). \tag{25}$$

Proposition 3: *The value of the firm relying on internal financing is:*

$$U(c) = \begin{cases} \gamma_u(C_H^*)F_0(c) - \omega_u(C_H^*)G_0(c), & c \leq C_H^* \\ V_1(c - I), & c > C_H^* \end{cases} \tag{26}$$

The optimal investment threshold, C_H^*, is the unique solution to

$$\gamma_u(C_H^*)F_0(0) + \omega_u(C_H^*)G_0(0) = l_0 - \Theta(0),$$

where the constants Θ, γ_u and ω_u are given as

$$\gamma_u(c) = \frac{(V_1(c - I) - \Theta(c))G(c) - (V_1'(c - I) - \Theta'(c))G_0'(c)}{F_0'(c)G_0(c) - F_0(c)G_0'(c)}, \tag{27}$$

$$\omega_u(c) = \frac{(V_1(c - I) - \Theta(c))F(c) - (V_1'(c - I) - \Theta'(c))F_0'(c)}{F_0'(c)G_0(c) - F_0(c)G_0'(c)}, \tag{28}$$

$$\Theta(c) = \frac{\Phi+\lambda}{\Phi+\lambda+r}\left(\frac{(r-\delta)c+\mu_0}{\Phi+\lambda+\delta}+c\right)+\frac{\Phi(V_1(C_1^*)-C_1^*-I)}{\Phi+\lambda+r}+\frac{\lambda l_0}{\Phi+\lambda+r} \tag{29}$$

A4. The value of the firm with both internal and external financing

Proposition 4: *The value of the firm with a growth option in place can be written as:*

$$V_0(c) = \begin{cases} W(c), & \text{for } c \leq C_L^* \\ \gamma_v F_0(c) + \omega_v G_0(c) + \Theta(c), & \text{for } C_H^* \geq c \geq C_L^* \\ V_I(c-I), & \text{for } c \geq C_H^*. \end{cases} \tag{30}$$

The optimal switching points $C_L^* \geq C_W^*$, $C_H^* \in [I, C_1^* + I]$, and the constants γ_v and ω_v are the unique solutions to conditions 8.

A5. Optimal investment threshold

Appendix A4 shows that the marginal value of cash is U-shaped. Since the marginal value of cash is increasing with both the risk of default and the probability of investment, intermediate dividend payments are only optimal when the investment threshold C_H^* is sufficiently high. Given that $C_H^* \geq I$, we conjecture that for a sufficiently low investment cost, $I < I^*$, the optimal strategy is to rely on internal financing and the value function is given by $U(c)$ in Proposition 3. For this strategy to be optimal it should be that its value dominates that of any other policy. Specifically, we need that $U(c; C_H^*) \geq W(c, C_W^*)$ for all $c \geq 0$. Since, the value functions follow the same ODE and the same lower boundary condition $U(0) = W(0) = l_0$, we also need that $U'(0, C_H^*) \geq W(0, C_W^*)$.

Suppose instead that $W'(0, C_W^*) > U'(0, C_H^*)$. In this case the optimal strategy is no longer characterized by Proposition 3. Rather, the value function is given by Proposition 4 in which the value function $V_0(c)$ coincides with $W(c)$ for all $c \leq C_W^*$, and C_L^* is chosen to ensure that $V_0(c) \geq U(c)$ for all $c > 0$. Thus, to determine the investment cut-off I^* that makes the firm indifferent between the value functions $U(c)$ and $V_0(c)$ we introduce the following notation $u(c;I) = U(c, C_H^*(I); I)$ and $W(c;I)$ to show the dependence of these functions on the investment cost. As we know that for $U'(0, C_H^*(I); I) \geq W(0;I)$ the optimal strategy is to always rely on internal financing, and for $W'(0;I) > U'(0, C_H^*(I); I)$ the optimal strategy is characterized by Proposition 4, we can determine the investment cut-off I^* as the unique solution to the following condition

$$u'(0;I^*) = W'(0;I^*). \tag{31}$$

For a more rigorous proof we refer the reader to the online appendix of Hugonnier et al. (2015).

■

2.5 Proofs of Propositions

Proof of Proposition 1

The solution to the ordinary differential equation

$$rV_i(c) = ((r-\delta)c + \mu)V_i'(c) + \frac{\sigma^2}{2}V_i''(c) + \Phi\left[V_i(C_i^*) - C^* + c - V_i(c)\right] \tag{33}$$

can be found by first finding a separate solution to the homogeneous and the inhomogeneous parts of the equation. The homogeneous part can be written as

$$(\Phi + r)V_i(c) = ((r-\delta)c + \mu)V_i'(c) + \frac{\sigma^2}{2}V_i''(c).$$

To find a solution we apply a transformation equation to rewrite it on the form of a Kummer's equation for $g(\cdot)$:

$$z(c)g''(z(c)) + (b - z(c))g'(z(c)) - ag(z(c)) = 0.$$

Define the transformation equation $V_i(c) = g(z(c)) = g\left(-\frac{[(r-\delta)C+\mu_i]^2}{(r-\delta)\sigma^2}\right)$ and $z(c) \equiv -\frac{[(r-\delta)c+\mu_i]^2}{(r-\delta)\sigma^2}$. Using this we can express the first and second order differentials as

$$
\begin{aligned}
V_i'(c) = g'(z(c)) &= -\frac{2((r-\delta)c+\mu_i)}{(r-\delta)\sigma^2}(r-\delta)g'(z(c)) = \frac{-2((r-\delta)c+\mu_i)}{\sigma^2}g'(z(c)) \\
V_i''(c) = g''(z(c)) &= \frac{2(r-\delta)}{\sigma^2}g'(z(c)) + \left(-\frac{2((r-\delta)c+\mu_i)}{\sigma^2}\right)^2 + g''(z(c)) \\
&= \frac{2(r-\delta)}{\sigma^2}g'(z(c)) + \frac{4(r-\delta)}{\sigma^2}z(c)g''(z(c)).
\end{aligned}
$$

Inserting this into the homogeneous part of the ODE given by (7), and rearranging, we get

$$
\begin{aligned}
\frac{\Phi+r}{2(r-\delta)}g(z(c)) &= -z(c)g'(z(c)) + \frac{1}{2}g'(z(c)) + z(c)g''(z(c)) \\
z(c)g''(z) &+ (b-z(c))g'(z(c)) - ag(z(c)) = 0,
\end{aligned}
$$

which is Kummer's equation with a and b defined as $a \equiv -\frac{\Phi+r}{2(r-\delta)}$ and $b \equiv \frac{1}{2}$.

A numerical satisfactory solution of the Kummer equation near the origin is given by the combination of two linear independent functions

$$
V_i(c) = \gamma_i F_i(c) + \omega_i G_i(c),
$$

where the functions $F_i(c)$ and $G_i(c)$ are given by

$$
F_i(c) = M\left(a, b, z(c)\right) \quad \text{and} \quad G_i(c) = \frac{(r-\delta)c+\mu_i}{\sqrt{(r-\delta)}\sigma}M\left(a+1-b, 2-b, z(c)\right) \tag{34}
$$

with $M(\cdot)$ representing the Kummer function of the first kind (Abramowitz and Stegun, 1964). We can now complete the proof by finding the particular solution for the inhomogeneous part of the ODE. As the inhomogeneous part is linear in c, we conjecture the following solution:

$$\mathbb{V}(c) = \mathbb{A}c + \mathbb{B}. \tag{35}$$

Inserting this, along with the first and second order derivatives, into equation 7, we get

$$(\Phi + r)(\mathbb{A}c + \mathbb{B}) = ((r - \delta)c + \mu_i)\mathbb{A} + \Phi \left[V_i(C_i^*) + c - C_i^* \right]. \tag{36}$$

For this to hold for all c we need $\mathbb{A}$ and $\mathbb{B}$ to satisfy the following relations:

$$\mathbb{A}((\Phi + r) - (r - \delta)) - \Phi = 0 \quad \text{and} \quad \mathbb{B}(\Phi + r) - \mu_i \mathbb{A} - \Phi(V_i(C_i^*) - C_i^*) = 0.$$

Hence, the approximate solution to equation (7) can be written as

$$V_i(c) = \gamma_i F_i(c) + \omega_i G_i(c) + \frac{\Phi}{\Phi + r} \left(\frac{\mu_i + (r - \delta)c}{\Phi + \delta} + V_i(C_i^*) + c - C_i^* \right),$$

where the two first terms are the solution to the homogeneous part and the third term is the solution to the inhomogeneous part of the ODE. To determine γ_i and ω_i we need to apply the boundary conditions of the reflective barrier problem:

$$V_i(c) = V_i(C_i^*) + c - C_i^*, \text{ for } c \geq C_i^* \tag{37}$$

$$\lim_{c \uparrow C_i^*} V_i'(c) = 1 \tag{38}$$

$$\lim_{c \uparrow C_i^*} V_i''(c) = 0. \tag{39}$$

By applying the smooth-pasting (equation (38)) and high-contact conditions (equation (39)), we get

$$\gamma_i F_i'(c) + \omega_i G_i'(c) + \frac{\Phi}{\Phi+\delta} = 1 \quad \text{and} \quad \gamma_i F_i''(c) + \omega_i G_i''(c).$$

Solving the two equations gives us the functions γ_i and ω_i as

$$\gamma_i(c) = \frac{\delta}{\Phi+\delta}\frac{-G_i''(c)}{F_i''(c)G_i'(c) - F_i'(c)G_i''(c)}, \tag{40}$$

$$\omega_i(c) = \frac{\delta}{\Phi+\delta}\frac{F_i''(c)}{F_i''(c)G_i'(c) - F_i'(c)G_i''(c)}. \tag{41}$$

We can use the following relations between the two linearly independent solutions $F_i(c)$ and $G_i(c)$, which follows from Abel's Identity and the fact that $F_i(c)$ and $G_i(c)$ solve equation (33) (see Hartman, 1964; Hugonnier et al., 2015):

$$F_i'(c)G_i(c) - F_i(c)G_i'(c) = -\frac{\sqrt{(r-\delta)}}{\sigma}e^{-((r-\delta)c+\mu_i)^2/((r-\delta)\sigma^2)} \tag{42}$$

$$F_i''(c)G_i(c) - F_i(c)G_i''(c) = \frac{2\sqrt{(r-\delta)}}{\sigma^3}((r-\delta)c+\mu_i)e^{-((r-\delta)c+\mu_i)^2/((r-\delta)\sigma^2)} \tag{43}$$

$$F_i''(c)G_i'(c) - F_i'(c)G_i''(c) = \frac{2\sqrt{(r-\delta)}}{\sigma^3}re^{-((r-\delta)c+\mu_i)^2/((r-\delta)\sigma^2)}. \tag{44}$$

Hence, we can rewrite γ_i and ω_i as

$$\gamma_i(c) = \frac{-G''(c)\delta e^{((r-\delta)c+\mu_i)^2/((r-\delta)\sigma^2)}}{2\sigma^{-3}\sqrt{(r-\delta)}(\Phi+\delta)(\Phi+r)} \quad \text{and} \quad \omega_i(c) = \frac{F''(c)\delta e^{((r-\delta)c+\mu_i)^2/((r-\delta)\sigma^2)}}{2\sigma^{-3}\sqrt{(r-\delta)}(\Phi+\delta)(\Phi+r)}. \tag{45}$$

■

Proof of Proposition 2

The solution to (46) partly follows from the proof of Proposition 1. Define the transformation equation $W(c) = g(z(c)) = g\left(-\frac{[(r-\delta)C+\mu_0]^2}{(r-\delta)\sigma^2}\right)$. We can then rewrite the homogeneous part as

$$
\begin{aligned}
rW(c) =& ((r-\delta)c+\mu_0)W'(c)+\frac{\sigma^2}{2}W''(c)+\lambda\left[V_P(c)-W(c)\right] \\
&+\Phi\left[V(C_1^*)+c-I-C_1^*-W(c)\right],
\end{aligned}
\tag{46}
$$

on the form of the Kummer equation

$$
z(c)g''(z)+(b-z(c))g'(z(c))-ag(z(c))=0
$$

with a, b, and $z(c)$ defined as $a \equiv -\frac{\Phi+\lambda+r}{2(r-\delta)}$, $\quad b \equiv \frac{1}{2}$, $\quad$ and $\quad z(c) \equiv -\frac{[(r-\delta)c+\mu_0]^2}{(r-\delta)\sigma^2}$. To find a particular solution for the ODE's inhomogeneous part we conjecture the following:

$$
\Theta(c) = \mathbb{A}c + \mathbb{B}. \tag{47}
$$

Inserting this and its first and second order derivatives into equation (46), we get

$$
(r+\lambda+\Phi)(\mathbb{A}c+\mathbb{B}) = ((r-\delta)c+\mu_0)\mathbb{A}+\Phi\left[V_I(C_1^*)+c-C_1^*-I)\right]+\lambda V_P(c). \tag{48}
$$

For this to hold for all c we need $\mathbb{A}$ and $\mathbb{B}$ to satisfy the following relations:

$$
\begin{aligned}
\mathbb{A}((\Phi+\lambda+r)-(r-\delta))-\Phi-\lambda=0 \\
\mathbb{B}(\Phi+\lambda+r)-\mu\mathbb{A}-\Phi(V_I(C_1^*)-C_1^*)-\lambda V_P(c)=0,
\end{aligned}
$$

which we can solve for $\mathbb{A}$ and $\mathbb{B}$. Hence, the general solution of (46) can be approximated by

$$
W(c) = \gamma_w F_0(c) + \omega_w G_0(c) + \Theta(c),
$$

where the third term is the solution to the inhomogeneous part, which can be written as

$$\Theta(c) = \frac{\Phi+\lambda}{\Phi+\lambda+r}\left(\frac{\mu_0+(\Phi+\lambda+r)c}{\Phi+\lambda+\delta}\right)+\frac{\lambda V_P(c)}{\Phi+\lambda+r}+\frac{\Phi}{\Phi+\lambda+r}\left(V_I(C^*)-C_1^*-I\right).$$

By applying the boundary conditions of the reflective barrier, similar to (37), (38), and (38), we get:

$$\gamma_w F_0'(c)+\omega_w G_0'(c)+\Theta'(c)=1 \quad \text{and} \quad \gamma_w F_0''(c)+\omega_w G_0''(c)=0.$$

Note that $\Theta(c)$ is linear in c, and therefore $\Theta''(c)=0$. Solving the two equations gives us the functions γ_w and ω_w as

$$\gamma_w(c)=\frac{-(1-\Theta'(c))G_i''(c)}{F_i''(c)G_i'(c)-F_i'(c)G_i''(c)} \quad \text{and} \quad \omega_w(c)=\frac{(1-\Theta'(c))F_i''(c)}{F_i''(c)G_i'(c)-F_i'(c)G_i''(c)}. \tag{49}$$

■

Proof of Proposition 3

The proof of Proposition 3 follows from the proof of Proposition 2.

A4. The value of the firm with both internal and external financing

Proof of Proposition 4

The proof of Proposition 4 follows from that of Proposition 2. As ODE (21) and (7) are the same, we can perform the equivalent rewriting to the Kummer equation. The only difference lies within the set of boundary conditions. Hence, the solution to the inhomogeneous part is given by

$$\Theta(c) = \frac{\Phi+\lambda}{\Phi+\lambda+r}\left(\frac{\mu_0+(\Phi+\lambda+r)c}{\Phi+\lambda+\delta}\right)+\frac{\lambda V_P(c)}{\Phi+\lambda+r}+\frac{\Phi}{\Phi+\lambda+r}\left(V_I(C^*)-C_1^*-I\right) \tag{50}$$

and the solution to the homogeneous part is given by

$$V_0(c) = \gamma_v F_0(c) + \omega_v G_0(c).$$

Hence, the general solution of equation (7) can be approximated by

$$V_0(c) = \gamma_v F_0(c) + \omega_v G_0(c) + \Theta(c),$$

where γ_v and ω_v are constants to be determined.

The value of the firm with cash holdings above the optimal investment threshold, C_H^*, is equal to the value of the firm after investing at a level of cash equal to $c - I$. We can express this as

$$V_0(c) = V_I(c - I), \text{ for } c \geq C_H^*. \tag{51}$$

The investment policy C_H^* and the corresponding firm value can therefore be found as the solution to equation (7) subject to the boundary conditions:

$$V_0(c) = V_I(c - I), \text{ for } c \geq C_H^* \tag{52}$$

$$V_0'(C_H^*) = V_I'(C_H^* - I). \tag{53}$$

Using the two upper boundary conditions (52)-(53), we can determine the constants γ_v and ω_v as

$$\gamma_v(c) = \frac{(V_I(c-I) - \Theta(c))G(c) - (V_1'(c-I) - \Theta'(c))G_0'(c)}{F_0'(c)G_0(c) - F_0(c)G_0'(c)}, \tag{54}$$

$$\omega_v(c) = \frac{(V_I(c-I) - \Theta(c))F(c) - (V_1'(c-I) - \Theta'(c))F_0'(c)}{F_0'(c)G_0(c) - F_0(c)G_0'(c)}. \tag{55}$$

When $C_L^* > C_W^*$, the investment thresholds C_H^* and the strategy switching threshold C_L^* are given by the unique solutions to the lower boundary conditions 8 and 9. Thus for $c < C_W^*$ the value is equal to $W(c)$ and for $C_L^* < c < C_H^*$ the value is given by $V_0(c)$.

To understand why intermediate dividend payouts may be optimal, consider a firm that always relies on internal financing. Defining the marginal value of cash as $U'(c) = \gamma_u F_0'(c) + \omega_u G_0'(c) + \Theta'(c)$ and plotting this, Figure 2 shows that the marginal value is less than one for some levels of $c \leq C_H^*$. As the firm always has the option to pay out the marginal dollar as dividends, it is optimal to pay out cash in those circumstances. Thus, there exists a region in which the marginal value of cash is less than one, and it may therefore be optimal for the firm to make an intermediate dividend payment to shareholders. To determine if such a strategy exists, we check if $C_L^* > C_W^*$. If $C_W^* >= C_L^*$ it is always optimal for the firm to retain cash and it will only pay dividends subsequent to investing. In this case the investment strategy and value function are given by Proposition 3.

■

2.6 References

Abramowitz, M. and I. A. Stegun (1964). *Handbook of mathematical functions: with formulas, graphs, and mathematical tables.* Number 55. Courier Corporation.

Acharya, V. V., H. Almeida, and M. Campello (2007). Is cash negative debt? A hedging perspective on corporate financial policies. *Journal of Financial Intermediation 16*(4), 515–554.

Anderson, R. W. and A. Carverhill (2012). Corporate liquidity and capital structure. *Review of Financial Studies 25*(3), 797–837.

Azar, J. A., J.-F. Kagy, and M. C. Schmalz (2016). Can changes in the cost of carry explain the dynamics of corporate "cash" holdings? *The Review of Financial Studies 29*(8), 2194–2240.

Baik, B., G. Hoberg, J. Kim, and P. Oh (2017). Shocks to product networks and post-earnings announcement drift. *Working Paper*.

Bates, T. W., K. M. Kahle, and R. M. Stulz (2009). Why do us firms hold so much more cash than they used to? *Journal of Finance 64*(5), 1985–2021.

Dittmar, A. and J. Mahrt-Smith (2007). Corporate governance and the value of cash holdings. *Journal of Financial Economics 83*(3), 599–634.

Gao, X. and J. R. Ritter (2010). The marketing of seasoned equity offerings. *Journal of Financial Economics 97*(1), 33–52.

Gompers, P., J. Ishii, and A. Metrick (2003). Corporate governance and equity prices. *The Quarterly Journal of Economics 118*(1), 107–156.

Gryglewicz, S. (2011). A theory of corporate financial decisions with liquidity and solvency concerns. *Journal of Financial Economics 99*(2), 365–384.

Han, S. and J. Qiu (2007). Corporate precautionary cash holdings. *Journal of Corporate Finance 13*(1), 43–57.

Hartman, P. (1964). Ordinary differential equations. *Classics in Applied Mathematics 38.*

Harvey, C. R., K. V. Lins, and A. H. Roper (2004). The effect of capital structure when expected agency costs are extreme. *Journal of Financial Economics 74*(1), 3–30.

Hoberg, G., G. Phillips, and N. Prabhala (2014). Product market threats, payouts, and financial flexibility. *Journal of Finance 69*(1), 293–324.

Hugonnier, J., S. Malamud, and E. Morellec (2015). Capital supply uncertainty, cash holdings, and investment. *Review of Financial Studies 28 (2)*, 392–445.

Jensen, M. C. (1986). Agency costs of free cash flow, corporate finance, and takeovers. *American Economic Review 76*(2), 323–329.

Kalcheva, I. and K. V. Lins (2007). International evidence on cash holdings and expected managerial agency problems. *Review of Financial Studies 20*(4), 1087–1112.

Kaplan, S. N. and L. Zingales (1997). Do investment-cash flow sensitivities provide useful measures of financing constraints? *The Quarterly Journal of Economics*, 169–215.

Kisser, M. (2013). The real option value of cash. *Review of Finance 17*, 1649–1697.

Lambrecht, B. and W. Perraudin (2003). Real options and preemption under incomplete information. *Journal of Economic Dynamics and Control 27*(4), 619–643.

Lamont, O., C. Polk, and J. Saa-Requejo (2001). Financial constraints and stock returns. *Review of Financial Studies 14*(2), 529–554.

Li, J. Y. and D. C. Mauer (2014). Financing uncertain growth. *Working Paper*.

Lins, K. V., H. Servaes, and P. Tufano (2010). What drives corporate liquidity? An international survey of cash holdings and lines of credit. *Journal of Financial Economics 98*(1), 160–176.

Lyandres, E. and B. Palazzo (2015). Cash holdings, competition, and innovation. *Journal of Financial and Quantitative Analysis (forthcoming).*

Ma, L., A. S. Mello, and Y. Wu (2018). First mover advantage, time to finance, and cash holdings. *Working Paper*.

Mason, R. and H. Weeds (2010). Investment, uncertainty and pre-emption. *International Journal of Industrial Organization 28*(3), 278–287.

Morellec, E., B. Nikolov, and F. Zucchi (2014). Competition, cash holdings, and financing decisions. *Working Paper*.

Whited, T. M. and G. Wu (2006). Financial constraints risk. *Review of Financial Studies 19*(2), 531–559.

3 Further empirical tests

3.1 Matching

To further mitigate the potential of unobservable characteristics influencing the main analysis, we use a matched sample approach as a further robustness check. Using the firm size in the year prior to the introduction of ASR, treated firms with a public float below $2 billion are matched to a set of control firms. This matching results in 217 treated and 250 control firms.

Columns 1-7 of Table A2 depict the summary statistics for the main variables of interest. The matching significantly reduced the differences between the two groups, e.g., the average public float of the treated firms is $1.09 billion for WKSI eligible firms, and $ 418 million for the remaining firms.

Table A3 reports the difference-in-differences estimates of the main regression specification using the full set of control variables as well as year and firm fixed effects. Columns 2 and 3 present the matched sample estimates whereas columns 4 and 5 report the original estimates. The significance and the size of the coefficients stays very similar, both for the overall sample and for the sub-sample of firms that are subject to high preemption risk. Hence, it is unlikely that our results are driven by unobservable differences between the treatment and the control groups.

3.2 Traditional measures of financial constraints

As a next step, we extend the analysis about how distinct time frictions in raising external financing are. One potential worry may arise if time-to-finance is correlated with traditional measures of financial constraints. Stated differently, are those firms that take longer to raise capital also those that are traditionally seen as more financially constrained? All regressions include a large set of firm level control variables as well as time and firm fixed effects to capture the financial stability of firms.[18] We further examine two measures that

[18]Undisclosed results show that controlling for the age of the firms also does not alter the main results.

are commonly used in the literature to proxy for how constrained firms are: the Kaplan and Zingales (1997) and the Whited and Wu (2006) indexes to see whether the effect of the Security Offering Reform of 2005 can be explained by changes in the traditional measures of financial constraints. Table A4 shows that the two indexes do not change around the introduction of the reform of 2005. Hence, in accordance with the recent CFO study of Lins, Servaes, and Tufano (2010), these results confirm the importance of time-to-finance as a distinct reason for holding cash.

3.3 Different treatment and sample-selection boundaries

In the main specification treated firms are defined as firms with a public float of more than $800 million. This criterion can be relaxed. To do so, we reestimate our main specification with a full set of fixed effects and controls for different treatment criteria. We report results for three different cut-off levels: $700, $800, and $900 million.[19] Columns 1-3 in Table A5 depict the results for the full sample, and columns 4-6 report the diff-in-diff-in-diff results that focus on high preemption risk firms. All estimates remain consistent and statistically significant across the different cut-offs.

3.4 Earnings volatility and better governed firms

Next, we empirically examine two of the above described implications, namely that the effect of time-to-finance is stronger both for firms with higher earnings volatility and for better governed firms.

Columns 1-3 of Panel A in Table A6 highlight that firms with higher EBITDA volatility react more strongly to a change in their time-to finance; the coefficient decreases from -2% to -5.1%. Thus, the more risky firms are, the stronger they respond to a decrease in their time-to-finance.[20] Moreover, columns 4-6 verify that this result is reinforced in the high

[19] We refrain from reporting the results using higher cut-off levels, since it is unlikely that firms are able to actively increase more than 30%, as public float is primarily driven by exogenous variation in stock prices. However, untabulated results verify that results still hold for higher cut-off levels.

[20] The results are stable to using the three-year volatility of sales instead.

preemption risk sub-sample.

Panel B differentiates between better-governed firms and their worse-governed counterparts. We use the G Index developed by Gompers, Ishii, and Metrick (2003), which combines 24 governance provisions into one index, as a measure of managerial agency costs. Columns 1 and 4 present the overall effect for the full and the high preemption risk sample, while columns 2-3 and 5-6 present the results for higher levels of corporate governance quality. Consistent with the model's predictions, we document that the effect of time-to-finance increases with corporate governance quality, both in the general and in the high preemption risk sample. Hence, firms with lower managerial agency costs react stronger to a decrease in their time-to-finance.

3.5 Summary statistics for the restricted sample

Table A7 depicts the summary statistics for the restricted sample of firms that have a public float \$250 million and \$2.5 billion. See Section 5.2 in the paper for more details.

4 Definition of variables

Variable	Definition or calculation	Source
Eligibility for the ASR		
Public Float	in million $, hand-collected using the 10-K filings and a text search algorithm	SEC EDGAR
Dependent variable		
Cash	cash and short-term investments *(che)* / total assets *(at)*	Compustat
Control variables		
Size	log(public float)	EDGAR
Sales	sales *(sale)* / total assets	Compustat
R&D Expenses	research and development expense *(xrd)* / total assets	Compustat
Capital Expenditures	capital expenditures *(capx)* / total assets	Compustat
Leverage	book value of debt *(dltt+dlc*)/ total assets	Compustat
Dividends	total dividends *(dvt*)/ total assets	Compustat
Profit	earnings before interest *(ebitda)* / total assets	Compustat
Working Capital	net current assets *(act-ch)* / total assets	Compustat
Tangibility	property, plant and equipment *(ppegt)* / total assets	Compustat
Acquisitions	acquisitions *(aqc)* / total assets	Compustat
Tobin's Q	market value of equity *(prcc_f*csho+dltt+dlc)* / total assets	Compustat
Age	log(firm age in years)	Compustat
HHI	log(Herfindahl-Hirschman Index) based on sales	Compustat
Industry Sigma	mean of the standard deviation of cash flow for the previous 10 years for firms in the same FIC 100 industry (following Bates et al. (2009))	Compustat
Preemption risk		
Avg. R&D Expenses	top percentiles of annual average industry wide R&D expenses, where the industry classification is based on the Fixed Industry Classification (FIC 100)	Hoberg and Phillips Library
Alternative measures of preemption risk		
Fluidity Measure	firm-by-firm product market similarity based on the textual analysis of product descriptions based on the 10-K filings	Hoberg et al. (2014)
Peers	close (remote) peers are firms that share the same TNIC3 code (TNIC2 code but not TNIC3 code)	Baik et al. (2017)
Further variables		
Profit Volatility	3 year moving average of the EBITDA volatility	Compustat
G Index	governance index that combines 24 provisions	Gompers et al. (2003)

5 Tables, and figures

Table A1. Benchmark parameter values

This table lists the benchmark parameter values (Panel A), which are similar to Morellec et al. (2014) and Hugonnier et al. (2015), as well as the optimal thresholds either without a growth option (Panel B), without competition (Panel C), or with competition (Panel D).

Panel A: Benchmark parameters		
Expected earnings (before investment)	μ_0	0.05
Expected earnings (after investment)	μ_1	0.10
Expected earnings (after preemption)	μ_P	0.025
Earnings volatility	σ	0.10
Risk-free rate	r	0.06
Cost-of-carry	δ	0.02
Investment cost	I	0.75
Recovery value	α	0.50
Arrival rate of investors	Φ	1.50
Time-to-finance (in years)	$1/\Phi$	0.66
Probability of preemption	λ	0.50
Panel B: Benchmark optimal thresholds (no growth option)		
Payout threshold (after investment)	C_1^*	0.287
Payout threshold (after preemption)	C_p^*	0.292
Panel C: Benchmark optimal thresholds (no competition, $\lambda = 0$)		
Payout threshold (before investment)	C_W^*	0.319
Internal financing threshold	C_L^*	0.889
Investment threshold	C_H^*	0.931
Panel D: Benchmark optimal thresholds (with competition, $\lambda = 0.5$)		
Payout threshold	C_W^*	0.297
Internal financing threshold	C_L^*	0.582
Investment threshold	C_H^*	0.845

Table A2. Matched sample: Summary statistics

Columns 1-7 of this table depict the matched sample summary statistics for the key variables of interest. Treated firms are are matched to control firms based on their size in the year 2004. All variables are defined in Appendix B.

Variable	Group	Mean	SD	P25	Median	P75
Cash	Treated	0.22	0.20	0.05	0.15	0.35
	Control	0.19	0.19	0.05	0.12	0.27
Public Float	Treated	1330	479	905	1244	1693
	Control	484	134	359	497	595
Sales	Treated	1.04	0.63	0.66	0.92	1.28
	Control	1.00	0.63	0.60	0.89	1.29
R&D Expenses	Treated	0.05	0.07	0.00	0.03	0.08
	Control	0.05	0.07	0.01	0.03	0.08
Capital Expenditures	Treated	0.04	0.04	0.02	0.03	0.06
	Control	0.04	0.03	0.02	0.03	0.06
Leverage	Treated	0.21	0.21	0.02	0.18	0.31
	Control	0.25	0.26	0.02	0.20	0.38
Profit	Treated	0.13	0.10	0.10	0.13	0.18
	Control	0.09	0.13	0.07	0.11	0.15
Working Capital	Treated	0.38	0.16	0.26	0.39	0.49
	Control	0.37	0.15	0.27	0.36	0.47
Tobin's Q	Treated	2.09	1.39	1.17	1.64	2.57
	Control	1.50	0.80	1.01	1.27	1.71
Tangibility	Treated	0.22	0.16	0.09	0.18	0.30
	Control	0.23	0.19	0.09	0.18	0.34
Acquisitions	Treated	0.05	0.09	0.00	0.00	0.05
	Control	0.04	0.08	0.00	0.00	0.04
Industry Sigma	Treated	1.11	4.29	0.09	0.21	0.64
	Control	0.75	1.92	0.07	0.22	0.64
Age	Treated	17.49	11.66	9.00	13.00	24.00
	Control	16.74	11.22	8.00	12.00	24.00

Table A3. Matched sample: Effect of reduced time-to-finance on cash holdings
This table presents the estimates of the full sample fixed-effect regression for both the matched sample approach (columns 2-3) and the regular full sample approach (columns 4-5). The dependent variable is the cash-to-asset ratio measured as cash and short-term investment (che) over total assets (at). All variables are defined in Appendix B. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Matched Sample		*General Sample*	
	All	High Risk	All	High Risk
	Cash	Cash	Cash	Cash
Post x Treat	-0.021**	-0.078**	-0.024***	-0.066***
	(0.010)	(0.036)	(0.006)	(0.021)
R&D	0.129	0.199	0.098**	0.236***
	(0.144)	(0.164)	(0.048)	(0.072)
Sales	-0.064***	-0.145	-0.085***	-0.173***
	(0.018)	(0.104)	(0.012)	(0.039)
Sales growth	-0.061***	-0.049	-0.063***	-0.094***
	(0.017)	(0.063)	(0.009)	(0.030)
Leverage	-0.025	-0.148***	-0.069***	-0.096***
	(0.031)	(0.042)	(0.021)	(0.035)
Dividends	-0.222*	-0.612	-0.186	-0.436**
	(0.126)	(0.533)	(0.129)	(0.208)
Profit	0.018	-0.046	0.099***	0.177***
	(0.075)	(0.105)	(0.028)	(0.055)
Tobin's Q	0.016***	0.016*	0.014***	0.013***
	(0.005)	(0.008)	(0.002)	(0.003)
Public Float	0.006	-0.011	-0.003	-0.008
	(0.007)	(0.019)	(0.004)	(0.008)
Age	0.014	0.371**	-0.073***	-0.032
	(0.039)	(0.155)	(0.020)	(0.051)
Working Capital	0.298***	0.377***	0.174***	0.139***
	(0.047)	(0.065)	(0.023)	(0.034)
HHI	0.005**	0.004	0.005***	0.006
	(0.002)	(0.007)	(0.002)	(0.004)
Capital Expenditures	-0.165	0.332	-0.112*	-0.191
	(0.135)	(0.421)	(0.067)	(0.166)
Tangibility	-0.586***	-0.991***	-0.611***	-0.844***
	(0.109)	(0.287)	(0.052)	(0.140)
Acquisitions	-0.262***	-0.351***	-0.338***	-0.551***
	(0.031)	(0.084)	(0.023)	(0.059)
Industry Sigma	0.000	0.001	0.001**	-0.007
	(0.000)	(0.016)	(0.000)	(0.004)
Year & Firm FE	Yes	Yes	Yes	Yes
N	1832	269	6440	1387
adj. R^2	0.89	0.87	0.89	0.85

Table A4. Traditional measures of financial constraints

This table presents the estimates of the full sample fixed-effect regression for two traditional measures of financial constraints: the Kaplan-Zingales index (columns 2-3) and the Whited-Wu index (columns 4-5). We follow Lamont, Polk, and Saa-Requejo (2001) when calculating the Kaplan-Zingales index, except that we leave out cash, as this changes around the Security Offering Reform of 2005: -1.001909*[(ib + dp)/l.ppent] + 0.2826389*[(at + prcc_f - ceq - txdb)/at] + 3.139193*[(dltt + dlc)/(dltt + dlc + seq)] - 39.3678*[(dvc + dvp)/l.ppent]. The Whited-Wu index is computed at: -0.091*[(ib + dp)/at] - 0.062*dividends indicator + 0.021*[dltt/at] - 0.044*log(at) +0.102*avg. sales growth - 0.035*sales growth. The following variables are included as control variables: Cash, R&D, profitability, Tobin's Q, firm size (except for the Whited-Wu index), working capital, HHI, capital expenditures, tangibility, acquisitions, and industry sigma. All control variables are defined in Appendix B. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Kaplan – Zingales index		*Whited – Wu index*	
	All	*High Risk*	*All*	*High Risk*
Post x Treat	0.127	10.995	−0.013	0.018
	(4.052)	(28.063)	(0.015)	(0.020)
Controls	Yes	Yes	Yes	Yes
Year & Firm FE	Yes	Yes	Yes	Yes
N	6032	879	5985	879
adj. R^2	0.21	0.16	0.55	0.65

Table A5. Robustness checks: Different sample selection criteria

This table presents the estimates of the Fixed-Effect regression for different treatment group cut-off levels. Results are presented for a cut-off of $700 million (columns 1 and 4), $800 million (columns 2 and 5), and $900 million (columns 3 and 6). Columns 1-3 present the results of the full sample. Columns 4-6 report the results for the high preemption risk sample. Treat is an indicator variable equal to one if the firm has a public float higher than the treatment thresholds. To save space, the variable high, which is an indicator variable that is one for firms whose R&D expenditures are in the top quartile and zero for those in the lowest quartile, is not reported. The dependent variable is the cash-to-asset ratio measured as cash and short-term investment (che) over total assets (at). Post is an indicator variable equal to one in the three fiscal years following December 31st, 2005. All other variables are defined in Appendix B. Standard errors are robust and clustered at the firm level. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Full Sample			*High Preemption Risk*		
	$700 Million	*$800 Million*	*$900 Million*	*$700 Million*	*$800 Million*	*$900 Million*
Post × Treat	-0.021^{***}	-0.024^{***}	-0.023^{***}	-0.017^{**}	-0.018^{**}	-0.017^{*}
	(0.006)	(0.006)	(0.006)	(0.008)	(0.008)	(0.008)
Post × Treat × High				-0.034	-0.048^{**}	-0.045^{*}
				(0.023)	(0.023)	(0.024)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
N	6650	6440	6292	3061	2967	2897
adj. R^2	0.89	0.89	0.89	0.92	0.92	0.92

Table A6. Volatility and managerial agency costs

This table presents the estimates of the fixed-effect regression. Columns 1-3 depict the full sample results and column 4-6 report the high preemption risk sub-sample results. Columns 2-3 and 4-5 depict the 50th and 25th percentile of the sales volatility and the G Index distribution. Panel A separates firms according to their three year EBITDA volatility whereas the results in Panel B are based the G Index. The dependent variable is the cash-to-asset ratio measured as cash and short-term investment (che) over total assets (at). Treat is an indicator variable equal to one if the firm has a public float higher than \$800 million. Post is an indicator variable equal to one in the three fiscal years following December 31st, 2005. The log of firm age is included as an additional control variable and all other variables are defined in Appendix B. Standard errors are robust and clustered at the firm level. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Full Sample			*High Preemption Risk*		
	all	50^{th} *percentile*	25^{th} *percentile*	*all*	50^{th} *percentile*	25^{th} *percentile*
Panel A: Volatility						
Post x Treat	-0.024^{***}	-0.039^{***}	-0.050^{**}	-0.066***	-0.081***	-0.072^{**}
	(0.006)	(0.013)	(0.024)	(0.021)	(0.026)	(0.029)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
N	6075	2651	993	1387	1055	756
adj. R^2	0.89	0.86	0.87	0.85	0.86	0.84
Panel B: G-Index						
Post x Treat	-0.026^{**}	-0.032^{**}	-0.056^{***}	-0.085**	-0.109**	-0.165^{**}
	(0.010)	(0.013)	(0.018)	(0.036)	(0.046)	(0.061)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
N	2272	1370	624	369	255	126
adj. R^2	0.88	0.88	0.88	0.83	0.80	0.81

Table A7. Summary statistics for the restricted sample
This table depicts the summary statistics for the variables which are used in the empirical analysis. The treated group refers to firms that have a public float higher than $800 million and lower than $2.5 billion, and the control group depicts firms whose public float is between $250 million and $700 million. All variables are defined in Appendix B.

Variable	Group	Mean	SD	P25	Median	P75
Cash	Treated	0.21	0.19	0.06	0.14	0.30
	Control	0.30	0.25	0.10	0.23	0.46
Public Float	Treated	1394	699	793	1200	1680
	Control	422	256	266	369	542
Total Assets	Treated	1394	1395	560	1018	1618
	Control	489	565	171	335	547
Sales	Treated	1.02	0.62	0.64	0.90	1.28
	Control	0.97	0.64	0.52	0.87	1.24
R&D Expenses	Treated	0.05	0.06	0.00	0.03	0.07
	Control	0.08	0.10	0.01	0.04	0.11
Capital Expenditures	Treated	0.04	0.04	0.02	0.03	0.06
	Control	0.04	0.04	0.01	0.03	0.05
Leverage	Treated	0.20	0.20	0.02	0.18	0.31
	Control	0.18	0.23	0.00	0.07	0.28
Profit	Treated	0.13	0.10	0.10	0.13	0.18
	Control	0.06	0.20	0.03	0.11	0.15
Working Capital	Treated	0.37	0.16	0.26	0.37	0.48
	Control	0.41	0.18	0.29	0.40	0.52
Tobin's Q	Treated	2.07	1.42	1.15	1.60	2.57
	Control	2.22	1.81	1.16	1.66	2.58
Tangibility	Treated	0.22	0.17	0.10	0.17	0.30
	Control	0.18	0.17	0.05	0.12	0.24
Acquisitions	Treated	0.05	0.10	0.00	0.00	0.05
	Control	0.03	0.08	0.00	0.00	0.02
Age	Treated	18.60	12.16	9.00	14.00	30.00
	Control	14.86	10.49	7.00	11.00	20.00
Industry Sigma	Treated	0.97	4.23	0.09	0.21	0.64
	Control	0.91	3.19	0.11	0.23	0.85

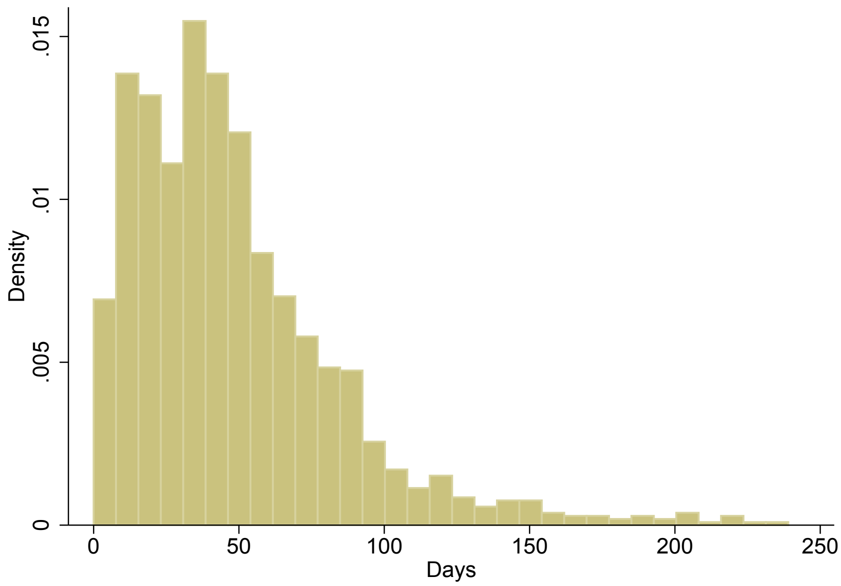

Figure A1. Time between a security offering and the first amendment
This figure depicts the average number of days that elapsed between non-ASR issuances and their first amendment. The time period is 2002-2005.

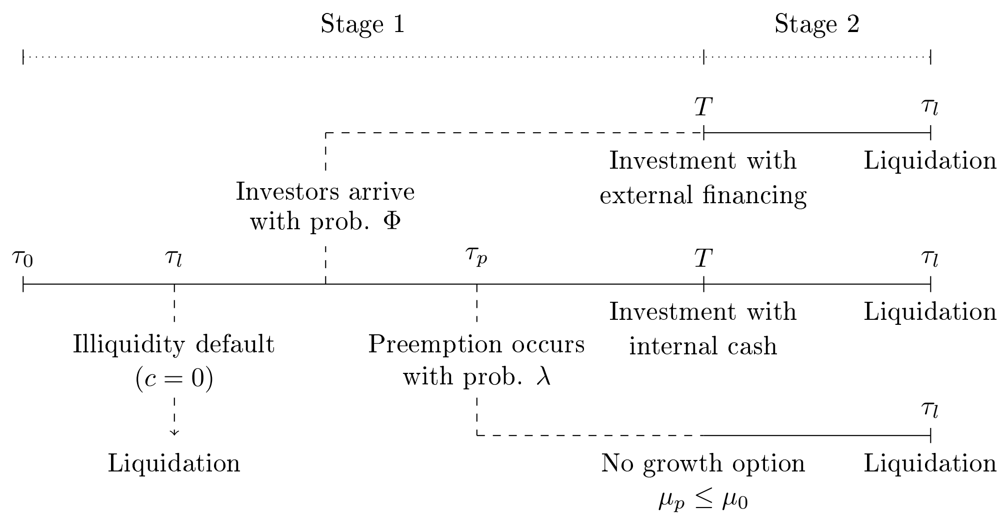

Figure A2. Timeline
This figure presents the timeline and the different stopping times of the firm. In stage 1; that is, before the investment occurs at time T, the firms risks being liquidated due to preemption with probability λ or due to illiquidity. We denote the time of default due to illiquidity as τ_l and the time of preemption as τ_p. The firm may generate sufficient internal funds or meet investors with probability Φ to undertake an investment. Once the firm invests, it enters stage 2 and continues its operations until liquidation occurs at time τ_l. The dashed line indicates that either preemption, the arrival of investors, or illiquidity default may, or may not, occur over the time interval τ_0 to T.

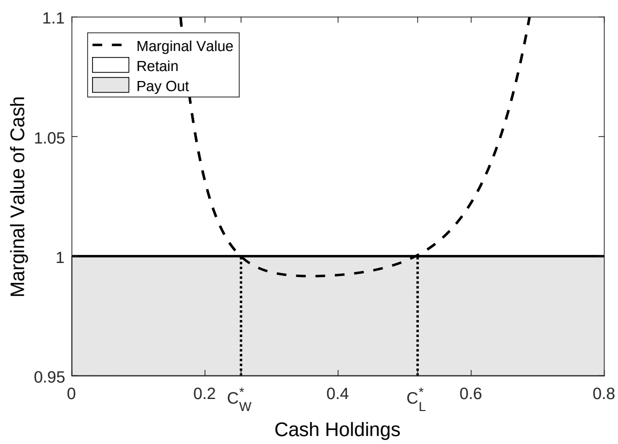

Figure A3. Marginal value of cash
This figure illustrates the marginal value of cash (the dashed line) as a function of the firm's cash holdings, when the firm relies on both internal and external financing. At the lower bound, the marginal value of cash is high, as it alleviates the risk of illiquidity. Correspondingly, the marginal value of cash is high when the firm is close to having enough cash to finance the investment cost internally. As we move away from the default and investment threshold the marginal value of cash decreases. For some levels of cash holdings the marginal value of cash goes below one. Since the firm can pay out cash as dividends valued at par, it will be optimal for the firm to pay out cash as dividends until the marginal value of cash is equal to one.

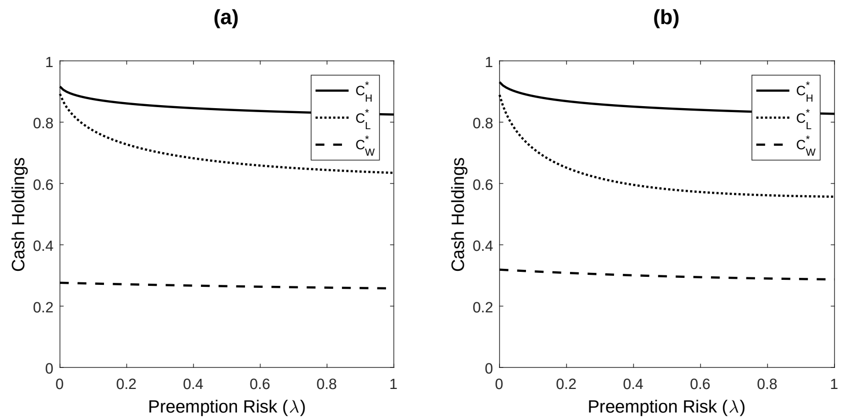

Figure A4. Optimal payout and investment strategies & preemption risk
This figure illustrates the optimal payout and investment thresholds as a function of preemption risk for different levels of time-to-finance. Panel (a) represents the case of a shorter time-to-finance $\Phi = 3$, and Panel (b) illustrates the case of a longer time-to-finance $\Phi = 1.5$. In the area below C_W^* (the dashed line) the optimal policy is to retain earnings and search for investors. In the area between C_W^* and C_L^* (the dotted line) it is optimal for the firm to pay a lump-sum dividend to reduce the cash holdings to C_W^*. Between C_L^* and C_H^* (the solid line) the optimal policy is to retain earnings and to search for investors, and in the area above C_H^* the firm's optimal policy is to invest with interval funds. The area between C_H^* and C_L^* can be interpreted as the cash held for investment purposes, whereas the area below C_W^* can be interpreted as the cash held for hedging illiquidity.

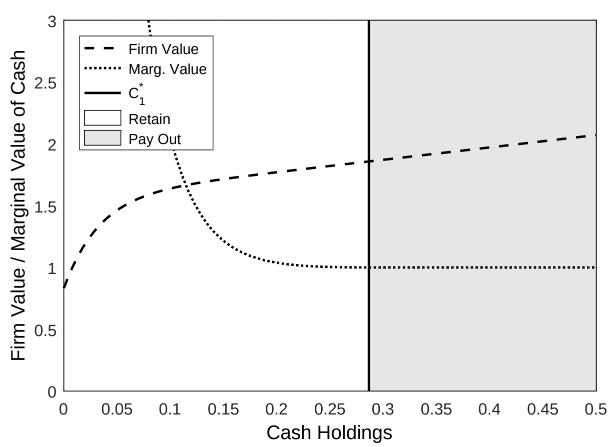

Figure A5. Firm value, marginal value of cash & payout boundary
This figure illustrates the value of the firm (the dashed line) and the marginal value of cash (the dotted line) after an investment occurred, both as a function of cash. The vertical line represents the optimal payout boundary, C_1^*. When cash holdings are lower than C_1^* (the white area), it is optimal for the firm to retain its earnings and to search for investors to reduce the risk of illiquidity. When cash holdings are sufficiently high; i.e. above C_1^* (the gray area), the cost of holding cash outweighs the benefits from a reduced default probability. The firm therefore pays out all cash above C_1^* as dividends. Since there are no taxes, the marginal value of cash payed out as dividends is equal to one.

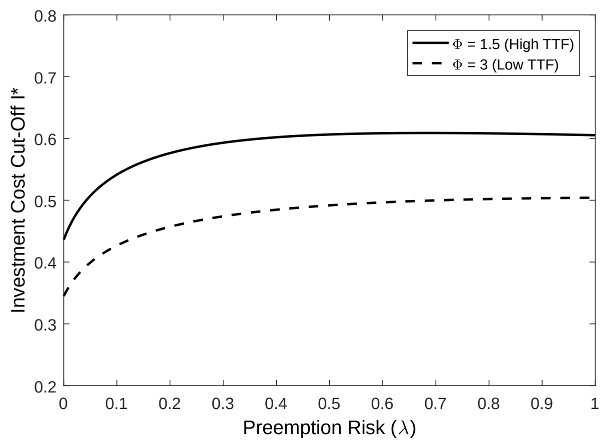

Figure A6. Optimal investment cut-off
This figure depicts the optimal investment cut-off I^* as a function preemption risk. The solid line represents the case of high time-to-finance $\Phi = 3$ and the dashed line the case of low time-to-finance ($\Phi = 1.5$). When $I < I^*$ the firm always rely on internal cash to finance its growth option. If $I > I^*$ the firm uses external financing to cover the investment costs when cash holdings are sufficiently low ($c \leq C_L^*$) and uses internal financing when cash holdings are sufficiently high ($C_L^* \leq c \leq C_H^*$).

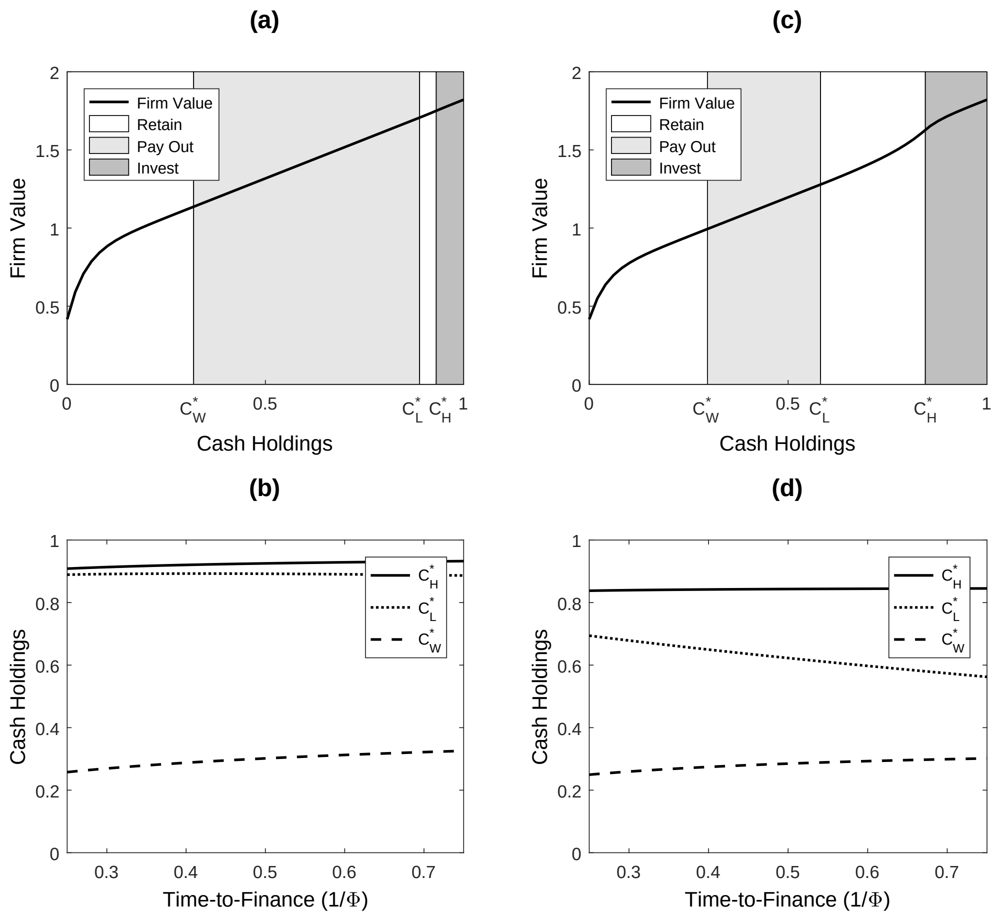

Figure A7. Optimal payout, investment strategies, firm value, and time-to-finance
This figure illustrates the optimal payout and investment thresholds, and the value of the firm as a function of cash. Panels (a) and (b) represent the case of no competition, $\lambda = 0$, and Panels (c) and (d) illustrates the case of $\lambda = 0.5$. The figure can be interpreted as follows: In the regions below C_W^* and between C_L^* and C_H^*, the optimal policy is to retain earnings and to search for investors. The area between C_H^* and C_L^* can be interpreted as the cash held for investment purposes, whereas the area below C_W^* can be interpreted as the cash held for hedging illiquidity. Between C_W^* and C_L^* it is optimal for the firm to pay a lump-sum dividend to reduce the cash holdings to C_W^*. Finally, in the region above C_H^* the firm's optimal policy is to invest with internal financing.

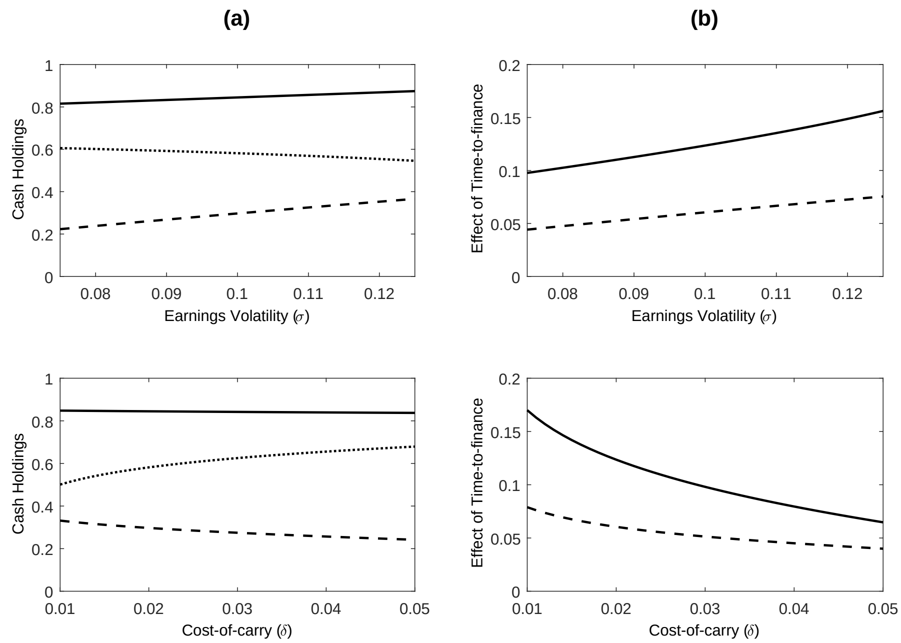

Figure A8. Optimal payout and investment strategies & time-to-finance
Panel (a) depicts the optimal payout and investment strategies as a function of the earnings volatility and the cost-of-carry. The solid line represents the optimal investment threshold C_H^* and the dotted line represents the optimal threshold C_L^* at which the firm switches between relying on both internal and external financing to only rely on external financing. The dashed line represents the optimal payout threshold C_W^* of a firm only relying on external financing. The area between C_H^* and C_L^* illustrates the amount of cash held for investment purposes, whereas the area below C_W^* can be interpreted as the cash held for hedging illiquidity risk. Panel (b) illustrates the effect of a change in the time-to-finance from $\Phi = 3$ to $\Phi = 1.5$ for different levels of earnings volatility and the cost-of-carry. The effect is measured as the aggregate change in retention regions for the the two parameterizations. The solid line represents the case of high preemption risk $\lambda = 0.5$, while the dashed line represents the case of no preemption risk.