

Hedging liquidity funding risk

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Abstract

The effect of high hedging needs on liquidity management is investigated empirically, whereas the effects on cash holdings, cash retention rates from issue proceeds, and financing decisions is investigated. This research is conducted using a large sample of publicly listed U.S. firms, covering a timeframe of 1972 to 2018, with data from Compustat and CRSP. Ambiguous results are found, which is deemed to be caused by imprecise proxies for investment opportunities, that are needed to construct the measure of hedging needs. Therefore it is concluded that more sophisticated proxies are needed before the effect of hedging needs on liquidity management can be properly investigated empirically.

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1 Introduction

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1 Introduction

Firms need to be sufficient liquid. A lack of liquidity may cause a firm to cut spending and thereby make it incur opportunity costs of missed investments equal to their net present value (NPV); if cutting investments is not enough to close the deficit, the firm would be rendered unable to meet financial obligations which would ensue costs of financial distress and possibly default. The likelihood of a lack of liquidity to occur is called liquidity funding risk, hereafter in this paper simply referred to as liquidity risk¹. Access to external finance through capital markets makes the problem posed by a lack of liquidity a lot less severe: the opportunity costs of missed investments, costs of financial distress or costs of default are only incurred if the costs of external financing are higher, otherwise external financing is committed and the accompanying costs are incurred. The importance of managing one's own liquidity is therefore heavily dependent on the ease of obtaining funding through financial markets. Keynes (1936) stated that "there is no reason to hold idle cash to bridge over intervals if it can be obtained without difficulty at the moment it is actually required". This is to say that if funding is to be obtained without friction from capital markets there would be no need for firms to manage their own liquidity. The opposite is also implied: in absence of functioning financial markets, liquidity management is of dire importance.

In recent times, this notion was perhaps never more visible than during the financial crisis of 2008, when the financial markets² became deadlocked due to solvency concerns of major financial institutions caused by massive losses on mortgage-based derivatives, culminating with the failure of Lehman Brothers on September 15th, 2008. These solvency concerns caused capital markets to dry up: the LIBOR (London Interbank Offered Rates) spiked from 2.1% on September 12th to 6.4% on September 16th, reflecting how illiquid the financial markets became (Mitchell & Pulvino 2012). Governmental intervention in the form of a \$700 billion bailout program (the Troubled Assets Relief Program) saved many financial institutions, but with the intention of thereby saving the United States from the economic cataclysm that the failure of these "too big to fail" institutions would ensue. There are many answers to why their failure would have been so disastrous, but from a corporate perspective the exacerbated effects of the inability to meet liquidity needs is a major argument for

¹Outside the context of this paper it is important to specify this type of liquidity risk as liquidity funding risk, as in the context of asset pricing liquidity risk is rather understood to be liquidity trading risk, which is the risk of not being able to sell an asset within a reasonable amount of time at a fair price (Fabozzi 2013).

² Financial markets and capital markets are not used interchangeably. Financial markets refer to the entire financial sector, including the markets for financial instruments such as derivatives, whereas capital markets specifically refer to the markets for debt and equity capital.

why the failing of financial markets would have implied great economic damage, especially against the backdrop of macroeconomic parameters (e.g. household income) that their failure would have also worsened. Firms would no longer be able to cover liquidity shortages with external finance, be unable to meet short-term liabilities and thereby default despite being solvent (having a positive long-term NPV), which entails the destruction of capital (Gryglewicz 2011). Governmental intervention saved firms from having to default on payment obligations, but it did result in a decline in corporate investment. As shown by Duchin et al. (2010), this decline in investment following the financial crisis was significantly greater for firms that relied more heavily on external finance, firms that held lower cash reserves, and firms that were more financially constrained, which appears to confirm a causal relation between the shock in liquidity supply and corporate investment. Fortunately, capital markets do function under normal conditions, so cash shortfalls do not tend to have consequences as bad as described above. But their terrible potency does give cause to wonder how firms hedge against liquidity (funding) risk.

Due to transaction costs and information asymmetry firms there is always some difficulty to acquiring cash through capital markets, so along the lines of Keynes' proposition, preventing liquidity shortfalls is always relevant. But whereas financial constraints define the gravity of insufficient hedging of liquidity risk, they do not quite capture the need to hedge liquidity risk itself. Rather, following Acharya et al. (2007), the need to hedge liquidity risk is regarded as the propensity to be unable to meet liquidity demand through one's own proceeds. This need to hedge liquidity risk differs across firms, which raises the question of whether a greater need to hedge liquidity risk actually cause firms to commit more prudent liquidity management. It is this question that I venture to answer in this paper. I hypothesize that it does. Specifically, in this paper the following hypotheses are sought to be proven:

1. Firms that face a greater need to hedge liquidity risk hold greater cash reserves.

Holding cash is the most straightforward way to hedge against liquidity risk. If the liquidity of the firm is prone to be more heavily strained, holding greater cash reserves would allow the firm to bear that heavier strain without having to rely on external financing.

2. Firms that face greater greater liquidity risk hedging needs retain greater fractions of external financing issues as cash reserves, when their cash reserves had been depleted.

Following the same reasoning as above, firms that face greater liquidity risk would require greater cash reserves to hedge against that liquidity risk. If cash reserves do happen to be depleted and debt, equity or a combination thereof is issued, firms are therefore expected to retain a greater fraction of that funding in reserve to alleviate expected future liquidity concerns.

3. When engaging in external financing, a greater need to hedge liquidity risk makes firms more likely to issue equity instead of debt.

High leverage causes added strain on a firm's cashflow through increased interest expenditures. If a firm knows it has a higher propensity to face cash shortfalls, it should try to avoid additional strain on its cashflow to avoid opportunity costs (Huang & Ritter 2021).

To investigate these hypotheses, an empirical analysis is conducted on financial data from Compustat of publicly listed U.S. firms, supplemented with data from CRSP (the Center for Research in Security Prices), within a timeframe starting in 1972 and ending in 2018. This follows the methodology of Huang & Ritter (2021), which -for the purpose of reliability and verifiability- is first recreated, after which it is altered to serve the investigative purposes of this research. The alterations constitute the creation and analysis of variables for (liquidity risk) hedging needs and added data restrictions to facilitate proper analysis of these variables. These alterations are largely based on the methodology of Acharya et al. (2007). The analysis involves OLS (ordinary least squares) regressions on relations between hedging needs and cash reserves and hedging needs and cash retention rates from external financing issues, and a multinomial logit regression to investigate the effect of hedging needs on the debt-equity choice when engaging in external financing.

As is apparent in the rationale for conducting this research and in the literature concerning liquidity management, financial constraints are expected to have a considerable influence on the effect of liquidity risk hedging needs on liquidity management; the hypothesized effects of hedging needs should be stronger for more financially constrained firms. However, financial constraints were decided not to be included in this research due to a number of reasons. First, two out of three proxies considered for financial constraints -all based on the methodology of Acharya et al. (2007)- were problematic in transposing to this research because of inability to discern a narrow financially constrained subsample. This will be elaborated upon in the methodology section to share these considerations to the benefit of future research. Secondly, analysing these effects would require a great increase in volume of measurements, as it would require repeating all regressions for financially constrained subsamples based on multiple metrics of financial constraints, so this would result in a very lengthy result section that threatened to drown out the other findings of the research. In that sense, it was regarded that keeping the focus on the liquidity risk hedging needs metrics is preferable. So despite the theoretical importance, practical considerations pointed towards the threat that the inclusion of an analysis of financial constraints would not yield robust findings while watering down the attention on the other hypotheses of this research through a greatly increased volume of analyses. Therefore it was decided to exclude financial constraints from the analysis.

2 Theoretical framework

2.1 The importance of liquidity management

The literature on liquidity management stems back to Keynes' (1936) seminal work 'The General Theory of Employment, Interest and Money', in which he identified four motives for firms to hold cash: (i) the income-motive: to bridge the interval between the income of cash and its disbursement; (ii) the business-motive: to bridge the interval between incurring business costs and the receipt of proceeds³; (iii) the precautionary-motive: to provide for contingencies requiring sudden expenditure or unforeseen investment opportunities; and (iv) the speculative-motive: to profit from changes in rates of interest⁴.

The precautionary-motive is central to this research. Keynes theorized a few factors impacting this motive. He argued that the strength of this motive depends on the relative cost of holding cash: if the cash can only be retained by forgoing profitable investment, this increases the (opportunity) costs of holding cash and thus weakens the motive; if deposit interest is earned or bank charges are avoided by holding cash, this strengthens the motive. The strength of this motive also depends on the cheapness and reliability of obtaining cash through lending, particularly through overdraft or equivalent arrangements. This reasoning suggests that firms that have expansive agreements for overdraft or credit lines, are not as motivated for holding precautionary cash because they do not need to hold precautionary cash as they can call upon reserves of easily accessible (cheap) credit. As referred to earlier, Keynes supported this claim with the consideration that there would be no need to hold cash if cash can be obtained without difficulty when it is required. This difficulty of obtaining financing is referred to as financial constraints in the terminology of modern literature. All firms are subject to some degree of financial constraint, as capital markets are subject to imperfect information and the fixed and variable transaction costs of financing. Therefore liquidity management, in light of Keynes' assertion, is relevant for all firms. However, not all firms are subject to financial constraint to the same degree, and therefore liquidity management is of greater importance to firms that are more financially constrained.

³ The income-motive and business-motive are also jointly referred to as the transaction-motive: holding cash to facilitate both inward and outward transactions.

⁴ This undoubtedly an oversimplification, the actual explanation requires a couple of paragraphs. A more satisfactory explanation is omitted due to its irrelevance to this research.

A theoretical analysis of liquidity management under full financial constraints is provided by Gryglewicz (2011). In this paper, he argues that a firm that has no access to external financing is not able to cover liquidity shortfalls and is therefore liable to default because of illiquidity; such an event is called liquidity default. Liquidity default happens when a firm is unable to meet its financial obligations because of the inability to liquidate assets or otherwise raise funds to meet the obligations (i.e. cash-flow insolvency). In contrast to solvency default (i.e. balance-sheet insolvency), which occurs when the net present value (NPV) of the expected future cash flows of a firm drops below zero. A paramount difference is that liquidity default entails the destruction of capital because it implies discontinuation of the operations of a firm despite them being profitable on the long-term, whereas solvency default implies no destruction of capital since it occurs when the continuation of the firm no longer has any (expected) value. Gryglewicz theorizes that liquidity default therefore is a situation to be avoided, to the extent that the outward cash flow necessary to overcome the liquidity needs does not entail (balance-sheet) insolvency. This implies that under prolonged denial of access to external finance, firms would need to hold as much cash as their net present value if they were to fully hedge the risk of liquidity default.

Simply put, firms are required to hold immense cash reserves to be fully independent of capital markets for hedging the risk of liquidity default. However, firms are expected by their shareholders to realize a return on capital rather than hold it in abundant idle reserves. This incentivizes them to rely on capital markets for the provision of liquidity -being the purpose of capital markets in the first place- which is justified by the reliability of accessible capital through capital markets; marked only by a few exceptions such as the 1929 great depression and 2008 financial crisis. This illustrates the deeply rooted reliance of (operating) firms on capital markets, which is wholly agreeable under normal conditions, but is a cause of grave concern under high financial constraint, as when capital markets operate less smoothly or stop functioning at all. This notion is supported by Almeida et al. (2004), who show that the cash flow sensitivity of cash -i.e. the propensity to save cash out of the internal cash flow as reserves- is close to zero for financially unconstrained firms, and is significantly larger for financially constrained firms.

2.2 Hedging needs

Theoretical disquisition on the need to hedge against any financial risk is provided by Froot et al. (1993). In this paper it is argued that it makes sense for firms to hedge as long as external finance is more costly than internal finance, and developed several implications of this point on optimal hedging strategy. The two implications that are of interest here are:

- “Firms will want to hedge less, the more closely correlated are their cash flows with future investment opportunities.
- Firms will want to hedge more, the more closely correlated are their cash flows with collateral values (and hence with their ability to raise external finance).”

To develop an intuition on the first implication, Froot et al. use an example of an oil company. The cash flow generated by its assets in place is strongly dependent on the price of oil, as can be easily envisioned. But so are its investment opportunities: the NPVs of investment opportunities in the oil industry are much more likely to be positive when the price of oil is high. Therefore it can be supposed that such a firm has a relatively high correlation of operating cash flow and investment opportunities, and therefore has little need for hedging. In fact, it means that the oil company should leave its market value exposed to the price of oil to maintain the congruency between its cash flows and investment opportunities.

The second implication paints a somewhat different picture. It is quite possible that raising external finance becomes more costly for a firm when its cash flow experiences negative shocks. This gives an incentive to hedge more, since this would avoid having to resort on external finance when times are bad and financing is costly⁵.

A clarification that might need to be made is how hedging translates to liquidity risk, as people often think of hedging as the use of derivatives (futures, forwards and options) to insulate a firm from the risk posed by future fluctuations in the price of a commodity that the firm depends on. That view is wholly correct, but hedging is a somewhat more of an abstract and expansive concept, as it implies limiting exposure to any risk. In that sense it can be easily seen that liquidity funding risk (reminder: the risk of not being able to fund expenses when they need to be made) is just a risk like any other that might be hedged.

Although the theory proposed by Froot et al. (1993) does not specifically mention hedging of liquidity risk, its implications apply to liquidity risk just as well as to specific commodity risks. Acharya et al. (2007) are the ones who make the bridge of the motives for hedging from Froot et al. to cash and debt management policies. They specifically research the difference between the roles of cash and debt for ensuring the ability to fund future investment: do firms prefer more cash instead of greater unused debt capacity under certain conditions, or is cash simply negative debt as is assumed in leverage

⁵ This incentive to avoid having to rely on external finance when it is costly has also been seen during the 2008 financial crisis, when in anticipation of capital markets drying up, firms drew down their existing credit lines in what basically constitutes a new type of banking run (Ivashina & Scharfstein 2010).

evaluation models? They derive theoretically that financially constrained firms that have a low correlation between cash flow and investment opportunities (i.e. have high hedging needs) should allocate their free operating cash flows primarily to cash holdings -i.e. have a positive cash flow sensitivity of cash- and should also have a positive cash flow sensitivity of debt, meaning that more debt should be taken in high-cash flow states. Conversely, if a financially constrained firm has low hedging needs, it should show no significant propensity to save cash from free cash flows, and should have a significantly negative cash flow sensitivity of debt, meaning that it should use that cash flow to work off debt. In short, when firms are financially constrained and their hedging needs are high they should prefer more cash over greater unused debt capacity, and if their hedging needs are low they should show a preference for lower debt instead of more cash.

They also provide empirical evidence to support their theory, and in doing so devise several measures for hedging needs. These measures are also used in this paper, and will be discussed in more detail in the methodology section. It must be noted that their metric for hedging needs has no regard for the implication of the theory of Froot et al. (1993) that firms have a greater need to hedge if their cash flows are highly correlated with their ability to raise external finance. By following the definitions for hedging needs of Acharya et al. (2007) this issue is also not empirically addressed in this paper, which leaves this as an opportunity for future research to explore.

2.3 Liquidity management and financing decisions

The questions of whether and how hedging needs translate to prudent liquidity management, financial decisions are also of concern. Although liquidity management is acknowledged as a central tenet of corporate finance, literature has long treated the nature of liquidity needs as irrelevant to capital structure. Static trade-off theory (Kraus & Litzenger, 1973) proposes that firms have a target debt ratio which balances the tax benefits of debt derived from the tax deductibility of interest payments with the costs of (too) high debt levels due to financial distress. The static trade-off theory predicts that firms engage in capital restructuring whenever the debt ratio deviates substantially from the target debt ratio, even in absence of liquidity needs. When engaging in external finance to sate liquidity needs, the firm chooses to issue debt, equity, or a combination of both in order to achieve and maintain a target debt ratio. The theory acknowledges that liquidity needs are an obvious motivation for deciding to raise external finance, but it does not acknowledge that those liquidity needs might have an impact on the choice between financing types and thereby the resulting capital structure.

The pecking order theory (Myers and Majluf, 1984) proposes that the choice for the source of funding is governed by a fixed order of preference (a pecking order) which is mainly driven by adverse selection

problems: internal funds first, followed by debt financing, hybrid financing through a combination of debt and equity or through hybrid securities like convertible debt, and lastly equity financing. The choice for a less preferable source is made only when the more preferable ones are deemed infeasible or are otherwise too troublesome. So, the static trade-off theory predicts security issuance in absence of liquidity needs which the pecking order does not. Other than that, the treatment of liquidity in the pecking order theory is comparable to that of the static trade-off theory, considering that the nature of the liquidity needs are not regarded as a relevant factor.

Baker & Wurgler (2002) observed that equity is far more often issued when the market value of a firm's equity is high and is issued much less and repurchased more often when the market value is low. This leads them to propose the theory that a firm's current capital structure is simply "the cumulative outcome of past attempts to time the equity market". Obviously, the nature of liquidity needs are not a relevant component to this theory.

DeAngelo, DeAngelo & Whited (2011) proposed that firms indeed have leverage targets, as proposed by the static trade-off theory of Kraus & Litzenberger (1973), but that firms can intentionally deviate from these targets through issuing debt to fund investment needs, and that leverage ratios slowly but surely have an average movement back towards the target. Whereas the older theories on capital structure view liquidity needs as an obvious motivation for issuing equity or debt, these theories do not consider liquidity needs as a determinant of the resulting capital structure. The model of DeAngelo, DeAngelo & Whited (2011) does incorporate liquidity needs as a determining factor of the resulting capital structure, and their theory appears to have a very strong ability to describe capital structures.

This brings us to Huang & Ritter (2021) who find that external financing decisions are primarily motivated by immediate and near cash depletion (depletion in t and in $t+1$). This does not contrast the static trade-off or pecking order theories, as these assume liquidity needs to be a prime motivator for engaging in external finance. However, Huang & Ritter also show that the decision to issue either debt or equity is also strongly dependent on the nature of these cash needs. Firms are more prone to prevent immediate cash depletion through debt issuance, but less so if the firm has operated at a loss in that same year.

For instance, firms with short-lived cash needs have a higher tendency to issue debt, whereas firms with long-term cash needs tend to opt for equity issuance instead.

factors firms have a have a greater tendency to issue debt rather than equity and It was also found that firm characteristics that are associated with long-lived cash needs -small size, low-profitability,

growth, R&D intensity- are found to make firms more likely to issue equity instead of debt, and conversely short-term liquidity needs make firms more prone to issue debt⁶. If anything, Huang & Ritter show that the nature of liquidity needs is an important determinant of the choice between debt and equity, and thereby a determining factor for corporate capital structure.

One aspect of the nature of liquidity needs that they did not include in their analysis, is the correlation between a firm's cash flow and investment opportunities: hedging needs. This presents an opportunity to make a novel contribution to the literature. Also, their methodology lends itself excellently for the purpose of investigating the effect of hedging needs on not only financing decisions, but also on cash holdings and cash retention rates. The theoretical grounds for investigating these relations are provided below.

2.4 Theoretical foundations of the hypotheses

2.4.1 Ratio of cash over assets

As touched upon earlier, Duchin et al. (2010) found that the decline in investment during and following the subprime mortgage crisis has been notably more severe for firms that, among others, held lower amounts of cash in reserves. This supports the theoretical implications of the liquidity management model of Gryglewicz (2011), as financial constraints push a firm to be self-reliant in preventing future cash shortfalls. Cash holdings provide just that: self-sufficiency for hedging liquidity risk. The idea is very straightforward: future cash needs can be met by holding cash in reserve. Therefore, firms that have more difficulty with meeting cash needs through their own cash flow should hold more cash in reserve to make sure that future cash needs can be met.

It is possible that the increased strain on liquidity management that asynchronous cash flows and investment opportunities pose, force these firms to utilize more of their cash on hand, resulting in lower cash holdings rather than larger ones. But this would imply lower levels of precautionary cash for firms that have more need of it, which would mean that these firms have hedged their liquidity risk less and are therefore more prone to incurring opportunity costs of missed investments.

Almeida et al. (2014) point out that there has been a recent increase in the ratio of cash over assets (as is confirmed in the appendix) that is still largely unexplained. While this trend is not of particular

⁶ A disclaimer must be made that a large battery of literature has investigated relations between firm characteristics and financing decisions before this; examples are Kurshev & Strebulaev (2006) who observe that small firms are more likely to issue equity, and DeAngelo, DeAngelo & Stulz (2010) who find that older firms are less likely to issue equity.

interest here, this observation does point out that the theory on cash holdings is still ripe for improvement.

2.4.2 Cash retention rates

Acharya et al. (2007) find that hedging needs cause constrained firms to have a positive cash flow sensitivity of cash. To investigate the same relation would be redundant, but this finding does give reason to hypothesize that hedging needs also cause cash to be sensitive to finance from external sources. In other words, high hedging needs are expected to cause greater portions of financing issues to be held in reserve.

2.4.3 Financing decisions

Opler et al. (1999) state that firms equate the marginal costs of holding liquid assets to its marginal benefits. Benefits constitute benefits of the prevention of costs associated with cash shortfalls. But firms can also diminish the likelihood of facing a liquidity shortfall by lowering leverage, as this would lower interest expenses and principal repayments. They state that a theory of optimal liquid asset holdings needs to address the issue of why it is more efficient for a firm to hold an additional dollar of liquid assets instead of lowering leverage⁷. This underlines the importance of considering leverage as a liquidity management-parameter, and gives reason to hypothesize that firms that face high hedging needs and need to engage in external finance would want to avoid increasing their leverage in doing so. As a result, firms that face high hedging needs are expected to prefer equity or a combination of debt and equity over straight debt issues, when engaging in external finance.

3 Data & Methodology

The methodology of Huang & Ritter serves as the basis of the methodology for this research. After replication, adjustments are made to make the methodology suited to the needs of this research

3.1 Recreating the methodology of Huang & Ritter (2021)

Following Huang & Ritter (2021) (for brevity's sake also referred to as H&R), annual financial information is retrieved from Compustat and is supplemented with various data items from CRSP (the Center for Research in Security Prices): stock returns, Standard Industry Classification (SIC) codes, and the difference in time between the first data entry and the year of observation (this serves as a proxy

⁷ This is exactly the challenge that Acharya et al. (2007) have taken up, as their research question revolves around the motives to hold cash rather than debt or vice versa. Opler et al. (1999) literally state twice that cash is not simply negative debt as leverage models often assume, and Acharya et al. (2007) titled their paper: "Is cash negative debt? ..."

for firm age). The sample consists exclusively of U.S. firms. Cash flow information is required for years t and $t-1$. Because cash flow information is available from 1971, my sample starts in 1972. The sample ends in 2013, as returns are considered for the years $t+1$ until $t+3$, and H&R conducted their analysis in 2017 so they only had data available up until 2016. Including later years would cause the observations at the end of the timeframe to have missing values for those variables. A non-missing value for the stock return one year prior to fiscal year t and a non-missing value for the book value of assets at the end of fiscal year $t-2$ are required. Firm-years are dropped if either the market capitalization or book value of assets of a firm is lower than \$10 million in terms of purchasing power at the end of 2010. Firm-years are dropped if they report a major merger happening in that fiscal year⁸. Financial firms and utility firms are dropped from the sample, as defined through Fama & French's 17 industry classification⁹. Firm-years are dropped that have missing values for either cash, preceding year's cash, assets, or liabilities. Firm-years are also dropped if the cash flow identity is violated, which occurs when the difference between the uses and sources of funds in that year is greater than 0.5% of assets in $t-1$. Uses and sources of funds are defined differently for the four different reporting format codes present in the sample, and are constructed in accordance with the Compustat manual; see appendix A.3 for detailed definitions. Firm-years are dropped if either the book value of assets or the market capitalization of the firm is less than \$10 million in the year of observation, as expressed in 2010 buying power.

As in Huang & Ritter (2021), net debt or net equity issuance is defined as, respectively, those net debt or net equity proceeds are greater than or equal to 5% of the book value of assets and 3% of the market value of equity at the beginning of the year. This follows McKeon (2015), who reported that a 3% market equity filter removes nearly all firm-years from the equity issue category for which equity is issued only through stock option exercises. Other variable definitions can be found in appendix sections A.1 and A.2. The only deviation in variable definitions from Huang & Ritter is that of ΔD , the change in interest-bearing debt, which is defined by H&R as $DLTIS$ (long-term debt issuance) – $DLTR$ (long-term debt reduction) – $DLCCH$ (changes in current debt) for firms reporting format code 1, 2 and 3 and as $DLTIS - DLTR + DLCCH$ for firms reporting format code 7. In this paper ΔD is defined as $DLTIS - DLTR - DLCCH$ for format code 1 only, and as $DLTIS - DLTR + DLCCH$ for format codes 2, 3 and 7. The reason for this deviation is that Huang & Ritter's use of $DLCCH$ does not line up with the Compustat manual on the classification of sources and uses of funds in the various types of cash flow statements

⁸ This is the case when the footnote of the Compustat 'Sales/Turnover (Net)' item reports AB, FD, FE, or FF codes. Major mergers are dropped because firms may have solved their cash shortfalls this way.

⁹ Source: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/det_17_ind_port.html.

(see appendix A.3). Dasgupta et al. (2011) provide definitions for many of the same variables used in Huang & Ritter (2021), and they indeed define ΔD differently, in a way that is congruent with the Compustat manual. Because of this, the definition of Dasgupta et al. (2011) for ΔD is used in this paper instead of that of Huang & Ritter. The impact of this deviation on the data is limited, as DLCCH is considerably smaller than DLTIS and DLTR: DLCCH has a mean of $-\$0.55M$ and a standard deviation of $\$285M$, whereas DLTIS and DLTR have means and standard deviations of $\$133M$ and $\$1295M$, and $\$111M$ and $\$1149M$, respectively.

The resulting sample contains 109,669 (firm-year) observations, and covers the same timeframe as Huang & Ritter: 1972 to 2013. Of these observations, 12,369 report an equity issue and 23,216 report a debt issue. The total sample is 11.6% smaller than the Huang & Ritter sample of 124,058 observations, but the relative occurrence of issues is very similar to that of Huang & Ritter, with 10.6% of firm-years having an equity issue versus 11.3% in the Huang & Ritter sample, and debt issues occurring in 21.2% of observations in both samples.

A more detailed account of the distribution of the recreated Huang & Ritter sample can be found in table 1, which corresponds with table 1 from Huang & Ritter (2021). Most percentages deviate less than one percent point from the percentages found by H&R and none deviate more than 2.5 percent points. This suggests that the difference of 14,389 observations with the Huang & Ritter sample does not give cause significant sample selection bias. It is unclear what causes this difference in sample size, although one plausible cause is that in this paper the Compustat and CRSP data had been merged on the eight-digit CUSIP (Committee on Uniform Security Identification Procedures) codes, whereas another method would be to merge using PERMLinks: the links of Compustat's GVKEY-identifiers to CRSP's PERMNO-identifiers found in the 'Compustat-CRSP merged' database. The latter method tends to yield more matches, which may (at least in part) explain the difference in sample size since some data screens do require CRSP data. There is no apparent reason to assume that this difference in matching methods (assuming that H&R indeed used PERMLinks for the data merger) causes non-random sampling and would thereby cause sample selection bias.

Table 1. Recreated Huang & Ritter (2021) sample distribution. N represents the amount of firm-year observations, % represents their relative occurrence. NCF denotes net cash flow, ICF represents internal cash flow. See appendix A.2 for detailed variable definitions. An issue is defined as having occurred when the change in debt or equity is greater than 5% of the book-value of assets and greater than 3% of the market capitalization of the firm. A pure debt or pure equity issue means that only debt or only equity has been issued and not both. A dual issue is said to have occurred when both debt and equity are issued. $Cash_{ex\ post}$ represents the cash holdings the firm would have had if they had not issued finance, being defined as: $Cash_{t-1} + NCF_t$. $Cash_{ex\ ante}$ is defined as: $Cash_{t-1} + NCF_{t-1}$. Ex post and ex ante cash depletion are defined as, respectively, $Cash_{ex\ post}$ or $Cash_{ex\ ante}$ being smaller or equal to zero.

1.A		Distribution by financing or not and financing type	
	N	%	
Total sample	109,669	100%	
No issue	77,125	70.3%	
Pure debt issue	20,148	18.4%	
Dual issue	3,068	2.8%	
Pure equity issue	9,328	8.5%	

1.B		Distribution by cash depletion and financing or not					
	All firm-years		No financing		Financing		
	N	%	N	%	N	%	
$Cash_{ex\ post} \leq 0$	27,179	24.8%	5,385	7.0%	21,794	67.0%	
$Cash_{ex\ post} > 0$	82,490	75.2%	71,740	93.0%	10,750	33.0%	
$Cash_{ex\ ante} \leq 0$	31,093	28.4%	17,251	22.4%	13,842	42.5%	
$Cash_{ex\ ante} > 0$	78,576	71.6%	59,874	77.6%	18,702	57.5%	

1.C		Likelihood of financing, conditional on cash depletion	
	Cash depletion	No cash depletion	
$Cash_{ex\ post}$	80.2%	13.0%	
$Cash_{ex\ ante}$	44.5%	23.8%	

1.D		Distribution by cash depletion and financing type					
	Pure debt issue		Dual issue		Pure equity issue		
	N	%	N	%	N	%	
All	20,148	100.0%	3,068	100.0%	9,328	100.0%	
$Cash_{ex\ post} \leq 0$	15,059	74.7%	2,701	88.0%	4,034	43.2%	
$Cash_{ex\ post} > 0$	5,089	25.3%	367	12.0%	5,294	56.8%	
$Cash_{ex\ ante} \leq 0$	8,358	41.5%	1,775	57.9%	3,709	39.8%	
$Cash_{ex\ ante} > 0$	11,790	58.5%	1,293	42.1%	5,619	60.2%	

Table 1. (Continued)

1.E Likelihood of financing type, conditional on ex post cash depletion and financing										
Debt issue										81.5%
Equity issue										30.9%
Dual issue										12.4%
1.F Distribution by financing and internal cash flow										
		No issue		Debt issue		Dual issue		Equity issue		
		N	%	N	%	N	%	N	%	
ICF<0		9,303	57.0%	3,350	20.5%	961	5.9%	4,630	28.4%	
ICF>=0		67,822	72.7%	19,866	21.3%	2,107	2.3%	7,766	8.3%	
1.G Distribution by financing, cash depletion, and internal cash flow										
			Cash _{ex post} ≤0		Cash _{ex post} >0		Cash _{ex ante} ≤0		Cash _{ex ante} >0	
			ICF<0	ICF>=0	ICF<0	ICF>=0	ICF _{t-1} <0	ICF _{t-1} >=0	ICF _{t-1} <0	ICF _{t-1} >=0
No issue	N		726	4,659	8,577	63,163	2,492	14,759	6,562	53,312
	%		14.3%	21.1%	76.4%	88.6%	43.5%	58.2%	66.3%	77.6%
Debt issue	N		2,578	15,182	772	4,684	1,507	8,626	1,193	11,890
	%		50.7%	68.7%	6.9%	6.6%	26.3%	34.0%	12.1%	17.3%
Equity issue	N		2,597	4,138	2,033	3,628	2,315	3,169	2,478	4,434
	%		51.0%	18.7%	18.1%	5.1%	40.5%	12.5%	25.0%	6.5%
Dual issue	N		812	1,889	149	218	591	1,184	336	957
	%		16.0%	8.6%	1.3%	0.3%	10.3%	4.7%	3.4%	1.4%

Table 1.B and 1.C show that the likelihood of financing is much greater for firms that face immediate cash depletion (meaning that cash would be depleted before the end of the current fiscal year). Table 1.D shows pure debt and dual issues occur mostly when cash would have actually been depleted ex post, but that pure equity issues are actually somewhat less likely to occur when cash would be depleted either ex ante or ex post. Table 1.E reports that if a firm decides to engage in external financing and will in fact face cash depletion, debt is issued in 81.5% of all cases, equity is issued in 30.9% of cases, and a combination of both are issued in 12.4% of cases. Table 1.F suggests that when a firm is unprofitable, defined as having a negative internal cash flow¹⁰, it is much more likely to issue equity than when it would have been profitable. Unprofitable firms are more or less equally likely to issue debt as profitable firms. Table 1.G shows that profitable firms that do not face immediate cash depletion are overwhelmingly prone to refrain from financing (88.6% for no ex post cash depletion and 77.6% for no ex ante cash depletion). It can also be seen that firms that do not face immediate

¹⁰ Internal cash flow is synonymous to operational cash flow, as it is often called elsewhere. In this paper the terminology of Huang & Ritter (2021) is assumed in this regard.

(ex post and ex ante) cash depletion are not likely to issue debt, irrespective of whether they are profitable or not. By contrast, unprofitability does make equity issues more likely, despite there being no threat of immediate cash depletion.

Further testing of compatibility with the findings of H&R requires running a regression to see whether comparable effects of variables are found. To this end, table 2 portrays the effects of the control variables on the net cash flow over beginning of year's assets¹¹, which in H&R is used to construct a fitted net cash flow parameter in order to create a standardized measure of ex ante cash depletion. This table corresponds to table B.1 in the appendix of H&R. In this table we do see notable differences from H&R. Mainly, we see that the net cash flow in t-1 over assets in t-1 is not found to have a significant effect, whereas in H&R it does. This also applies to the term spread and leverage, both in t-1. Prior-year's stock return is also not found to be significant, but that is also the case in H&R. H&R find a coefficient of -33.3 for prior year's research and development (R&D) expenses, significant at the 1% level, and a coefficient of 4.1 for prior year's industry volatility, also significant at the 1% level. Remarkably, I also find significant coefficients of the same signs (+/-), but the orders of magnitude are reversed: the coefficient for R&D expenses in t-1 is more than ten times smaller and the coefficient for industry volatility in t-1 is more than ten times greater. It is unclear what causes these findings to deviate as much as they do. Variable construction has been given much scrutiny, but even then R&D expenses are more less unaltered from its Compustat definition (see appendix A.2 for details), so there is not much that could have gone wrong in defining this variable at all. The most likely explanation is that the difference in sample causes the regression results to be as different as they are. All in all, the explanatory value of the regression in table 2 is not as good as its counterpart in H&R, shown by an adjusted R-squared of 9.4% versus H&R's 15.5%.

¹¹ 'Beginning of year' means the values at the beginning of the fiscal year. All financial information on a fiscal year is given at the end of the fiscal year, so the values at the beginning of a fiscal year refer to the parameter values at t-1.

Table 2. Fitted net cash flow regression. This table reports the coefficients of the OLS regression with net cash flow (NCF) over assets_{t-1} as the dependent variable. Median NCF_{t-1}overassets_{t-1} represents the median net cash flow in t-1 divided by assets in t-1 for firms grouped in the same industry (based on Fama & French 17-industry classification), same tercile of firm size (based on book value of assets) and the same tercile of Tobin's Q. Median NCF over assets is assigned missing values when the group contains less than ten unique firms. Returns are reported as decimals (5% is shown as 0.05), the term and default spreads are reported as percentages. Detailed variable definitions can be found under appendices A.1 and A.2. N denotes the number of observations, T-statistics are calculated using robust standard errors clustered on firm-level and corrected for heteroskedasticity. The significance levels are indicated by *, **, and ***, that denote significance levels of 5%, 1% and 0.1%, respectively.

	Coeff.	T-stat.
Median NCF _{t-1} / Assets _{t-1}	0.2	1.5
Tobin's Q _{t-1}	-3.0**	-3.1
Return _{t-1}	0.1	0.1
Return _{t+1,t+3}	0.6***	6.1
Term spread _{t-1}	0.1	0.2
Default spread _{t-1}	-2.0***	-3.8
Ln(sales) _{t-1}	3.2***	10
Ln(age) _t	1.9***	6
Leverage _{t-1}	-9.2	-1.9
R&D _{t-1}	-2.2*	-2.4
Industry volatility _{t-1}	53.0***	4.3
Dividend payer _{t-1}	-1.9***	-4.8
Constant	-17.6***	-7.5
Industry dummies	Yes	
Year dummies	Yes	
N	100,185	
adj. R-sq	9.4%	

3.2 Methodological deviations from Huang & Ritter (2021)

The prior data restrictions have all been in line with the methodology of Huang & Ritter (2021). Now, adjustments are made to tailor the methodology to the purposes of this research. First, the sample of H&R ends in 2013 because data until t+3 is needed and the latest data they had available was on 2016. While this research is conducted, data is available until 2021, so the sample can be extended to include observations in 2018. Firm-years reporting a negative research and development (R&D) expense (Compustat's annual data item 'XRD', item number 46) are dropped from the sample. The reason for this is that, according to Compustat, this item only includes expenses of a firm. As a logical consequence, it should not be possible for this item to report a negative value. Negative values are therefore assumed to be misreported. Because of the importance of research development expenses as both a control variable and as a proxy for investment opportunities by which one of the liquidity

hedging needs proxies is constructed, firm-years reporting a negative value for this item are removed from the sample.

As also done by Acharya et al. (2007), nearly bankrupt firms are dropped from the sample, whereas they are defined as having a total debt greater than the total assets of a firm in year t . The rationale behind this is that nearly bankrupt firms tend to have very different liquidity management policies than companies that are not under similar duress. The intuition is apparent in the cash-management model of Gryglewicz (2011): due to creditors' superior claim in case of bankruptcy, (liquid) assets will be pocketed by creditors rather than shareholders in case of liquidation; given that firms (should) act in the interest of shareholders, a nearly bankrupt firm is incentivized to put liquid assets to use for salvation of the firm by pursuing positive NPV projects by which the overall NPV of the firm's future cash flows is prevented from losing its positive value. So, theoretically, a nearly bankrupt firm should have as little cash in reserves without immediately endangering the continuation of operations.

Finally, after all other data restrictions have been executed, firms are dropped from the sample if they do not have six consecutive observations by year. This is inspired by Acharya et al. (2007) who have the same restriction to minimize the impact of sample attrition on the data process, and, as they say: "it allows us to compute a robust empirical counterpart of the notion of firms' hedging needs".

The latter reason is not considered to be subject to much argument; there are at least a few observations necessary to compute a useful correlation for the hedging needs variable. Too little observations would cause the correlation to be more sensitive to stochastic variation, thereby being prone to show erratic behaviour and have severe outliers. However, this alteration of the composition of the sample does cause sampling bias. The minimum number of observations is required *after* having removed firm-years through the other data restrictions. Combined with the requirement of a non-missing stock return in year $t-1$, for instance, which causes the first year of observation to never be included, a minimum of six years after the 't-1 stock return' restriction actually requires seven observed years per firm. The requirement of a non-missing value for assets at the end of $t-2$ means that firms are listed for at least eight years, and one year more for each observation that does not meet the other requirements. Dropping firms from the sample that have five observed years or less, therefore removes many young firms from the sample that have become quickly delisted. For the firms that were delisted due to default, this restriction causes the sample to be biased towards healthy firms. For the young firms that are delisted due to being acquired, this might cause the sample to be biased towards firms with management that enjoy more trust from the market as their market capitalization would be lower, making them more viable acquisition targets.

The final sample contains 99,565 firm-year observations of 6,298 distinct firms, with data ranging from 1972 to 2018. The sample contains 19,945 instances of net debt issues and 9,819 counts of net equity issues.

3.2.1 Liquidity risk hedging needs

The liquidity risk hedging needs (simply referred to as ‘hedging needs’) variables are constructed according to Acharya et al. (2007). The need to hedge liquidity risk is defined as the inverse correlation between a firm’s internal cash flow (ICF) and its investment opportunities: if these are very asynchronous (so the correlation is negative), the firm would have a higher need for precautionary cash as it is less likely to be able to finance investments through the cash flow generated through its own operations. If the correlation is below -0.2, the firm is said to have high hedging needs, and if the correlation is above 0.2 the firm is designated as having low hedging needs. These cut-off points at (+/-) 0.2 may seem arbitrary, but are set as such as to secure significant deviation from 0 while at the same time not constricting the size of the sample too much. Acharya et al. have provided robustness checks, whereas greater and smaller cut-off points were chosen, and their findings were robust to these variations.

Acharya et al. treat hedging needs as a constant value over the entire timeframe for each firm. This creates a forward-looking problem: the metric for hedging needs for earlier years in the sample is constructed using observations that occurred later. This is justifiable if it can be argued that the correlation between ICF and investment opportunities is a fixed firm characteristic, but Acharya et al. (2007) do not address this issue, but the example of the oil company put forward in Froot et al. (1993) (that is discussed in section 2.2) does give some intuition as to why hedging needs may indeed be a fixed firm characteristic. However, with their example of the oil firm, Froot et al. also show that the correlation between a firm’s cash flow and investment opportunities is dependent on the cost of extraction (production, if you will) per unit of oil that can be obtained through an investment opportunity, whereas higher marginal costs make the firm’s investment opportunities more leveraged to the price of oil and therefore gives a lower incentive to hedge. The cost of production is likely to change over time due to innovation, changes in the cost of labour and changing prices of commodities needed for extraction, so in that regard the hedging needs of a firm should vary over time as well and can therefore not be seen as a fixed firm characteristic. This consideration warrants deviation from the methodology of Acharya et al. (2007). To address this issue, the hedging needs variables are constructed for each firm-year observation through a recursive rolling correlation with a minimum of five observations. Recursive means that the starting period of the rolling window stays fixed, so that the number of observations taken to calculate the correlation grows as the number of observations

per firm prior to the current firm-year observation grows. This increasing number of observations used for the correlation reflects the idea that as firms grow older they have more insight into their own financial characteristics and can therefore assess their own need to hedge liquidity risk more accurately. What would arguably be a better solution to this issue is to view part of the correlation as a constant characteristic and part of the correlation as time varying. As with the example of the oil company, the intrinsic coherence of cash flow and innovation is caused by them both being dependent on the price of oil, which can be considered to be a time-invariant characteristic, while the average cost of production does pose a time-variant characteristic. This opens up the challenge for sophisticated modelling, which is left for future research to take up.

As in Acharya et al. (2007), the industry median research and development expenses, and growth in sales in the three years following the observation are used as proxies for investment needs. However, it is difficult to assess how reliable they are, and it is found that their distributions vary greatly, as will be shown in the descriptive statistics. Therefore, other proxies are also considered.

The market-to-book ratio (Q) of a firm is also used as proxy for investment opportunities, as is a common practice in the literature (Opler et al., 1999; Smith & Watts, 1992; Jung et al., 1996), but it certainly is not absolved from doubt. The market value of a firm and its variance can be caused by a great many phenomena. All measures of Q therefore leave a large portion of it unexplained, but Erickson & Whited (2008) show that the 'Tobin's Q' measure of Q is preferable. There is also an endogeneity issue with using Q in this context, as the market might not only price the firm's perceived investment opportunities, but also its ability to seize those opportunities, which would mean that there is an endogenous relationship between a firm's Q and internal cash flow. This endogenous relation, while a valid concern, is assumed to be only marginally present, if present at all. This is definitely a topic for debate, as this is really about the degree of market efficiency that can be assumed, which in this paper is assumed to be only limited. This renders the Q not useless as a proxy for investment needs, which would be the case under perfectly efficient markets. To address this concern, the industry median Q is also taken as a proxy for investment needs. The idea behind this is that the endogenous effect (if it exists) is perhaps not eliminated, but it is diluted due to the industry aggregate to such an extent that the endogeneity concern should truly be negligible.

The three of the four hedging needs variables are based on industry means or medians as proxies for investment opportunities. However, using industry medians asserts relative homogeneity of industry groups. Acharya et al. (2007) address this issue by restricting the sample to manufacturing firms (SIC codes 2000 – 3999), as these industries are relatively homogenous. This restriction is not used in this paper: all industries are part of the analysis except for utility and financial firms. Industry

heterogeneity is therefore a likely source of noise that can cause industry median based hedging needs variables to be less effective than firm Q-proxy for . This was tested by running the regressions again for the subsample of firms with SIC codes ranging from 2000 to 3999, but this worsened the significance of the hedging needs variables' coefficients rather than improve, even though the subsample still comprised about 56,000 observations despite the new restriction. The regressions on the manufacturing subsample are not reported.

3.2.2 Metrics for financial constraints

As touched upon earlier, financial constraints are of considerable theoretical importance to liquidity management, and therefore to the effect of liquidity hedging needs as well. Eventually, financial constraints were decided to be excluded from this research as explained in the introduction. However, some effort was put in to transpose the proxies used for classifying financially constrained firms, as used in Acharya et al. (2007), to this research, which raised considerations that might be of methodological value for future research.

First, a yearly ranking of pay-out policies with regards to dividends and share buybacks, whereas the least paying three deciles of firms per year are designated as financially constrained. The rationale being that high-dividend payers are less likely to be financially constrained as they have chosen to pay out cash to their investors rather than use that cash for investment (Froot et al. 1993). Out of the final sample of 99,565 firm-year observations, 53,754 firm-years did not report any dividend payment in the prior year, and 35,705 reported neither a dividend payment nor any purchase of common or preferred stock: so 35.86% of firm-years reported no pay-out at all. If these firms reporting no pay-out were evenly distributed over the observed years, this would mean that the lowest three deciles - that would be classified as financially constrained all have zero pay-outs- while 5.86% of the total sample are equally financially constrained by this definition while not being classified as such. This problem could be overcome by instead designating the lowest four deciles as financially constrained (or perhaps the lowest three octiles, to narrow down the subsample as much as possible). However, the firms with zero pay-outs are not equally distributed over the sample. The most extreme cases were 2004 in which 51% of firms made no pay-outs to investors, and 2018 in which only 18% of firms reported no pay-outs¹². This makes pay-out policy a problematic measure of financial constraint,

¹² Note that this observation is in line with Kahle & Stulz (2020) that note that whereas in the beginning of the 2000s there was concern in the literature about disappearing dividends (Fama & French 2001), in recent times the high pay-outs to investors even raise political concerns with prominent figures like Marco Rubio and Bernie Sanders arguing in favour of constraining corporate pay-out policies. A figure is added in the appendix that supports these observations.

because for many years in the 90s and 00s this measure cannot discern variations in financial constraints for about half of the observations.

Long-term debt and commercial paper (i.e. debt with a maximum maturity of 365 days) ratings are two other metrics used by Acharya et al. (2007) to proxy for financial constraints. Firms that have no long-term or short-term debt rating are designated as firms with greater financial constraints, because these firms can be regarded as more opaque with regards to credit risk and should therefore endure more difficulty in accessing credit. This makes for promising metrics, and like Acharya et al. (2007) the long-term debt ratings and commercial paper ratings were retrieved from Compustat. However, after merging on fiscal year and Compustat's GVKEY-firm identification and allowing firm-years that reported no rating to be assigned a rating if it if they had been assigned to that firm in a prior year, out of the total 99,656 observations only 8,795 firm-years were found to have commercial paper ratings and 24,168 firm-years had long-term debt ratings. Based on commercial paper ratings this would mean that about 91% of firms should be designated as financially constrained and based on the long-term debt ratings this would apply to 76% of observations. Quite convincingly, this does not narrow down the subsample enough to designate a financially constrained subsample. Combining these two metrics, meaning that a firm-year would be classified as financially constrained if both ratings are missing, also does not work because only 24,532 observations were found to have at least one type of rating¹³.

The remaining metric for financial constraint is an annual ranking of firm size based on the beginning-of-year's book value of assets. The idea behind this comes from Erickson & Whited (2000), which state that smaller firms are likely to be less well-known and therefore more likely to face information asymmetries. Just as with the pay-out policy ranking, the three deciles with the lowest book value of assets in t-1 in fiscal year t was designated as financially constrained. Unlike the other metrics, this metric does not face problems with specifying a narrow subsample because the book value of assets is always a positive value and can therefore be used to specify however a small subsample as is desired. Of the metrics for financial constraints that were considered, this is therefore the only one for which the assessed methodology was found to be viable. This played an important role in deciding against incorporating financial constraints in the analysis put forward in this paper. As is often the case, firm size does not only proxy for financial constraints, so multiple measures of financial

¹³ As of the end of February 2017, the Compustat Standard & Poor's Ratings database has been discontinued and is therefore no longer updated. For this research it is only a minor consideration because this only concerns two out of 46 years in the sample, but future research on contemporary matters should therefore use a different source of debt ratings.

constraints are needed to eliminate sample selection bias from the analysis. Otherwise, whatever findings there are would be insufficiently robust.

3.3 Descriptive statistics

3.3.1 Hedging needs

Figure 1 shows the frequency distribution of firms per level hedging needs, whereas the correlation of ICF with the proxy for investment opportunities is rounded to the nearest decimal. Notable is that the R&D-based hedging needs has a much lower number of observations. This is because 49,108 firm-year observations report no R&D expenses, so the R&D-based hedging needs measure could only be constructed for 47,958 firm-year observations. The total number of non-missing values for the other hedging needs variables is considerably higher, with 73,580 values for Firm Q, 74,409 for industry median Q, and 74,436 for the industry median sales growth-based variables. These other measures of hedging needs all have approximately 25,000 missing values in the total sample. This is mainly caused by the restriction of a minimum of five observations needed for the correlation, so the first four firm-year observations have missing values for all 6,298 firms in the sample. Simple arithmetic shows that this restriction accounts for 25,192 missing observations per hedging needs measure.

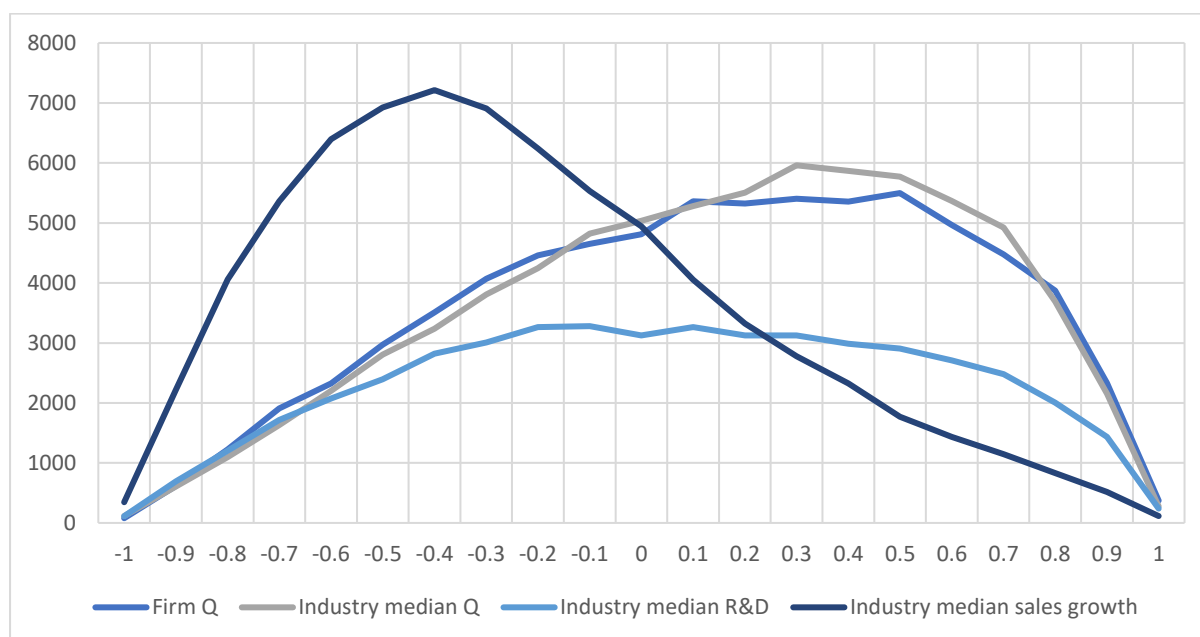


Figure 1. Frequency distribution of firm-year observations per level of hedging needs. Hedging needs are defined as the correlation between a firm's internal cash flow and investment opportunities. The different graphs represent hedging needs measures based on different proxies for investment opportunities. Hedging needs are rounded to the nearest decimal.

From this figure we can also see that the hedging needs measures based on Firm Q and industry median Q are very much alike, as can be expected, that the industry median R&D-based hedging needs measure follows a similar distribution, albeit with less observations, and that the industry median

sales growth-based measure of hedging needs has a very different distribution from the others. As a result, using industry median sales growth as a proxy for investment opportunities for the correlation between investment opportunities and internal cash flow causes significantly more firms to be designated as having high hedging needs compared to the other measures. This implies that there is a strong discrepancy between the identification of hedging needs among the industry median sales growth-based hedging needs variable and the others. Table three confirms this to be the case, as the correlation between the sales growth-based hedging needs variable and the other variables- used as ordinal identifiers to identify high, intermediate or low hedging needs- ranges between 0.218502 and 0.268660. However, the industry median R&D-based hedging needs variable shows the greatest deviation from the other variables with correlations ranging from 0.139366 to 0.242095. As expected, industry median Q- and firm Q-based variables show the strongest correlation at 0.506402. Still, this is not a particularly close correlation, which implies that there is ample room for sophistication of proxying for investment opportunities conditional on exogeneity to cash flow.

Table 3. Covariance matrix for the ordinal identifier hedging needs variables. Each hedging need variable is defined as the correlation between internal cash flow and investment opportunities, using a recursive rolling window with a minimum of five non-missing observations. The variables are named after the proxy for investment opportunities that is used. If the correlation is below -0.2, an observation is identified as having high hedging needs, and the hedging needs variable is given a value of 1, and if the correlation is greater than 0.2 the observation is designated as having low hedging needs and the variable is set to -1. For correlations with a smaller absolute deviation from 0 than 0.2 the variable is set to 0.

	Firm Q	Industry median Q	Industry median R&D
Industry median Q	0.506402		
Industry median R&D	0.139366	0.242095	
Industry median sales growth	0.268660	0.229054	0.218502

3.3.2 Cash holdings and financing decisions

Table 4 shows the distribution of firm-year observations in the sample per financing type. This is the same table as table 1.A, but now for the sample after deviations from the methodology of Huang & Ritter (2021). Note that the relative occurrences are more or less the same as the figures shown in table 1. Implications are already discussed at table 1 so discussing them here would be superfluous.

Table 4. Firm-year observations per issue type. An issue is defined as having occurred when the change in debt or equity is greater than 5% of the book-value of assets and greater than 3% of the market capitalization of the firm. A pure debt or pure equity issue means that only debt or only equity has been issued and not both. A dual issue is said to have occurred when both debt and equity are issued.

	count	%
No issue	71,999	72.30%
Pure debt issue	17,747	17.80%
Dual issue	2,198	2.20%
Pure equity issue	7,621	7.70%
All observations	99,565	100.00%

Table 5 shows the mean and median cash-to-asset ratios and excess cash ratios per financing type. Here it can be seen that firms that do not engage in external financing have cash-to-asset ratios that are close to the sample-wide average. For the non-issuers this is not surprising, as table 4 shows they make up 72.3% of the full sample, but for dual issuers this is remarkable. Excess cash appears to be different for dual issuers and non-issuers, as for non-issuers this is still near the sample wide average, but for dual issuers median excess cash ratios look much more like the medians of the pure debt issuers. The table also shows that debt issuers have significantly smaller cash holdings than average, while equity issuers tend to have significantly larger cash holdings than average. This seems to be in line with the hypotheses of this paper: firms that have higher hedging needs are expected to hold greater cash reserves and are expected to be more inclined to issue equity rather than debt.

Table 5. Cash to asset ratios and excess cash ratios. This table reports the means and medians (medians in italics) of cash holdings and excess cash. Excess cash is defined as the difference in cash ratio (defined as cash over assets) from the median cash ratio of firms in the same tercile of book-value of assets, tercile of Tobin's Q, and industry as defined through Fama & French's 17-industry classification system.

	No issue	Pure debt issue	Dual issue	Pure equity issue	Debt issue	Equity issue	All
$\frac{\text{cash}_{t-1}}{\text{assets}_{t-1}}$	16.0%	9.4%	14.8%	27.5%	10.0%	24.7%	15.7%
	<i>8.7%</i>	<i>4.8%</i>	<i>6.5%</i>	<i>15.5%</i>	<i>4.9%</i>	<i>12.4%</i>	<i>7.9%</i>
cash / assets	15.5%	8.0%	15.4%	31.6%	8.8%	27.9%	15.4%
	<i>8.7%</i>	<i>3.8%</i>	<i>7.0%</i>	<i>23.1%</i>	<i>4.0%</i>	<i>17.8%</i>	<i>7.8%</i>
$\frac{\text{cash}_{t+1}}{\text{assets}_{t+1}}$	15.5%	8.0%	13.8%	29.1%	8.6%	25.7%	15.2%
	<i>8.7%</i>	<i>3.9%</i>	<i>5.8%</i>	<i>19.8%</i>	<i>4.0%</i>	<i>14.7%</i>	<i>7.8%</i>
Excess cash _{t-1}	5.8%	0.2%	1.0%	8.9%	0.3%	7.1%	4.9%
	<i>0.7%</i>	<i>-2.0%</i>	<i>-2.3%</i>	<i>1.3%</i>	<i>-2.0%</i>	<i>0.1%</i>	<i>0.0%</i>
Excess cash _t	5.4%	-1.0%	1.6%	13.0%	-0.7%	10.5%	4.8%
	<i>0.7%</i>	<i>-2.5%</i>	<i>-2.1%</i>	<i>7.1%</i>	<i>-2.5%</i>	<i>4.0%</i>	<i>0.0%</i>
Excess cash _{t+1}	5.7%	-0.9%	0.6%	11.3%	-0.7%	8.9%	4.8%
	<i>0.9%</i>	<i>-2.5%</i>	<i>-2.6%</i>	<i>4.6%</i>	<i>-2.5%</i>	<i>1.7%</i>	<i>0.0%</i>

Panel A of table 6 shows that whereas pure debt issues are of quite a significant size, with a mean of 19.4% and a median of 12.2%, dual issues and pure equity issues tend to be much larger in size. When equity is issued the net change in equity is 50.1% at the mean, and 24.2% at the median, whereas debt issues (both straight and dual issues) have a mean of 21.6% and a median of 12.8% increase in net debt over beginning-of-year assets. Other notable figures are that the mean profitability of (pure) equity issuers is much lower than the full sample mean, whereas they operate close to break-even, while debt issuers have a mean and median operating cash flow (i.e. internal cash flow: ICF) that resembles the full sample mean and median. The median profitability of equity issuers, 9.5%, is considerably higher than the mean profitability at 2.1%. This indicates that there is great deviation of profitability for equity issuers, and that equity is likely to be issued when a firm incurs a significant loss. This somewhat seems to contradict the market timing theory of capital structure, but it must be

held in mind that a firm can also operate at a loss through large investments, which would not necessarily indicate a worsened market capitalization of the firm. Both equity and debt issuers tend to invest a greater degree of their assets than the sample wide average, but similarly so. Dual issuers tend to invest much more. This is to be expected, considering the large size of dual issues depicted by the net change in debt and equity over assets, as also shown in the table. Dividends over assets appears to be the same for all types of (non-) issues, and the change in non-cash net working capital is higher for both equity and debt issuers, with a more pronounced difference for debt issuers. Of particular interest is the net change in cash over assets for the different issuers: equity issuers are found to keep a much larger portion of their proceeds in reserve, as is conformant to the earlier observation on table 5. Another very notable figure is that all types of issuers show a large increase in non-cash assets with respect to the sample-wide average, but that this is staggeringly so for dual issuers, who have a mean increase of 89.5% and a median of 48.1%. This seems to show that dual issues are committed when very rigorous investment and expansion of the firm is needed. This gives rise to the suspicion that high hedging needs might correlate significantly with dual issuing, as dual issuers have lower average internal cash flow to assets while they also commit a great deal of investment and acquisition of illiquid assets.

Table 6. Summary statistics of cash flow components per financing type. NS denotes net spending, dD denotes change in Debt, dE denotes change in Equity, ICF stands for internal cash flow, NWC is the abbreviation of net working capital and NCF of net cash flow. See appendix A.2 for detailed variable definitions. Panel A shows the means and medians (medians in italics) of cash flow components. Panel B shows the means of cash flow components and what fraction of the subsamples have values for those cash flow components exceeding 50% and 100%. Panel C shows the correlation between the lagged values of cash flow components.

6.A	Pure debt issue	Dual issue	Pure equity issue	Debt issue	Equity issue	All
dD / assets _{t-1}	19.4%	39.3%	-4.9%	21.6%	5.0%	2.7%
	<i>12.2%</i>	<i>20.6%</i>	<i>-1.1%</i>	<i>12.8%</i>	<i>0.0%</i>	<i>0.0%</i>
dE / assets _{t-1}	-1.1%	38.9%	53.3%	3.3%	50.1%	4.6%
	<i>0.0%</i>	<i>19.1%</i>	<i>26.5%</i>	<i>0.0%</i>	<i>24.2%</i>	<i>0.0%</i>
ICF / assets _{t-1}	12.9%	7.7%	0.5%	12.3%	2.1%	11.1%
	<i>12.5%</i>	<i>12.8%</i>	<i>8.5%</i>	<i>12.5%</i>	<i>9.5%</i>	<i>11.6%</i>
investments / assets _{t-1}	21.9%	55.4%	16.7%	25.6%	25.4%	11.3%
	<i>15.9%</i>	<i>34.6%</i>	<i>8.8%</i>	<i>16.9%</i>	<i>11.9%</i>	<i>6.8%</i>
dividends / assets _{t-1}	1.2%	0.8%	0.6%	1.1%	0.6%	1.3%
	<i>0.2%</i>	<i>0.0%</i>	<i>0.0%</i>	<i>0.1%</i>	<i>0.0%</i>	<i>0.0%</i>
dnoncashNWC / assets _{t-1}	5.4%	7.6%	1.5%	5.7%	2.8%	1.7%
	<i>3.3%</i>	<i>4.3%</i>	<i>2.0%</i>	<i>3.4%</i>	<i>2.4%</i>	<i>1.1%</i>
dcash / assets _{t-1}	1.5%	19.1%	28.2%	3.5%	26.1%	3.4%
	<i>0.1%</i>	<i>3.1%</i>	<i>7.7%</i>	<i>0.2%</i>	<i>6.4%</i>	<i>0.2%</i>
dnoncashassets / assets _{t-1}	29.5%	89.5%	26.1%	36.2%	40.3%	13.4%
	<i>20.1%</i>	<i>48.1%</i>	<i>11.9%</i>	<i>21.6%</i>	<i>17.2%</i>	<i>6.1%</i>

Table 6. (Continued)

6.B	Equity issue (N = 9,819)		Debt issue (N = 19,945)	
	NS / dE	dcash / dE	NS / dD	dcash / dD
mean	127.4%	39.7%	194.4%	8.7%
% with ratio>0.5	58.8%	36.7%	91.4%	15.2%
% with ratio>1	41.5%	14.1%	82.5%	6.7%

6.C	All	Debt issue	Equity issue
Correlation between $ICF_{t-1} \div Assets_{t-1}$ and $ICF_t \div Assets_{t-1}$	0.456843	0.511534	0.437785
Correlation between $ICF_t \div Assets_{t-1}$ and $ICF_{t+1} \div Assets_{t-1}$	0.564674	0.601906	0.494661
Correlation between $ICF_{t+1} \div Assets_{t-1}$ and $ICF_{t+2} \div Assets_{t-1}$	0.577382	0.577982	0.518917
Correlation between $Loss_{t-1}$ and $Loss_t$	0.549415	0.521399	0.71697
Correlation between $Loss_t$ and $Loss_{t+1}$	0.553499	0.49297	0.700497
Correlation between $Loss_{t+1}$ and $Loss_{t+2}$	0.552699	0.48667	0.68447
Correlation between $NS_{t-1} \div Assets_{t-1}$ and $NS_t \div Assets_{t-1}$	0.152413	0.227858	0.204596
Correlation between $NS_t \div Assets_{t-1}$ and $NS_{t+1} \div Assets_{t-1}$	-0.08938	0.264008	0.187225
Correlation between $NS_{t+1} \div Assets_{t-1}$ and $NS_{t+2} \div Assets_{t-1}$	0.338613	0.440483	0.353795

Panel B of table 6 shows that equity issuers have a mean net spending that is 27.4% greater than the net change in equity, and debt issuers have a mean net spending that is almost twice the increase in debt. For 58.8% the ratio of net spending over net change in equity is greater than 0.5 and for 41.5% of issuers this ratio exceeds 1. This also shows that 41.1% spend less than 50% of equity proceeds. These figures are much higher for debt issuers, as 91.4% spends more than half of the issue proceeds and 82.5% spends more than the full proceeds. This indicates that while both types of issuers tend to spend much of their proceeds, debt issuers are much more prone to immediately spend most, if not all proceeds. Debt issuers do not tend to get much larger cash reserves, while equity issuers do. This confirms that debt issuers have short-lived cash needs whereas equity issuers have long-lived cash needs. This is in line with the hypothesis that firms with high hedging needs, being considered as having long-lived cash needs, are more likely to issue equity than debt.

Panel C of table 6 shows that debt issuers tend to have more stable cash flows than both equity issuers and the entire sample, and that equity issuers have less stable cash flows than average. Profitability and unprofitability is considerably more persistent for equity issuers than for debt issuers and the overall average. This could indicate that unprofitable firms want to avoid increased expenses through interests when engaging in external finance and that they face considerably higher interest rates because they are perceived to have greater default risk. Net spending appears to be only weakly persistent for all firms, but greater for firms that due engage in external finance than firms that do

not, and more so for debt issuers than equity issuers. This seems to show, considering the findings of panel 6.B, that security issuing firms have longer-lived cash needs than non-issuing firms.

4 Results

4.1 Cash holdings

Table 7 shows the effects of high hedging needs on cash holdings, whereas in panel A a recursive rolling window is used for constructing the hedging needs variables to avoid the forward-looking problem, and in panel B the method of Acharya et al. (2007) is used, in which hedging needs are treated as a fixed firm characteristic. Only the firm Q-based hedging needs variable constructed according to the method of Acharya et al. (2007) shows a significant effect, but shows a negative sign instead of the hypothesized positive sign. This finding suggests that instead of holding larger reserves to prevent future cash shortfalls, firms that have asynchronous operating cash flows and investment needs are rather forced to utilize a greater degree of their liquidity, resulting in lower precautionary cash holdings. As a result, these firms have a greater degree of unhedged liquidity risk, meaning that they are more liable to face opportunity costs of forgone investments. However, this finding is hardly robust, as all other measures are insignificant, including the non-forward looking firm Q-based measure of hedging needs.

Table 7. Cash holdings. This table reports the ordinary least squares (OLS) regressions for the cash held by firms scaled by beginning of year's assets. The dependent variable is cash/assets. High hedging needs is a dummy variable when the correlation between internal cash flow (ICF) and investment opportunities is lower than -0.2. Panel A shows the regressions whereas the hedging needs correlations are based on a recursive rolling window, requiring at least five non-missing observations, and panel B shows the regression for which the hedging needs variables are based on a correlation using all observations per firm in the sample. The columns show the same regression with different measures of hedging needs, whereas the variation lies in the proxies for investment opportunities that are used: in the first column the yearly industry mean market-to-book ratio (Q) used as proxy for investment opportunities, in the second column the market-to-book ratio (Q) is used, the third column uses the industry median R&D in year t, the fourth column shows the sales growth over years t+1 to t+3 as proxy for investment opportunities. The significance level is denoted by *, **, and ***, corresponding to a significance level of 10%, 5% and 1%, respectively.

7.A	Firm Q		Industry median Q		Industry median R&D		Industry median sales growth	
	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
High hedging needs	0.000251	0.4	0.000675	0.9	0.00135	1.6	-2.5E-05	0
cash _{t-1} / assets _{t-1}	0.825***	220.1	0.825***	220.1	0.825***	220.1	0.825***	220.1
Ln(Assets) _{t-1}	-0.00046	-0.8	-0.00045	-0.8	-0.00046	-0.8	-0.00045	-0.8
Tobin's Q _{t-1}	0.00198***	4.5	0.00199***	4.5	0.00198***	4.5	0.00198***	4.5
Return _{t-1}	0.00372***	5.7	0.00372***	5.7	0.00373***	5.7	0.00372***	5.7
Return _{t+1, t+3}	-1.2E-05	-0.1	-1.3E-05	-0.1	-1.1E-05	-0.1	-1.2E-05	-0.1
Term spread _{t-1}	0.00159**	2.3	0.00158**	2.3	0.00159**	2.3	0.00158**	2.3
Default spread _{t-1}	-0.001	-0.6	-0.001	-0.6	-0.00099	-0.6	-0.001	-0.6
	-		-		-		-	
Ln(sales) _{t-1}	0.00344***	-5.4	0.00345***	-5.4	0.00343***	-5.4	-0.00345***	-5.4
Ln(Age) _t	0.00374***	10.3	0.00372***	10.2	0.00365***	10.1	0.00375***	10
Leverage _{t-1}	0.0002	0.1	0.000208	0.1	0.000207	0.1	0.000189	0.1
R&D _{t-1}	0.00226	1.4	0.00226	1.4	0.00226	1.4	0.00226	1.4
Industry volatility _{t-1}	0.264***	15.2	0.264***	15.3	0.263***	15.3	0.264***	15.3
	-		-		-		-	
Dividend payer _{t-1}	0.00378***	-5.8	0.00375***	-5.7	0.00379***	-5.8	-0.00378***	-5.8
Constant	0.0123***	4.2	0.0123***	4.2	0.0124***	4.2	0.0122***	4.1
N	97493		97493		97493		97493	
adj. R-squared	79.7%		79.7%		79.7%		79.7%	

7.B	Firm Q		Industry median Q		Industry median R&D		Industry median sales growth	
	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
High hedging needs	-0.00238**	-3	0.000675	0.9	0.001	1.2	-0.000831	-1.3
cash _{t-1} / assets _{t-1}	0.825***	220.2	0.825***	220.1	0.825***	220	0.825***	220
Ln(Assets) _{t-1}	-0.000364	-0.6	-0.000451	-0.8	-0.000451	-0.8	-0.000417	-0.7
Tobin's Q _{t-1}	0.00202***	4.5	0.00199***	4.5	0.00198***	4.5	0.00199***	4.5
Return _{t-1}	0.00369***	5.6	0.00372***	5.7	0.00372***	5.7	0.00373***	5.7
Return _{t+1, t+3}	-0.0000285	-0.2	-0.0000126	-0.1	-0.0000136	-0.1	5.63E-07	0
Term spread _{t-1}	0.00160*	2.3	0.00158**	2.3	0.00159*	2.3	0.00158*	2.3
Default spread _{t-1}	-0.000975	-0.6	-0.001	-0.6	-0.000998	-0.6	-0.00102	-0.6
Ln(sales) _{t-1}	-0.00351***	-5.5	-0.00345***	-5.4	-0.00344***	-5.4	-0.00344***	-5.4
Ln(Age) _t	0.00366***	10.1	0.00372***	10.2	0.00374***	10.3	0.00377***	10.4
Leverage _{t-1}	0.000117	0.1	0.000208	0.1	0.000189	0.1	0.0000851	0
R&D _{t-1}	0.00224	1.4	0.00226	1.4	0.00225	1.4	0.00227	1.4
Industry volatility _{t-1}	0.266***	15.4	0.264***	15.3	0.263***	15.3	0.264***	15.3
Dividend payer _{t-1}	-0.00388***	-5.9	-0.00375***	-5.7	-0.00380***	-5.8	-0.00372***	-5.7
Constant	0.0129***	4.4	0.0123***	4.2	0.0121***	4.1	0.0125***	4.2
N	97493		97493		97493		97493	
adj. R-squared	79.7%		79.7%		79.7%		79.7%	

4.2 Cash retention rates

Table 8 shows the retention rates of issue proceeds for different subsamples. Huang & Ritter (2021) run the same regressions as regressions 1 to 7, and although they also find notably higher retention rates of debt issue proceeds for the subsamples not facing cash depletion, they do find consistently significant effects for dD / assets_{t-1} across all samples. This begs the question of whether the divergent definitions of dD causes this difference in findings. This was tested (but is not reported), and it was found that the regressed effects were actually even less significant when the definitions of Huang & Ritter were used. This adds to the suspicion that their stated definition of dD is simply a misrepresentation, and that they actually did use the definitions that are coherent with the Compustat manual and Dasgupta et al. (2011).

Contrary to the subsamples that are not limited to firms with high hedging needs, the subsamples that do have that restriction do have significant retention rates of debt proceeds when debt is issued, also when facing immediate cash depletion. These retention rates are all found to be higher than for the non-restricted subsample. However, when not facing immediate cash depletion the retention rate is found to be lower for all different measures of hedging needs. These findings suggest that when faced with immediate cash depletion, firms that have high hedging needs are more keen on keeping cash in reserve than firms that do not have high hedging needs. But it can also clearly be seen that immediate cash depletion leads to very low retention rates of debt issue proceeds whereas these retention rates are very high when cash depletion is not looming.

The retention rates of equity proceeds are found to be consistently significant for all subsamples, including firms that face immediate cash depletion. The question here is really if the retention rates of equity are higher for the subsamples of firms facing high hedging needs. For firms that face immediate cash depletion, the retention rate is higher for all measures of hedging needs except when industry median growth in sales is used as proxy for investment opportunities. For firms that do not face immediate cash depletion, the results are ambiguous, as two measures (using firm Q and the industry median R&D as proxies) of hedging needs do show a considerably higher retention rates than the full sample of firms that do not face immediate cash depletion, and two measures show lower retention rates. Therefore the equity proceed retention rates for firms that do face immediate depletion are considered to be robustly higher, but for the firms that do not face immediate cash depletion the results are not considered to be conclusive.

Table 8. Cash retention rates of financing issues. This table shows regressions with $\text{dcash} * 100 / \text{assets}_{t-1}$ as the independent variable. Each regression is run on a different subsample. Regressions 1 to 3 are run on the full sample and subsamples of debt and equity issuances. Regressions 4 to 7 are run on the equity and debt issue subsamples, which are further split on whether the firm faces immediate cash depletion or not, which is said to occur when $\text{cash}_{\text{ex post}}$ is less or equal to zero. The other regressions do the same, but are run on subsamples of high hedging needs according to the reported proxy used for investment opportunities. The figures in bold show the retention rates of equity and debt proceeds for the subsamples that are not restricted to firms that are designated as having high hedging needs. The significance level is denoted by *, **, and ***, corresponding to a significance level of 10%, 5% and 1%, respectively.

			dE / assets_l1	dD / assets_l1	ICF / assets_l1	Constant	N	adj. R-sq
(1)								
Full sample		Coeff.	75.5***	-16.4	57.4**	-6.0**	99547	49.0%
		T-stat.	21.3	-1.2	3	-3		
(2)								
Equity issue		Coeff.	77.9***	-24.1	46.8***	-12.7***	9818	66.1%
		T-stat.	19.5	-1.7	3.5	-5.8		
(3)								
Debt issue		Coeff.	56.5***	0.4	-8.6	2.6	19945	45.7%
		T-stat.	5	0.1	-0.9	1		
(4)								
Equity issue	Cash _{ex post} ≤ 0	Coeff.	63.3***	-15.2	6.9	-14.1***	4883	77.4%
		T-stat.	14.4	-1.6	1	-5.1		
(5)								
Debt issue	Cash _{ex post} > 0	Coeff.	107.2***	64.1***	60.2***	-13.8***	4935	71.7%
		T-stat.	16.5	4.2	10	-5		
(6)								
Equity issue	Cash _{ex post} ≤ 0	Coeff.	57.9***	-7.1	-13.5	1.8	14733	61.7%
		T-stat.	5.2	-1.1	-1.5	0.9		
(7)								
Debt issue	Cash _{ex post} > 0	Coeff.	87.6***	93.1***	41.7***	-9.5***	5212	80.7%
		T-stat.	20.8	50.6	9.2	-13.8		
Firm Q								
(8)								
Equity issue	Cash _{ex post} ≤ 0	Coeff.	77.1***	23.7***	45.2***	-21.7***	802	83.3%
		T-stat.	7.9	3.5	4.2	-5.6		
(9)								
Debt issue	Cash _{ex post} > 0	Coeff.	138.9***	-39.8	50.5***	-26.5***	884	71.0%
		T-stat.	5.9	-0.6	4.9	-2.6		
(10)								
Equity issue	Cash _{ex post} ≤ 0	Coeff.	43.3***	7.8***	2.3	-2.6***	2534	44.5%
		T-stat.	8	3	0.7	-4.9		
(11)								
Debt issue	Cash _{ex post} > 0	Coeff.	99.8***	83.6***	49.3***	-8.4***	1058	75.1%
		T-stat.	7.1	17.7	3.9	-4		
Industry median Q								
(12)								
Equity issue	Cash _{ex post} ≤ 0	Coeff.	73.2***	11.4**	35.4***	-20.0***	798	80.4%
		T-stat.	7.3	2.1	3.6	-5.2		
(13)								
Debt issue	Cash _{ex post} > 0	Coeff.	98.7***	13.9	14.8	-9.2***	887	20.2%
		T-stat.	17.6	0.3	0.3	-5		
(14)								
Equity issue	Cash _{ex post} ≤ 0	Coeff.	51.5***	8.5**	1.4	-3.3***	2344	52.9%
		T-stat.	4.5	2.4	0.5	-5.5		
(15)								
Debt issue	Cash _{ex post} > 0	Coeff.	83.7***	88.5***	39.9***	-8.6***	961	79.8%
		T-stat.	12.2	35.2	7.7	-10.6		

Table 8. (Continued)

		Industry median R&D						
		(16)						
Equity issue	Cash _{ex post} ≤ 0	Coeff.	67.2***	21.8**	33.7***	-17.6***	678	79.4%
		(17)						
	Cash _{ex post} > 0	Coeff.	124.0***	-27.6	42.8***	-23.8**	867	74.5%
		(18)						
Debt issue	Cash _{ex post} ≤ 0	Coeff.	55.0***	11.2**	7.2*	-4.4***	1939	56.7%
		(19)						
	Cash _{ex post} > 0	Coeff.	97.5***	85.2***	44.0***	-8.2***	839	83.3%
		T-stat.	11.2	24.1	5.5	-5.7		
		Industry median sales growth						
		(20)						
Equity issue	Cash _{ex post} ≤ 0	Coeff.	63.1***	10.2**	10.1*	-13.3***	1337	81.7%
		(21)						
	Cash _{ex post} > 0	Coeff.	95.7***	50.0*	13.7	-4.9	1547	26.2%
		(22)						
Debt issue	Cash _{ex post} ≤ 0	Coeff.	55.6***	4.5***	-8.6**	-0.7	5677	64.3%
		(23)						
	Cash _{ex post} > 0	Coeff.	90.0***	92.8***	36.2***	-8.0***	2397	72.6%
		T-stat.	7.9	32.4	5.8	-7.2		

4.3 Financing decisions

Table 9 shows that, when accounting for the forward looking problem as reported in panel A, the industry median Q-based measure of high hedging needs has a statistically significant effect in making firms more likely to issue equity instead of debt. However, the only other significant effect of having high hedging needs is a negative effect on dual issuance when using industry median sales growth as proxy for investment opportunities, which is contrary to the hypothesis. Panel B shows the effect of the hedging needs measures that treat hedging needs as a fixed firm characteristic, following the definitions of Acharya et al. (2007), and here high hedging needs are found to give firms a significant preference for making a dual issue (both debt and equity) instead of straight debt, for the measures of hedging needs that use Firm Q and industry median sales growth as proxies for hedging needs. The other two measures do not report significant effects on the choice between issue types. All in all, it must be concluded that the results are inconclusive, just as the other findings are also ambiguous. The best explanation for that is the wildly varying distributions of hedging needs, as reported in figure 1. This suggests that better proxies for investment opportunities must be found that are exogenous to cash flow, before hedging needs can be properly investigated empirically.

Table 9. Debt vs. equity choice. This table shows the multinomial logit regressions on the choice to issue debt or equity, conditional on financing. All independent variables are standardized, meaning that they have a mean of 0 and standard deviation of 1. The coefficients represent the marginal effects at the means of the independent variables. The high hedging needs variable is a dummy variable that equals 1 if the correlation between the firm's internal cash flow and investment opportunities is below -0.2. The four regressions are defined and titled according to the proxy used for investment opportunities by which the hedging needs variable is constructed: 'Firm Q' uses the firm's Tobin's Q of fiscal year t-1, 'Industry median Q' uses the Tobin's Q of the industry group based on the three-digit SIC code, 'Industry median R&D' uses the R&D expenses of the same industry (based on three digit SIC-codes) as proxy, 'Industry median sales growth' uses the median growth in sales for the years t+1 to t+3 for firms in the same industry, again based on the three digit SIC-codes. Other variable definitions can be found in appendix A.2. The regressions are run on 27,195 firm-year observations. Pure debt financing is the base case and is therefore not reported. Panel A uses a recursive rolling regression for constructing the hedging needs variables, and panel B uses the correlation of all observations per firm. The significance level is denoted by *, **, and ***, corresponding to a significance level of 5%, 1% and 0.1%, respectively.

9.A	Firm Q				Industry median Q			
	Dual issue		Pure equity issue		Dual issue		Pure equity issue	
	Coeff.	Z-stat.	Coeff.	Z-stat.	Coeff.	Z-stat.	Coeff.	Z-stat.
High hedging needs	6.70E-05	0	0.003	1	7.20E-04	0.4	.0054*	1.8
cash _{t-1}	-0.0011	-0.1	-.0838***	-2.8	-0.0011	-0.1	-.0842***	-2.8
ICF _{t-1}	.012**	2	-.081***	-3.3	.0119**	2	-.0796***	-3.3
Tobin's Q _{t-1}	.0125***	3.8	.0841***	13.7	.0125***	3.8	.0842***	13.8
return _{t-1}	.0166***	9.2	.0474***	13.7	.0166***	9.2	.0474***	13.7
return _{t+1, t+3}	-0.0025	-1.3	-.0166***	-4.9	-0.0025	-1.3	-.0166***	-4.9
term spread _{t-1}	0.0074	1.4	6.00E-04	0.1	0.0074	1.4	6.10E-04	0.1
default spread _{t-1}	.013**	2.2	-0.0133	-1.4	.013**	2.2	-0.0132	-1.4
ln sales _{t-1}	-.0245***	-9.8	-.0818***	-17.8	-.0245***	-9.8	-.0818***	-17.8
ln age	-.0187***	-9.2	-.0229***	-6.8	-.0188***	-9.2	-.0233***	-6.9
leverage _{t-1}	.0311***	15.5	.0443***	11.2	.0311***	15.5	.0443***	11.2
R&D _{t-1}	.6663***	7.5	2.885***	16.2	.665***	7.5	2.882***	16.2
Industry volatility _{t-1}	.0039*	1.8	.0381***	11.4	.0039*	1.9	.0381***	11.4
Dividend payer _{t-1}	-.0071***	-3	-.0405***	-10.7	-.0071***	-3	-.0403***	-10.7
pseudo R-squared	19.16%				19.17%			
	Industry median R&D				Industry median sales growth			
	Dual issue		Pure equity issue		Dual issue		Pure equity issue	
	Coeff.	Z-stat.	Coeff.	Z-stat.	Coeff.	Z-stat.	Coeff.	Z-stat.
High hedging needs	-1.40E-04	-0.1	0.0031	1	-.0062***	-2.9	-0.0026	-0.8
cash _{t-1}	-0.0011	-0.1	-.0839***	-2.8	-0.0014	-0.1	-.0839***	-2.8
ICF _{t-1}	.012**	2	-.0805***	-3.3	.012**	2	-.0809***	-3.3
Tobin's Q _{t-1}	.0124***	3.8	.0838***	13.7	.0123***	3.8	.0838***	13.7
return _{t-1}	.0165***	9.2	.0474***	13.7	.0165***	9.2	.0473***	13.6
return _{t+1, t+3}	-0.0025	-1.3	-.0166***	-4.8	-0.0026	-1.3	-.0166***	-4.9
term spread _{t-1}	0.0074	1.4	6.30E-04	0.1	0.0073	1.4	4.70E-04	0.1
default spread _{t-1}	.013**	2.2	-0.0132	-1.4	.0128**	2.2	-0.0134	-1.4
ln sales _{t-1}	-.0245***	-9.7	-.0816***	-17.7	-.0238***	-9.4	-.0814***	-17.6
ln age	-.0186***	-9.1	-.0231***	-6.8	-.0165***	-7.8	-.0215***	-6.1
leverage _{t-1}	.0311***	15.5	.0444***	11.2	.0307***	15.3	.044***	11.1
R&D _{t-1}	.6647***	7.5	2.873***	16.1	.6686***	7.5	2.886***	16.2
Industry volatility _{t-1}	.0039*	1.9	.038***	11.4	.0039*	1.9	.0383***	11.5
Dividend payer _{t-1}	-.0071***	-3.1	-.0407***	-10.8	-.0067***	-2.9	-.0406***	-10.8
pseudo R-squared	19.16%				19.18%			

Table 9 (Continued)

9.B	Firm Q				Industry median Q			
	Dual issue		Pure equity issue		Dual issue		Pure equity issue	
	Coeff.	Z-stat.	Coeff.	Z-stat.	Coeff.	Z-stat.	Coeff.	Z-stat.
high hedging needs	.004*	2.3	0.0035	1.2	0.0024	1.4	0.0018	0.6
cash_t-1	-0.0012	-0.1	-.084**	-2.8	-0.0012	-0.1	-.084**	-2.8
ICF_t-1	0.0119	1.9	-.0816***	-3.3	.0119*	2	-.0808***	-3.3
Tobin's Q_t-1	.0118***	3.6	.083***	13.5	.0123***	3.7	.0836***	13.7
return_t-1	.0168***	9.4	.0476***	13.7	.0166***	9.3	.0474***	13.7
returnt+1, t+3	-0.0025	-1.2	-.0165***	-4.8	-0.0025	-1.2	-.0165***	-4.8
term spread_t-1	0.0073	1.4	5.00E-04	0.1	0.0074	1.4	5.10E-04	0.1
default spread_t-1								
1	.013*	2.2	-0.0134	-1.4	.013*	2.2	-0.0134	-1.4
ln sales_t-1	-.0243***	-9.7	-.0816***	-17.7	-.0243***	-9.6	-.0816***	-17.7
ln age	-.0183***	-9.1	-.0221***	-6.6	-.0185***	-9.2	-.0222***	-6.7
leverage_t-1	.0311***	15.4	.0443***	11.2	.031***	15.4	.0442***	11.2
R&D_t-1	.6796***	7.6	2.907***	16.3	.6681***	7.5	2.889***	16.2
Industry volatility_t-1	0.0037	1.8	.038***	11.4	0.0038	1.8	.0382***	11.4
Dividend payer_t-1	-.0069**	-3	-.0405***	-10.7	-.007**	-3	-.0405***	-10.8
pseudo R-sq	19.18%				19.17%			

	Industry median R&D				Industry median sales growth			
	Dual issue		Pure equity issue		Dual issue		Pure equity issue	
	Coeff.	Z-stat.	Coeff.	Z-stat.	Coeff.	Z-stat.	Coeff.	Z-stat.
high hedging needs								
cash_t-1	-0.0011	-0.6	0.0029	1	.005**	2.7	0.0022	0.8
ICF_t-1	-0.0011	-0.1	-.0837**	-2.8	-9.50E-04	-0.1	-.0837**	-2.8
Tobin's Q_t-1	.012*	2	-.0808***	-3.3	0.0118	1.9	-.0815***	-3.3
return_t-1	.0125***	3.8	.0838***	13.7	.0123***	3.7	.0837***	13.7
returnt+1, t+3	.0165***	9.2	.0474***	13.7	.0165***	9.2	.0472***	13.6
term spread_t-1	-0.0025	-1.3	-.0166***	-4.8	-0.0028	-1.4	-.0168***	-4.9
default spread_t-1								
1	0.0074	1.4	6.00E-04	0.1	0.0074	1.4	6.40E-04	0.1
ln sales_t-1	.0129*	2.2	-0.0132	-1.4	.0131*	2.2	-0.0134	-1.4
ln age	-.0246***	-9.8	-.0816***	-17.7	-.0253***	-10	-.0821***	-17.8
leverage_t-1	-.0186***	-9.3	-.0225***	-6.8	-.0188***	-9.4	-.0225***	-6.8
R&D_t-1	.0311***	15.5	.0443***	11.2	.0314***	15.6	.0446***	11.2
Industry volatility_t-1	.6681***	7.5	2.876***	16.1	.6743***	7.6	2.897***	16.3
Dividend payer_t-1	0.004	1.9	.0379***	11.3	0.0039	1.8	.0381***	11.4
	-.0071**	-3	-.0407***	-10.8	-.0074**	-3.2	-.0408***	-10.8
pseudo R-sq	19.16%				19.18%			

5 Conclusions

The effect of hedging needs on liquidity management is empirically analysed for publicly listed U.S. firms. The found effects of hedging needs on cash holdings (cash to asset ratios) is found to be inconclusive. One significant effect was found, using the firm's Tobin's Q as proxy for investment opportunities, which suggests that firms that face high hedging needs have lower cash-to-asset ratios, which implies that such firms are more exposed to liquidity risk and are therefore more liable to incur opportunity costs of missed investments. However, the results are found not to be robust to using different proxies for investment opportunities that are exogenous to cash flow. Also, firm Q is subject to endogeneity concerns as the market capitalization of a firm might not only reflect the market's assessment of a firm's investment opportunities, but also its ability to seize (fund) such opportunities.

Cash retention rates of issue proceeds are found to be higher for firms facing high hedging needs when they issue debt and do face immediate cash depletion, and lower when they do not face immediate cash depletion. When issuing equity, firms having high hedging needs retain more of their proceeds as reserves when they do face immediate cash depletion and the results are ambiguous for when they do not. This is also not enough to conclusively say that retention rates are indeed higher for firms that face high hedging needs, but are somewhat promising. If anything, this underlines the notion that the proxies for investment opportunities that are exogenous to cash flow lack sophistication, as portrayed by their wildly varying distributions.

5.1 Limitations and future research

An important limitation is that only the effect of high hedging needs on liquidity management is investigated through the analysis. The effect of low hedging needs is not addressed.

The hedging needs metrics used in this paper are solely based on the finding of Froot et al. (1993) that firms have a greater need to hedge if their cash flows and investment opportunities are less correlated, and in doing so have no regard for the implication of the theory of Froot et al. (1993) that firms have a greater need to hedge if their cash flows are highly correlated with collateral values, and thereby their ability to raise external finance. This remains as a challenge for future empirical research to devise a proper methodology for.

The hedging needs metrics are devised according to a recursive rolling correlation between internal cash flow and investment opportunities. Although it is considered to be a better method than the one used by Acharya et al. (2007), it is not investigated whether this is the best measure for hedging needs.

The suspicion is put forward that a model that splits the correlation in a time-invariant and a time-variant component might be more applicable, considering that time-variant and time-invariant causes of the correlation can be thought of.

The effect of financial constraints on the impact of hedging needs on liquidity management is not considered in the empirical analysis presented in this paper. Three measures of financial constraints were considered, of which only firm size was deemed to have a viable methodology. Future research is invited to investigate the importance of financial constraints in this regard. The Kaplan-Zingales index, Whited-Wu index, and firm size are deemed to be practicable proxies for this endeavour.

6 References

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

Almeida, H., Campello, M., Cunha, I., & Weisbach, M. S. (2014). Corporate liquidity management: A conceptual framework and survey. *Annu. Rev. Financ. Econ.*, 6(1), 135-162.

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

Baker, M., & Wurgler, J. (2002). Market timing and capital structure. *The journal of finance*, 57(1), 1-32.

Brunnermeier, M. K. (2009). Deciphering the liquidity and credit crunch 2007-2008. *Journal of Economic perspectives*, 23(1), 77-100.

Brunnermeier, M. K., & Pedersen, L. H. (2009). Market liquidity and funding liquidity. *The review of financial studies*, 22(6), 2201-2238.

Bushman, R. M., Smith, A., & Zhang, F. (2007). Investment-cash flow sensitivities are really investment-investment sensitivities. Working paper, University of North Carolina.

Dasgupta, S., Noe, T. H., & Wang, Z. (2011). Where did all the dollars go? The effect of cash flows on capital and asset structure. *Journal of Financial and Quantitative Analysis*, 46(5), 1259-1294.

DeAngelo, H., DeAngelo, L., & Stulz, R. M. (2010). Seasoned equity offerings, market timing, and the corporate lifecycle. *Journal of financial economics*, 95(3), 275-295.

DeAngelo, H., DeAngelo, L., & Whited, T. M. (2011). Capital structure dynamics and transitory debt. *Journal of financial economics*, 99(2), 235-261.

DeAngelo, H., Gonçalves, A. S., & Stulz, R. M. (2018). Corporate deleveraging and financial flexibility. *The Review of Financial Studies*, 31(8), 3122-3174.

Donaldson, G. (1961), *Corporate Debt Capacity: A Study of Corporate Debt Policy and the Determination of Corporate Debt Capacity* (Harvard Graduate School of Business Administration, Boston).

Duchin, R., Ozbas, O., & Sensoy, B. A. (2010). Costly external finance, corporate investment, and the subprime mortgage credit crisis. *Journal of financial economics*, 97(3), 418-435.

Erickson, T., & Whited, T. M. (2000). Measurement error and the relationship between investment and q. *Journal of political economy*, 108(5), 1027-1057.

Erickson, T., & Whited, T. M. (2006). On the accuracy of different measures of q. *Financial management*, 35(3), 5-33.

Fabozzi, F. J. (2013). *Bond markets, analysis, and strategies*. Eighth edition. MIT Press.

- Fama, E. F., & French, K. R. (2001). Disappearing dividends: changing firm characteristics or lower propensity to pay?. *Journal of Financial economics*, 60(1), 3-43.
- Fama, E. F., & French, K. R. (2002). Testing trade-off and pecking order predictions about dividends and debt. *The review of financial studies*, 15(1), 1-33.
- Frank, M. Z., & Goyal, V. K. (2003). Capital structure decisions. Available at SSRN 396020.
- Frank, M. Z., & Goyal, V. K. (2009). Capital structure decisions: which factors are reliably important?. *Financial management*, 38(1), 1-37.
- Froot, K. A., Scharfstein, D. S., & Stein, J. C. (1993). Risk management: Coordinating corporate investment and financing policies. *the Journal of Finance*, 48(5), 1629-1658.
- Gomes, A., & Phillips, G. (2012). Why do public firms issue private and public securities?. *Journal of Financial Intermediation*, 21(4), 619-658.
- Gryglewicz, S. (2011). A theory of corporate financial decisions with liquidity and solvency concerns. *Journal of Financial Economics*, 99(2), 365-384.
- Huang, R., & Ritter, J. R. (2021). Corporate cash shortfalls and financing decisions. *The Review of Financial Studies*, 34(4), 1789-1833.
- Ivashina, V., & Scharfstein, D. (2010). Bank lending during the financial crisis of 2008. *Journal of Financial economics*, 97(3), 319-338.
- Kahle, K., & Stulz, R. M. (2020). Why are Corporate Payouts so High in the 2000s? (No. w26958). National Bureau of Economic Research.
- Kahle, K. M., & Walkling, R. A. (1996). The impact of industry classifications on financial research. *Journal of financial and quantitative analysis*, 31(3), 309-335.
- Keynes, J. M. (1936). *The General Theory of Employment, Interest and Money*. DE Moggridge (Ed.), 7.
- Jung, K., Kim, Y. C., & Stulz, R. (1996). Timing, investment opportunities, managerial discretion, and the security issue decision. *Journal of Financial Economics*, 42(2), 159-185.
- Kraus, A., & Litzenberger, R. H. (1973). A state-preference model of optimal financial leverage. *The journal of finance*, 28(4), 911-922.
- Kurshev, A. , & Strebulaev, I. A. (2006). Firm size and capital structure. In *EFA 2005 Moscow Meetings Paper*.
- McKeon, S. B. (2015). Employee option exercise and equity issuance motives. Available at SSRN 1920985.
- Myers, S. C. (1984). Capital structure puzzle.
- Myers, S. C., & Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of financial economics*, 13(2), 187-221.
- Opler, T., Pinkowitz, L., Stulz, R., & Williamson, R. (1999). The determinants and implications of corporate cash holdings. *Journal of financial economics*, 52(1), 3-46.

Riddick, L. A., & Whited, T. M. (2009). The corporate propensity to save. *The Journal of Finance*, 64(4), 1729-1766.

Riddiough, T. J., & Wu, Z. (2009). Financial constraints, liquidity management and investment. *Real Estate Economics*, 37(3), 447-481.

Shyam-Sunder, L., & Myers, S. C. (1999). Testing static tradeoff against pecking order models of capital structure. *Journal of financial economics*, 51(2), 219-244.

Smith Jr, C. W., & Watts, R. L. (1992). The investment opportunity set and corporate financing, dividend, and compensation policies. *Journal of financial Economics*, 32(3), 263-292.

Financial Times: Illiquidity vs. Insolvency <https://www.ft.com/content/07b6a662-bf29-3d4f-b9d5-ab7a6385bdb8>

U.S. Dollar inflation rates: Retrieved from: <https://www.macrotrends.net/countries/USA/united-states/inflation-rate-cpi>

10 year Treasury yield rates. Retrieved from: <https://www.macrotrends.net/2016/10-year-treasury-bond-rate-yield-chart>

1 year Treasury yield rates: <https://www.macrotrends.net/2492/1-year-treasury-rate-yield-chart>

7 Appendix

Appendix A.1: Compustat cash flow statement variable definitions

Abbreviation	Annual data item number	Full name
ESUBC	106	Equity in Net Loss - Earnings
SPPE	107	Sale of Property
SSTK	108	Sale of Common and Preferred Stock
SIV	109	Sale of Investments
DLTIS	111	Long-Term Debt - Issuance
IVCH	113	Increase in Investments
DLTR	114	Long-Term Debt - Reduction
PRSTKC	115	Purchase of Common and Preferred Stock
IBC	123	Income Before Extraordinary Items (Cash Flow)
XIDOC	124	Extraordinary Items and Discontinued Operations (Cash Flow)
DPC	125	Depreciation and Amortization (Cash Flow)
TXDC	126	Deferred Taxes (Cash Flow)
DV	127	Cash Dividends (Cash Flow)
CAPX	128	Capital Expenditures
AQC	129	Acquisitions
SPPIV	213	Sale of Property, Plant and Equipment and Investments - Gain (Loss)
FOPO	217	Funds from Operations - Other
FSRCO	218	Sources of Funds - Other
FUSEO	219	Uses of Funds - Other
WCAPC	236	Working Capital Change - Other - Increase/(Decrease)
CHECH	274	Cash and Cash Equivalents - Increase/(Decrease)
DLCCH	301	Current Debt - Changes
RECCH	302	Accounts Receivable - Decrease (Increase)
INVCH	303	Inventory - Decrease (Increase)
APALCH	304	Accounts Payable and Accrued Liabilities - Increase/(Decrease)
TXACH	305	Income Taxes - Accrued - Increase/(Decrease)
AOLOCH	307	Assets and Liabilities - Other - Net Change
IVSTCH	309	Short-Term Investments - Change
IVACO	310	Investing Activities - Other
FIAO	312	Financing Activities - Other
EXRE	314	Exchange Rate Effect

Appendix A.2: Constructed variable definitions

Variable name	Definition
dD	Change in interest-bearing debt in year t. Defined as: $DLTIS - DLTR + DLCCH$ for format codes 2, 3 and 7. For format code 1 this is: $DLTIS - DLTR - DLCCH$. This deviates from the definition of Huang & Ritter (2021), but is consistent with Dasgupta et al. (2011) and the Compustat guide's assignment of DLCCH as either a source or use of funds (see appendix A.3).
dE	Change in equity from the statement of cash flow in year t. Defined as: $SSTK - PRSTKC$.
Term spread $t-1$	The percentage yield difference between a 10-year and a 1-year constant fixed maturity U.S. treasury bond, on the first observed day before the end of fiscal year t.*
Default spread $t-1$	The percentage yield difference between a Moody's Baa and Aaa rated corporate bonds, on the day immediately prior to the beginning of fiscal year t. Note that daily Baa yields were available since 1986, so before that the weekly yields were used to construct the spreads, causing the spread to be quoted at most seven days before the beginning of fiscal year t.
Tobin's Q_{t-1}	$(CSHO * PRCC_F + LT + PSTKL - TXDITC) / \text{assets}$, whereas CSHO is common shares outstanding, PRCC_F is closing price of common stock at the end of fiscal year, LT is total liabilities, PSTKL is the liquidating value of preferred stock and TXDITC is deferred taxes and investment tax credit. If PSTKL is missing the redemption value (PSTKRV) is used, and if that is also missing the carrying value (PSTK) is used.
$\ln(\text{sales})_{t-1}$	Natural logarithm of sales (SALE) in fiscal year t-1, expressed in 2010 dollars.
$\ln(\text{assets})_{t-1}$	Natural logarithm of assets in fiscal year t-1, expressed in 2010 dollars.
$\ln(\text{Age})_t$	Natural logarithm of firm age in fiscal year t, whereas age is defined as the years between the date of observation and the date of first data entry in the CRSP database.
Leverage $_{t-1}$	$(LT + MIB + TXDITC + PSTKL - DCVT) / \text{assets}$ in t-1, whereas LT is total liabilities, MIB is minority interest, TXDITC is deferred taxes and investment tax credit, PSTKL is liquidating value of preferred stock and DCVT is convertible debt.
R&D $_{t-1}$	Research and development expenses (Compustat item XRD) in t-1. Set to zero if missing.
Industry volatility $_{t-1}$	The average standard deviation of cash flow over beginning-of-year assets of firms with the same two-digit SIC code, whereas cash flow is defined as OIBDP (operating

Appendix A.3: Uses and sources of funds per Compustat cash flow format

Format code	1				2				3				7			
Format name	Working Capital Statement				Cash Statement by Source and Use of Funds				Cash Statement by Activity				Statement of Cash Flows			
	Sources of funds	of	Uses of funds	of	Sources of funds	of	Uses of funds	of	Sources of funds	of	Uses of funds	of	Sources of funds	of	Uses of funds	of
Variables	IBC		DV		IBC		DV		IBC		DV		IBC		DV	
	DPC		CAPX		DPC		CAPX		DPC		CAPX		DPC		CAPX	
	XIDOC		IVCH		XIDOC		IVCH		XIDOC		IVCH		XIDOC		IVCH	
	TXDC		DLTR		TXDC		DLTR		TXDC		DLTR		TXDC		DLTR	
	ESUBC		PRSTKC		ESUBC		PRSTKC		ESUBC		PRSTKC		ESUBC		PRSTKC	
	SPPIV		AQC		SPPIV		AQC		SPPIV		AQC		SPPIV		AQC	
	FOPO		CHECH		FOPO		CHECH		FOPO		CHECH		FOPO		CHECH	
	SPPE		FUSEO		SPPE		FUSEO		SPPE		FUSEO		SPPE			
	SSTK		WCAPC		SSTK				SSTK				SSTK			
	SIV		DLCCH		SIV				SIV				SIV			
	DLTIS				DLTIS				DLTIS				DLTIS			
	FSRCO				FSRCO				FSRCO				FSRCO			
							WCAPC								INVCH	
							DLCCH								APALCH	
															TXACH	
															AOLOCH	
															IVSTCH	
															IVACO	
															FIAO	
															EXRE	
															DLCCH	

Appendix A.4: Cash over asset ratios over time

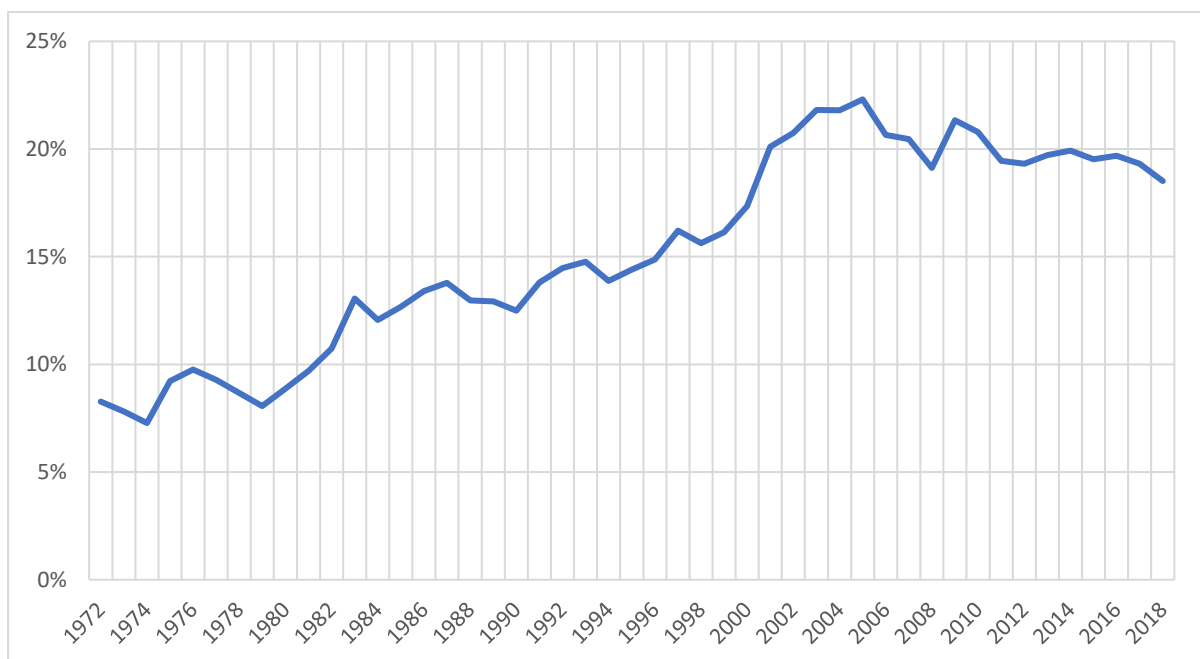


Figure 2. Mean ratio of cash over assets per fiscal year. Cash is defined as Compustat’s annual data item 1: cash and short-term investments. Assets is defined as Compustat’s annual data item 6: assets – total.

Appendix A.5: The percentage of firms reporting no stock repurchases or dividend payments

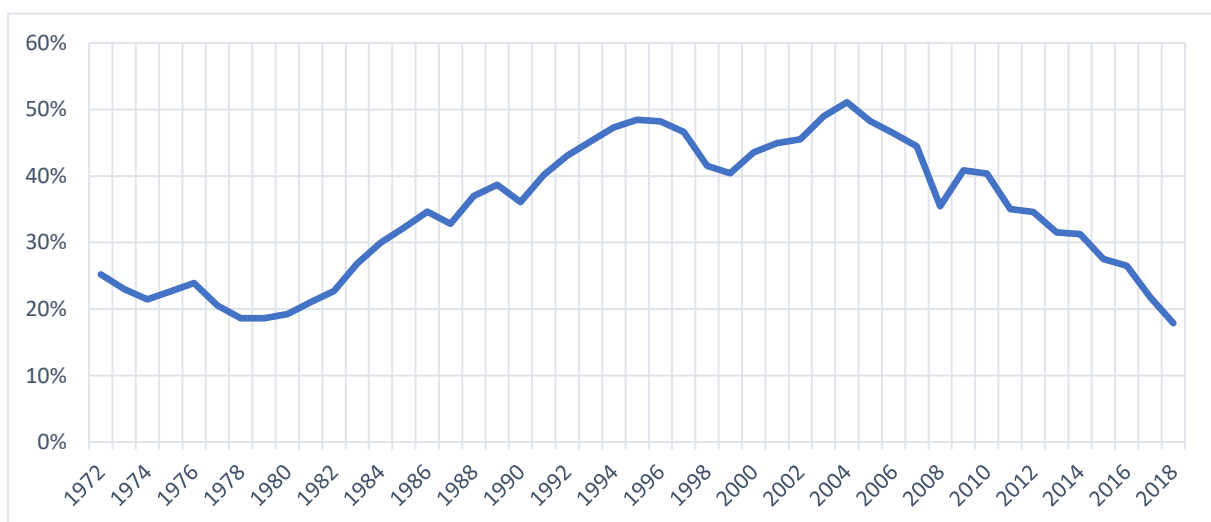


Figure 3. The percentage of firms reporting no stock repurchases or dividend payments

Appendix A.6: Likelihood of financing sorted by firm characteristics

Table 10. Likelihood of financing sorted by firm characteristics. This table shows the likelihood of financing based on quartiles of firm characteristics and cash flow components, except for dividend payer_{t-1}, which is a dummy variable, and R&D (research & development) group, which categorizes firms as either having incurred no R&D expenses and splitting the rest of the sample in a higher R&D paying half and a lower R paying half. OIBD means operating income before depreciation and amortization, NCF signifies net cash flow. For more detailed variable definitions see appendix A.2.

		ni	di	ei			ni	di	ei
cr _{t-1}	1				dcash / assets _{t-1}	1 (low)			
	(low)	67.2%	26.7%	8.5%		1 (low)	77.0%	18.0%	6.6%
	2	70.4%	24.3%	7.7%		2	74.4%	22.2%	4.7%
	3	75.6%	18.5%	8.0%		3	73.9%	21.6%	6.2%
	4					4 (high)	63.9%	18.3%	21.9%
	(high)	76.0%	10.6%	15.3%					
cash_expost / assets _{t-1}	1				dnoncashassets / assets _{t-1}	1 (low)			
	(low)	26.2%	61.1%	20.4%		1 (low)	87.5%	6.1%	7.1%
	2	86.1%	9.0%	5.3%		2	86.1%	8.3%	6.0%
	3	89.2%	6.0%	5.2%		3	74.8%	19.1%	6.8%
	4					4 (high)	40.9%	46.6%	19.5%
	(high)	87.7%	4.1%	8.5%					
cash_exante / assets _{t-1}	1				tobinsQ _{t-1}	1 (low)			
	(low)	58.1%	30.9%	15.6%		1 (low)	80.5%	16.6%	3.7%
	2	73.1%	21.7%	6.8%		2	73.5%	21.6%	6.7%
	3	77.6%	17.0%	6.8%		3	68.4%	24.5%	10.1%
	4					4 (high)	65.8%	18.2%	19.3%
	(high)	80.4%	10.6%	10.3%					
cash_fitted / assets _{t-1}	1				return _{t-1}	1 (low)			
	(low)	60.4%	26.1%	17.5%		1 (low)	74.3%	18.2%	9.3%
	2	70.6%	24.5%	6.8%		2	74.8%	19.7%	7.2%
	3	76.3%	19.1%	6.1%		3	74.1%	20.5%	7.4%
	4					4 (high)	66.1%	21.7%	15.6%
	(high)	80.3%	11.1%	10.1%					
fittedNCF / assets _{t-1}	1				returnf1tof3	1 (low)			
	(low)	62.0%	21.0%	20.9%		1 (low)	63.4%	23.1%	17.2%
	2	71.0%	21.2%	10.4%		2	73.9%	19.4%	8.5%
	3	75.2%	20.7%	5.7%		3	76.7%	18.4%	6.4%
	4					4 (high)	75.0%	19.3%	7.5%
	(high)	79.4%	18.0%	3.5%					
NCF _{t-1} / assets _{t-1}	1				termspread _{t-1}	1 (low)			
	(low)	56.6%	26.9%	21.5%		1 (low)	71.5%	22.2%	8.4%
	2	72.8%	21.6%	7.2%		2	70.0%	21.6%	10.9%
	3	79.1%	17.0%	5.1%		3	73.4%	19.4%	9.4%
	4					4 (high)	74.5%	16.8%	10.8%
	(high)	80.7%	14.7%	5.6%					
NCF / assets _{t-1}	1				defaultspread _{t-1}	1 (low)			
	(low)	27.9%	54.6%	25.8%		1 (low)	68.8%	21.5%	12.3%
	2	75.9%	18.7%	5.7%		2	73.9%	18.7%	9.2%
	3	93.0%	3.8%	3.3%		3	73.6%	18.9%	9.7%
	4					4 (high)	73.0%	21.0%	8.2%
	(high)	92.5%	3.0%	4.7%					

Table 11. (Continued)

NCF _{t+1} / assets _{t-1}	1				lnsales _{t-1}	1 (low)	65.%	18.1%	20.8%
	(low)	54.8%	27.1%	23.7%					
	2	75.6%	19.4%	6.2%					
	3	81.2%	15.6%	3.9%					
	4								
(high)	77.%	18.3%	6.1%	4 (high)	78.%	19.3%	3.6%		
NCF _{t+2} / assets _{t-1}	1				age	1(young)	64.9%	22.8%	16.1%
	(low)	59.%	24.4%	21.5%					
	2	76.7%	18.2%	6.4%					
	3	79.2%	17.3%	4.4%					
	4								
(high)	73.5%	20.5%	7.8%	4(old)	79.4%	17.5%	4.1%		
oibd _{t-1} / assets _{t-2}	1				leverage _{t-1}	1 (low)	77.9%	12.8%	10.8%
	(low)	70.3%	14.%	18.7%					
	2	76.7%	19.1%	5.7%					
	3	71.7%	23.9%	6.1%					
	4								
(high)	70.5%	23.1%	8.9%	4 (high)	69.%	22.5%	11.7%		
ICF _{t-1} / assets _{t-2}	1				rnd _{t-1}	0(or missing)	71.2%	23.4%	7.9%
	(low)	70.5%	14.3%	18.%					
	2	76.4%	19.7%	5.5%					
	3	72.7%	23.1%	6.%					
	4								
(high)	69.7%	23.1%	9.9%	2 (high)	69.9%	14.5%	18.2%		
ICF / assets _{t-1}	1				industryvolatility _{t-1}	1 (low)	75.1%	21.6%	4.8%
	(low)	69.3%	16.9%	16.6%					
	2	76.6%	19.5%	5.1%					
	3	74.5%	21.5%	5.6%					
	4								
(high)	68.8%	22.2%	12.1%	4 (high)	70.4%	16.%	16.2%		
investments _{t-1} / assets _{t-2}	1				divpayer _{t-1}	0 (Nonpayer)	68.2%	20.%	14.9%
	(low)	77.2%	13.6%	10.9%					
	2	77.8%	16.3%	7.2%					
	3	73.1%	21.1%	7.6%					
	4								
(high)	61.2%	29.2%	13.8%	1 (Payer)	77.2%	20.1%	3.9%		
investments _{t-1} / assets _{t-1}	1								
	(low)	76.7%	13.8%	11.2%					
	2	77.3%	16.6%	7.5%					
	3	73.3%	20.7%	7.8%					
	4								
(high)	62.%	29.1%	13.%						

Appendix A.7: Mean hedging needs per industry

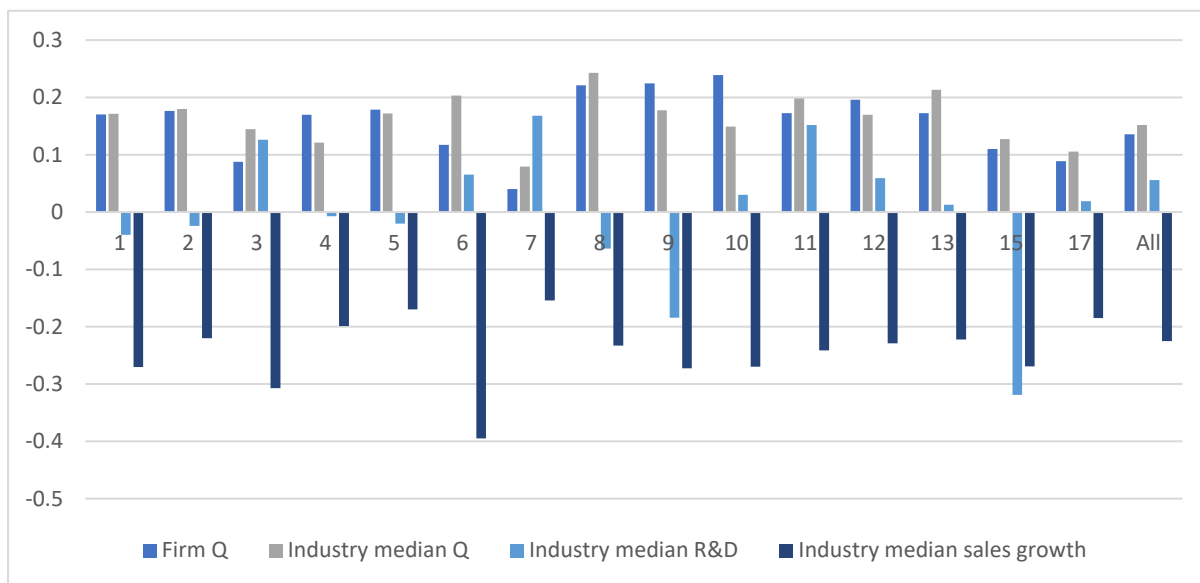


Figure 4. Mean hedging needs per industry. The industries are classified according to Fama & French 17 industry classification model and are numbered as follows: 1: Food; 2: Mining & Minerals; 3: Oil and petroleum products; 4: Textiles, apparel and footwear; 5: Consumer durables; 6: Chemicals; 7: Drugs, soap, perfumes and tobacco; 8: Construction and construction materials; 9: Steel works; 10: Fabricated products; 11: Machinery and business equipment; 12: Automobiles; 13: Transportation; 15: Retail stores; 17: Other. Industry numbers 14 (Utilities) and 16 (Financial services) are dropped from the sample and are therefore not included in the analysis. ‘All’ portrays the mean hedging needs of all firms in the sample.

Appendix A.8: Distribution of firms with high hedging needs per industry

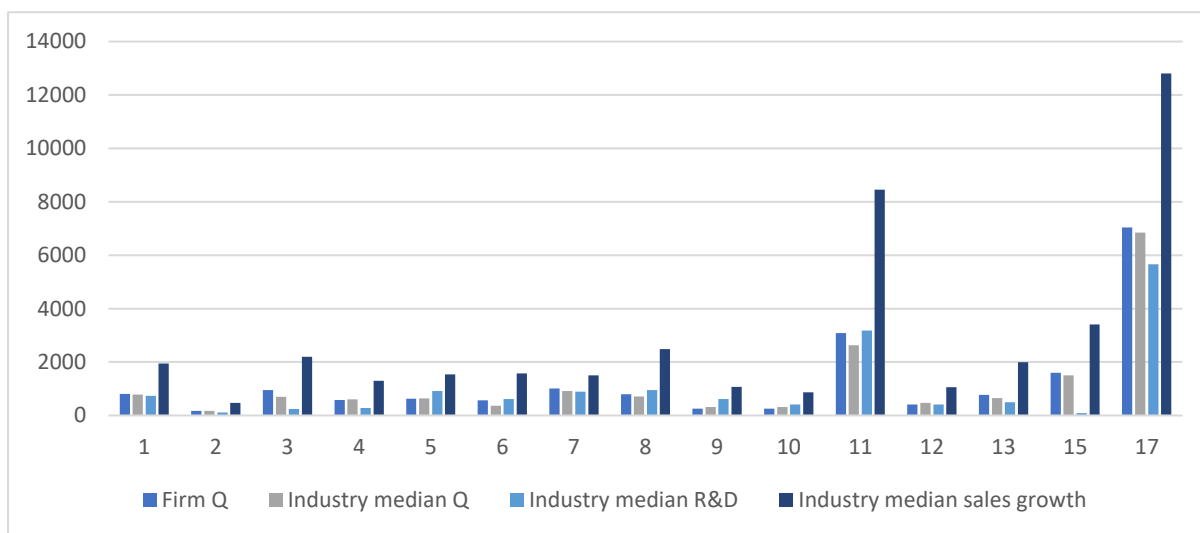


Figure 5. Distribution of firms with high hedging needs per industry. The industries are classified according to Fama & French 17 industry classification model and are numbered as follows: 1: Food; 2: Mining & Minerals; 3: Oil and petroleum products; 4: Textiles, apparel and footwear; 5: Consumer durables; 6: Chemicals; 7: Drugs, soap, perfumes and tobacco; 8: Construction and construction materials; 9: Steel works; 10: Fabricated products; 11: Machinery and business equipment; 12: Automobiles; 13: Transportation; 15: Retail stores; 17: Other. Industry numbers 14 (Utilities) and 16 (Financial services) are dropped from the sample and are therefore not included in the analysis. ‘All’ portrays the mean hedging needs of all firms in the sample.