LUND UNIVERSITY

SCHOOL OF ECONOMICS AND MANAGEMENT

# Cash Holdings, Secured Debt and Collateral:

## Unencumbered tangibility as financial slack

**Master's Thesis in Corporate Finance**

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# Abstract

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**Five keywords:** Corporate Cash Holdings, Secured Debt, Unencumbered Tangibility, Precautionary Motive, Financial Constraints

**Purpose:** The purpose of this study is to empirically investigate the relationship between unencumbered tangibility and cash holdings, and to evaluate if corporations consider them to be substitutable variables of corporate liquidity.

**Methodology:** The study relies on a panel data set and then employs a firm fixed effect regression model to estimate the strength and direction of the relationship of interest. It then proceeds by dividing up the sample into financially constrained and unconstrained firms to compare the effect this has on the relationship in question. Finally, the sample is divided based on the external credit market conditions of each year.

**Theoretical perspectives:** The theoretical background of this study is based on the established literature on the motives for corporate cash holdings and is complemented with a treatment of the characteristics of secured debt and collateral.

**Empirical foundation**: The sample consists of annual data for firms listed on major US exchanges between 2013-2022.

**Conclusion:** The study finds a statistically and economically significant inverse relationship between unencumbered tangibility and corporate cash holdings. Additionally, it finds that the relationship is amplified by the presence of financing constraints. Taken together, the findings confirm that unencumbered tangibility is a determinant of cash holdings. They also suggest that firms may compensate for the loss of financial and operational flexibility associated with secured debt by holding more cash, which is in accordance with the precautionary motive for cash holding.

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# 1. Introduction

## 1.1 Background and problem discussion

The last few years have been characterized by volatile financial, economic, and political conditions; as illustrated by the onset and evolution of the Covid-19 pandemic, the Russian invasion of Ukraine, and the worldwide runaway inflation and nearly unprecedented interest rate hikes accompanying it. These unstable conditions of the business environment have brought about renewed interest in the role of corporate cash holdings and unencumbered tangibility in the uncertainty-mitigating toolbelt of corporations today.

Furthermore, the outbreak of the Covid-19 virus saw credit markets tightening to an alarming extent, just as the viability of many companies' revenue streams came into serious question. As a result, many companies rushed to the debt markets to shore up capital for the coming crisis, most being required to pledge collateral to an unparalleled degree (Asgari, Smith & Rennison, 2020; Benmelech, Kumar & Rajan, 2022). This rush to shore up cash led to record-breaking cash levels, and, as the pandemic has come under control, a discussion about the usefulness and drawbacks associated with corporate cash holdings (Financial Times, 18 December 2020, Scaggs, 2022).

Corporate cash holdings is a term used to describe liquid assets held on a company's balance sheet and includes actual cash held in bank accounts but also short term investments that can be liquidated quickly and reliably. These are assets that are under the direct control of managers and can be used to finance the daily operations of the company, investments, and debt repayments etc. Unencumbered tangibility refers to the amount of corporate assets that are not currently pledged as collateral and are available to be explicitly pledged as collateral in the process of issuing secured debt (see section 4.2.2).

The literature on the role and determinants of corporate cash holdings dates back to at least the first half of the 20th century with the introduction of the transactions and precautionary motive for cash holdings by Keynes (1936). The idea for the transaction cost motive is that liquid assets allow a company to save on transaction costs associated with selling assets and/or raising external capital while the precautionary motive refers to the absolute availability of internal cash reserves even in the face of external credit rationing.

Subsequent research has developed concepts regarding competitive and operational flexibility motivations in favor of corporate cash holdings (Baskin, 1987; Cossin & Hricko, 2004), as well as agency theory concerns against cash holdings (Jensen & Meckling, 1976). Empirically, further investigations have shown that the precautionary motive dominates in practice, observing that riskier access to external capital and increased risk of cash flow shortfalls are related to higher levels of cash (Opler, Pinkowitz, Stulz & Williamson, 1999; Almeida, Campello & Weisbach, 2004, Bates, Kahle & Stulz, 2009; Harford, Klasa & Maxwell; 2014).

Additionally, the role of secured debt and collateral in determining corporate financial policies has been a trending topic in academic research recently (Berger, Frame & Ioannidou, 2016; Lian & Ma, 2021; Benmelech, Kumar & Rajan, 2021; Benmelech, Kumar & Rajan, 2022; Rampini & Viswanathan, 2022; Luck & Santos, 2022). This literature has, among other things, found attributes such that secured debt is generally cheaper than similarly issued unsecured debt, that it allows firms to avoid credit rationing by lenders but that it also restricts the operational flexibility of the issuing firm. It has also been shown that secured debt is primarily issued by financially constrained firms, with the authors arguing that this is due to an asymmetrical cost-benefit tradeoff between constrained and unconstrained firms.

## 1.2 Purpose and research discussion

As mentioned above, there has been considerable research into the role of corporate cash holdings and secured debt; however, the interrelatedness of these two has not been touched upon so far. In addition, there appears to be significant overlap in the characteristics of cash holdings and unencumbered tangibility, i.e., they both appear to limit the negative effects of external financing constraints and promote operational flexibility. Consequently, the purpose of this study is to empirically investigate the relationship between unencumbered tangibility and cash holdings, and to evaluate if corporations consider them to be substitutable variables of corporate liquidity. This leads us to formulate the following research question:

*Are cash holdings and unencumbered tangibility substitutable aspects of corporate financial liquidity policies?*

## 1.3 Empirical approach and main findings

In order to investigate the research question the study relies on a panel data set of public US companies between 2013 and 2022. We then employ a firm fixed effect regression model to estimate the effect of unencumbered tangibility on corporate cash holding levels. This regression finds statistically significant support for an inverse and economically meaningful relationship between the two variables. Dividing up the sample into financially constrained and unconstrained firms generates the insight that the negative correlation is amplified by the presence of financing constraints. The results are robust to various definitions of the variables, different classification schemes and alternate model specifications.

## 1.4 Contribution

To the best of our knowledge our study is the first to investigate the relationship between corporate cash holdings and unencumbered tangibility. Our results contribute to several strands of the corporate finance literature. First, we have shown that unencumbered tangibility has a significant role in the determination of corporate cash holdings, adding to the extensive extant literature on this topic. Secondly, our results provide additional insights into the implications and usage patterns of secured debt, an area which has seen a renewed interest in the corporate finance research field as of late. Finally, we are also contributing to the vast empirical evidence on the effects of financing constraints on corporate financial policies and behavior.

## 1.5 Disposition

The remainder of the paper is structured as follows. Section 2 provides theoretical background on corporate cash holdings as well as secured debt and collateral. Section 3 provides a summary of previous empirical findings related to the field of study; the section then ends with the development of three empirically testable hypotheses. Following this, section 4 proceeds to describe the data gathering process, the finished sample and the variables used in the study. Section 5 describes the methodological approach and the statistical tests that are carried out. Next, section 6 presents and interprets the results of the main regressions as well as the robustness tests. Section 7 offers an analysis of the previously described results and relates the findings to the existing literature. Finally, section 8 begins with a summary of the whole paper and finishes with a brief discussion about the limitations of the study and suggestions for future research.

# 2. Theoretical Foundation

## 2.1 Cash holdings

### 2.1.1 Agency costs of managerial discretion.

In their seminal paper from 1976 Jensen and Meckling define the concept of agency costs of outside equity. The theory states that investors will demand a discount on equity stakes they acquire in companies due to the risk that the entrepreneur-manager will engage in behavior that does not maximize shareholder wealth. Jensen and Meckling focus on the risk that, as the manager owns an ever-smaller portion of the company, his incentive to engage in the consumption of private perquisites increases. This is because by utilizing firm resources for personal benefits he reaps the full utility of the benefits but only pays for a fraction of the costs. In addition, Opler et al. (1999) further argues that the manager's risk aversion plays a role in the agency costs of managerial discretion problem. This is because the manager likely has a significant portion of their personal wealth tied to the specific company in question, either through their stake in the company or their salary compared to the outside investor, who is assumed to have diversified holdings. The manager is therefore likely to be more risk averse and assumed to shy away from riskier investments even though the net present value may be positive, which incurs an unwanted opportunity cost on the investor.

Jensen (1986) makes the observation that agency costs of managerial discretion are likely to be more pronounced the more resources the manager has available, as they then have the option to use those resources to further their personal agenda. He specifically argues that firms with a lot of free cash flow are especially susceptible to this risk, as managers are then easily able to use this cash flow to maximize their own utility at the expense of shareholders. This misappropriation can take the form of increased consumption of private benefits, precautionary hoarding of cash, leading to underinvestment, or overinvestment in unprofitable projects in order to increase the manager's power base i.e., empire building. While Jensen argues this in relation to free cash flow the arguments are intimately linked and applicable to corporate cash holdings in general.

### 2.2.2 Precautionary and transaction cost motive of cash holdings

Two major motives for corporations to hold cash are to be able to fund their necessary and profitable investments when external financing is not available, as well as to save on transaction costs associated with liquidating assets or raising external financing (Keynes, 1936). In perfect financial markets there are no transaction costs and external financing should always be available at a fair price to meet any financing needs a firm may have. However, Opler et al. (1999) state that there are transaction costs associated with both selling assets and raising external capital. In addition, Myers and Majluf (1984) show that information asymmetries might raise the cost of external financing. These findings mean that the costs associated with liquidating assets or raising external capital can become so high that firms may abandon otherwise positive net present value investments. The precautionary motive states that internal cash holdings are a way to mitigate the negative effects associated with above mentioned financing frictions.

Almeida, Campello and Weisbach (2004) argue that financially constrained firms, i.e., firms for which financing costs are particularly severe or which are fully credit rationed, have more to gain from holding large cash reserves as they are more likely to find themselves with positive NPV investments that can't be financed externally. The same goes for companies with high cash flow volatility as they are more likely to face a shortfall and therefore need to access alternate financing sources to fund their investments needs (Opler et al. 1999).

### 2.2.3 Competitive and operational flexibility motive of cash holdings

In addition to the financial arguments for holding excess cash discussed above, corporations also use cash holdings as a tool to strengthen their competitive strategies. For example, Baskin (1987) presents two ways in which companies use cash holdings as part of their competitive strategy. He calls the first *passive preemption*, but it's more commonly known as the first mover advantage and refers to how the first entrant to a new market is able to create entry barriers and thereby capture monopolistic rents from said market. Large cash holdings facilitate the first mover advantage by allowing firms to respond more quickly to new opportunities, compared to competitors that do not have the required capital immediately available. The second competitive advantage of cash holdings is called the *warfare* incentive, more commonly referred to as the long purse strategy. The idea is that a lot of excess cash sends a credible signal of a firm's ability to counter aggression by competitors and therefore acts as a deterrence against encroachment on the firm's market (Baskin, 1987).

If corporations can use excess cash as a deterrence against predation by competitors there is also the argument of using cash holdings aggressively in the competitive landscape. Froot, Scharfstein and Stein (1993) argue that in certain market conditions it is increasingly profitable for firms to invest when their competitors, due to lack of capital, are forced to underinvest. This argument is empirically supported by Haushalter, Klasa and Maxwell (2007) who find evidence that firms do indeed try to gain market share when their rivals are forced to underinvest. From this perspective cash holdings can be seen as a competitive weapon allowing companies to capitalize on the troubles of their competitors.

Cossin and Hricko (2004) introduced a model for valuing cash holdings as *real options*. The logic is that excess cash allows firms to time their investments (exercise the option) to when the return (payoff) is the greatest. This can be tied to the classic *second-mover advantage* where the late entrant to a market is able to avoid all the pitfalls of the first mover and therefore generate a larger return on investment. Along the same line, Kim and Bettis (2014) argue that significant cash holdings allow firms flexibility in their choice of alternative investments, in the sense of waiting to see which option becomes more attractive. This can be illustrated best by the IT industry, where it can be crucial to choose the right platform to attach your products to.

## 2.2 Secured debt

### 2.2.1 Legal framework and characteristics of secured debt

The establishment of a debt contract generates a claim on the borrower for the creditor. In the case of violation of the terms of the contract, the creditor can force the borrower into bankruptcy with the goal of recovering the value of their claim through the liquidation of the borrower's assets. There is some divergence in the language used when referring to the assets backing up a debt claim in this way; nevertheless, this paper follows Rampini and Viswanathan (2022) and uses "collateral" to refer to any assets that are available to back debt claims.

So far in the description there is no differentiation between secured and unsecured corporate debt as they both are supported by the existence of assets in the borrowing firm. Where secure debt differs is that the creditor in a secured debt contract has a perfected security interest in an identifiable piece, or group, of collateral which grants the secured creditor protection from other creditors claiming that collateral (Bjerre, 1999).

While not a direct effect of the official registration which comes with perfecting a security interest, secured debt also allows the creditor the right to repossess the secured collateral in the case of default, as well as priority in bankruptcy. (Mann, 1997; Bjerre, 1999). The higher priority of the secured lender specifically applies to the pledged collateral or the proceeds from the liquidation of the secured assets up to the value of the creditor's claim. If the sale doesn't generate enough to cover the claim the remainder reverts to a general unsecured claim. Mann (1997) also explains that the vast majority of secured debt contracts contain provisions prohibiting the borrower from selling the pledged collateral without the creditors explicit consent, and combined with the perfection of the security interest this means the creditor has legal recourse to reclaim the collateral in case it is sold despite the provision against it.

### 2.2.2 Agency costs of debt

In the same paper discussed above, Jensen and Meckling (1976) also define the concept of agency costs of debt. In this case the agency conflict of interest is not between owners and managers but instead between shareholders and creditors and is referred to as the "risk-shifting" or "asset substitution" problem. The theory states that managers acting on behalf of shareholders have an incentive to engage in riskier behavior than was suggested when the debt was issued. This incentive is due to the asymmetric risk exposure between creditors and shareholders and would result in an appropriation of value from the creditors to the shareholders. Sophisticated lenders recognize this risk and as a result will either require higher interest rates or limit the amount of capital they are willing to commit, which may prevent the borrower from undertaking otherwise positive NPV investments.

Another agency cost that arises because of outstanding risky debt is the "underinvestment" or "debt overhang" problem that was introduced by Myers in 1977. This problem occurs when management, again acting in the interest of existing shareholders, forgoes positive NPV projects because the share of the value creation accruing to the firm's creditors is enough to make the project unprofitable for the equity holders. This can lead to agency costs of debt by inducing management to make suboptimal investment decisions which decreases the maximum firm value.

Tying into the discussion on the characteristics of secured debt, several authors have argued that secured debt can be an efficient way of mitigating the risk-shifting problem (Smith & Warner, 1979a,b; Stulz & Johnson, 1985; Mann, 1997).

The argument is that the provision included in most secured debt contracts that prohibits the borrower from selling the secured collateral without the permission of the lender will, at least partially, stop the borrower from changing the risk structure of the firm to the creditor's detriment. For example, the firm will not be able to sell the secured asset and replace it with a riskier one unless the creditor makes the assessment that it won't affect the value of the loan negatively. Stulz and Johnson (1985) goes on to show that secured debt may also mitigate the underinvestment problem described above. They describe how, by financing new investments with debt secured by the new assets, it is possible to limit how much of the new project's positive NPV is shared with existing debtholders. This increases the incentives for shareholders to undertake positive NPV investments in the presence of a debt overhang problem. Their analysis also finds that this is more likely to be beneficial for riskier firms.

In essence, through its mitigating effect on the agency costs described above, lenders of secured debt are able to extend financing at a cheaper rate and/or in greater quantity than would be the case if the debt was unsecured.

### 2.2.3 Information asymmetry

The relationship between borrowers and lenders is fraught with information asymmetry problems. These arise because borrowers, knowing more about the business than lenders, can't be assumed to be completely forthcoming about the true state of their business, due to incentives to present their company in the best light possible. This means that creditors must incur costs related to screening, monitoring and misvaluation which they will incorporate into the cost of the loan (Leland & Pyle, 1977). Some examples of the costs associated with information asymmetry are costs related to gathering information on the financial and business conditions of the borrower, costs related to the establishment of contractual clauses governing monitoring of the borrower and costs related to the risk that the lender misjudges the expected loss of the loan.

Benmelech, Kumar and Rajan (2021) argue that secured debt has smaller information costs than unsecured debt. They state that since the claim is secured by specific collateral the lender doesn't have to gather information on the whole firm, and since the collateralized asset is often easier to value correctly, both the information gathering and misvaluation costs are reduced. They also claim that monitoring costs are reduced since secured debt isn't reliant on complex covenants relating to the operations of the firm, which need to be monitored.

In contrast to the above arguments, Mann (1997) argues that the information costs associated with secured debt are higher than for a corresponding unsecured loan. His argument is that the valuation of specific collateral is added on top of the information gathering on the firm as a whole, thereby raising the costs. He also argues that securing debt is a way of giving the lender more power to enforce contractual covenants since it allows the threat of immediately seizing the collateral in case of a technical default. This indicates that not all secured debt is free from covenants and that the value obtained from monitoring is greater. This would increase the frequency and/or depth of the monitoring, thereby increasing the costs. This argument is further supported by Rajan and Winton (1995) who show that in certain circumstances, covenants and collateral can incentivize monitoring. Of course, the costs associated with monitoring need to be weighed against the benefits that come from increased information gathering.

To summarize, the role of secured debt on the information costs associated with borrowing is ambiguous. Some arguments indicate that it could alleviate information costs and credit rationing due to adverse selection and information asymmetry, while others claim that it increases the costs associated with screening and monitoring.

# 3. Empirical Review

## 3.1 Determinants of cash holdings and secured debt

There is a substantial and well-cited literature investigating the determinants of corporate cash holdings (Opler et al., 1999; Bates, Kahle & Stulz. 2009; Harford, Klasa & Maxwell 2014). There is also a significant number of studies empirically examining the usage of secured debt (Berger & Udell, 1989; Benmelech, Kumar & Rajan, 2021; Lian & Ma, 2021 Benmelech, Kumar & Rajan, 2022; Rampini & Viswanathan, 2022; Luck & Santos, 2022).

In their study looking at publicly traded U.S. firms between 1971-1994 Opler et al. (1999) develop a model to investigate the determinants of corporate cash holdings. They find evidence both for a static tradeoff model and for cash holdings as a function of firm performance, i.e., firms weigh the costs and benefits of excess cash, but ceteris paribus, firms that generate higher cash flows also tend to hold more cash.

Their results indicate that growth opportunities and risk are positively correlated with cash holdings while size, leverage and access to external financing has a negative correlation. Combined with the finding that firms primarily decrease cash holdings as a response to cash flow deficits, they argue that the precautionary motive for cash holdings appears to be strong in managers.

The findings mentioned above are generally replicated by Bates, Kahle and Stulz (2009) who shift the sample forward by a decade. In addition, they find that the average cash holding ratio has increased significantly during their sample period, increasing from 0.105 in 1980 to 0.232 in 2006. They argue that the increase is primarily due to shifting firm characteristics such as decreasing inventories and increasing R&D expenditures, which has decreased cash substitutes and increased the costs of external financing respectively. Harford, Klasa and Maxwell (2014) look at a similar sample and find support for the same determinants and trends described before. They also show that the maturity of a firm's long-term debt is negatively correlated with cash holdings and that a shortening of average debt maturities is an additional significant source for the increased average cash holdings observed over the sample period. The cause of the effect they suggest is that higher cash holdings mitigate the increased refinancing risk associated with shorter debt maturities, further supporting the precautionary motive for cash holdings.

Moving over to the empirical literature on secured debt usage, Berger and Udell (1989) investigate a sample of Commercial & Industrial loans originated between 1977 and 1988. They find that 58 % of the loans in their sample were secured by some form of explicit collateral. In a later paper, Benmelech, Kumar and Rajan (2021) show that the usage of secured debt by US firms has steadily decreased since the beginning of the 20$^{th}$ century. This is further supported by Lian and Ma (2021) who use a different classification of debt, but, in essence, shows that secured debt has become rarer in their 2002 to 2018 sample.

Berger and Udell (1989) further find that the secured loans in their sample were, on average, significantly smaller than the unsecured ones. Assuming that smaller companies take smaller loans on average, this finding is also supported by Rampini and Viswanathan (2022) who show, in their 1980 to 2018 sample, that secured debt is more common in smaller firms. The same authors also find that firms with a more tangible asset base both have higher leverage in general and have a higher proportion of secured debt in particular.

Moreover, while not directly investigating secured debt, the results found by Lei, Qui and Wan (2018) are highly relevant to the relationship between cash holdings and secured debt/unencumbered tangibility. The authors find that asset tangibility is negatively correlated with cash holdings. To the degree that higher asset tangibility enables the issuance of more secured debt, this would indicate a negative correlation between unencumbered tangibility and cash holdings as well.

In addition to the literature on when and how secured debt is used, there has also been considerable interest in the pricing of secured debt. Berger and Udell (1989) find that secured debt carries a higher interest rate in general which they interpret as secured debt being riskier than unsecured debt. In a later paper, Berger, Frame and Ioannidou (2016) argue that Berger and Udell's results are due to the selection bias of riskier firms offering security in riskier times. They develop a method of analyzing simultaneous issuances of secured and unsecured debt from the same company to combat this. Using the new methodology, Benmelech, Kumar and Rajan (2022) as well as Luck and Santos (2022) consider US firms from various databases and periods and find that secured debt is in fact cheaper in general. This indicates that controlling for all other variables, secured debt is less risky than unsecured debt.

## 3.2 Financial constraints, cash holdings and secured debt

Many of the studies looking at corporate cash holdings are also interested in whether financially constrained firms behave differently than their unconstrained counterparts. Kim, Mauer & Sherman (1998), Opler et al. (1999) and Bates, Kahle and Stulz (2009) all note that the signs of the coefficients on their variables are generally in line with the prediction that financially constrained firms hold more cash. For example, size and payout ratio are commonly used proxies for financial constraints and they are both negatively associated with cash holdings. In addition, larger R&D expenditures and market to book ratios are generally associated with less access to external financing and these characteristics are both positively associated with cash holdings. Considering that financially constrained firms are more likely to have to pass up on positive NPV projects unless they have saved up internal funds, these findings further support the precautionary motive for cash holdings. This view is also strengthened by the fact that financially constrained firms have been shown to have a higher cash flow sensitivity of cash holdings i.e., they have a stronger propensity to save cash out of cash flow (Almeida, Campello & Weisbach, 2004).

With regards to the trend of increasing cash holdings discussed above Bates, Kahle and Stulz (2009) find that the increase is primarily driven by non-dividend paying firms, a common proxy for financial constraints. Combining this with their observation that R&D ratios and cash flow volatility, factors associated with financial constraints, have increased over the sample period they suggest that financially constrained firms have increased their cash holdings more than unconstrained firms. After dividing their sample of US public firms between 1980 and 2014 into constrained and unconstrained firms based on firm size, Eskandari and Zamanian (2022) find additional evidence for the idea discussed above.

The motivation behind holding excess cash for financially constrained firms has been investigated by Campello, Graham and Harvey (2010). They conduct a survey of 1050 CFOs around the world and find that financially constrained firms mainly utilize cash holdings to maintain their investments when cash flows are lacking. Additionally, Denis and Sibilkov (2010) find that, for financially constrained firms, investment levels are positively associated with cash holdings. They also find that investments are more strongly linked to firm value for firms suffering from external financing frictions which they interpret as support for the validity of the precautionary motive for cash holdings.

Just as with the studies on cash holdings, a lot of the studies on secured debt also look at how financial constraints affect their results. For example, Benmelech, Kumar and Rajan (2021) find that for S&P rated firms between 1985 and 2015, the ratio of secured debt increases down the rating scale. They especially point out that there is a sharp divide between investment and speculative grade firms, with BB+ rated firms having almost a 3 times larger secured debt ratio compared to BBB- rated firms. Rampini and Viswanathan (2022) find very similar results looking at a comparable sample, as does Rauh and Sufi (2010) looking at a more limited 1996 to 2006 sample. Rampini and Viswanathan (2022) also find that firms increase their use of secured debt when they experience a downgrade in their credit rating.

In addition to looking at credit rating, Benmelech, Kumar and Rajan (2021) also divide their sample based on if the firms make payouts to shareholders or not and find similar results. Moreover, as mentioned above, Rampini and Viswanathan (2022) find that smaller firms generally use more secured debt than larger firms and Berger and Udell (1989) find that secured debt is used more by both smaller as well as riskier firms.

Using different proxies for financial constraints, such as: credit ratings, size and riskiness, the studies described above show a clear correlation between the degree of external financing frictions and the usage of secured debt. This pattern is often explained by suggesting that firms prefer not to issue secured debt if they can avoid it but, as they become more financially constrained, they are forced to explicitly collateralize their loans to a larger degree. This is consistent with the fact that riskier firms are more constrained, and that securing debt decreases the risk for the lender.

In line with the findings on how financial constraints affect the usage of secured debt, Benmelech, Kumar and Rajan (2022) find that the pricing of secured debt is highly dependent on the credit rating of the borrowing firm. Their analysis shows that the secured credit premium, the difference in yield between secured and unsecured debt issued by the same company at the same time, is negligible for investment grade firms. In contrast, for speculative grade loans, lenders are willing to pay a significant premium for the added security associated with explicit collateral. The authors also find that the degree of unencumbered tangibility is negatively correlated with the secured credit premium which they interpret as evidence that, as the amount of unpledged collateral backing up unsecured debt decreases, the desirability of having an explicit claim increases. Further support for the idea that lenders value secured debt higher as the riskiness of the borrower increases is found by Luck and Santos (2022) who show that the secured premium is larger for smaller as well as for riskier firms.

## 3.3 Credit conditions, cash holdings and secured debt

Surprisingly, the literature covering how credit conditions affect corporate cash holdings is more limited than the previous sections; however, some empirical investigations have been conducted in this area. Bates, Kahle and Stulz (2009) find that there is a negative correlation between credit market conditions, as measured by the AAA-BBB spread, and cash holdings. Similarly, Harford, Klasa and Maxwell (2014) include the spread between commercial and industrial loans over the federal funds rate in their regressions but don’t find any significance for this variable until they, based on the median of the C&I spread, split their sample into strong and weak credit conditions. When this is done, they find a negative correlation while credit conditions are strong and a positive correlation as credit conditions get weaker.

In addition, Sun and Xia (2022) find that, as credit conditions become more uncertain, companies draw down on their spare debt capacity and hold the proceeds in cash. These findings suggest that firms increase their cash holdings as they get more worried about external credit markets shutting down.

In the regression described above, Harford, Klasa and Maxwell (2014) also find that the relationship between cash holdings and their main explanatory variable, long-term debt maturity structure, is much stronger as credit conditions are worsening. They interpret this as evidence of the fact that an increase in refinancing risk is associated with firms holding larger cash levels. Seeing as refinancing risk is a subset of the factors motivating the precautionary motive for cash holdings, this is further support for that theory.

When it comes to the relationship between secured debt and credit market conditions, Benmelech, Kumar and Rajan (2021) find that the share of secured bonds issuance has shown a clear countercyclical trend over the last century. They argue that this means that lenders require more explicit collateral as credit conditions worsen. They further find that between 1980-2018 the increased share of secured debt issuance during tighter credit conditions is almost entirely driven by speculative grade firms. This is true both in terms of number of issuances and the dollar value of issuances (Benmelech, Kumar & Rajan, 2022). In slight contrast to the findings above, Luk and Zheng (2022) show that the issuance of secured debt is actually trivially procyclical; however, the issuance of unsecured debt is strongly procyclical resulting in the share of secured debt issuance increasing as credit market conditions become weaker. This suggests that, rather than requiring more security when credit conditions worsen, lenders cut back on the amount of unsecured credit that is available. Further support for this can be seen in Benmelech, Kumar and Rajan's (2022) examination of the Covid-19 outbreak where they find that unsecured debt issuance almost drops to zero while firms being able to offer specific collateral were still able to access the credit markets.

Regarding the pricing of secured debt, Benmelech, Kumar and Rajan (2022) find that as credit markets tighten, measured by the Baa-Aaa spread, the secured credit premium increases for speculative grade firms while it remains fairly constant for investment grade secured debt.

## 3.4 Hypothesis development

The precautionary motive for cash holdings states that firms may hold excess cash in order to hedge against the risk that they will not be able to access external financing when they need it the most. Additionally, the operational flexibility argument states that cash holdings allow companies to respond to operational as well as competitive opportunities and challenges in a more flexible manner. The argument that managers consider these motives in their liquidity considerations has found validity in several empirical studies.

These have found that firm characteristics associated with riskier access to external financing and a greater need for operational flexibility, such as smaller size, higher market to book ratios, higher cash flow volatility and larger R&D expenditures are generally positively associated with cash holdings (Opler et al. 1999; Bates, Kahle & Stulz, 2009; Harford, Klasa & Maxwell, 2014).

Relating to the above discussion, the literature on secured debt indicates that unencumbered tangibility, i.e., the presence of pledgeable collateral, serves a similar function as excess cash holdings. We have seen theoretical arguments for how secured debt can stave off credit rationing by mitigating agency and information costs of debt (Stulz & Johnson, 1985; Mann, 1997; Benmelech, Kumar & Rajan, 2021). Combined with Luk and Zheng's (2022) and Benmelech, Kumar and Rajan's (2022) findings that secured debt appears to be available even in tighter credit markets there is a strong argument that unencumbered tangibility increases the financial flexibility of a company. In addition, we have seen that securing debt decreases operational flexibility by limiting the firm's maneuverability with regards to the assets used as explicit collateral (Mann, 1997).

Drawing on the three lines of reasoning above i.e., that cash holdings facilitate operational and financial flexibility, that unencumbered tangibility also facilitates financial flexibility and that secured debt decreases operational flexibility, we hypothesize that as firms issue more debt and their unencumbered tangibility decreases, they hold more cash as a method of maintaining operational and financial flexibility. This results in our first empirical hypothesis:

**H1:** *Firms with less unencumbered tangibility hold more cash.*

In the first hypothesis we already touched on the idea that financial flexibility is a bigger concern for more financially constrained firms. Expanding on that idea, we have seen that there is ample empirical evidence that cash holdings are heavily related to whether a firm is financially constrained or not (Opler et al. 1999; Bates, Kahle & Stulz, 2009; Campello, Graham & Harvey, 2010). We have also seen the same trend with regards to companies' usage of secured debt (Berger & Udell, 1989; Rauh & Sufi, 2010; Benmelech, Kumar & Rajan, 2021; Rampini & Viswanathan, 2022). Both Luk and Zheng (2022) and Benmelech, Kumar and Rajan (2021) further show that the pricing benefit related to securing debt is primarily applicable to financially constrained firms.

Building on the fact that unconstrained firms have very little incentive to issue secured debt, as they will incur a loss in operational flexibility but only a minimal gain in the cost of debt, we expand on our first hypothesize and suggest that an eventual negative correlation between unencumbered tangibility and cash holdings will be stronger for financially constrained firms compared to unconstrained ones. This is the foundation for hypothesis two:

**H2:** *Financial constraints amplify the inverse relation between cash holdings and unencumbered tangibility.*

Taking inspiration from Harford, Klasa and Maxwell's (2014) idea that firms should be more worried about refinancing risk as external credit market conditions worsen, we hypothesize that the relationship between unencumbered tangibility and cash holdings becomes stronger as credit markets get weaker. The logic is based on our premise that companies will increase their cash holdings as their ability to issue secured debt decreases, partly, to maintain their financial flexibility. Bringing together this idea with Luk and Zheng's (2022) findings that the issuance of unsecured debt is strongly procyclical we have a situation where, in times of tight credit conditions, firms without the ability to issue secured debt, i.e., firms without pledgeable collateral, will find it almost impossible to access external credit. Therefore, firms with low unencumbered tangibility should be more concerned about external market conditions and therefore increase their cash holdings more as a response to signs of the credit markets tightening. This leads to the hypothesis that:

**H3:** *As credit conditions worsen, the relationship between unencumbered tangibility and cash holdings becomes stronger.*

# 4. Data and Sample Description

## 4.1 Sample description

To investigate the relationship between cash holdings and unencumbered tangibility, the sample is constructed from S&P Capital IQ as this is the only available database with the necessary data on debt capital structures of firms, including the use of secured and unsecured debt. Further, the sample is restricted to firms incorporated in the United States and to the major US exchanges, including the NYSE, NYSEAM, NASDAQCM, NASDAQGM and NASDAQGS. We retrieve all data regarding all firm years accessible to us via Capital IQ, resulting in a sample consisting of annual data between 2013-2022. Further, firms with non-positive sales or assets are excluded for the years in which they are non-positive in order to exclude inactive firms. Financial firms with Standard Industrial Classification (SIC) codes between 6000-6999 are excluded, as their business has marketable securities as part of their inventories and may also carry cash to meet statutory capital requirements rather than for economic reasons. Utility firms with SIC codes between 4900-4999 are also excluded as the cash holdings of these firms could be subject to regulatory supervision. The final sample consists of an unbalanced panel of 22 072 firm observations with 3 047 unique firms.

Table 1 provides the sample distribution by year and industry. As can be observed, the sample is increasing towards the final years of the sample period. Further, the firms are categorized into industries based on their SIC code.

| Table 1: Sample Distribution by Year and Industry | | |
|---|---|---|
| **Period** | **Observations** | **Proportion** |
| 2013 | 1660 | 7,52% |
| 2014 | 1761 | 7,98% |
| 2015 | 1853 | 8,40% |
| 2016 | 1937 | 8,78% |
| 2017 | 2052 | 9,30% |
| 2018 | 2177 | 9,86% |
| 2019 | 2291 | 10,38% |
| 2020 | 2516 | 11,40% |
| 2021 | 2890 | 13,09% |
| 2022 | 2935 | 13,30% |
| **Total** | **22072** | **100,00%** |

| **Industry** | **Observations** | **Proportion** |
|---|---|---|
| Agriculture, Forestry, Fishing | 86 | 0,39% |
| Mining | 985 | 4,46% |
| Construction | 422 | 1,91% |
| Manufacturing | 11962 | 54,20% |
| Transportation & Public Utilities | 1127 | 5,11% |
| Wholesale Trade | 793 | 3,59% |
| Retail Trade | 1561 | 7,07% |
| Services | 5072 | 22,98% |
| Public Administration | 64 | 0,29% |
| **Total** | **22072** | **100,00%** |

Note: The first table provides provides descriptive statistics regarding the number of observations for each year and the corresponding proportion of the whole sample. The second table provides the same information with regards to the sample distibution across industries.

## 4.2 Variable definition

### 4.2.1 Dependent variable

The dependent variable in the analysis is *cash holdings*. *Cash holdings* have been defined in various ways in prior literature, including as cash to assets, cash to net assets (where net assets is defined as assets minus cash), cash to sales and the log of cash to net assets (Bates, Kahle & Stulz, 2009). In Opler et al.'s paper from 1999, the authors employ the logarithm of cash to net assets as their cash metric. The more recent published paper on cash holdings from Bates, Kahle and Stulz (2009) employs the more traditional measure of cash to assets, arguing that Opler's measure generates outliers for firms with most of their assets in cash. Therefore, this study will follow Bates, Kahle and Stulz's approach and use cash to assets as the metric for cash holdings. In addition, the main regression of the study is reproduced using the logarithm of cash to assets, as it could limit the impact of outliers even further.

Furthermore, this study will follow the agreed upon practice of including cash equivalents and marketable securities in the measurement of cash holdings (Opler et al. 1999; Bates, Kahle & Stulz, 2009; Harford, Klasa & Maxwell 2014). However, as Capital IQ labels marketable securities as short-term investments in their database, *cash holdings* will be defined as cash and short-term investments scaled by total assets.

### 4.2.2 Main explanatory variable

The main explanatory variable of the study is referred to as *unencumbered tangibility*. The variable is meant to be a proxy for the amount of available collateral a firm can pledge as security for secured debt, and is calculated as net property, plant and equipment minus secured debt scaled by total assets. This definition results in the logic that a higher ratio of this metric means that the firm has more pledgeable collateral, and therefore a greater ability to issue secured debt. The variable *unencumbered tangibility* was employed in Benmelech, Kumar and Rajan (2022) where the authors measured the secured premium given a firm's level of pledgeable assets.

### 4.2.3 Control variables

For the control variables this paper will follow Opler et al. (1999), however *acquisition activity* will also be included as Bates, Kahle and Stulz (2009) found a significant relationship between acquisitions and corporate cash holdings, arguing that the variable is, just like *capital expenditures*, a proxy for a firm's level of investment. The variables in this section have all been shown to be significant determinants of corporate cash holdings in one or several of the studies presented in section 3.

**Market to book value** is defined as the book value of assets minus the book value of equity plus the market value of equity scaled by total assets, (BV assets - BV Equity + MV equity)/Assets. The argument for including MTB ratio is that it's a proxy for the likelihood of future positive NPV projects and investment opportunities. Firms with a higher ratio should value cash more and hold higher levels as it's costlier for these firms to be financially constrained (Bates, Kahle & Stulz, 2009).

**Assets** is measured as the natural logarithm of total assets. One argument for including assets is that the transaction cost motive would suggest that there are economies of scale to holding cash. Larger firms, as measured by assets should therefore hold lower levels of cash to assets (Mulligan, 1997).

Moreover, the precautionary motive for cash holdings states that smaller firms should hold larger cash to asset ratios since they are more likely to suffer from information asymmetry problems when raising external capital (Harford, Klasa & Maxwell, 2014).

**Cash flow** is defined as earnings after interest, taxes and dividends, but before depreciation and amortization, scaled by total assets. Cash flow should have a positive impact on a firm's cash holdings as firms with greater cash flows should accumulate more cash all else equal. Opler et al., (1999) and Harford, Klasa and Maxwell (2014) find this to be true, but the results in Bates, Kahle and Stulz (2009) differ.

**Net working capital** is defined as current assets minus current liabilities minus cash and short-term investments, scaled by total assets. This variable has in previous literature had a negative relation with cash holdings (Bates, Kahle & Stulz 2009; Opler et al. 1999; Harford, Klasa & Maxwell, 2014). The argument for a negative relationship is that the assets in NWC can be seen as substitutes to cash, thus firms with higher levels of NWC could easily convert these assets to cash, and therefore not have to use capital markets when there is a cash shortage (Ozkan & Ozkan, 2004).

**Capital expenditures** is measured as capital expenditures scaled by total assets. Bates, Kahle and Stulz (2009) perspective on capital expenditures is that it should decrease cash holdings since the investment will create assets that could be collateralized and thus increase debt capacity and reduce the need for cash as a precautionary motive. Harford, Klasa and Maxwell's (2014) argument is slightly different, in that they simply predict firm's cash holdings to decrease with larger investments due to the fact that these firms are able to accumulate less cash.

**Leverage** is defined as total debt divided by total assets. There are arguments for leverage to be both positively and negatively associated with cash holdings. Based on Bates, Kahle and Stulz's (2009) findings, higher leverage should be associated with lower levels of cash holdings, as firms will use their cash to pay down debt if it's sufficiently constraining. In contrast, Acharya, Almeida and Campello (2007) find that in financially constrained firms, higher leverage is associated with higher cash holdings.

**Industry sigma** is a proxy for industry cash flow risk. The variable is calculated as follows. For each year, the standard deviation of each firm's cash flow is calculated based on the previous three firm years. Further, the standard deviation is then averaged across their 2 digit SIC codes for each year. For the first three years of the sample the standard deviation for the third year has been used, to avoid having to drop the first two years. Moreover, the cash flow metric in this variable is the same as the *cash flow* variable described above. The argument for including cash flow risk as a cash determinant stems from the precautionary motive. Opler et al. (1999) argue that higher cash flow uncertainty entails a greater risk of required capital expenditures exceeding internally generated cash flows, leading to a deficit.

**Research and development** has been calculated as R&D expenditures scaled by total assets. Opler et al. (1999) scale R&D by sales in their paper; however, Bates, Kahle and Stulz (2009) found that their regression results were similar when scaling by total assets instead. Comparing the two metrics, R&D scaled by total assets is employed in the regressions of this paper as some of the firms in the sample with low sales generated severe outliers, whereas the R&D to asset metric didn't. The *R&D* variable is, as *MTB*, a variable proxying for growth opportunities (Harford, Klasa and Maxwell, 2014). Thus, firms with higher R&D should hold higher levels of cash.

**Dividend** is a dummy variable defined as 1 in the years for which a firm has paid a common dividend, otherwise the variable is set to 0. For firms that pay dividends, the precautionary motive should be weaker as these firms are generally assumed to have greater access to capital markets. These firms could also reduce their dividends if funds are needed, compared to firms that don't pay dividends which have to raise funds by other means (Opler et al. 1999). Thus, the dividend metric should be negatively associated with cash holdings.

**Acquisition activity** is calculated as cash acquisition expenditures scaled by total assets. This variable is included in Bates, Kahle and Stulz (2009) and Harford, Klasa and Maxwell (2014) but not in Opler et al. (1999). Nevertheless, as the former authors have found significant results, the acquisition variable will be included in the regressions as well. The economic reasoning behind including acquisition expenditures is the same as for capital expenditures.

### 4.2.4 Additional variables

This section defines the additional variables which are utilized to determine financial constraint levels, the external credit market conditions and to test the robustness of the regression results.

**Firm size** is defined as the revenue of the year and is one of the financial constraint criteria utilized. Firm size has been shown in previous literature to be a useful predictor of financial constraint levels (Hadlock & Pierce, 2010; Almeida, Campello & Weisbach, 2004; Faulkender & Wang, 2006).

**Payout ratio** is defined as common dividends plus common stock repurchases, scaled by net income. Payout ratio is the second financial constraint criteria and has also been found to be a good measure for financial constraints (Almeida, Campello & Weisbach, 2004; Faulkender & Wang, 2006).

**Corporate bond rate spread** is defined as the average yearly spread between the yield on corporate bonds and the federal funds rate. The variable is employed to split the sample into years with "weak" credit conditions and "strong" credit conditions.

A table of the spread can be seen in table 10. Moreover, the variable is also included as a control variable in Model C following Harford, Klasa and Maxwell (2014).

**The logarithm of cash holdings** is defined as the natural logarithm of cash and short-term investments, scaled by assets. The logarithm of cash holdings is employed as an alternative metric for the dependent variable as robustness test, to prevent outliers from unduly affecting the results.

**Unencumbered tangibility II** is defined as Net Property, Plant and Equipment plus inventory plus accounts receivable minus secured debt, scaled by assets. This metric is utilized as an alternative metric for the main explanatory variable to verify the robustness of the regression results. The inclusion of inventory and accounts receivable is motivated by Luck and Santos' (2022) findings that collateralizing accounts receivable and inventories has become more common in recent years.

**Net debt issued** is defined as debt issuance minus debt repurchases scaled by total assets. This variable is included as an additional variable in the robustness test to account for omitted variable bias as the variable has been shown to be a significant determinant of cash holdings (Bates, Kahle & Stulz, 2009).

**Net equity issued** is defined as stock issued minus stock repurchases scaled by total assets. This variable is also included as an additional variable in the robustness test accounting for omitted variable bias, as the variable also has been shown to be a significant determinant of cash holdings (Bates, Kahle & Stulz, 2009).

## 4.3 Summary statistics

### 4.3.1 Descriptive statistics

In table 2, the summary statistics of the variables that will be used in the regressions are presented. In order to deal with the issue of outliers distorting the estimations and inferences drawn, the variables have been winsorized at the 1st and 99th percentile. This is true for all variables except *leverage* which has been winsorized to fall between zero and one, this is in accordance with prior literature (Bates, Kahle, Stulz, 2009).

As observed in the table, the dependent variable *cash holdings* has a mean of 0.238, a lower median of 0.138 and the standard deviation is 0.251.

Moreover, the maximum value is quite high, which could suggest that there are firms in the sample with excessively large cash holdings such as biotech research firms with no other assets than cash. To control for the possibility of these firms biasing the results robustness tests are conducted. Analyzing the main explanatory variable, *unencumbered tangibility*, the mean is 0.062 and the median 0.049. Since this variable is dependent on two values in the numerator, Net PP&E and Secured debt, it is somewhat more difficult to interpret it. A high value could be a result of either high Net PP&E, low usage of secured debt or both, whereas the opposite is true for a low value of the metric. Since the mean is quite low and the minimum value is negative, it suggests that some of the firms in the sample have encumbered more assets than they have available as Net PP&E, which might appear as an error at first glance. This is not surprising though as Net PP&E isn't the only type of asset that a firm can pledge as collateral. For example, Luck and Santos (2022) find that accounts receivable and inventories are common to pledge as well.

Moreover, Benmelech, Kumar and Rajan (2021) find that intangible assets such as brands and patents have increased in their usage as collateral and can nowadays be pledged to a certain extent. Analyzing the control variables, *assets* is right skewed, as the mean is significantly higher than the median. To mitigate this issue, the logarithm of assets is employed in the regression. The mean of *cash flow* is slightly negative at -0.086 and has a median of 0.04. These numbers might seem low but are similar to Opler et al.'s (1999) whose cash flow variable has a mean of 0.037 and median of 0.07. The slight difference could be due to having a sample of different years. Analyzing the dividend ratio, the mean is 0.362, which indicates that about one third of the sample is paying dividends. Comparing the rest of the statistics for the variables, they appear similar to Opler et al.'s (1999).

**Table 2: Descriptive statistics**

| Variable | Firm obs | Mean | Median | SD | Min | Max |
|---|---|---|---|---|---|---|
| ***Dependent:*** | | | | | | |
| Cash holdings | 22072 | 0,238 | 0,138 | 0,251 | 0,001 | 0,946 |
| ***Main explanatory:*** | | | | | | |
| Unencumbered tangibility | 22072 | 0,062 | 0,049 | 0,26 | -0,78 | 0,814 |
| ***Main Controls:*** | | | | | | |
| Market to book value | 22072 | 2,692 | 1,801 | 2,661 | 0,58 | 17,627 |
| Assets (millions) | 22072 | 6686,84 | 887,75 | 18886,61 | 3,37 | 137100 |
| Ln(Assets) | 22072 | 6,666 | 6,789 | 2,29 | 1,215 | 11,828 |
| Cash flow | 22072 | -0,081 | 0,04 | 0,381 | -2,3 | 0,313 |
| Net working capital | 22072 | 0,019 | 0,021 | 0,205 | -0,92 | 0,562 |
| Capital expenditures | 22072 | 0,036 | 0,023 | 0,042 | 0 | 0,239 |
| Leverage | 22072 | 0,263 | 0,228 | 0,234 | 0 | 1 |
| Industry sigma | 22072 | 0,095 | 0,078 | 0,052 | 0,003 | 0,291 |
| R&D | 22072 | 0,048 | 0 | 0,101 | 0 | 0,602 |
| Dividend dummy | 22072 | 0,362 | 0 | 0,481 | 0 | 1 |
| Acquisition activity | 22072 | 0,025 | 0 | 0,062 | 0 | 0,352 |
| ***Additional variables:*** | | | | | | |
| Firm size | 22072 | 4825,79 | 660,85 | 13524,22 | 0,163 | 98375 |
| Payout ratio | 22072 | 0,37 | 0,01 | 1,193 | -4,73 | 6,91 |
| Corporate bond spread | 22072 | 1,604 | 1,529 | 0,634 | 0,772 | 2,829 |
| Logarithm of cash holdings | 22072 | -2,153 | -1,984 | 1,409 | -6,53 | -0,056 |
| Unencumbered tangibility II | 22072 | 0,276 | 0,269 | 0,3 | -0,64 | 0,885 |
| Net debt issued | 22072 | 0,022 | 0 | 0,111 | -0,28 | 0,557 |
| Net equity issued | 22072 | 0,072 | 0 | 0,245 | -0,25 | 1,248 |

Note: The table reports summary statistics for the variables used in the study. For an explanation of the definition and/or construction of each variable, see table 7.

### 4.3.2 Correlation analysis

In table 3, the Pearson correlation matrix is provided. It can be observed that most of the variables are statistically significant at the 1% level. Most of the variables also have the expected signs in terms of their correlation to *cash holdings*. *Unencumbered tangibility* is negatively correlated with cash holdings which is in line with the hypotheses of this paper. *Cash flow* is however also negatively correlated with *cash holdings* which is surprising as the literature would predict the opposite relationship.

The correlation coefficients have been analyzed for issues pertaining to multicollinearity. Considering Wooldridge's (2019) comments that the limit for when multicollinearity is not perfectly defined, the rule of thumb of 0.7 in correlation proposed by Dormann et al. (2013) is followed.

When considering the magnitude of the correlations in the table, there is no relationship that has a correlation above 0.5. Which would suggest that no variable has to be dropped and that the individual predictors can give valid results.

**Table 3: Correlation table**

| Variables | (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) | (k) | (l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (a) Cash holdings | 1 | | | | | | | | | | | |
| (b) Unencumbered tangibility | -0.144*** | 1 | | | | | | | | | | |
| (c) Market to book value | 0.325*** | -0.113*** | 1 | | | | | | | | | |
| (d) Assets | -0.408*** | 0.197*** | -0.221*** | 1 | | | | | | | | |
| (e) Cash flow | -0.364*** | 0.209*** | -0.307*** | 0.506*** | 1 | | | | | | | |
| (f) Net working capital | -0.273*** | 0.089*** | -0.320*** | 0.137*** | 0.461*** | 1 | | | | | | |
| (g) Capital expenditures | -0.222*** | 0.468*** | -0.035*** | 0.086*** | 0.104*** | -0.024*** | 1 | | | | | |
| (h) Leverage | -0.316*** | -0.378*** | 0,01 | 0.229*** | -0.068*** | -0.210*** | 0.046*** | 1 | | | | |
| (i) Industry sigma | 0.429*** | -0.056*** | 0.145*** | -0.207*** | -0.301*** | -0.223*** | -0.093*** | -0.075*** | 1 | | | |
| (j) R&D | 0.404*** | -0.149*** | 0.319*** | -0.333*** | -0.476*** | -0.278*** | -0.100*** | -0.081*** | 0.263*** | 1 | | |
| (k) Dividend dummy | -0.340*** | 0.228*** | -0.140*** | 0.461*** | 0.283*** | 0.170*** | 0.070*** | 0.056*** | -0.234*** | -0.253*** | 1 | |
| (l) Acquisition activity | -0.177*** | -0.119*** | -0.049*** | 0.103*** | 0.083*** | 0.038*** | -0.090*** | 0.089*** | -0.061*** | -0.072*** | 0.041*** | 1 |

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

Note: The table shows the correlation between the variables used in the main regression model. For an explanation of the definition and/or construction of each variable, see table 7.

# 5. Methodology

## 5.1 Econometric methodology

To analyze the predicted negative relationship between unencumbered tangibility and cash holdings, the methodological approach has taken inspiration from Opler et al.'s (1999) model by including control variables which the authors have found to be significant determinants of cash holdings. Furthermore, Bates, Kahle and Stulz (2009) have influenced the choice of metric for cash holdings and in adjusting some of the control variables. When considering the main regression models to apply, much of the previous literature within the field of corporate cash holdings has utilized a pooled OLS with year and industry fixed effects. A firm fixed effects model is also frequently used and occasionally the Fama-Macbeth and the random effects model (Ozkan & Ozkan, 2004; Dittmar, Mahrt-Smith & Servaes, 2003; Subramaniam, Tang, Yue & Zhou, 2011; Opler et al., 1999; Bates, Kahle & Stulz, 2009). The forefront of researchers within the field have been hesitant to use an instrumental variable in their models. As using a poor instrument could yield even worse results than using the OLS, this study will not deviate from that choice (Wooldridge, 2009). In accordance with prior literature, the study will start with the pooled OLS and proceed by including controls for industry and year fixed effects. Following this, a firm fixed effect model is then applied to capitalize on the fact that the sample has a panel data structure. The fixed effect model is chosen over the random effects model as it's supported by the Hausman test shown in table 9. Furthermore, various robustness tests are conducted to deal with potential omitted variable bias and measurement error. Simultaneity is also discussed, and sample splits are constructed to verify the results.

## 5.2 Pooled OLS, fixed effects & standard errors

As mentioned above, the firm fixed effect model is used to take advantage of, and control for, the additional information inherent in a panel data set. Compared to the pooled OLS regressions, the firm fixed effects model can control for unmeasured time invariant factors, also referred to as unobserved heterogeneity. The firm fixed effects model allows for the unobserved heterogeneity to be correlated with the explanatory variables by eliminating the time constant factors completely (Wooldridge, 2009). In order to control for endogeneity resulting from heterogeneity bias, the fixed effect model is used to produce unbiased estimators and increase the robustness of the results. Additionally, year and industry fixed effects will be employed to account for time and industry-related unobserved heterogeneity.

In order to address the risk of heteroskedastic standard errors the White test is conducted. Since the test returns a chi square statistic of 6958.65 and a p-value of 0.000 (see table 8), the null hypothesis of homoscedasticity is rejected. Furthermore, as this paper utilizes a panel data set, the unmeasured factors could be correlated over time. To mitigate these issues, clustered robust standard errors are utilized in all regression models, as it deals with both heteroscedasticity and serial correlation in the error term (Bailey, 2017). The standard errors are primarily clustered by firm which is in accordance with prior literature (Harford, Klasa & Maxwell, 2014; Bates, Kahle & Stulz 2009). Nonetheless, clustering by industry is also done as a control.

## 5.3 Statistical tests

### 5.3.1 Heteroscedasticity

Heteroscedasticity refers to the issue where the variance of the error terms is conditional on the value of the explanatory variables. If this issue is present, the OLS is no longer the best linear unbiased estimator, and the usual standard errors are no longer valid (Bailey, 2017). To establish if heteroscedasticity is present a White test is conducted. The result of the test is given in table 8.

### 5.3.2 Hausman test

To confirm the use of the fixed effects model over the random effects model the Hausman test is conducted. The random effects would only be preferable over the fixed effects model if the unobserved effects are uncorrelated with the explanatory variables in the regression model. Moreover, a rejection of the null hypothesis of the Hausman test would indicate that the correlation isn't zero and that the fixed effect estimates are preferred. Since the null hypothesis is rejected in table 9, the study will proceed with the firm fixed effects model over the random effects model.

## 5.4 Regression models

Given the exposition from the earlier parts of this section, the model to test hypothesis 1 is defined as:

**Model A:**

$$Cash\ holdings = \alpha_0 + \beta_1 Unencumbered\ tangibility_{i,t} + \beta_2 MTB_{i,t} + \beta_3 Assets_{i,t} + \beta_4 Cashflow_{i,t} + \beta_5 NWC_{i,t} + \beta_6 Capex_{i,t} + \beta_7 Leverage_{i,t} + \beta_8 Industry\ sigma_{i,t} + \beta_9 R\&D_{i,t} + \beta_{10} Dividend\ dummy_{i,t} + \beta_{11} Acquisitions_{i,t} + \delta_i + \theta_i + \varepsilon_{i,t} \quad *$$

** ($\delta_i$ represents firm fixed effects while $\theta_i$ represents time fixed effects)*

In order to examine the second hypothesis, firms are classified as financially constrained or unconstrained and analyzed in separate regressions. The coefficients of interest are then compared with a test of equality of coefficients. To accomplish this, the sample is split based on three different financial constraints criteria. The first financial constraint criterion is firm size and is based on the firm's revenue. This has been shown in previous literature to be a useful predictor for financial constraint levels (Hadlock & Pierce, 2010; Almeida, Campello & Weisbach, 2004). Moreover, for each year of the sample period, firms are assigned to the financially constrained (unconstrained) group if their revenue is less (greater) than or equal to the 30$^{th}$ (70$^{th}$) percentile of that year. The second financial constraint criterion is payout ratio which also has been found to be useful in predicting financial constraint levels (Almeida, Campello & Weisbach, 2004; Faulkender & Wang, 2006). Firms are then assigned the same way for this criterion as for firm size.

Finally, the risk that the measures of financial constraints may not perfectly capture the desired characteristics is taken into account by utilizing a combination of the two previous criteria (Farre-Mensa and Ljungqvist, 2016). By combining two measures of financial constraint an even more strict separation can be achieved. Firms are thus assigned to the financially constrained (unconstrained) group for a particular year of the sample period, if they're identified as both constrained (unconstrained) in the firm size and payout ratio measurement for that year. The same regression as in model A is applied to test hypothesis 2 but with the reduced sample of only financially constrained and unconstrained firms. The following model is defined:

**Model B:**

$$Cash\ holdings = \alpha_0 + \beta_1 Unencumbered\ tangibility_{i,t} + \beta_2 MTB_{i,t} + \beta_3 Assets_{i,t} + \beta_4 Cashflow_{i,t} + \beta_5 NWC_{i,t} + \beta_6 Capex_{i,t} + \beta_7 Leverage_{i,t} + \beta_8 Industry\ sigma_{i,t} + \beta_9 R\&D_{i,t} + \beta_{10} Dividend\ dummy_{i,t} + \beta_{11} Acquisitions_{i,t} + \delta_i + \theta_i + \varepsilon_{i,t}$$

To test the third hypothesis, a similar procedure as described in the previous paragraph is followed. The conditions of the credit markets are measured by calculating the spread between corporate bonds and the federal funds rate based on the average rate for each year. Inspiration is taken from Harford, Klasa and Maxwell (2014) who used the Commercial & Industrial loan spread in their study; however, the report listing the C&I spread was discontinued halfway through the sample of this study, leading to the use of the average corporate bond spread as a substitute. The sample is then split by assigning the three years with the highest spread as years with "weak" credit conditions while the three years with the lowest spreads were assigned as "good" credit conditions. These are then the two sample groups that are used in the regressions. The complete list of the yearly corporate bond spreads can be found in table 10.

The first two regressions will utilize firm fixed effects in accordance with the previous argumentation. In addition, a pooled OLS controlling for industry fixed effects is also utilized following Harford, Klasa and Maxwell (2014). Furthermore, both of these two models will include the corporate bond spread for each year as a control variable, also in accordance with Harford, Klasa and Maxwell (2014). Since the corporate bond spread is a macro variable which is collinear with the year controls, the year controls are omitted from the regressions. The resulting model is defined below:

**Model C:**

$$Cash\ holdings = \alpha_0 + \beta_1 Unencumbered\ tangibility_{i,t} + \beta_2 MTB_{i,t} + \beta_3 Assets_{i,t} + \beta_4 Cashflow_{i,t} + \beta_5 NWC_{i,t} + \beta_6 Capex_{i,t} + \beta_7 Leverage_{i,t} + \beta_8 Industry\ sigma_{i,t} + \beta_9 R\&D_{i,t} + \beta_{10} Dividend\ dummy_{i,t} + \beta_{11} Acquisitions_{i,t} + \beta_{12} Spread_{i,t} + \delta_i + \varepsilon_{i,t}$$

## 5.5 Robustness tests

To validate the results of the regressions various robustness tests are conducted. Firstly, as mentioned previously, an alternative metric, *unencumbered tangibility II,* will be utilized as the main explanatory variable. The concern is that the first definition isn't capturing the economic factor of interest, seeing as secured debt can be collateralized by not only Net PP&E but also other assets such as accounts receivable and inventory. This metric is employed for regressions concerning hypothesis 1 and 2. Another robustness test will be to include additional control variables to mitigate the risk for omitted variable bias and endogeneity. The variables *net debt issued* and *net equity issued* will be introduced as they have been shown to be significant determinants of cash holdings (Bates, Kahle & Stulz, 2009). Since capital raises tend to be done as discrete occurrences while capital expenditures are usually a more continuous process, we hypothesize that firms should have more cash immediately after raising capital as they have not immediately spent the money just raised. Thus, these variables are included to capture the effect of firms having unusually high cash holdings as a result of raising funds that will be spent in the future.

Furthermore, we observe that the sample includes outliers for cash holdings and the firms in the sample with particularly large cash holdings are quite different from the other firms in the sample, it raises concern that these firms could create results unrepresentative of the rest of the sample. Therefore, we also reproduce the regressions of hypothesis 1 utilizing the logarithm of cash holdings instead of levels, this is done to prevent these outliers from having an unduly strong impact on our results. For a similar type of robustness check for the regressions concerning hypothesis 2, we eliminate the fourth quartile of cash holders in the sample and re-estimate the results. As financial constraints are known to be positively correlated with corporate cash holdings, the procedure is done after the sample has been divided into constrained and unconstrained firms in order to not risk eliminating a majority of the financially constrained firms.

## 5.6 Simultaneity

One issue which Opler et al. (1999) present in their cash holding methodology is that of simultaneity, that some of the cash determinants are determined jointly with cash holdings. Further, the simultaneous determination could cause endogeneity as it could result in the estimates of the model to be inconsistent. Opler et al.'s (1999) approach to address this issue is to omit the variables that could be problematic.

It is however not possible to proceed like this in our model as we then would omit the main explanatory variable. Nonetheless, exploring simultaneity between *unencumbered tangibility* and *cash holdings* suggests that it isn't an issue. An issue with simultaneity for our model would mean that unencumbered tangibility not only influences cash holdings, but that cash holdings also influence unencumbered tangibility. To argue why this is implausible, we can examine unencumbered tangibility consisting of Net PP&E and secured debt. It is not realistic that an increase in a firm's cash holdings would cause a firm to sell off PP&E or take on more secured debt (why take on more debt if you have an increase in cash?). Moreover, if a firm's cash holdings decrease, it also isn't plausible that the firm would invest in PP&E as a result. Nevertheless, there could be an argument that a firm will try to decrease their usage of secured debt if their cash holdings decrease, in line with the precautionary motive, but this would be difficult with a decrease in cash holdings.

# 6. Empirical Results

## 6.1. Regression results relating to hypothesis 1

**Table 4: Regression results**

| Model | A1 | A2 | A3 | A4 | A5 |
|---|---|---|---|---|---|
| Method | OLS | OLS | FE | FE | FE |
| **Dependent variable** | Cash holdings | Cash holdings | Cash holdings | Cash holdings | Cash holdings |
| Unencumbered tangibility | -0.125*** | -0.115*** | -0.096*** | -0.095*** | -0.095*** |
| | (0.012) | (0.014) | (0.015) | (0.015) | (0.024) |
| Market to book value | 0.013*** | 0.013*** | 0.003*** | 0.002** | 0.002*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.000) |
| Assets | -0.009*** | -0.011*** | -0.011*** | -0.009** | -0.009** |
| | (0.002) | (0.002) | (0.004) | (0.004) | (0.004) |
| Cash flow | -0.013 | 0.002 | 0.044*** | 0.042*** | 0.042*** |
| | (0.010) | (0.009) | (0.009) | (0.008) | (0.014) |
| Net working capital | -0.192*** | -0.209*** | -0.078*** | -0.079*** | -0.079*** |
| | (0.016) | (0.017) | (0.017) | (0.017) | (0.024) |
| Capital expenditures | -0.616*** | -0.486*** | -0.470*** | -0.449*** | -0.449*** |
| | (0.050) | (0.051) | (0.046) | (0.047) | (0.080) |
| Leverage | -0.355*** | -0.356*** | -0.229*** | -0.222*** | -0.222*** |
| | (0.015) | (0.016) | (0.015) | (0.015) | (0.029) |
| Industry sigma | 1.189*** | -0.011 | 0.088* | 0.129** | 0.129** |
| | (0.059) | (0.060) | (0.048) | (0.051) | (0.052) |
| R&D | 0.307*** | 0.297*** | -0.148*** | -0.127*** | -0.127 |
| | (0.037) | (0.036) | (0.045) | (0.045) | (0.081) |
| Dividend dummy | -0.052*** | -0.052*** | -0.006 | -0.003 | -0.003 |
| | (0.005) | (0.005) | (0.004) | (0.004) | (0.004) |
| Acquisition activity | -0.484*** | -0.426*** | -0.235*** | -0.240*** | -0.240*** |
| | (0.020) | (0.020) | (0.014) | (0.014) | (0.032) |
| Constant | 0.294*** | 0.372*** | 0.399*** | 0.360*** | 0.360*** |
| | (0.013) | (0.120) | (0.026) | (0.030) | (0.027) |
| Year controls | No | Yes | No | Yes | Yes |
| Industry controls | No | Yes | No | No | No |
| Firm fixed effects | No | No | Yes | Yes | Yes |
| Standard errors | Clustered (firm) | Clustered (firm) | Clustered (firm) | Clustered (firm) | Clustered (industry) |
| Observations | 22,072 | 22,072 | 22,072 | 22,072 | 22,072 |
| Number of firms | 3,047 | 3,047 | 3,047 | 3,047 | 3,047 |
| Adjusted R-squared | 0.487 | 0.524 | 0.117 | 0.131 | 0.131 |

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

Note: The table presents results for regressions A1-A5, all with *Cash Holdings* as the dependent variable. Regression A1 utilizes a Pooled-OLS model. Regression A2 applies Year and Industry controls to the Pooled-OLS. Regression A3 utilizes Firm Fixed Effects. Regression A4 applies Year controls to the Firm Fixed Effects. Finally, regression A5 utilizes a Firm Fixed effect with Year controls. Regressions A1-A4 employ clustering by firm. Regression A5 employs clustering by industry. For an explanation of the definition and/or construction of each variable, see table 7.

Table 4 presents the results of the five regression models for which the objective is to test hypothesis 1, whether unencumbered tangibility is a determinant of cash holdings. As can be observed, the table consists of five different regressions, utilizing both the statistical model of Pooled OLS and firm fixed effects.

Four of the five regressions are clustered by firm and are initially not controlling for year or industry fixed effects, but as the table progresses these controls are included. The fifth regression is clustered by industry to confirm the robustness of the results. In model A4 the majority of the variables obtain statistical significance, with only the variable *dividend dummy* being statistically insignificant. As for the economic significance, most of the control variables in the firm fixed effects models have the same economic magnitude as in Bates, Kahle and Stulz (2009) which utilizes the same cash holding metric as this paper. Nonetheless, the *R&D* variable has a slightly larger economic effect, but this is a consequence of the decision to utilize assets in the denominator and not sales. Moreover, the signs of the coefficients are in line with Bates, Kahle and Stulz (2009) except for *assets* and the *dividend dummy*, but the differences are extremely small and therefore trivial. Moreover, all the signs except R&D are in accordance with the literature review for the control variables.

Moving on to analyzing the results of the main explanatory variable *unencumbered tangibility*, statistical significance is obtained in all five regressions at the 1% level. Moreover, the relationship to cash holdings is negative and therefore in accordance with hypothesis 1. As the coefficient is -0.095 in model A4, a decrease of 10 percentage points in *unencumbered tangibility* is associated with an increase of 0.95 percentage points in *cash holdings*. Moreover, a decrease of one standard deviation in *unencumbered tangibility* is associated with an increase of 2,47 percentage points in *cash holdings*. Which signifies that *unencumbered tangibility* has a noticeable economic impact on corporate cash holdings as it represents more than a 10% increase over the mean of *cash holdings* which is 0.238.

To analyze the robustness of the relationship, table 11 provides three additional regression results using a different metric for unencumbered tangibility, then for cash holdings, and finally controlling for more variables. Further, the models apply firm fixed effects and the standard errors are clustered at the firm level. Analyzing the results, the relationship between *unencumbered tangibility* and *cash holdings* is still statistically significant at the 1% level in all of the three regression models. Moreover, when utilizing the alternative metric for unencumbered tangibility, the economic significance even increases. When controlling for net equity issue and net debt issue, the economic significance decreases somewhat, but is still quite high.

Utilizing the logarithm of cash holdings as the dependent variable continues to provide a notable economic relationship. Since the statistical and economic significance still are valid given these tests, it can be concluded that the results relating to hypothesis 1 are robust.

## 6.2. Regression results relating to hypothesis 2

**Table 5: Regression results**

| | Firm Size | | Payout Ratio | | Payout Ratio & Firm Size | |
|---|---|---|---|---|---|---|
| | Constrained | Unconstrained | Constrained | Unconstrained | Constrained | Unconstrained |
| Model | B1 | B2 | B3 | B4 | B5 | B6 |
| **Dependent variable** | Cash holdings | Cash holdings | Cash holdings | Cash holdings | Cash holdings | Cash holdings |
| Unencumbered tangibility | -0.193*** | -0.073*** | -0.130*** | -0.040* | -0.195*** | -0.095*** |
| | (0.027) | (0.015) | (0.020) | (0.021) | (0.028) | (0.019) |
| Market to book value | 0.003** | 0.001 | 0.002** | -0.002 | 0.003** | -0.001 |
| | (0.001) | (0.002) | (0.001) | (0.002) | (0.001) | (0.002) |
| Assets | 0.014* | -0.028*** | -0.004 | -0.032*** | 0.010 | -0.031*** |
| | (0.007) | (0.005) | (0.005) | (0.008) | (0.007) | (0.009) |
| Cash flow | 0.028*** | 0.020 | 0.029*** | 0.119** | 0.025** | 0.055 |
| | (0.010) | (0.018) | (0.009) | (0.049) | (0.011) | (0.050) |
| Net working capital | -0.070*** | -0.244*** | -0.039** | -0.236*** | -0.051** | -0.277*** |
| | (0.023) | (0.028) | (0.019) | (0.034) | (0.023) | (0.031) |
| Capital expenditures | -0.547*** | -0.374*** | -0.462*** | -0.499*** | -0.555*** | -0.502*** |
| | (0.084) | (0.060) | (0.072) | (0.078) | (0.098) | (0.101) |
| Leverage | -0.332*** | -0.076*** | -0.264*** | -0.090*** | -0.329*** | -0.077*** |
| | (0.028) | (0.017) | (0.020) | (0.022) | (0.029) | (0.022) |
| Industry sigma | 0.168 | 0.044 | 0.136 | 0.151*** | 0.181 | 0.110 |
| | (0.157) | (0.048) | (0.105) | (0.057) | (0.184) | (0.067) |
| R&D | -0.061 | 0.110 | -0.113** | -0.391** | -0.075 | -0.106 |
| | (0.047) | (0.212) | (0.045) | (0.167) | (0.047) | (0.268) |
| Dividend dummy | 0.013 | -0.007 | 0.002 | -0.010 | -0.010 | 0.000 |
| | (0.014) | (0.005) | (0.006) | (0.008) | (0.018) | (0.007) |
| Acquisition activity | -0.446*** | -0.149*** | -0.326*** | -0.236*** | -0.434*** | -0.196*** |
| | (0.049) | (0.014) | (0.029) | (0.022) | (0.056) | (0.024) |
| Constant | 0.428*** | 0.414*** | 0.426*** | 0.445*** | 0.469*** | 0.441*** |
| | (0.043) | (0.049) | (0.037) | (0.067) | (0.046) | (0.089) |
| Method | FE | FE | FE | FE | FE | FE |
| Year controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry controls | No | No | No | No | No | No |
| Firm fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Standard errors | Clustered (firm) | Clustered (firm) | Clustered (firm) | Clustered (firm) | Clustered (firm) | Clustered (firm) |
| Observations | 6,627 | 6,618 | 10,703 | 6,618 | 5,706 | 3,764 |
| Number of firms | 1,313 | 938 | 2,488 | 1,486 | 1,260 | 743 |
| Adjusted R-squared | 0.168 | 0.144 | 0.144 | 0.168 | 0.169 | 0.180 |

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

Note: The table presents results for regressions B1-B6, all with *Cash Holdings* as the dependent variable. All regressions employ Firm Fixed Effects, Year controls and Standard Errors clustered by firm. In regressions B1-B2 the sample has been split into constrained (unconstrained) based on the 30th (70th) percentile of Total Revenue. In regressions B3-B4 the sample has been split into constrained (unconstrained) based on the 30th (70th) percentile of Payout Ratio. In regressions B5-B6 the sample has been split into constrained (unconstrained) based on if the firm was both in the 30th (70th) percentile of Total Revenue and Payout Ratio. For an explanation of the definition and/or construction of each variable, see table 7.

Table 5 provides the regression results to analyze hypothesis 2, whether the inverse relationship between cash holdings and unencumbered tangibility amplifies as a result of financial constraints. Moreover, the regressions have been conducted based on three different financial constraint criteria, including firm size, firm payout ratio and the combination of the two. The model which is utilized for all the regressions applies firm fixed effects, year controls and clustering at the firm level.

The main explanatory variable *unencumbered tangibility* is still statistically significant in all of the six regressions, and at the 1% level in five of them. Moreover, when analyzing the economic significance for *unencumbered tangibility*, the significance is considerably larger for financially constrained firms compared to unconstrained firms, this holds across the three financial constraint criteria. The difference is also statistically significant when utilizing a test of equality between the coefficients, as observed in table 12. For the division based on the firm size criterion, the economic effect is -0.193 for constrained firms compared to -0.073 for unconstrained firms. Compared to the regression based on the full sample, the economic relationship is stronger for constrained firms and weaker for unconstrained firms. Consequently, the results are in accordance with hypothesis 2 since the results show a significantly stronger inverse relationship between unencumbered tangibility and cash holdings for firms that are financially constrained compared to unconstrained.

To analyze the robustness of the results, table 13 provides six additional regressions based on the firm size criteria. Regression B7 and B8 utilizes the alternative measure for unencumbered tangibility for both constrained and unconstrained firms. As can be observed, the economic difference is even greater, as the coefficient is -0.337 for constrained firms and -0.121 for unconstrained. When including controls for net debt issue and net equity issue, the difference is still significant. Further, the results are also robust to eliminating the sample of firms with cash holdings in the top quartile. Finally, all the tests of equality are significant at the 1% level, showing the strength of the results (table 12).

## 6.3. Regression results relating to hypothesis 3

**Table 6: Regression results**

| | Credit conditions | | Credit conditions | |
|---|---|---|---|---|
| | Strong | Weak | Strong | Weak |
| Model | C1 | C2 | C3 | C4 |
| **Dependent variable** | Cash holdings | Cash holdings | Cash holdings | Cash holdings |
| Unencumbered tangibility | -0.099*** | -0.096*** | -0.097*** | -0.115*** |
| | (0.023) | (0.025) | (0.017) | (0.017) |
| Market to book value | -0.000 | 0.003 | 0.013*** | 0.012*** |
| | (0.001) | (0.002) | (0.001) | (0.002) |
| Assets | -0.018*** | -0.015** | -0.013*** | -0.012*** |
| | (0.005) | (0.006) | (0.002) | (0.002) |
| Cash flow | 0.065*** | 0.042*** | -0.010 | 0.010 |
| | (0.019) | (0.016) | (0.013) | (0.012) |
| Net working capital | -0.050* | -0.098*** | -0.215*** | -0.230*** |
| | (0.028) | (0.033) | (0.021) | (0.021) |
| Capital expenditures | -0.351*** | -0.490*** | -0.542*** | -0.466*** |
| | (0.076) | (0.068) | (0.067) | (0.063) |
| Leverage | -0.241*** | -0.237*** | -0.356*** | -0.349*** |
| | (0.022) | (0.025) | (0.018) | (0.018) |
| Industry sigma | 0.134* | 0.146* | -0.192** | 0.129 |
| | (0.079) | (0.085) | (0.093) | (0.094) |
| R&D | -0.092 | -0.055 | 0.261*** | 0.332*** |
| | (0.071) | (0.073) | (0.043) | (0.042) |
| Dividend dummy | -0.007 | -0.010 | -0.059*** | -0.054*** |
| | (0.006) | (0.006) | (0.006) | (0.006) |
| Acquisition activity | -0.177*** | -0.224*** | -0.412*** | -0.419*** |
| | (0.029) | (0.029) | (0.028) | (0.029) |
| Corporate bond rate spread | -0.048*** | -0.019*** | -0.176*** | 0.028*** |
| | (0.012) | (0.006) | (0.014) | (0.006) |
| Constant | 0.498*** | 0.460*** | 0.648*** | 0.454** |
| | (0.045) | (0.036) | (0.021) | (0.177) |
| Method | FE | FE | OLS | OLS |
| Year controls | No | No | No | No |
| Industry controls | No | No | Yes | Yes |
| Firm fixed effects | Yes | Yes | No | No |
| Standard errors | Clustered (firm) | Clustered (firm) | Clustered (firm) | Clustered (firm) |
| Observations | 6,942 | 6,725 | 6,942 | 6,725 |
| Number of firms | 2,929 | 2,974 | 2,929 | 2,974 |
| Adjusted R-squared | 0.125 | 0.147 | 0.530 | 0.507 |

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

Note: The table presents results for regressions C1-C4, all with *Cash Holdings* as the dependent variable. Regressions C1 and C2 employ Firm Fixed Effects. Regressions C3 and C4 employ Pooled-OLS and Industry controls. *Corporate bond rate spread* is collinear with Year controls, consequently these are not included. All regressions employ Standard Errors clustered by firm. The sample has been split into strong (weak) credit market conditions based on the 3 years with the lowest (highest) *Corporate bond rate spread*. For an explanation of the definition and/or construction of each variable, see table 7.

Table 6 provides the results for the regressions investigating hypothesis 3, whether as credit conditions worsen the relationship between unencumbered tangibility and cash holdings becomes stronger. As can be observed, regressions C1 and C2 utilize firm fixed effects, while C3 and C4 utilize industry fixed effects. Both of the regressions use robust standard errors clustered by firm. Analyzing the statistical significance of the separate coefficients, *unencumbered tangibility* is significant for all regressions. Nonetheless, the magnitude on the coefficients for *unencumbered tangibility* are almost identical between model C1 and C2. For model C3 and C4, the coefficients vary somewhat, as unencumbered tangibility is -0.115 for weak credit conditions and -0.097 for strong credit conditions. Since the coefficient has a greater negative sign for weak credit markets, it would indicate that as credit conditions worsen, firm's respond to a loss of pledgeable collateral by increasing cash holdings more strongly, than if the credit conditions were strong; however, conducting a test of equality (see table 12) between the coefficient *unencumbered tangibility* for model C3 and C4, shows that the difference is not statistically significant. We can therefore not claim to have found support for hypothesis 3.

# 7. Analysis

## 7.1 The relationship between unencumbered tangibility and cash holdings

Based on the regression results discussed above we find significance for a negative relationship between unencumbered tangibility and cash holdings. The results are robust to the use of both pooled OLS and firm fixed effect regression models, with and/or without industry and year controls. We have also considered the potential for misspecification of the dependent and independent variables and found similar, or even stronger, results with our alternative definitions. Given the robustness of the results we find strong support for our first hypothesis that firms with less unencumbered tangibility have higher cash holdings.

We primarily interpret these results as evidence for Benmelech, Kumar and Rajan's (2021) argument that unencumbered tangibility is a form of financial slack which can to some extent be substituted with increased cash holdings. This is in line with the precautionary motive which states that firms want to maintain financial flexibility in order to hedge against the risk that internal cash flows will not be enough to fund the operational and investment needs of the company.

The logic of the precautionary motive explanation for the substitutability of unencumbered tangibility and cash holdings is as follows: the ability to issue secured debt contributes to financial flexibility in that it ensures a firm's access to external financing when it is needed, even in the face of factors that might otherwise result in a too expensive or rationed credit supply, such as agency costs of debt and tightening credit market conditions (Smith & Warner, 1979a,b; Myers & Majluf, 1984; Stulz & Johnson, 1985; Benmelech, Kumar & Rajan, 2021,2022; Luk & Zheng, 2022). Even the ability to sell an unpledged asset to raise funds demonstrates how unpledged assets contribute to financial flexibility. As such, when a firm issues more secured debt, it loses the financial flexibility that comes with unencumbered tangibility. Building on this, we also show that cash holdings serve the same purpose of securing financial flexibility as does pledgeable collateral (Opler et al. 1999; Almeida, Campello & Weisbach, 2004; Harford, Klasa and Maxwell, 2014). Therefore, there is an argument in favor of the firm deciding to increase its cash holdings to maintain the financial flexibility that is lost as a consequence of issuing secured debt.

Further supporting the substitutability of cash holdings and unencumbered tangibility idea is the discussion regarding operational flexibility. To elucidate this argument, we have described how secured debt restricts the operational maneuverability of a company by limiting its ability to sell the pledged asset, regardless of if that is to change strategic direction or to capitalize on value creating deal opportunities (Mann, 1997; Benmelech, Kumar & Rajan, 2021). In addition, any covenants included in the debt contract which restricts the operations of the firm carry the added enforceability attached to the lender's right to seize the pledged asset in the case of a technical default (Rajan & Winton, 1995; Mann, 1997). We have also explained that cash holdings can contribute to operational and competitive flexibility by facilitating the ability to capitalize on new opportunities, hedge against competitive threats, and maintain optionality with regards to future investments (Baskin, 1987; Cossin & Hricko, 2004; Haushalter, Klasa & Maxwell, 2007; Kim & Bettis, 2014). The presence of cash holdings doesn't eliminate the burden of having pledged assets, but it does increase the company's ability to respond to changing internal and external conditions and therefore suggests that cash holdings may compensate for the loss of operational flexibility associated with decreased unencumbered tangibility.

In addition to the two main explanations for the negative relationship between cash holdings and unencumbered tangibility described above, our theoretical setting finds supplemental support through other mechanisms of action. For example, Rajan and Winton (1995) and Mann (1997) argue that the additional enforceability of covenants associated with secured debt increases the incentive for lenders to monitor. Increased monitoring may decrease the agency costs of managerial discretion described by Jensen and Meckling (1976). Consequently, the value of cash holdings would increase, providing another channel through which the negative correlation between unencumbered tangibility and cash holdings may be explained.

Finally, our results complement and expand on the findings in Lei, Qui and Wan (2018) who find that asset tangibility is inversely correlated with cash holdings. The similarity lies in the fact that asset tangibility, just as unencumbered tangibility, is related to the ability to issue debt in general and secured debt in particular. While they proceed to investigate how financial development affects the asset tangibility sensitivity of cash holdings, our paper instead looks at the unencumbered tangibility sensitivity of cash holdings. Both papers therefore show how the ability to issue more debt is a determinant of corporate cash holdings.

## 7.2 Financial constraints, unencumbered tangibility and cash holdings

Analyzing the results of the regressions in table 5 concerning the amplifying impact of financial constraints on the inverse relationship between cash holdings and unencumbered tangibility, we again find strong support for our hypothesis. The results show a statistically significant difference in the predicted direction between the coefficients for the constrained firms versus the unconstrained firms. Moreover, we show the robustness of the results with respect to various classification schemes for financial constraints as well as alternative definitions of the explanatory variable.

The previous subsection described the general outline of why there is an inverse relationship between cash holdings and unencumbered tangibility, therefore this section will focus on the reasons why this relationship would be amplified by financial constraints.

We have provided ample evidence and explanations for the fact that financially constrained firms hold more cash and that the precautionary motive has more pull for these firms. The general idea is that firms facing more financing constraints are less able to cover cash flow shortfalls with external financing.

Add to that the fact that the opportunity cost of forgoing investments is often greater for these firms and it's clear why they prefer to have higher cash holdings compared to unconstrained firms (Kim, Mauer & Sherman, 1998; Opler et al, 1999; Almeida, Campello & Weisbach, 2004; Campello, Graham & Harvey, 2010; Denis & Sibilkov, 2010). As described above, we have seen that secured debt can also serve as financial slack in accordance with the precautionary motive.

Now, we will suggest a few different explanations for why the relationship in question appears to be stronger for financially constrained firms. The first argument draws on the findings that the secured credit premium is larger for financially constrained firms (Benmelech, Kumar & Rajan, 2022; Luck & Santos, 2022). Consequently, the marginal cost associated with having to rely increasingly on unsecured instead of secured debt as their unencumbered tangibility decreases is higher for these firms than for unconstrained firms. This increases the motive to hold additional cash in order to avoid having to incur the cost associated with external financing. The second argument is similar to the first, but instead of relying on the increased cost of unsecured financing this argument assumes that the financially constrained firm has already tapped their available unsecured debt and are relying on secured debt in order to not be fully credit rationed (Smith & Warner, 1979a,b; Stulz & Johnson, 1985; Mann, 1997, Benmelech, Kumar & Rajan, 2021).

As these firms' unencumbered tangibility decreases, the risk of being without access to external debt financing increases. This effectively forces them to increase their cash holdings or risk having to give up on profitable investments in the future. Both explanations show why cash holdings and secured debt are more important as sources of financial slack for firms facing financing constraints and support the findings that the negative correlation is amplified by the presence of financing constraints.

Moreover, another explanation for our results relates to the operational flexibility motive described in the previous section i.e., that as firms issue more secured debt their operational flexibility decreases, and this can be partly mitigated by increasing cash holdings. We have showed earlier that financial constraints are correlated with firm characteristics such as, smaller size, higher R&D expenditures and increased cash flow volatility (Opler et al, 1999; Almeida, Campello & Weisbach, 2004; Bates, Kahle & Stulz, 2009).

Now we suggest that these characteristics are also associated with an increased need for operational flexibility, e.g., smaller firms are less mature and haven't found their niche yet, R&D heavy firms are more subjected to the outcome risk of investments, and increased cash flow volatility is related to more environmental uncertainty (Denis & Sibilkov, 2010). These firms therefore need to be able to change their direction quickly and are therefore more exposed to the costs of operational and competitive rigidity. Because of this, these firms are more likely to increase their cash holdings as their use of secured debt increases as a means of maintaining their operational and competitive flexibility.

Our results and the discussion above relate to the findings in previous literature showing that the use of secured debt is more prevalent in financially constrained firms, and that the least constrained firms rarely issue secured debt (Rauh & Sufi, 2010; Benmelech, Kumar & Rajan, 2022; Rampini & Viswanathan, 2022). As our results show that the relationship between cash holdings and unencumbered tangibility is mainly driven by financially constrained firms, we find validity for the argument in Benmelech, Kumar and Rajan (2022) that companies use secured debt as a "lifeline" when other sources of external financing are not available. Seeing that unconstrained firms usually have access to unsecured debt and therefore have no secured debt to speak of, there is a much smaller relationship for our investigation to capture. In contrast, financially constrained firms are quite often rationed with regards to unsecured debt and therefore the balance between cash holdings and unencumbered tangibility becomes a much more prominent feature for these companies.

It is also possible to connect our results to the findings in Harford, Klasa and Maxwell (2014). Their paper looks at how refinancing risk affects cash holdings, and our paper investigates unencumbered tangibility; however, they both focus on financing risk associated with external debt financing and find that the level of financing risk is positively associated with the level of corporate cash holdings and that this relationship is amplified by the presence of financing constraints.

### 7.3 Credit conditions, unencumbered tangibility and cash holdings

Examining the result from table 6 and table 12 we can see that we find no significant difference between the coefficients on unencumbered tangibility in our regressions based on strong and weak credit market conditions. Consequently, we can't claim to have found any support for our third hypothesis; however, we are still not convinced that the effect does not exist in the manner we described while developing the hypothesis (see section 3.4).

Instead, we wonder if the lack of significant results is due to the limited sampling period in our study which might not have contained enough variation in the external credit conditions. The limited sample also didn't allow us to distinguish between when credit market conditions are deteriorating and when they are actually tough, and it was in making this distinction that the inspiration of our investigation, Harford, Klasa and Maxwell (2014), found the strongest results. Therefore, we refrain from completely rejecting the hypothesis that external credit market conditions affect the relationship between cash holdings and unencumbered tangibility until there has been a study looking at a more representative sample period.

# 8. Conclusion

## 8.1 Summary and conclusion

The inspiration for this study has been the renewed interest in corporate cash holdings and secured debt which has emerged with the business climate disturbances associated with the Covid-19 pandemic, Russia-Ukraine war and the following inflation. The purpose has been to empirically investigate the relationship between cash holdings and unencumbered tangibility in order to understand how companies balance these two factors. Consequently, we gathered a panel data set of publicly traded US companies and carried out fixed effect regression models in order to examine the relationship. Examining the results of the regressions we find statistical support for our first hypothesis of an inverse correlation between our variables of interest. After proceeding to divide our sample into financially constrained and unconstrained firms, we conduct the same regressions as for the full sample. In doing this, we find statistical support for our second hypothesis that the presence of financing constraints amplifies the inverse correlation between cash holdings and unencumbered tangibility. Furthermore, the results relating to hypotheses one and two are robust to various definitions of variables, different classification schemes and alternative model specifications. Finally, we conclude by splitting the sample based on the prevailing external credit market conditions of each year in order to investigate if this has any effect on the relationship studied. We do not find statistical support for the difference of the coefficients in these two regressions and can therefore not claim to have found support for the third hypothesis, that worse external credit market conditions strengthen the negative correlation between corporate cash holdings and unencumbered tangibility.

The study contributes to the knowledge in the field of corporate liquidity and the precautionary motive for cash holdings by showing that unencumbered tangibility is a significant determinant of corporate cash holdings. We also complement the recent discussions and findings relating to the role and pattern of secured debt usage. Our results suggest that unencumbered tangibility is a way for companies to ensure access to external financing and therefore serves the precautionary motive. In addition, we argue that the operational flexibility lost by collateralizing assets in secured debt contracts can be abated by an increase in cash holdings, providing a further channel for the cause of the observed effect.

## 8.2 Limitations and future research

While conducting the study we have done our best to address the problems that have occurred in a satisfactory manner. Nonetheless, we are left with a few limitations which we will address now. The main source of the issues we ran into relates to the lack of access to a longer sample, which was due to the version of Capital IQ available to us only allowing extracting the most recent 10 years of data. This could be the reason for the lack of significant results regarding hypothesis 3, as the last 10 years are not representative of normal variation in credit market conditions. It also affected our ability to create a statistically adequate industry sigma variable; however, this does not seem to have hindered the study. In addition to the limited sample length, we also suspect that our data extraction excludes firms that have been delisted from public markets during the sample period which could introduce a type of survivorship bias; however, it is not clear whether this would actually skew the results of this study. While we are confident about the results presented in this paper, given the concerns just presented we recommend future research try to replicate the results utilizing a more comprehensive data set.

For future research into the interplay between cash holdings and unencumbered tangibility, we would like to see an investigation into whether the relationship found in this study translates into how investors value corporate cash holdings. Our suggestion would be employing the marginal value of cash approach developed by Faulkender and Wang (2006) to see if the degree of unencumbered tangibility changes the value of an additional dollar in cash holdings. Finally, it may also be interesting to see if the relationship is dependent on varying characteristics of secured debt brought on by different legislations.

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# Appendix

### Table 7: Variable description

| Table 7: Variable description | |
|---|---|
| Variable | Definition |
| ***Dependent:*** | |
| Cash holdings | Cash & Short term investments / Total Assets |
| ***Main explanatory:*** | |
| Unencumbered tangibility | (Net PP&E - Secured debt) / Total Assets |
| ***Main Controls:*** | |
| Market to book value | (Total Assets - BV Equity + MV Equity) / Total Assets |
| Assets | Ln(Total Assets) |
| Cash flow | (EBITDA - Interest expense - Taxes - Dividends) / Total Assets |
| Net working capital | (Working capital - Cash & Short term investments) / Total Assets |
| Capital expenditures | Capital expenditures / Total Assets |
| Leverage | Debt / Total Assets |
| Industry sigma | The mean of 3 years Std. Dev. of *Cash flow* for firms in the same industry |
| R&D | R&D expenditures / Total Assets |
| Dividend dummy | Dummy variable set to 1 if the firm paid a dividend in the year, and set to 0 if nc |
| Acquisition activity | Cash acquisitions / Total Assets |
| ***Additional variables:*** | |
| Firm Size | Total Revenue |
| Payout ratio | (Dividends+Repurchases) / Net income |
| Corporate bond rate spread | The yearly average spread between corporate bonds and the federal funds rate |
| Logarithm of cash holdings | Ln(Cash holdings) |
| Unencumbered tangibility II | (Net PP&E + Accounts receivable + Inventory - Secured debt) / Total Assets |
| Net debt issued | (Debt issuance - Debt repurchases) / Total Assets |
| Net equity issued | (Common stock issued - Common stock repurchases) / Total Assets |

Note: The table presents the the definition and/or construction of each of the variables used in the study.

### Table 8: Test for heteroskedasticity

| Table 8: Test for Heteroskedasticity | | | | |
|---|---|---|---|---|
| **White test** | **$H_0$** | **$X^2$ Statistic** | **df** | **P-value** |
| Model A1 | Homoskedasticity | 6958,65 | 76 | 0,000 |

Note: White test to test for heteroskedasticity in the sample.

**Table 9: The Hausman test**

| Table 9: The Hausman test | | |
|---|---|---|
| **$X^2(20)$** | **Prob > $X^2$** | **Best fit** |
| 1879,76 | 0,000 | Fixed effects |

Note: Hausman test to decide between Firm Fixed Effects or Random Effects.

**Table 10: Credit conditions**

| Table 10: Credit conditions | | |
|---|---|---|
| **Year** | **Average spread** | **Credit conditions** |
| 2013 | 1,48 | |
| 2014 | 1,10 | Strong |
| 2015 | 1,92 | Weak |
| 2016 | 2,26 | Weak |
| 2017 | 1,34 | |
| 2018 | 1,53 | |
| 2019 | 1,01 | Strong |
| 2020 | 1,65 | |
| 2021 | 0,77 | Strong |
| 2022 | 2,83 | Weak |

Note: The table presents the yearly average spread between corporate bonds and the federal funds rate. The third column shows if the year has been characterized as representing Strong or Weak credit market conditions.

## Table 11: Regression results

| Table 11: Regression results | | | |
|---|---|---|---|
| Model | A6 | A7 | A8 |
| Method | FE | FE | FE |
| **Dependent variable** | Cash holdings | Cash holdings | Ln(Cash holdings) |
| Unencumbered tangibility | | -0.068*** | -0.298*** |
| | | (0.015) | (0.087) |
| Unencumbered tangibility II | -0.231*** | | |
| | (0.014) | | |
| Market to book value | 0.002*** | 0.000 | 0.007* |
| | (0.001) | (0.001) | (0.004) |
| Assets | -0.017*** | -0.011*** | -0.121*** |
| | (0.004) | (0.004) | (0.022) |
| Cash flow | 0.042*** | 0.063*** | 0.187*** |
| | (0.008) | (0.008) | (0.042) |
| Net working capital | -0.039** | -0.082*** | -0.342*** |
| | (0.016) | (0.017) | (0.095) |
| Capital expenditures | -0.329*** | -0.516*** | -2.190*** |
| | (0.044) | (0.045) | (0.303) |
| Leverage | -0.278*** | -0.224*** | -1.076*** |
| | (0.015) | (0.015) | (0.082) |
| Industry sigma | 0.123** | 0.112** | 1.061*** |
| | (0.050) | (0.049) | (0.380) |
| R&D | -0.100** | -0.097** | -0.138 |
| | (0.042) | (0.044) | (0.170) |
| Dividend dummy | -0.001 | -0.004 | -0.030 |
| | (0.004) | (0.004) | (0.035) |
| Acquisition activity | -0.260*** | -0.372*** | -1.134*** |
| | (0.014) | (0.016) | (0.090) |
| Net debt issued | | 0.193*** | |
| | | (0.012) | |
| Net equity issued | | 0.159*** | |
| | | (0.009) | |
| Constant | 0.485*** | 0.386*** | -1.055*** |
| | (0.030) | (0.029) | (0.164) |
| Year controls | Yes | Yes | Yes |
| Industry controls | No | No | No |
| Firm fixed effects | Yes | Yes | Yes |
| Standard errors | Clustered (firm) | Clustered (firm) | Clustered (firm) |
| Observations | 22,072 | 22,072 | 22,072 |
| Number of firms | 3,047 | 3,047 | 3,047 |
| Adjusted R-squared | 0.183 | 0.208 | 0.090 |

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

Note: Robustness tests for the regressions in table 4. The table presents results for regressions A6-A8. Regressions A6 and A7 has *Cash Holdings* as the dependent variable. Regression A8 has the natural logarithm of *Cash Holdings* as the dependent variable. All the regressions utilize Firm Fixed Effects, Year controls and Standard Errors clustered by firm. For an explanation of the definition and/or construction of each variable, see table 7.

## Table 12: Test of equality

| Table 12: Test of equality | | | | |
|---|---|---|---|---|
| **Coefficient** | **Between model** | **$H_0$** | **$X^2$ Statistic** | **P-value** |
| Unencumbered tangibility | Model B1 & B2 | Equal | 75,25 | 0,000 |
| Unencumbered tangibility | Model B3 & B4 | Equal | 8,18 | 0,004 |
| Unencumbered tangibility | Model B5 & B6 | Equal | 58 | 0,000 |
| Unencumbered tangibility II | Model B7 & B8 | Equal | 298,86 | 0,000 |
| Unencumbered tangibility | Model B9 & B10 | Equal | 84,06 | 0,000 |
| Unencumbered tangibility | Model B11 & B12 | Equal | 96,08 | 0,000 |
| Unencumbered tangibility | Model C3 & C4 | Equal | 0,99 | 0,32 |

Note: The table shows results for "tests of equality of coefficients" which statistically compare the coefficients of the corresponding regressions. All results indicate a significant difference, except for the test between models C3 and C4.

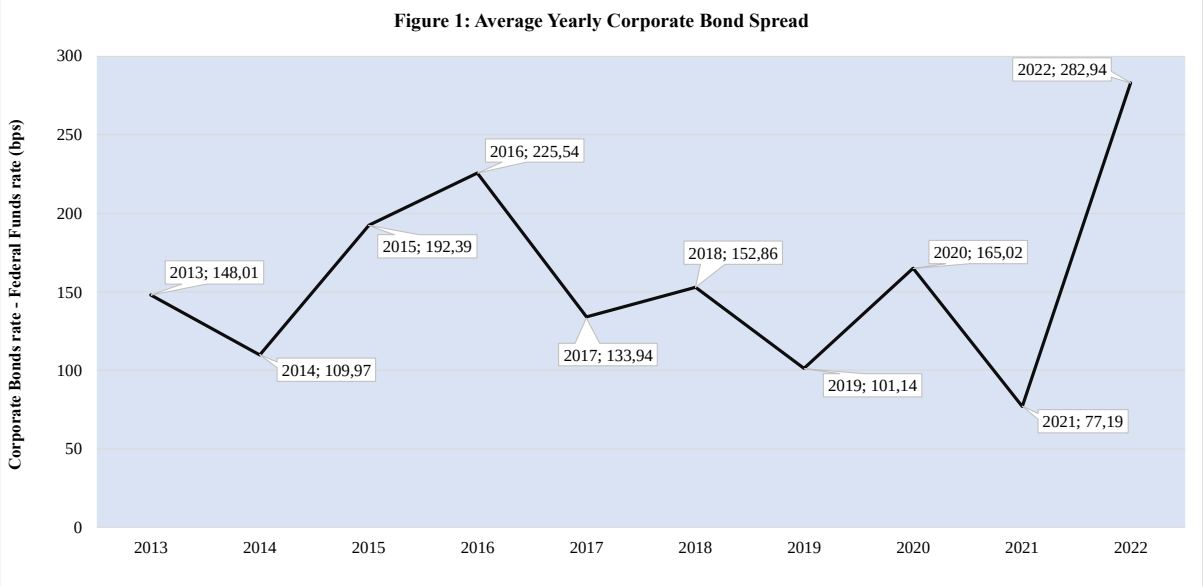
## Table 13: Regression results

| Table 13: Regression results | | | | | | |
|---|---|---|---|---|---|---|
| Model | B7 | B8 | B9 | B10 | B11 | B12 |
| Method | FE | FE | FE | FE | FE | FE |
| | Constrained | Unconstrained | Constrained | Unconstrained | Constrained | Unconstrained |
| **Dependent variable** | Cash holdings | Cash holdings | Cash holdings | Cash holdings | Cash holdings | Cash holdings |
| Unencumbered tangibility | | | -0.162*** | -0.058*** | -0.124*** | -0.022*** |
| | | | (0.027) | (0.015) | (0.023) | (0.007) |
| Unencumbered tangibility II | -0.337*** | -0.121*** | | | | |
| | (0.024) | (0.016) | | | | |
| Market to book value | 0.003** | 0.002 | 0.001 | 0.001 | 0.004*** | 0.003* |
| | (0.001) | (0.002) | (0.001) | (0.002) | (0.001) | (0.001) |
| Assets | 0.001 | -0.034*** | 0.009 | -0.033*** | 0.003 | -0.015*** |
| | (0.007) | (0.005) | (0.007) | (0.005) | (0.007) | (0.003) |
| Cash flow | 0.028*** | 0.024 | 0.046*** | 0.047** | 0.014 | 0.005 |
| | (0.010) | (0.018) | (0.010) | (0.023) | (0.009) | (0.015) |
| Net working capital | -0.022 | -0.211*** | -0.066*** | -0.253*** | -0.050** | -0.093*** |
| | (0.022) | (0.027) | (0.022) | (0.027) | (0.021) | (0.015) |
| Capital expenditures | -0.407*** | -0.321*** | -0.599*** | -0.440*** | -0.325*** | -0.142*** |
| | (0.083) | (0.058) | (0.082) | (0.059) | (0.068) | (0.037) |
| Leverage | -0.379*** | -0.096*** | -0.319*** | -0.100*** | -0.250*** | -0.050*** |
| | (0.026) | (0.018) | (0.028) | (0.017) | (0.027) | (0.009) |
| Industry sigma | 0.150 | 0.042 | 0.156 | 0.046 | 0.081 | -0.013 |
| | (0.149) | (0.048) | (0.147) | (0.047) | (0.124) | (0.027) |
| R&D | -0.040 | 0.167 | -0.052 | 0.147 | -0.048 | 0.138 |
| | (0.045) | (0.208) | (0.046) | (0.206) | (0.048) | (0.091) |
| Dividend dummy | 0.012 | -0.006 | 0.012 | -0.004 | 0.012 | -0.000 |
| | (0.013) | (0.005) | (0.013) | (0.005) | (0.014) | (0.003) |
| Acquisition activity | -0.470*** | -0.154*** | -0.517*** | -0.274*** | -0.272*** | -0.034*** |
| | (0.048) | (0.014) | (0.046) | (0.019) | (0.045) | (0.006) |
| Net debt issued | | | 0.163*** | 0.170*** | | |
| | | | (0.023) | (0.018) | | |
| Net equity issued | | | 0.144*** | 0.172*** | | |
| | | | (0.010) | (0.027) | | |
| Constant | 0.559*** | 0.508*** | 0.441*** | 0.480*** | 0.334*** | 0.221*** |
| | (0.042) | (0.051) | (0.041) | (0.050) | (0.035) | (0.027) |
| Year controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry controls | No | No | No | No | No | No |
| Firm fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Standard errors | Clustered (firm) | Clustered (firm) | Clustered (firm) | Clustered (firm) | Clustered (firm) | Clustered (firm) |
| Observations | 6,627 | 6,618 | 6,627 | 6,618 | 4,971 | 4,964 |
| Number of firms | 1,313 | 938 | 1,313 | 938 | 1,081 | 816 |
| Adjusted R-squared | 0.246 | 0.161 | 0.237 | 0.189 | 0.120 | 0.123 |

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

Note: Robustness tests for the regressions in table 5. The table presents results for regressions B7-B12, all with *Cash Holdings* as the dependent variable. All regressions employ Firm Fixed Effects, Year controls and Standard Errors clustered by firm. In all regressions the sample is divided into constrained (unconstrained) based on the 30th (70th) percentile of *Firm Size*, measured by *Total Revenue*. For an explanation of the definition and/or construction of each variable, see table 7.

## Figure 1: Average yearly corporate bond spread




Note: The figure presents the average yearly Corporate bond rate spread. It is calculated as the difference between the yearly average of the Corporate bond rate over the Federal Funds rate.