Impact of firm's financial policy, investment opportunities, and the cost of external capital on the value of cash

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Paavo Taimisto
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Department of Accounting and Finance
HELSINGIN KAUPPAKORKEAKOULU
HELSINKI SCHOOL OF ECONOMICS

Aalto University
School of Economics
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Paavo Taimisto

Abstract
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IMPACT OF FIRM'S FINANCIAL POLICY, INVESTMENT OPPORTUNITIES, AND THE COST OF EXTERNAL CAPITAL ON THE VALUE OF CASH

PURPOSE OF THE STUDY

The purpose of this thesis is to examine the cross-sectional variation of the value of firm's cash holdings, and how the value of cash changes over time. The study contributes to the existing literature on the value of cash in two important ways. First, the study examines how the financing constraints and investment opportunities together affect the value the shareholders place on cash. Second, the thesis establishes a link between the value of cash and the time-variation of the cost of external capital.

The thesis also aims to find support for the findings related to the cross-sectional variation in the earlier literature. While earlier studies have mainly focused on the US firms, this study uses data from the U.K.

DATA

The data in this study comprise of 8,243 firm-year observations from a total of 1,193 U.K. publicly listed firms. The dependent variable in the analysis is firm-specific excess return during a fiscal year, and the independent variables consist of firm-specific variables controlling for profitability, financing policy, and investment policy. The data cover all years from 1997 to 2008.

RESULTS

The main findings of this study are, first, that neither financing constraints nor investment opportunities alone affect the value the shareholders place on firm's cash holdings. However, firms that are financially constrained and have good investment opportunities have the highest value placed on cash. Second, the value of cash does change over time, and is dependent on the cost of raising external capital.

The thesis also confirms most of the cross-sectional variation found in the earlier studies. However, statistically significant evidence for the value of cash decreasing as the cash levels increase is not found.

KEYWORDS

Value of cash, cash holdings, financial policy, investment opportunities, cost of external capital

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Pro Gradu -tutkielma
Paavo Taimisto

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TUTKIELMAN TAVOITTEET

Tämän tutkielman tavoitteena on tutkia yrityksen kassavarojen arvon vaihtelua yritysten välillä sekä miten kassan arvo muuttuu ajan myötä. Tutkielma edistää nykyistä kirjallisuutta yrityksen kassavarojen arvosta kahdella merkittävällä tavalla. Ensinnäkin, tutkielmassa tarkastellaan miten rahoitusrajoitteet sekä investointimahdollisuudet yhdessä vaikuttavat osakkeenomistajien kassavaroille antamaan arvoon. Toisekseen, tutkielma luo yhteyden kassavarojen arvon sekä ulkoisen pääoman kustannusten ajan yli tapahtuvalle muutokselle.

Tutkielman tavoitteena on myös tukea aiemman kirjallisuuden päätelmiä yritysten välisistä eroista. Aiemmat tutkimukset ovat pääosin keskittyneet yhdysvaltalaisiin yrityksiin, kun taas tämä tutkielma käyttää aineistoa Iso-Britanniasta.

LÄHDEAINEISTO

Lähdeaineisto koostuu 8 243 yritysvuodesta, jotka ovat peräisin 1 193 brittiläisestä julkisesti listatusta yrityksestä. Selitettävä muuttuja analyysissa on yrityksen osakkeen ylituotto tilikauden aikana, ja selittävät muuttujat koostuvat yrityskohtaisista muuttujista, jotka kontrolloivat kannattavuutta, rahoitus- sekä investointipolitiikkaa. Lähdeaineisto kattaa vuodet 1997-2008.

TULOKSET

Tutkielman tärkeimmät tulokset ovat ensinnäkin, etteivät rahoitusrajoitteet tai investointimahdollisuudet yksinään vaikuta osakkeenomistajien yrityksen kassavaroille antamaan arvoon. Kuitenkin yritysten, joilla on sekä rahoitusrajoitteita että hyviä investointimahdollisuuksia, kassavaroille annetaan suurin arvo. Toisekseen, kassavarojen arvo muuttuu ajan myötä, ja on riippuvainen ulkoisen pääoman kustannuksista.

Tutkielma vahvistaa myös yritysten välisen vaihtelun kassavarojen arvon suhteen. Kuitenkin, tilastollisesti merkittävää näyttöä kassavarojen arvon pienenemisestä kassavarojen lisääntyessä ei löydy.

AVAINSANAT

Kassan arvo, yrityksen kassavarat, rahoituspolitiikka, investointimahdollisuudet, ulkoisen pääoman kustannus

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1. Introduction

During the 2007-2008 credit crunch both business executives and media made the phrase "cash is king" popular again. While firms' internal cash flows were declining, stock markets had plunged and the credit market had all but frozen, the scarcity of cash became a reality for many firms. For example, General Motors (GM), the United States based automaker, announced on November 7th 2008 that it could run out of liquidity despite the on-going restructuring process.[1] GM eventually reorganized through bankruptcy proceedings but its plight was a demonstration of the importance of cash holdings. Although the decline in cash flows tends to be inevitable in many industries during a downturn, the symptoms could be relieved by holding a sufficient amount of cash as a buffer before the crisis. However, for several reasons the shareholders do not always want to see the firm to pile up cash and sit on it. The shareholders' view on firm's cash holdings and the value they place on it will be examined in this thesis.

The determinants and implications of corporate cash holdings have attracted increased interest from the academics during the past ten years. One of the key questions has been what the relation between cash holdings and firm value is. In broad terms, the two main factors in the equation are the benefits of liquidity for a firm and the agency costs of managerial discretion. Both arguments have their proponents. For example, Myers and Majluf (1984) argue that costly external financing means that firms should maintain a sufficient cash reserve that provides liquidity to take advantage of emerging positive NPV projects. However, according to Jensen (1986) the agency costs of managerial entrenchment mean that large cash holdings should be paid to shareholders to keep managers from overinvesting in negative NPV projects. Apparently, there is no uniform truth which would apply to all firms at once as both the needs of a firm and its managers are heterogeneous.

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[1] "GM warns it could run out of cash in 2009", *USA TODAY*, updated 16.11.2008. (http://www.usatoday.com/money/companies/earnings/2008-11-07-general-motors_N.htm)

The literature on the market value of cash can be divided into two in regard whether the studies concentrate on the benefits of liquidity or the agency costs. The former approaches the question typically by examining the financial policy and corporate finance decisions of a firm, whereas the latter estimates the degree of agency conflicts through corporate governance factors. Despite the common division between the two issues, both are at least implicitly always present in the tests and findings.

Most of the literature aiming to estimate the link between firm's financial policy and exact market value of cash holdings has focused on the firms in the United States (U.S.) Pinkowitz and Williamson (2004), Faulkender and Wang (2006), and Denis and Sibilkov (2007) all study how firm's financial characteristics and the value of cash play together. Pinkowitz and Williamson (2004) show that, on average, the market value of a dollar held by a firm is approximately $1.20, suggesting that shareholders believe the benefits of liquidity outweigh the potential agency problems associated with it. Faulkender and Wang (2006), employing a different methodology, find the market value of a dollar to be $0.94 on average. Their results imply that the potential agency costs, and tax effects, outweigh the benefits in a mean firm. Denis and Sibilkov (2007) concentrate on firm's financial constraints and investment opportunities and find consistent results. Nevertheless, there is significant cross-sectional variation in the market value of cash, thus concentrating on mean values reveals only little about the link between financial policy and value of cash.

The other branch of value of cash literature concentrates on corporate governance effect. For example, Dittmar and Mahrt-Smith (2007) use U.S. data to show that an extra $1 of cash for a poorly governed firm is worth from $0.42 to $0.88 while good governance doubles the value. Pinkowitz et al. (2006) used a cross-border data and found that an extra $1 is associated with an increase in the firm value of $0.29 to $0.33, depending on the corporate governance criteria, in countries with poor shareholder protection while an extra $1 of cash is associated with an increase of $0.91 to $0.95 in firm value in countries with good shareholder protection. Furthermore, Kalcheva and Lins (2003) found that minority investors who are not well protected apply a discount to firms holding high levels of cash. This is consistent with the findings of Frésard and Salva (2009) who show that the value of $1 of excess cash for a typical non-U.S.

firm is $0.58, while it is $1.61 for firms listed in the U.S. via an exchange listing implying that investors discount the value of corporate cash reserves when they are at high risk of being turned into private benefits.

Understanding the value of cash is not only of interest to researchers and academics but even more so to practitioners. Equity analysts, corporate financiers and chief financial officers all should be very interested to know what factors impact the value of firm's cash holdings and why. Often equity analysts simply add cash on top of enterprise value without giving a consideration on whether there might be reasons why the cash should not be valued at par. However, as the studies show, the markets do value cash in different firms differently, and therefore the analysts perhaps should too – especially if a firm has plenty of liquid assets. For corporate financiers the situation is slightly different as they often give an opinion on what the value of a target firm would be to an acquirer, hence eliminating the effect of prevailing corporate governance and financial policy. Still, it could be valuable insight to understand the value of cash when assessing the current market value of a firm. Finally, the finance department of a firm should know why their cash may not be valued at par and what they could do about it if they wanted. This gives firms not only an understanding of shareholders' preferences but perhaps an option to cater them.

The purpose of this thesis is to approach the question of the value of firms' cash holdings in two ways. First, following Faulkender and Wang (2006), who studied the cross-sectional variation in the marginal value of corporate cash holdings that arises from differences in corporate financial policy, I test whether financial policies have similar implications on the value of cash also in the United Kingdom. Following Faulkender and Wang (2006) I predict that the marginal value of cash decreases significantly as firms' cash levels and leverage increases. As the cash level increases, firms become more likely to distribute it to their shareholders who incur a dividend tax which should decrease the value of a dollar. In addition, firms with excess cash are more likely to waste it on negative NPV projects, as suggested by Jensen (1986). Firms with high leverage are more likely to use the extra dollar to cover debt instead of spending it to increase shareholder wealth (see e.g. Black and Scholes (1973)). Furthermore, I examine to what extent the ease of accessing external capital markets impact the value the shareholders place on cash in a firm and

what role do investment opportunities play in determining the value of cash. Then I extend earlier literature by examining how these two factors work together.

Second, inspired by the credit crunch of 2007-2008, I examine how changes in the external capital markets impact the value of cash over time. To my knowledge, there have not been previous studies on the time-variation in the value of cash. There are several reasons why a credit crunch should influence any results related to firm's cash holdings. First, Almeida et al. (2004) show that financially constrained firms save significantly larger fraction of their cash flows following negative macroeconomic shocks than before. This implies that the link between firm's retained cash flow and earnings is dynamic and can change over time. Second, a the importance of cash is stressed in a recession. When the credit becomes more rationed, firms that have plenty of cash do not have to worry about not being able to finance daily operations. Intuitively, firms with plenty of cash are less likely to see their credit rating downgraded and are able maintain an access to capital markets. Moreover, these firms can take advantage of the plight of the weaker firms, who might have less of liquid assets, through aggressive competitive measures or acquisitions. Therefore, it would seem reasonable for a firm to hoard loads of cash during the good times in order to be able to strike when the economy turns south. Finally, as the credit becomes more rationed, it also becomes more costly. This is true especially for financially constrained firms. In the context of the most recent credit crunch, by the end of 2008 the spread between Moody's, a credit rating agency, Baa- and Aaa-rated corporate bond yields had risen by more than 250 basis points above its long-term average. Firms rated below investment grade faced even direr consequences as the high-yield spread (the spread between the yield of the Merrill Lynch High Yield Master II Index and the Merrill Lynch AAA corporate bond index) increased from just above 2% in June 2007 to nearly 16% in December 2008. Meanwhile the stock markets began free falling at the end of 2007 increasing the cost of equity and many firms found raising external capital extremely costly.

I use a sample of 9,084 firm-years covering firms in the United Kingdom (UK) from 1997 to 2008 to test hypotheses in Faulkender and Wang (2006), impact of investment opportunities on the value of cash, and the change in value of cash over the economic cycle. I concentrate on the UK corporate world since other countries than the U.S. have been widely neglected in the earlier

literature and hence I try to make conclusions on whether findings there also hold in another corporate culture setting. The UK was chosen because it has the third highest number of listed firms after the U.S. and Japan, and the financial data are not only available but also relatively reliable. The firms in the UK differ from the firms in the U.S. not only in regard of their corporate governance (see e.g. Ozkan and Ozkan (2004) but also in some extent in their financial characteristics. The time span was chosen for two reasons. First, the number of firms for which financial data is available through databases diminishes notably before 1996 and is therefore using data before 1996 is less likely to provide an accurate view of the value of cash in the UK firms. The usable observations start from 1997 because for most of the variables I require a change during a fiscal year. Second, the extraordinary state in the financial markets during 2007-2008 allows me to study how it may have impacted the value of cash. In addition, the sample also includes the burst of so-called dot-com bubble which also increased the cost of raising capital for a certain period.

My findings contribute to the existing literature in the field of value of firm's cash holdings in many ways. However, two findings stand out. First, I show that neither the financing constraints nor investment opportunities alone increase the value the shareholders place on cash, but when these two are in effect together, the effect is dramatic. The value of cash in financially constrained firms with good investment opportunities is more than double compared to firms which only fulfill one, or none, of the two criteria. Second, I find evidence supporting the time-varying nature of the value of firm's cash holdings. Not only does the value of cash change from year to year, but it is also significantly dependent on the state of the external capital markets.

Furthermore, I find support for the earlier work, namely that the value of cash decreases as the leverage increases (Faulkender and Wang (2006)), and that the firm's cash holdings, on average, decrease when the cost of external capital increases as argued by Opler et al. (1999). However, I do not find support for the marginal value of cash decreasing with increasing levels of cash holdings as suggested by Faulkender and Wang (2006). Finally, my findings suggest that the value of cash in the UK firms is systemically lower than in the U.S. Compared to the average value of cash in the U.S. as suggested by Faulkender and Wang (2006) or Pinkowitz and Williamson (2004), the average value of cash in the UK seems to be approximately half. Because

the results are controlled for financial aspects but not corporate governance issues, it is likely that the latter could explain the difference. Alternative explanation is the different sample period. However, I do not test for corporate governance issues in this thesis.

I use the following terms interchangeably in this thesis. First, I refer to firm's cash holdings in a few ways, mainly as cash holdings, cash reserves, or simply cash. However, cash level is used to refer to cash ratio (cash to net assets). Second, I use the marginal value of cash, the value of cash, value of an extra dollar of cash, value of additional cash, and the value the shareholders place on cash while referring to the value of firm's cash holdings. Third, it should be noted that since most of the previous studies have been done with U.S. data, I discuss the value of a dollar in the theory section. However, my data are from the UK, and hence in the empirical part I am examining the value of a pound.

The thesis is structured as follows. In Section 2 I review the relevant earlier literature and theories on the value of firms' cash holdings. In Section 3 I present the hypotheses. Section 4 discusses the methodology to test the empirical predictions. Section 5 describes the sample, data sources and summary statistics. In Section 6 I show the empirical results. Finally, Section 0 concludes.

2. Theory

Here I will discuss the earlier literature related to the value of firm's cash holdings, and present the relevant theory. I start with laying out the background for understanding why firms hold in the first place. Even though it is not the focus of my thesis, it is necessary to understand why the firms hold cash in order to understand how the shareholders determine the value they place on cash. Then I will present the relevant earlier studies and findings in the value of cash literature. Finally, I theorize why the value of cash should change over time.

2.1. Motives for holding cash

If all firms operated in a world of perfect capital markets, cash holdings would be irrelevant. If a firm found itself in need of cash for operations or investments, it could raise funds at zero cost. Since there is no liquidity premium in such a world, holdings of liquid assets have no opportunity

cost. Hence, if a firm borrows money and invests it in liquid assets, shareholder wealth is unchanged.

However, in the real world the markets are not perfect and holding liquid assets has its cost. Therefore, a firm needs to strike balance between the marginal cost of holding liquid assets and marginal benefit of holding those assets. This is close to the tradeoff theory in the capital structure literature: firms trade off the costs and benefits of holding cash to derive optimal cash levels (Opler et al. (1999)).

Out of the five theories why firms hold cash I present here and which have been identified in the earlier literature, the first four are components of the tradeoff theory i.e. benefits and costs of holding cash. First I address the two of the most important and established theories, the transaction and precautionary motives which both were discussed already by Keynes (1936). Then I discuss the agency motives and after that turn to recently identified tax motive. Finally I present an alternative for the tradeoff theory, the financing hierarchy theory, which also arises from the capital structure literature.

2.1.1 The transaction motive

The transaction motive for holding cash arises from the cost of converting cash substitutes into cash. According to Keynes (1936), a firm can save in transaction costs by using cash to make payments without having to liquidate assets. Miller and Orr (1966) model the demand for cash to finance daily operations, and the required cash level. A firm short of liquid assets has to raise funds in the capital markets, liquidate existing assets, reduce dividends or investment, renegotiate existing financial contracts, or use a combination of these actions. Since there are both fixed and variable costs in raising cash, the company should hold a buffer of cash to avoid raising cash frequently, and thus to avoid related fixed transaction costs.

Myers and Majluf (1984) argue that raising external financing is more costly than using internally generated funds in the presence of asymmetric information. Since outsiders know less than the management, they might discount the price of securities more than management is willing to accept. Therefore, the management may find it profitable not to sell the securities, and even

reduce investments instead. For that reason, it may be optimal for firms to hold a certain level of cash to meet the needs for investment expenditure.

Opler et al. (1999) show how the transaction cost model implies the impact of several variables on the firm liquid assets. As these variables incur a different transaction cost, they impact the liquid assets in two ways. First, liquid assets increase with (1) the volatility of cash flow divided by total assets, and (2) the length of the cash conversion cycle. Second, in the context of my thesis the liquid assets decrease most importantly with (1) interest rates and the slope of the term structure, (2) the cost of raising debt, but also with (3) the ease of selling assets, (4) the cost of hedging risk, and (5) the size of a firm's dividend. Furthermore, liquid assets decrease as the firm's marginal tax rate increases.

2.1.2 The precautionary motive

Keynes (1936) defines precautionary motive for cash as he argues that precautionary cash balances are held "to provide for contingencies requiring sudden expenditure and for unforeseen opportunities of advantageous purchases, and also to hold an asset of which the value is fixed in terms of money to meet a subsequent liability in terms of money. . . ." Although incomplete, this definition is still valid implying that firms hold cash to better cope with adverse shocks when access to capital markets is costly (Bates et al. (2008)).

Opler et al. (1999) find evidence supporting the theory as they show that firms with riskier cash flows and poor access to capital markets hold more cash. This is supported by Almeida et al. (2004) who model how firms anticipating financing constraints in the future respond by hoarding cash today. They find that financially constrained firms save cash out of cash inflows, while unconstrained firms do not.

Han and Qiu (2007) argue that in order to maximize the return from current and future investments, a financially constrained firm facing higher cash flow volatility needs to increase its cash holdings and to voluntarily reduce its current investment level because of the intertemporal trade-off between current investments and future cash flow volatility. They find support for the theory as they show both theoretically and empirically that a financially constrained firm

increases its cash holdings in response to an increase in cash flow volatility. In contrast, the cash holdings of financially unconstrained firms are not sensitive to cash flow volatility. Similarly, Opler et al. (1999) find evidence for firms with better investment opportunities to hold more cash because adverse shocks and financial distress are more costly to them.

These findings not only prove the importance of the precautionary motive for corporate cash holdings but also show how corporate financial policy and financial constraints have a significant role in how these motives affect behavior of firms and their managers in real life.

2.1.3 The agency motive

Jensen (1986) argues that entrenched managers have incentives to rather retain cash than increase payouts to shareholders even when the firm has poor investment opportunities. Opler et al. (1999) offer reasons why managers may employ suboptimal cash policies. First, managers may accumulate cash to pursue their own personal interests. Cash allows managers to make investments the external capital markets would not be willing to finance. They can usually spend a dollar of cash in hand even when they are unable raise funding from the markets. Consequently, they might make investments which can have an adverse effect on firm value. Jensen's (1986) free cash flow problem predicts that managers with excess cash are likely to overinvest. Thus, a one dollar increase in firm's cash holdings may lead to a significantly less than one dollar increase in firm value. As the outsiders do not know whether the managers are raising cash to increase firm value or pursue own objectives, the cost of external capital is likely to rise.

Another reason offered by Opler et al. (1999) for managers to hold excess cash is because they are risk averse. By holding excess cash they minimize potential costs for financial distress. If the manager can keep the firm afloat, she is more likely to keep her job. This may have negative implications on shareholder wealth if positive NPV, yet risky, investment opportunities are foregone.

The agency motive for holding cash is consistent with cross-country evidence by Dittmar et al. (2003) who suggest firms hold more cash in countries with greater agency problems.

2.1.4 The tax motive

A more recent study by Foley et al. (2007) shows that U.S. corporations that would incur tax consequences associated with repatriating foreign earnings hold higher levels of cash. Affiliates for which the implied tax consequences of repatriation are the highest have also the highest cash levels. This implies that multinational firms are more likely to accumulate cash. The extent this applies to the UK firms has yet to be studied.

2.1.5 The financing hierarchy theory

While the tradeoff theory and hence the four previous motives imply that there could be an optimal level for holding cash for a firm, the financing hierarchy theory suggests that there is no optimal amount of cash, based on arguments similar to the pecking order theory of capital structure (Opler et al. (1999)). According to the theory, firms do not wish to issue equity because it is expensive due to information asymmetries. They sell debt when they do not have sufficient resources, and when they can do so. When they have sufficient resources to invest in the profitable opportunities available, they repay debt that becomes due, and accumulate more cash otherwise. The theory implies that firm's cash holdings are less of a strategic choice but more a result of a dynamic, endogenous process.

However, because the cost of raising external capital is a factor in both the tradeoff and the financing hierarchy theory they are not mutually exclusive. The transaction motive suggests that firms hold cash in order to minimize transaction costs; the precautionary motive implies that firms hoard cash when they can to avoid raising costly external capital, while the financing hierarchy theory is, simply put, based on the availability and the cost of capital. Nevertheless, despite of the similar implications of the two theories they are still likely play a stand-alone part. Opler et al. (1999) find evidence for both theories but argues that the tradeoff theory is more dominant.

2.2. Value of firm's cash holdings

Next I discuss what implications holding cash has on firm performance. Then, I move to discuss how different firm-specific attributes impact how shareholders value firm's cash holdings. I'll

show how companies can be divided in three regimes in regard of why they hold cash and how it impacts valuation. Then I'll explore how the valuation of cash holdings may change with the state of the external capital markets.

2.2.1 Cash and firm performance

To determine the value of firm's cash holdings it is constructive to first discuss how cash holdings are likely to impact firm performance. The tradeoff theory for holding cash implies arguments for and against holding plenty of cash, and therefore examining how performance is affected by firm's cash reveals what is the relative importance of the motives. In general, financial characteristics of firms with large cash holdings are consistent with motives that enhance value (e.g. Opler et al. (1999)), whereas agency motive plays a role when managers have weaker incentives to maximize shareholder value (e.g. Harford (1999)).

Mikkelson and Partch (2003) studied how persistent excess cash holdings impact performance. They show that U.S. firms that held 25% or more of their assets in cash from 1986 to 1991 had a greater operating performance in the following five years than firms matched on size and industry and firms that had transitory large cash holdings. They also show that persistent policies of large cash holdings do not represent a conflict between managers and stockholders' interest. Their findings also support those of Opler et al. (1999) as they show that high cash firms grow faster, undertake higher levels of investment, and have higher ratios of market-to-book value of assets.

Fresard (2009) shows that firm's cash holdings strategically influence product market outcomes. Larger relative-to-rivals cash reserves lead to systematic future market share gains at the expense of industry rivals. Although Fresard (2009) does not study specifically why this happens, he mentions some of the possible explanations. First, firm with large cash holdings may finance easier competitive strategies, e.g. predatory pricing; see Bolton and Scharfstein (1990). Second, the company can use cash reserves to fund competitive policies such as advertising targeted against rivals and the construction of efficient distribution networks; see Campello (2006). Finally, the large cash effect can have a preemptive effect if other firms are unwilling or unable to engage in competitive battles; see Benoit (1984).

2.2.2 Financial policy, investment opportunities and the value of cash

As noted, in an efficient market and under Modigliani-Miller theorem (Modigliani and Miller (1958)) firm would be able to raise cash whenever it needs without transaction costs and access to capital markets would not be limited even if the firm was highly leveraged. In addition, firm distributing cash to shareholders would not have to worry about taxing. The violation of Modigliani-Miller proposals was the foundation for why firms hold cash and it is also foundation why one dollar of cash should and is not always valued as one dollar in market value. In this thesis I study how cash is valued in the real world where Modigliani-Miller does not hold perfectly and concentrate first on firms' financial policies and investment opportunities.

Since Opler et al. (1999) published their study of determinants of cash holdings there has been ever growing interest in how shareholders value those cash holdings. Pinkowitz and Williamson (2004) were the first to study the market value of cash holdings. They focus on firm's investment and financing opportunity sets. They find that firm's growth opportunities have a positive relation with the market value of cash. Firms with more and better investment opportunities have a higher value on cash. They also show that firms with higher uncertainty in investments have a higher valuation. Furthermore, firms in financial distress have a lower valuation on cash. Faulkender and Wang (2006) support this finding as they show that firms with lower leverage, a proxy for financial distress, have higher value put on cash.

Finally, Pinkowitz and Williamson (2004) argue that access to capital markets does not impact the market value of cash. However, they do note that their proxy for access to capital markets, the size of a company, may not be perfect. Consequently, Faulkender and Wang (2006) show that constraints in accessing capital markets have a significant role in the market value of cash. Using a wider range of proxies, including existence of bond and commercial paper ratings, they show that the marginal value of cash for the mean constrained firm-year ranges from 28 to 63 cents higher than the mean unconstrained firm, depending upon the constraints criterion. Liu and Chang (2009) show similar evidence on the impact of financial constraints on the market value of cash. Faulkender and Wang (2006) also show that the marginal value of cash decreases with the size of cash holdings. They argue that this is due to increasing likelihood of distributing cash

back to shareholders, and therefore incurring transaction costs and taxation which drive down the value of cash.

2.2.3 Three cash regimes

Faulkender and Wang (2006), whom I follow in this study, divide firms in three different regimes in regard of their financial policy and consequently, how the firms are likely to treat their cash holdings. The purpose of the regimes is to show in a more material way how firms vary in regard to their financial policy and position, the extent of demand these firms have for cash, and most importantly, how their shareholders view their cash holdings. Not all firms fall to a specific category but somewhere in between. The value of cash in different cash regimes is examined in the subsample tests of Section 6.5.

The three cash regimes are:

Regime I: Distributing cash

Firms whose cash reserves appear to greatly exceed their needs in the foreseeable future, an additional dollar of cash reserves is more likely to be distributed to shareholders through dividends and/or share repurchases. Faulkender and Wang (2006) argue that this is because firms pay a higher tax on interest income than individuals would, and because of the agency costs due to free cash flow problem (Jensen (1986)). Consequently, because of the dividend tax shareholders only receive $1 – dividend tax. As such, the marginal value of cash is reduced to $1 – dividend tax, which can be significantly lower than $1. If corporate tax rate is higher than personal interest income tax rate, as in UK, the marginal value of cash is even less.

Further depressing the value of cash in Regime I, a firm with ample cash reserves is more likely to incur agency costs due to the agency problems as discussed by e.g. Jensen (1986). The more excess cash a firm has, the more likely it is to waste it on negative NPV investments or in other unprofitable ways. In addition, if a firm does not need to raise external financing, the firm and its managers are less likely to be exposed to outside monitoring which further exacerbates the problem.

Regime 2: Servicing debt or other liabilities

If a firm is highly leveraged, the contingent claims analysis (e.g. Black and Scholes (1973)) predicts that almost all firm value is in the hands of the debt holders. Therefore, an additional dollar in cash holdings goes largely to increasing value of debt, not equity, implying in turn that the equity market will place a low value on an additional dollar of cash for these firms.

On the other hand, this theory suggests that as the leverage decreases, the marginal value of cash to equity holders increases, because the probability of bankruptcy decreases, and therefore the probability of an additional dollar finding its way to the pockets of equity holders increases.

Regime 3: Raising cash

Third regime suggested by Faulkender and Wang (2006) is relevant for firms which are likely to raise cash in the near future. For these firms the marginal value of cash should the highest among the three cash regimes, and the exact value varies depending upon the ease with which the firm can access the capital markets, and thus with the transaction costs, direct or indirect, that are incurred by accessing the capital markets.

For financially unconstrained firms that are at the margin of raising cash the marginal value of cash should be somewhat higher than for other regimes. As firms face financing constraints, which are likely to increase transaction costs, they are expected to have even higher marginal values of cash.

2.2.4 Corporate governance and the value of cash

Here I will briefly discuss another important branch of studies on the value of cash, namely how corporate governance impacts the value the shareholders place on firm's cash holdings. I first present the findings in the related papers and then describe some of the UK-specific issues which may systemically impact the valuation of cash holdings.

Note that although the importance of corporate governance is well documented in earlier literature, in this study I do not measure the impact of corporate governance, but concentrate solely on the financial factors expected to be relevant for the value of firms' cash holdings. Still,

it should be understood that determining the exact value of cash holdings is a complex issue and that corporate governance differences between the UK and the U.S. might give explanation to differences in the value of cash.

Dittmar et al. (2003) study cross-border differences in corporate governance and cash holdings and find that firms in countries where shareholder rights are not well protected have twice the cash holdings that firms in countries with good shareholder protection have. After controlling for other variables, they conclude that investors in countries with poor shareholder protection cannot force managers to disgorge excessive cash balances. Pinkowitz et al. (2006) use similar data as Dittmar et al. (2003) as they study how value of cash depends on the corporate governance in any given country. Unsurprisingly, they find that an extra dollar of cash holdings is valued significantly higher in countries with better investor protection than in countries with weaker investor protection. Dittmar and Mahrt-Smith (2007) also study how corporate governance impacts the value of cash using U.S. data. They find that an extra dollar of cash is valued twice as much in firms with good corporate governance than in firms with poor corporate governance. They also find evidence that the discrepancy is due to the tendency of firms with poor corporate governance dissipate excess cash reserves more quickly on less profitable investments than those with good governance. This is in line with free cash flow problem documented by Jensen (1986).

There are a few things in the UK which give reason to assume that the value of firms' cash holdings there may differ systemically from the value of firms' cash holdings in the U.S. whereon most of the earlier studies have concentrated. First, the role of institutional ownership seems surprisingly unclear in the UK. Financial institutions own a significant share of listed UK equities as the proportion of shares held by domestic financial institutions (including insurance companies, pension funds, and unit trusts, investment trusts, and banks) was 43.4% at the end of 2008 (Office for National Statistics (2010)).[2] However, there is plenty of evidence that institutions do not take an active role in corporate governance in the UK. Franks et al. (2001) find

[2] Furthermore, investors from outside of the UK owned 41.5% of listed UK equities (Office for National Statistics (2010)). The exact share of foreign financial institutions is however not available.

that there is no significant relationship between high levels of institutional ownership and managerial disciplining in the UK. Similarly, Cosh and Hughes (1997) show that the presence of institutional shareholder has no significant impact on either level of pay or the likelihood of dismissal of top managers. Faccio and Lasfer (2000) give support to institutional investors' passive role as they find evidence that occupational pension funds are not effective monitors. Goergen and Renneboog (2001) argue that factors that might contribute to the passive stance of institutional shareholders in the UK include low-cost passive index strategies and insider-trading regulations.

Second, the board structure of the UK companies has been challenged in earlier corporate governance studies. The UK has a one-tier board structure meaning that both executive and non-executive directors sit on the same board and the executive officer can serve also as the chairman of the board. This structure has been criticized as it may jeopardize the independence of outside directors and their ability to monitor and control executive directors (see e.g. Ezzamel and Watson (1997)). Furthermore, there are no formal requirements for companies in the UK to appoint outside directors and company boards do not require outsider presentation. Ozkan and Ozkan (2004) find that 35.5% of firms in their sample have less than three non-executive directors on their boards in 1997, and non-executive directors have a majority of the board only in 24.8% of sample firms. Moreover, Franks et al. (2001) note that non-executive directors typically have a more of an advisory role rather than performing a disciplinary function as a result of few fiduciary obligations on directors. All this may have contributed negatively to the board's efficiency to control and monitor managers. If this is the case in the UK, the company boards dominated by inside directors may not play an important role in limiting the exercise of managerial discretion.

Third, there are other distinctive regulative features in the UK which were discussed by Franks et al. (2001). They argue that UK Takeover Code makes accumulation of controlling blocks expensive. Furthermore, they argue that the UK minority protection laws make share blocks a weak disciplining device. Similarly, Franks and Mayer (1996) find that takeovers do not work as corporate governance mechanism for disciplining poor managers in the UK, in contrast to the U.S. firms.

To summarize, weak external market discipline combined with inefficient monitoring by financial institutions and firm boards in the UK may give managers extra freedom to pursue their own interest which may include holding higher cash balances (Ozkan and Ozkan (2004)) and possibly inefficient use of the cash holdings. This could be reflected systemically in the value the shareholders place on cash in the UK.

2.3. Change over time

I extend the earlier studies on the value of cash holdings by examining how the value of an extra dollar in cash reserves has changed over time. More specifically, I look into whether credit crunches, when the spreads between prime-rated and other corporate bond yields increase like in 2007-2008, have had an impact on the values.

2.3.1 Long-term trend of increasing cash levels

The time-varying nature of the level of cash holding has been gaining more and more attention during the 21st century. The importance of cash has increased during the past few decades as the average cash holdings in firms have increased significantly. Bates and Kahl (2008) show that in the U.S. the cash-to-assets ratio in an average firm increased from 10.5% in 1980 to 23.2% in 2006. The increase has been more due to changes in firm characteristics than changes in firm characteristics' relation to cash. The most important changes have been fall in inventory levels, increase in cash flow risk for firms, fall in capital expenditure and increase in R&D expenditure.

In addition to overall increasing trend in cash levels, Almeida et al. (2004) suggest that cash holding patters should vary over economic cycles. Financially constrained firms should increase their propensity to retain cash following negative macroeconomic shocks, while unconstrained should not. This should be so because after these shocks the marginal attractiveness of future investments increases compared to current ones, and current cash flows decline. Financially unconstrained firms are unaffected and thus not need to increase cash reserves.

This finding could imply that the value of cash held by financially constrained firms should increase after macroeconomic shocks while the value of cash in unconstrained firms should not necessarily change. Financially constrained firms find it more expensive to access the external

capital markets, thus putting more value to the cash already held by the firm. This is supported by Opler et al. (1999) who argue that liquid asset holdings decrease with interest rates, and with the cost of raising debt.

2.3.2 Value of cash in a credit crunch

The events of the past few years have been extraordinary in the financial markets. The credit crunch of 2007-2008 and its background have been widely covered elsewhere but to understand why this may have a significant impact on how investors value cash, it is worth using this situation as an example and go through some of the main issues.

The bust of the subprime mortgage market soon evolved into a full-scale banking crisis, and eventually after a drastic loss of confidence led to the anticlimax of the subprime crisis, the bankruptcy of Lehman Brothers in September 2008. At this point already the credit market has been under severe strain, and the collapse of Lehman put it to a halt. Due to complete lack of confidence the banks did not lend money to each other or many of the firms in need of financing. Only the extraordinary measures taken by the governments and central banks, and perhaps a bit of luck, saved the whole financial system from a total failure.[3]

The described situation is a perfect example of a sudden financial sector-born credit shock. Gilchrist et al. (2009) argue that sych shocks can cause economic fluctuations. They offer two explanations why shocks to credit markets have played an important role in business cycle fluctuations during the previous decade and a half. First, the variation in credit spreads is mostly due to macroeconomic factors, such as liquidity and risk premiums. To the extent that in the corporate bond market, the key investors are banks, insurance companies, and other financial intermediaries, it is their willingness and ability to bear risk that dictates the development in the corporate credit market. Thus, as conditions in the financial sector deteriorate, the premium on the risk of default increases, which causes a drop in investment spending and a contraction in future economic activity. Second, as monetary policy tightens, or financial conditions in the

[3] For a complete discussion of the background of the 2007-2008 credit crunch, see e.g. Mizen (2008).

banking sector deteriorate, banks may be forced to cut back on their lines of credit. More generally, the process of credit disintermediation may increase liquidity risk for nonfinancial firms, which, in the case of a severe deterioration in economic and financial conditions, may turn into insolvency risk. This is consistent with the theory of debt-deflation, first introduced by Irving Fisher (1933) in the aftermath of the Great Depression, and it explains well the consequences of the latest credit crunch.

In a situation where the banks are not lending, the debt capital markets require high yields for even the safest of corporate bonds, and the equity markets have all but crashed it is fair to assume that investors would see any dollar of cash held by a firm in a more positive way than earlier. If a firm could raise cash from the external capital markets, it would have to incur higher costs than earlier. Moreover, some firms which during the boom years were able to raise cash may be unable to tap the external market at all boosting the value of cash held further. Fazzari et al. (2000) note that manufacturing firms often face negative cash flows during a recession. This should make the cash reserves in the balance sheet even more valuable and at worst, lead to a liquidity crisis.

3. Empirical predictions

After I have explored the theory behind the value of cash holdings, I move on to the empirical predictions. First I present hypotheses for the impact of financial policy and investment opportunities on the value of cash. I also lay out hypotheses on how the value of cash has changed over time and as a result of credit shocks.

3.1. Hypotheses for the impact of financial policy and investment opportunities

These hypotheses relate to the prior work in the field of corporate finance and the value of cash. Hypotheses 1 to 3 follow Faulkender and Wang (2006), while hypothesis 4 has been examined earlier by Pinkowitz and Williamson (2004). Hypothesis 5 extends the value of cash studies.

Hypothesis 1: The marginal value of cash is decreasing in the level of the firm's cash position.

Following Faulkender and Wang (2006), I first hypothesize that the marginal value the shareholders place on firm's cash holdings decreases as the level of cash holdings increases. The reasons are based on tax and agency considerations. As firm's cash level increases it becomes more likely to distribute the cash to shareholders who then consequently incur a dividend tax. Also, a firm with high cash holdings becomes more vulnerable to face agency costs as shareholders begin to worry about managers' interests and ability to invest cash in positive NPV projects. Therefore, the marginal value of cash should decrease as the level of the firm's cash position increases.

Hypothesis 2: An extra pound of cash holdings is less valuable for shareholders in highly levered firms than in firms with low leverage.

The second hypothesis from Faulkender and Wang (2006) which I test with my UK sample is the negative relation of the marginal value of cash and firm's leverage. The value of cash for shareholders in highly levered firms is likely to be less than in firms with low leverage as contingent claims analysis predicts that most of the value of these firms is in the hands of the debt holders. An extra pound is likely to go mostly to increase the value of debt and therefore, the value for shareholders is low.

Hypothesis 3: An extra pound of cash holdings is more valuable for shareholders in financially constrained firms.

The last hypothesis which follows Faulkender and Wang (2006) is that the ease of accessing external capital markets should have an impact on the value of cash. The access can be limited for various reasons, but often relates to asymmetric information about firm's condition, which is likely to be the case for smaller firms, firms with no credit rating or equity research coverage and firm's that do not pay dividends. These firms may be considered as financially constrained and can be thought of having higher costs when raising external funds.

Hence, having internal funds, i.e. cash at hand, should be more valuable for these firms than financially unconstrained firms who are more likely and able to obtain external financing.

Hypothesis 4: An extra pound of cash holdings is more valuable for firms with good investment opportunities.

Following Pinkowitz and Williamson (2004) I test whether firms with good investment opportunities have a higher valuation on their cash holdings than firms with weaker growth potential. Pinkowitz and Williamson argue that the primary theoretical determinant of the value of cash holdings should be the investment opportunity set of the firm. First, liquidity has value because without liquid assets firms would be forced to forego a positive NPV project (Myers and Majluf (1984)). This should increase the value of cash as it is expected to be a value-increasing asset.

Second, Jensen's (1986) free cash flow problem arises when firms have few good investment opportunities. If a firm with ample cash reserves has positive NPV investment opportunities, it is more likely to take advantage of these instead of wasting cash on unproductive ventures. Intuition is that given two identical firms except that one has a positive NPV investment opportunity and the other one has no investment opportunities, it is likely that first firm will spend its cash in a way more valuable to the shareholders.

Hypothesis 5: The marginal value of cash is the most for financially constrained firms with good investment opportunities.

One of arguments by Faulkender and Wang (2006) for financially constrained firms having a higher marginal value of cash is that when firms have positive NPV investment opportunities, the higher the cost of raising external capital is, the more likely these opportunities are foregone. However, they do not test for it empirically.

I hypothesize that the reason why financially constrained firms, and firms with good investment opportunities have a higher value placed on cash when examined separately, is in fact due to the combined effect of these two criteria. A financially constrained firm with no investment opportunities is not able to make return for the cash, while a financially unconstrained firm with good investment opportunities can simply raise external funding when it needs to. Hence, the

financially constrained firms with good investment opportunities should have a higher value placed on their cash holdings by their shareholders than other firms.

3.2. Hypotheses for the change over time

Hypothesis 6: When the cost of external capital increases, firms' cash holdings, on average, decrease.

When conditions in the corporate credit market worsen, it often leads to contraction in the economy (Fisher (1933)). As firms generate less internal cash flows and while at the same time corporate credit becomes more rationed and expensive, firms' cash reserves, on average, should decline. This was also suggested by Opler et al. (1999).

Hypothesis 7: An extra pound of cash holdings is more valuable when the cost of external capital is higher.

When the supply of credit becomes more rationed and hence more expensive, the cost of raising capital increases. The increased cost of capital then makes the firms more likely to forego positive NPV projects due to lack of funding. Therefore, when credit is more rationed, the cash holdings should become more valuable as they may enable firms to capitalize on positive NPV investment opportunities without incurring high costs of raising external capital.

4. Methodology

To measure the impact of corporate financial policy on the value of cash holdings, I follow Faulkender and Wang (2006) who developed a methodology which estimates the additional value the market incorporates into equity values that result from changes in the cash position of firms over the fiscal year. Since the stock returns are affected both by common risk factors and by changes in firm-specific characteristics, it is necessary to control for both to be able to estimate the value change attributed to the change of cash. The change in firm value is measured by the excess return for firm *i* during fiscal year *t* less the return of stock *i*'s benchmark portfolio during fiscal year *t*. Then the excess returns are regressed on changes in firm characteristics. Here the primary interest is on the estimated coefficient that corresponds to the variable measuring the

ratio of the unexpected change in cash to the firm's lagged equity value. Since both the dependent and independent variables are standardized by the lagged market value of equity, the coefficient measures the dollar change in shareholder value resulting from a one dollar change in the amount of cash held by the firm. Faulkender and Wang (2006) methodology is in effect a long-run event study, where the event is an unexpected change of cash holdings, controlled for other factors that may impact returns over the estimation window of one year.

4.1. Controlling for risk-related market-wide factors

Excess returns are examined to control for risk-related factors that may impact a firm's return and discount rate. Fama and French (1993) show that size and the book-to-market of equity explains common variation in stock returns. I use the 25 Fama-French portfolios (Fama and French (1993)) formed on size, measured as market capitalization, and book-to-market value of equity ratio (BE/ME hereafter) as my benchmark portfolios to arrive at the estimate of the excess return. For each year, firms are first sorted by size and divided in five size groups, and then firms are sorted by BE/ME ratios and divided in five BE/ME quintiles. Then I group every firm into one of 25 size and BE/ME portfolios based on the intersection between the size and BE/ME independent sorts. The excess return for a firm is calculated by deducting the firm *i*'s benchmark portfolio return during fiscal year *t* from the firm *i*'s stock return during fiscal year *t*. The fiscal year, or annual, returns are calculated using the monthly returns. Thus, the dependent variable for the baseline regression is

$$r_{i,t} - R_{i,t}^{B} , \qquad (1)$$

where $r_{i,t}$ is the stock return for firm *i* during fiscal year *t* and $R_{i,t}^{B}$ is stock *i*'s benchmark portfolio's return during the corresponding fiscal year *t*.

4.2. Controlling for firm-specific factors

To be able to examine how much the change in cash holdings impacts the change in equity value it is necessary to control for variables that could be correlated with both returns and change in cash holdings. Therefore, in addition to change in cash I regress the excess stock return over the fiscal year on changes in a firm's profitability, financing policy, and investment policy. I first

conduct full sample tests and test the hypotheses by including interaction terms, and then examine the differences in coefficients across subsamples.

The following equation describes my baseline regression:

$$r_{i,t} - R_{i,t}^{B} = \gamma_0 + \gamma_1 \frac{\Delta C_{i,t}}{M_{i,t-1}} + \gamma_2 \frac{\Delta E_{i,t}}{M_{i,t-1}} + \gamma_3 \frac{\Delta NA_{i,t}}{M_{i,t-1}} + \gamma_4 \frac{\Delta RD_{i,t}}{M_{i,t-1}} + \gamma_5 \frac{\Delta I_{i,t}}{M_{i,t-1}} + \gamma_6 \frac{\Delta D_{i,t}}{M_{i,t-1}} + \gamma_7 \frac{C_{i,t-1}}{M_{i,t-1}} + \gamma_8 L_{i,t} + \gamma_9 \frac{NF_{i,t}}{M_{i,t-1}} + \gamma_{10} \frac{C_{i,t-1}}{M_{i,t-1}} * \frac{\Delta C_{i,t}}{M_{i,t-1}} + \gamma_{11} L_{i,t} * \frac{\Delta C_{i,t}}{M_{i,t-1}} + \varepsilon_{i,t}, \quad (2)$$

where the term ΔX indicates unexpected change in variable X.

The dependent variable is described above. The independent variables are firm-specific factors that control for sources of value other than cash or may be correlated with cash holdings. $\Delta C_{i,t}$ is the unexpected change during fiscal year t in firm i's cash holdings in balance sheet and the most important variable in the regression. I assume that the unexpected change in cash holdings equals to the realized change in cash holdings during the fiscal year.[4] $\Delta E_{i,t}$ is the change during fiscal year t in earnings before interest and extraordinary items, and controls for firm's profitability. The changes in firm's investment policy are controlled by $\Delta NA_{i,t}$, the change during fiscal year t in total assets net of cash, and $\Delta RD_{i,t}$, the change during fiscal year t in R&D expenditure. The financing policy is controlled by $\Delta I_{i,t}$ which is the change during fiscal year t in interest expense, $\Delta D_{i,t}$ which is the change during fiscal year t in total dividends, $C_{i,t-1}$ which is firm i's lagged cash holdings at time t-1, $L_{i,t}$ which is market leverage at the of fiscal year t, and finally $NF_{i,t}$ which is the firm's net financing during the fiscal year t. I deflate the firm-specific factors (except leverage) by the one-year lagged market value of equity ($M_{i,t-1}$) to avoid the dominance of the largest firms in the results. As the stock return is also by definition divided by $M_{i,t-1}$, the

[4] Although, there may be expected factors contributing to the realized change, Faulkender and Wang (2006) show that the results are robust to alternative measures of the expected change in cash, and results using the absolute change in cash appear to be relatively unbiased. Therefore, as Dittmar et al. (2003) and Liu and Chang (2009) earlier I do not repeat the tests for alternative methods in Faulkender and Wang (2006).

standardization allows for interpreting the estimated coefficients as the dollar change in value for a one-dollar change in the corresponding independent variable.

To test the hypotheses stated in the previous section, I add interaction terms. The coefficients of these terms estimate how the financial variable included in the interaction term impacts the value of cash holdings. I use $\frac{C_{i,t-1}}{M_{i,t-1}} * \frac{\Delta C_{i,t}}{M_{i,t-1}}$ in order to estimate the effect of changes in the value of cash for different levels of cash holdings. Negative coefficient γ_{10} would support the first hypothesis and indicate that the marginal value of cash decreases in the amount of cash the firm has. The second interaction variable $L_{i,t} * \frac{\Delta C_{i,t}}{M_{i,t-1}}$ estimates the effect of leverage on the marginal value of cash holdings. Following the second hypothesis, I expect the coefficient γ_{11} to be negative supporting that when leverage increase, less of the value from additional cash goes to the equity holders. The lagged cash position and level of leverage are included in the regressions to ensure that the coefficients on the interaction terms are due to interaction, not just due to variables themselves.

I follow this methodology also when I examine how the value of cash has changed over time.

5. Data and summary statistics

For my empirical analysis of the marginal value of cash in the UK and how it may have changed over time with the availability of capital from the external market I use a sample of publicly listed UK firms from 1996 to 2008. Since most of the variables examined are changes during a fiscal year, the usable observations begin from 1997. The sample includes both active and inactive firms to avoid a survivorship bias.

In this section I describe how the variables were calculated and from where the data was obtained. Then I discuss the requirements for the data and how the variables were processed. Finally, I present the summary statistics. Additional variables required for subsample tests are described in the respective result sections.

5.1. Description of variables

Here I will first describe how the dependent variable is calculated, and then describe the independent variables in detail.

5.1.1 Dependent variable

The dependent variable is the excess return of a firm's stock (Eq. (1)). The stock return for a firm *i* during fiscal year *t*, $r_{i,t}$, is calculated using Total Return Index (item ReturnIndex) from Thomson Reuters Datastream database (referred as Datastream here after). The index adjusts for stock splits and dividends, and is hence the most exact measure of increase in firm equity value. I first retrieve a monthly index value for each firm and then calculate their fiscal year return using the monthly returns.

The stock *i*'s benchmark portfolio's return during the corresponding fiscal year *t*, $R_{i,t}^{B}$, is provided by Gregory et al. (2009) who make available the Fama-French and momentum portfolios and factors for the UK market for research purposes. Both the cut points for the size and BE/ME portfolios and portfolio returns are available. They adapt the Fama-French portfolio construction method to better suit the UK market. First, whereas Kenneth R. French provides on his web site the 25 size and BE/ME portfolio data so that size breakpoints are simply market equity quintiles, Gregory et al. (2009) argue that this may not be a proper method for the UK firms since there is a large tail of small and illiquid stocks listed in the London Stock Exchange. Therefore, those would dominate, at minimum, the four smallest quintiles while having similar characteristics and hence distort the results. Gregory et al. (2009) suggest following portfolio construction method where 350 largest firms form 4 portfolios and 1 portfolio formed from the rest. I follow this approach, however it should be noted that Gregory et al. (2009) also provide cut points and returns for portfolios where 3 size portfolios are formed from the largest (70^{th} percentile) firms and 2 portfolios from the rest. The results in this thesis are robust for this approach.

Second adaption Gregory et al. (2009) make relates to the timing of portfolio construction. The original Fama-French approach is to construct portfolios at beginning of July in year *t* to make sure the financial statements of most of the firms for the previous fiscal year *t*-1 are available.

They use the accounting data from December *t*-1 and market capitalization at the end of June in year *t*. However, Agarwal and Taffler (2008) find that in the UK 22% of firms have March year ends, with only 37% of firms having December year ends. For comparison, in the sample I use in this thesis 21% of firm-year ends were in March and 43% in December. Therefore, Gregory et al. (2009) use March year *t* accounting data and end of September year *t* market capitalization data. The portfolios are formed at the beginning of October in year *t*. This means that if a firm, for example, has a fiscal year ending in December, the size-BE/ME portfolio it belongs to may change in October, and the firm may have a different benchmark portfolio for the monthly returns from January to September and then from October to December.

5.1.2 Independent variables

The data for independent variables, which control for firm-specific characteristics, are retrieved from Thomson Reuters Worldscope database (referred as Worldscope here after). Here I describe how the data for each variable for a fiscal year *t* is retrieved and calculated. Except for leverage and one-year lagged cash holdings, I am interested in the change in the variables. The change is simply the difference between fiscal years *t* and *t*-1. In addition, all variables except for leverage and net financing are deflated by one-year lagged market value of equity. The variables used in Eq. (2) are measured as follows (Thomson Reuters Worldscope items are in parentheses):

a) **$C_{i,t}$ and $C_{i,t-1}$**

Cash holdings and one-year lagged cash holdings are measured as cash and short-term investments (CashAndSTInvestments). Since this is the most important variable, it should be noted that firm's cash holdings are considered to include cash and marketable securities in majority of academic studies.[5] Depending on the source, these can be listed as cash and equivalent, cash and short-term investments or cash and marketable securities. Nevertheless, in addition to cash the definition can include items such as

[5] An incomplete list of papers related to cash holdings include Opler et al. (1999), Mikkelson and Partch (2003), Pinkowitz and Williamson (2004), Almeida et al. (2004), Faulkender and Wang (2006), Dittmar et al. (2007), Harford et al. (2007), Bates et al. (2008), Ozkan and Ozkan (2008) and Frésard (2009).

commercial papers, treasury bills and other money market investments. Typically databases adjust the reported figures from company financial statements in order to make the data comparable across the companies.

b) $\boldsymbol{E_{i,t}}$

Earnings before interest and extraordinary items are calculated as earnings before extraordinary items (IncomeBefExtraItemsCFStmt) plus interest expenses (InterestExpenseOnDebt).

c) $\boldsymbol{NA_{i,t}}$

Total assets net of cash, or net assets, are measured as total assets (TotalAssets) minus cash holdings (CashAndSTInvestments).

d) $\boldsymbol{RD_{i,t}}$

R&D expenditure is simply R&D expenditure (ResearchAndDevelopmentExpense). It is set to zero if missing.

e) $\boldsymbol{I_{i,t}}$

Interest expense is measured as interest expenses on debt (InterestExpenseOnDebt).

f) $\boldsymbol{D_{i,t}}$

Total dividends are measured as common dividends paid (CommonDividendsCash).

g) $\boldsymbol{L_{i,t}}$

Market leverage is defined as the market debt ratio and calculated as total debt (STDebtAndCurPortLTDebt+TotalLTDebt) over the sum of total debt and the market value of equity (MarketValue from Thomson Reuters Datasream).

h) $\boldsymbol{NF_{i,t}}$

Net financing is total equity issuance (SaleOrIssuanceOfStockCFStmt) minus repurchases (PurchOfComAndPfdStkCFStmt) plus debt issuance (LTDebtIssuanceCFStmt) minus debt redemption (LTDebtReductionCFStmt).

i) $\boldsymbol{M_{i,t-1}}$

One-year lagged market value of equity is used to deflate the firm-specific factors except leverage and measured as the market value of equity (MarketValue from Thomson Reuters Datasream).

5.2. Data processing

After obtaining all the variables for the firms in my sample, in order to construct a reliable sample I process the data as follows.

First, all data are converted to real values in 2005 pounds using the consumer price index. 2005 is the base year of consumer price index provided by Office for National Statistics in the UK. The conversion allows me to eliminate the effect of inflation, which during the sample period averaged 1.6% per annum, and examine the real changes.

Second, using the full sample and changes based on real values, I winsorize the dependant variable and firm-specific factors at the 1% tails to reduce the impact of outliers. This means that for each variable I set all the data below (above) the 1^{st} (99^{th}) percentile equal to the 1^{st} (99^{th}) percentile. Winsorizing allows me to keep the observations in the sample while it still reduces the impact of outliers. This is contrary to trimming the data which simply means removing the outliers.

Third, I remove all missing firm-year observations for any variable in the model during the sample period. Since there is no reliable method to estimate the missing variables, they cannot be used in the model. The only exception is R&D expenditure. A missing observation is interpreted as the firm having no R&D expenditure during the fiscal year, and is set to zero.

Fourth, I eliminate all firm-years for which net assets are negative, the market value of equity is negative, or dividends are negative.

Finally, I remove all firm-years for which net sales are below 500 thousand pounds. Examining the data for these firms reveals a high amount of variables set to zero which I interpret as mistakes in either the firms' financial statements or Thomson Reuters Worldscope database.

After data cleaning process my final sample consists of 8,243 firm-year observations from a total of 1,193 firms.

5.3. Summary statistics

Table I presents the summary statistics for the sample using winsorized observations. Recall that except for leverage and net financing all the variables are changes during a fiscal year. Therefore a mean value implies how a variable has changed on average during the sample period.

The one-year excess return for an average firm has been slightly positive at 0.27% while the median firm has a negative excess return of -5.8%. This is consistent with the distribution of abnormal stock returns being right-skewed. The skewness is due to two reasons. First, negative equity return cannot exceed to -100% due to limited liability. Second, the upside for equity returns is unbounded and, for example, 4.50% of firm-year observations in my sample had a one-year excess stock return exceeding 100%.

The change in cash holdings for neither a mean or median firm is significant from zero and close to each other, implying that the distribution of the change in cash holdings is close to normal. The one-year lagged cash holdings for a median firm is 9.00% of the market value of equity at the beginning of the fiscal year, while the mean is significantly higher at 17.29%. This suggests that cash holdings are right-skewed. Recalling the reasons for holding cash, it may be so that most of the firms hold a minimum possible cash level to satisfy the transactional motive for cash, and then some firms choose to hold higher levels of cash due to precautionary motives or managerial discretion. The latter group then drives the average holdings higher. Nevertheless, both of the findings related to cash levels are consistent with Faulkender and Wang (2006) who examined the U.S. firms. The skewness of cash holdings is also documented in other studies of firm cash holdings, including Ozkan and Ozkan (2004) who studied the determinants of cash holdings for a sample of UK firms. However, their statistics are not directly comparable to summary statistics in this thesis because they use total assets to scale independent variables, whereas I use the lagged market value of equity.

Table 1
Summary statistics for the 1997–2008 sample

This table provides the summary statistics for the variables in the sample of firm-years from UK-based publicly traded firms over the period 1997 to 2008. $r_{i,t} - R_{i,t}$ is the excess stock return, where $r_{i,t}$ is the annual stock return of firm i at time t (fiscal year-end). $R_{i,t}$ is stock i's benchmark portfolio returns at time t. All variables except L_t and excess stock return are deflated by the lagged market value of equity (M_{t-1}). C_t is cash plus marketable securities, E_t is earnings before extraordinary items plus interest, and NA_t is total assets minus cash holdings. RD_t is R&D expenditure which is set to zero if missing. I_t is interest expense, total dividends (D_t) are measured as common dividend paid, L_t is market leverage, and NF_t is the total equity issuance minus repurchases plus debt issuance minus debt redemption. ΔX_t is compact notation for the 1-year change, $X_t - X_{t-1}$. The subscript $t-1$ means the value of the variable is at the beginning of fiscal year t or at the end of fiscal year $t-1$.

Variable	Mean	1st Quartile	Median	3rd Quartile	SD
$r_{i,t} - R_{i,t}$	0.0027	-0.3039	-0.0580	0.2104	0.4887
ΔC_t	0.0023	-0.0348	0.0000	0.0364	0.1570
C_{t-1}	0.1729	0.0323	0.0900	0.2047	0.2506
ΔE_t	0.0257	-0.0306	0.0090	0.0479	0.2882
ΔNA_t	0.0198	-0.1050	0.0230	0.1632	0.5519
ΔRD_t	-0.0005	0.0000	0.0000	0.0000	0.0153
ΔI_t	0.0002	-0.0024	0.0000	0.0036	0.0160
ΔD_t	-0.0007	0.0000	0.0000	0.0034	0.0198
L_t	0.2043	0.0210	0.1420	0.3261	0.2109
NF_t	0.0599	-0.0181	0.0000	0.0690	0.2526

The profitability of an UK average firm in my sample has increased statistically significantly by 2.57%. Both Faulkender and Wang (2006) and Pinkowitz and Williamson (2004) found an increase in profitability in their samples of U.S. firms. However, the magnitude of the increase in my sample is slightly higher. It is uncertain if this is due to different sample periods or if the profitability has increased more in the UK. The earnings are also slightly right-skewed implying that there are more firms with significant increase in earnings than with significant decrease. Similarly, net assets in both mean and median firms have increased by approximately 2% annually. Consistent findings for U.S. firms are reported by Faulkender and Wang (2006). However, R&D expenditure in a mean firm has decreased slightly contrary to the findings in the U.S. This could be explained by the coincidence of the "dot-com bubble" with my sample period. After the bubble burst, firms, on average, reduced their R&D spending.

The financing variables are generally consistent with findings by Faulkender and Wang (2006). Interest expenses appear quite stable, while dividend payments have declined slightly. The latter is consistent with findings by Ferris et al. (2006) who study corporate payouts in the UK and show that number of UK firms paying dividends has declined from 75.9% to 54.5% during 1988-2002, and the decline was fastest during 1998-2002. Leverage levels in the UK are lower than in the U.S. which is consistent with earlier literature (see e.g. Dittmar et al. (2003)). This seems also consistent with the findings in Ongena and Smith (2000) who show that in the UK an average firm has 2.9 bank relationships, while an average firm in the U.S. has 5.2 bank relationships (Houston and James (1996)). Although leverage is considered to proxy for financial distress, and hence have a negative impact on the marginal value of cash to equity holders, it could also at the very low levels give managers more discretion as they are likely to be less monitored by the external capital markets. Finally, net financing is also significantly positive, and a mean firm's net financing during a fiscal year stands at 5.99% of the one-year lagged market value of equity.

Table 2 provides the correlations between independent variables. There are only few large correlations, and hence I conclude that the variables do not suffer from multicollinearity. Especially the variables of most interest, cash and leverage, have a very low correlation with other variables.

6. Empirical results

In this section I present the results of regressions that test my empirical predictions. In Section 6.1. I use the full sample over the entire period to test the first two hypotheses. In Section 6.2. I show the implications of financing constraints on the results by using two measures to partition the sample, and then test for differences in the marginal value of cash between subsamples. Then in Section 6.3. I divide the full sample based on investment opportunities, and test whether the value of cash is dependent on the investment opportunity set a firm has. In Section 6.4. I examine what is the combined effect of financing constraints and investment opportunities. In Section 6.5. I examine three subgroups of firms which most resemble firms in the three cash regimes, based on their cash position, ability to serve debt, and investment opportunities. Finally, in Section 6.6.

Table 2
Correlation matrix of independent variables

This table provides the correlation of the independent variables in the sample of firm-years from UK-based publicly traded firms over the period 1997 to 2008. All variables except L_t and excess stock return are deflated by the lagged market value of equity (M_{t-1}). C_t is cash plus marketable securities, E_t is earnings before extraordinary items plus interest, and NA_t is total assets minus cash holdings. RD_t is R&D expenditure which is set to zero if missing. I_t is interest expense, total dividends (D_t) are measured as common dividend paid, L_t is market leverage, and NF_t is the total equity issuance minus repurchases plus debt issuance minus debt redemption. ΔX_t is compact notation for the 1-year change, $X_t - X_{t-1}$. The subscript $t-1$ means the value of the variable is at the beginning of fiscal year t or at the end of fiscal year $t-1$.

Variable	ΔC_t	C_{t-1}	ΔE_t	ΔNA_t	ΔRD_t	ΔI_t	ΔD_t	L_t	NF_t
ΔC_t	1.00	-0.34	0.05	0.06	0.04	0.04	0.04	-0.04	0.22
C_{t-1}	-0.34	1.00	0.07	-0.06	-0.09	-0.10	-0.06	0.03	-0.01
ΔE_t	0.05	0.07	1.00	0.06	-0.12	-0.01	0.00	-0.04	0.08
ΔNA_t	0.06	-0.06	0.06	1.00	0.13	0.37	0.23	-0.10	0.40
ΔRD_t	0.04	-0.09	-0.12	0.13	1.00	0.05	0.06	-0.03	0.05
ΔI_t	0.04	-0.10	-0.01	0.37	0.05	1.00	0.10	0.07	0.24
ΔD_t	0.04	-0.06	0.00	0.23	0.06	0.10	1.00	-0.13	0.03
L_t	-0.04	0.03	-0.04	-0.10	-0.03	0.07	-0.13	1.00	0.11
NF_t	0.22	-0.01	0.08	0.40	0.05	0.24	0.03	0.11	1.00

I concentrate on the changes in the marginal value of cash over time and to what extent it can be explained by the changes in the costs of accessing external capital markets.

6.1. Findings for cash level and leverage

The regression results for the full sample are presented in Table 2. The coefficients for each independent variable can be interpreted as the variable's contribution to the change in the firm's market value of equity during a fiscal year. I focus on the coefficients for the change in cash and the interaction terms. The column 1 of Table 3 shows the results for estimating the marginal value of cash without interaction with cash level or leverage. The initial coefficient estimate corresponding to the change in cash holdings suggests that an extra dollar of cash is valued by shareholders at £0.46. When I include the interaction terms for both the cash level ($C_{t-1} * \Delta C_t$) and leverage ($L_t * \Delta C_t$) to the regression the results change notably, as seen in the column 2 of Table 3. These two variables test for my hypothesis 1 and 2, respectively.

I hypothesized that the marginal value of cash declines as the firms' cash holdings increase, yet the empirical evidence seems not to fully support the hypothesis. The coefficient estimate corresponding to the interaction of the level of cash holdings with the change in cash implies that the marginal value of an extra pound of cash is worth only 1.1 pence less for a firm with cash holdings equal to 15% of its market value of equity than for otherwise identical firm but with cash holdings equal to 5% of its market value of equity. Although the sign of the coefficient estimate is negative, as expected, the economical magnitude of the finding is very small, and unsurprisingly, the coefficient has a p-value of only 0.17. Therefore, I must reject my first hypothesis that the level of firm's cash holdings would play a significant role in determining the value of extra cash.

This finding is not only contradictory to theory but also to the findings of Faulkender and Wang (2006) in the U.S. However, examining their findings gives insight to what may explain the result. In their study, the marginal value of a dollar for a firm with zero cash holdings and no leverage is $1.47. The coefficients for cash level and leverage interaction terms are -0.738 and -1.433, respectively. This suggests that in the U.S. the shareholders place a higher value on a dollar for those firms which have only little cash. As the U.S. firms' cash levels become higher, the marginal value of cash becomes closer to the marginal value of cash in the UK firms. This implies that shareholders in the UK firms are indifferent whether a firm has little or plenty of cash, it is discounted the same nevertheless. In other words, shareholders in UK firms holding high levels of cash do not put additional discount on the value of cash, and respectively, shareholders in UK firms with low levels of cash do not place extra premium on the value of cash. Because one of the main arguments for expecting the value of cash decrease as the level of cash holdings increases is growing concern for agency costs, it could be so that shareholders in the UK firms have a high concern for managements' unproductive cash policies to begin with regardless of how much cash a firm has. However, it could also be so that cash levels per se simply are irrelevant. What matters more is how the cash can and will be spent. These questions will be examined further below.

Table 3
Regression results for the whole sample

This table presents the results of regressing the excess stock return $r_{i,t} - R_{i,t}$ on changes in firm characteristics over the fiscal year. All variables except L_t and excess stock return are deflated by the lagged market value of equity (M_{t-1}). C_t is cash plus marketable securities, E_t is earnings before extraordinary items plus interest, and NA_t is total assets minus cash holdings. I use R&D expenditures (RDt) which is set to zero if missing. I_t is interest expense, total dividends (D_t) are measured as common dividend paid, L_t is market leverage, and NF_t is the total equity issuance minus repurchases plus debt issuance minus debt redemption. ΔX_t is compact notation for the 1-year change, $X_t - X_{t-1}$. The subscript $t - 1$ means the value of the variable is at the beginning of fiscal year t or at the end of fiscal year $t - 1$. White heteroscedastic-consistent standard errors, corrected for correlation across observations of a given firm, are in parentheses (White (1980)).

Independent variables	I	II	III
ΔC_t	0.463***	0.671***	0.624***
	(0.047)	(0.077)	(0.068)
ΔE_t	0.152***	0.149***	0.15***
	(0.025)	(0.025)	(0.025)
ΔNA_t	0.143***	0.143***	0.142***
	(0.014)	(0.013)	(0.014)
ΔRD_t	0.672	0.674	0.649
	(0.436)	(0.435)	(0.437)
ΔI_t	-1.749***	-1.619***	-1.634***
	(0.402)	(0.399)	(0.400)
ΔD_t	0.934***	0.981***	0.967***
	(0.260)	(0.261)	(0.259)
C_{t-1}	0.065***	0.058**	0.068***
	(0.025)	(0.026)	(0.025)
L_t	-0.442***	-0.444***	-0.445***
	(0.024)	(0.024)	(0.024)
NF_t	-0.116***	-0.125***	-0.119***
	(0.032)	(0.031)	(0.032)
$C_{t-1} * \Delta C_t$		-0.113	
		(0.082)	
$L_t * \Delta C_t$		-0.563***	-0.614***
		(0.136)	(0.134)
Intercept	0.082***	0.082***	0.082***
	(0.009)	(0.009)	(0.009)
Observations	8,243	8,243	8,243
Adj R^2	0.10	0.11	0.11

* Corresponds to significant at 10%; ** significant at 5%; and *** significant at 1%.

Nevertheless, because the interaction between firms' cash levels and the marginal value of cash is statistically insignificant, I drop the interaction term from the specification.[6] Results for the regression model, which will be used hereafter in subsample tests, can be seen in column 3 of Table 3.

The results are consistent with my second hypothesis that the marginal value of cash is decreasing with the amount of leverage. The coefficient estimate on $L_t * \Delta C_t$ in column 3 of Table 3 is negative, and significant at better than 1%. Economically, the estimate suggests that the value of an extra pound of cash decreases by 6.1 pence for every 10 percentage point increase in the leverage ratio. In other words, for a firm with 10% leverage ratio, the value of an additional pound of cash is equal to £0.56 (= £0.62 + (-0.614*10%)), compared to £0.62 in otherwise similar firm but with no leverage. This finding supports the notion that as firm uses more leverage, more of its value goes to the hands of debt holders. Because the probability of default is negatively correlated with the value of debt, and amount of cash holdings, i.e. liquidity, is negatively correlated with probability of default, an extra pound of cash is likely to increase the value of debt, and hence, to marginally lesser extent the value of equity. Firms with low levels of leverage are less likely to default on their debt, and therefore any change in cash holdings should benefit the equity holders more than in firms with high levels of leverage.

Having included the effect of leverage, and excluded the effect of level of cash holdings, I can now estimate the marginal value of cash for the mean firm in my sample. This procedure is also used to estimate the marginal value of cash for the various subsamples and during different years which are discussed below. Since most of the firms use some leverage, the marginal value of cash estimate is a function of the estimated coefficient for the change in cash and the interaction with leverage. The estimated coefficient for the change in cash in column 3 suggested that an extra pound of cash holdings increases shareholder wealth by £0.62 if the firm has no leverage. Since

[6] To confirm that level of cash holdings did not significantly impact the value of cash in subsamples below, I used a regression model including the cash level interaction term. In nearly all of the tests, the coefficient was insignificant. The results these subsample tests are not reported in the thesis but are available upon request.

the mean leverage ratio in Table 1 is 20.43%, the marginal value of cash to shareholders in the mean firm is £0.50 (= £0.62 + (-0.614*20.43%)). This finding suggests that exactly half of the full value of the extra pound of cash is incorporated into stock prices. In the stock market, the taxing considerations and agency costs seem to outweigh the benefits of cash holdings.

6.2. Financial constraints results

To test my third hypothesis on how the access to the capital markets impacts the marginal value of cash, I analyze separately firms which are financially constrained and firms which are financially unconstrained. To distinguish between financially constrained and financially distressed firm, a firm can be financially constrained even if it is in perfectly good financial condition as long as its access to the external capital markets is somehow restricted. Current literature identifies several approaches how measure financial constraints. Among the most widely used are measures based on dividends, size and credit ratings (see e.g. Almeida et al. (2004), Faulkender and Wang (2006), Denis and Sibilkov (2007)). Almeida et al. (2004) and Denis and Sibilkov (2004) use also Kaplan-Zingales (1997) index. However, neither of them find the index effective, hence I do not use it here. Unfortunately, I do not have firm-level credit ratings data available, so I use two alternative schemes to partition my sample.

1) Payout ratio

Fazzari et al. (1988) argue that unconstrained firms are more likely to have higher payout ratios, while constrained firms are likely to have lower payout ratios. Simply, firms with high payout ratios are more likely to have ample internal funds to cover their debt obligations and to finance their investments, and should therefore have fewer benefits from an extra pound of cash than firms with low payout ratios (Faulkender and Wang (2006)).

The total payout ratio is calculated as total dividends over earnings (item NetIncome in Worldscope). Total dividends are measured as total common dividends (CommonDividendsCash) plus repurchases (PurchOfComAndPfdStkCFStmt). I sort firms in my sample for each year separately according to their annual payout ratios and assign to financially constrained (unconstrained) group those firms whose payout ratios

are less (greater) than or equal to the payout ratio of the firm at the 30^{th} (70^{th}) percentile of the annual payout distribution. In my sample, the constrained group for years from 1997 to 2000 consists only of firms that do not pay dividends. Mainly for this reason, there are an unequal number of observations assigned to each group.

2) Firm size

Smaller firms are typically young, less well known, and thus vulnerable to capital market imperfections (Almeida et al. (2004)), whereas larger firms are thought to be better known and have a better access to capital markets (Faulkender and Wang (2006)). Hence, smaller firms should incur higher costs accessing the capital markets, and therefore have higher benefits from cash holdings.

I use sales (item Sales in Worldscope) as a proxy for firm size. For each year from 1997 to 2008, I rank all firms by their sales at the end of the previous fiscal year and assign to financially constrained (unconstrained) group those firms whose sales are less (greater) than or equal to sales of the firm at the 30^{th} (70^{th}) percentile of the annual size distribution.

Table 4 presents the summary statistics for the constrained and unconstrained groups under the two financial constraints criteria. The letter (C) refers to constrained groups and (U) to unconstrained groups. The first row for each variable reports the mean value for the corresponding variable, with medians in brackets. There seems to be a positive association among the groups. The association among the groups is consistent in six out of nine variables meaning that the variable *X* is larger in one group under both financial constraint criteria. The remaining three variables are never significantly contradictory. For example, the change in dividends in constrained firms is smaller than in unconstrained firms under payout criterion but larger under size criterion. However, the difference between means under size criterion is statistically insignificant (*t*-value 0.08, not reported in the table).

To understand the characteristics of financially constrained and unconstrained firms it is necessary to examine the statistics further. Perhaps surprisingly, there seems to be not much difference in the change in cash between financially constrained and unconstrained firms.

Assuming that firms with greater difficulty accessing capital are more likely to use their cash holdings than external capital for their financing needs (Faulkender and Wang (2006)) it seems that financially unconstrained firms do not differ too much on their financing decisions. However, the conclusion Faulkender and Wang (2006) made was that financially constrained firms are more likely to draw down their cash holdings relative to unconstrained firms. Their argument was supported by statistics in size and ratings subgroups. The statistics for the payout criterion were similar to mine in that the change in cash is more negative in financially unconstrained firms. This could simply be due to the fact that dividends are generally paid in cash, and hence should decrease the cash balance. Therefore, by definition, firms that have a higher payout ratio should have a more negative change in the cash holdings. More support to financially constrained firms' dependence on the internal cash holdings is found by examining the average, and median, cash holdings. The constrained firms hold significantly more cash than the unconstrained firms. Faulkender and Wang (2006) argue that since constrained firms are more reliant on internal firms, they hold higher levels of cash than firms than can easily raise more cash when they need it. This supports the precautionary motive for holding cash. Firms that cannot easily raise funding from the external capital market need to hoard cash in order to survive unexpected negative shocks and also to take advantage of arising investment opportunities. This is consistent with findings in Opler et al. (1999).

Other statistics for variables reveal more about the subgroups. The change in earnings is significantly larger for financially constrained firms than financially unconstrained firms under both criteria. This implies that financially constrained firms are likely to be small firms in a growth phase which is consistent with the criteria definitions. However, change in net assets reveals more about the nature of financially constrained firms. Under both criteria, the financially constrained firms' net assets grew less than net assets of financially unconstrained firms. Under payout criterion, the financially constrained firms' net assets on average even shrunk by 8.3% of the market value of equity. This implies that these firms are more likely to sell assets in order to raise cash, and hence not necessarily even able to satisfy the transactional motive for holding cash, which is to hold cash in order to avoid the need to sell assets and incur transaction costs. Hence, it is fair to assume that financially constrained firms are on average less likely to be able

Table 4
Summary statistics for constrained and unconstrained groups

This table presents summary statistics for key variables across groups of financially constrained and unconstrained firms (see text for definitions) from 1997 to 2008. The first number corresponds to the mean and the medians are in brackets. I use letter (C) for constrained firms and (U) for unconstrained firms. All variables except L_t and excess stock return are deflated by the lagged market value of equity (M_{t-1}). C_t is cash plus marketable securities, E_t is earnings before extraordinary items plus interest, and NA_t is total assets minus cash holdings. RD_t is R&D expenditure which is set to zero if missing. I_t is interest expense, total dividends (D_t) are measured as common dividend paid, L_t is market leverage, and NF_t is the total equity issuance minus repurchases plus debt issuance minus debt redemption. ΔX_t is compact notation for the 1-year change, $X_t - X_{t-1}$. The subscript $t-1$ means the value of the variable is at the beginning of fiscal year t or at the end of fiscal year $t-1$.

	Payout ratio		Firm size	
Financial criteria	(C)	(U)	(C)	(U)
ΔC_t	-0.0047	-0.0086	-0.0034	0.0028
	-[0.0030]	-[0.0010]	[0.0000]	[0.0000]
C_{t-1}	0.2184	0.1478	0.2217	0.1399
	[0.1130]	[0.0850]	[0.1190]	[0.0745]
ΔE_t	0.0364	0.0042	0.0595	0.0056
	[0.0040]	[0.0010]	[0.0125]	[0.0070]
ΔNA_t	-0.0834	0.0451	0.0101	0.0292
	-[0.0175]	[0.0175]	[0.0120]	[0.0270]
ΔRD_t	-0.0016	-0.0001	-0.0012	-0.0001
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
ΔI_t	-0.0007	0.0003	0.0001	0.0004
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
ΔD_t	-0.0046	0.0020	-0.0002	-0.0005
	[0.0000]	[0.0010]	[0.0000]	[0.0010]
L_t	0.2212	0.2119	0.1595	0.2514
	[0.1280]	[0.1790]	[0.0560]	[0.2130]
NF_t	0.1065	0.0082	0.1134	0.0199
	[0.0040]	-[0.0010]	[0.0010]	[0.0000]
Observations	3,574	2,478	2,478	2,478

to take advantage of investment opportunities due to lack of internal cash. Furthermore, financially constrained firms seem also more prone to cut R&D expenditure than financially unconstrained firms. Finally, the median leverage ratio under both criteria is much higher in financially unconstrained groups than in financially constrained groups. This suggests that unconstrained firms are able to raise, and refinance, debt more easily, and given that these firms are more likely to be at a mature stage due to slow earnings growth, more likely to be able to support higher leverage.

The results from the constrained and unconstrained firm-year subsamples are consistent with my hypothesis. Using both criteria, the marginal value of cash is significantly higher for constrained firms than unconstrained firms. As seen in Table 5, the estimated coefficient corresponding to the change in cash holdings is both statistically and economically significantly higher for constrained firms than for unconstrained firms, after controlling for interaction with leverage. The difference between the coefficients for the two different subsamples is significant at better than 99% under both criteria. This suggests that the market places a relatively high value on cash in those firms that may face problems, or higher costs, in raising external capital when they need additional funding. On the other hand, shareholders in firms that have an easier access to external capital markets place a relatively low value on cash holdings because of the costs associated with holding cash, such as agency costs and tax effects.

The coefficient estimated on the leverage interaction term varies notably between constrained and unconstrained group. First, under both criteria the estimated coefficient is statistically significant at or better than 5% level for constrained firms but insignificant for unconstrained firms. Economically, the coefficient on the interaction is much more negative in the constrained group than in the unconstrained group but close to the corresponding coefficient using the whole sample as seen in Table 3. Hence, in constrained firms less of the value of an extra pound goes to the shareholders than in unconstrained firms. This may suggest that investors are more wary of the prospects of a highly leveraged, financially constrained firm to overcome the situation, while the investors in a highly leveraged, financially unconstrained firm believe that the firm can restructure its balance sheet utilizing the better access to capital markets.

Since most of the firms have some debt in their balance sheet, to determine the marginal value of cash for an average constrained and unconstrained firm, I must incorporate both coefficient estimates that include the change in cash. Using the summary statistics from Table 4 and coefficient estimates from Table 5, I first estimate the value of an extra pound of cash under the payout criterion. In the mean constrained firm the value the shareholders place on an additional pound of cash equals to £0.57 (= £0.725 + (-£0.692*0.221)), while the shareholders in the mean unconstrained firm place a value of £0.25 (= £0.322 + (-£0.345*0.212)). Under size criteria, the shareholders in the mean constrained and unconstrained firm place a value of £0.59 and £0.32, respectively, on an additional pound of cash. Under both criteria, the value of cash is more highly valued for constrained firms than it is for unconstrained firms. These findings support my fourth hypotheses in which I predict that the marginal value of a pound is more for a constrained firm than for an unconstrained firm. The differences in the value between the two groups range from £0.27 to £0.32, consistent with findings by Faulkender and Wang (2006). The difference demonstrates the market's view on the cost of difficulties in accessing capital markets, and how the constrained firms are rewarded with higher valuations for holding cash balances and hence avoiding potential underinvestment problems.

Yet, the differences in costs of raising capital may not be the sole reason for differences in the values shareholders place on cash holdings. Part of the explanation may be due to differences in agency costs across the subsets. For example, it could be so that the unconstrained firms, which are typically more mature firms than constrained firms and may have less profitable investment opportunities, are seen as more likely to waste cash on value destroying ventures. Some indication of this can be seen in Table 5. The change in net assets has a higher coefficient for the constrained firms than for unconstrained firms. This suggests that the market views investments made by constrained firms more positively than unconstrained firms. The combined effect of financial constraints and investment opportunities is further examined in Section 7.4.

Table 5
Regression results for constrained and unconstrained groups

This table presents regression results across groups of financially constrained and unconstrained firms (see text for definitions) from 1997 to 2008. I use letter (C) for constrained firms and (U) for unconstrained firms. The dependent variable in all regressions is $r_{i,t} - R_{i,t}$ the excess stock return, where $r_{i,t}$ is the annual stock return of firm i at time t (fiscal year-end) and $R_{i,t}$ is stock i's benchmark portfolio returns at time t. All variables except L_t and excess stock return are deflated by the lagged market value of equity (M_{t-1}). C_t is cash plus marketable securities, E_t is earnings before extraordinary items plus interest, and NA_t is total assets minus cash holdings. I use R&D expenditures (RD_t) which is set to zero if missing. I_t is interest expense, total dividends (D_t) are measured as common dividend paid, L_t is market leverage, and NF_t is the total equity issuance minus repurchases plus debt issuance minus debt redemption. ΔX_t is compact notation for the 1-year change, $X_t - X_{t-1}$. The subscript $t-1$ means the value of the variable is at the beginning of fiscal year t or at the end of fiscal year $t-1$. White heteroscedastic-consistent standard errors, corrected for correlation across observations of a given firm, are in parentheses (White (1980)).

	Payout ratio		Firm size	
Independent variables	(C)	(U)	(C)	(U)
ΔC_t	0.725***	0.322**	0.661***	0.320***
	(0.088)	(0.139)	(0.093)	(0.123)
p-value ($C - U \neq 0$)	0.00		0.00	
ΔE_t	0.124***	0.361***	0.082**	0.262***
	(0.026)	(0.094)	(0.032)	(0.053)
ΔNA_t	0.141***	0.002	0.156***	0.131***
	(0.017)	(0.031)	(0.021)	(0.025)
ΔRD_t	0.495	-0.124	0.844	0.830
	(0.492)	(0.926)	(0.556)	(1.455)
ΔI_t	-1.622***	-2.618***	-0.676	-2.767***
	(0.499)	(0.716)	(0.621)	(0.728)
ΔD_t	0.362	0.474	2.350***	-0.267
	(0.440)	(0.313)	(0.700)	(0.353)
C_{t-1}	0.148***	0.031	0.099**	0.034
	(0.036)	(0.040)	(0.042)	(0.040)
L_t	-0.446***	-0.361***	-0.438***	-0.460***
	(0.036)	(0.037)	(0.049)	(0.039)
NF_t	-0.105***	0.151**	-0.147***	-0.039
	(0.040)	(0.068)	(0.045)	(0.059)
$L_t * \Delta C_t$	-0.692***	-0.345	-0.520**	-0.012
	(0.166)	(0.285)	(0.209)	(0.218)
Intercept	0.010	0.074***	0.011	0.124***
	(0.015)	(0.012)	(0.019)	(0.013)
Observations	3,574	2,732	2,740	2,732
Adj R^2	0.12	0.07	0.10	0.13

* Corresponds to significant at 10%; ** significant at 5%; and *** significant at 1%.

6.3. Investment opportunity results

To test whether cash holdings are valued higher in firms with more or better investment opportunities than in firms with less or worse investment opportunities, I use market-to-book equity ratio (referred as ME/BE here after) as a proxy for growth opportunities. Penman (1996) argues that ME/BE is the appropriate indicator of earnings growth and of investment opportunities. Therefore, the firms with the highest ME/BE should have a higher value placed on an extra pound of cash. More specifically, I use both industry average ME/BE, defined by firm's two-digit SIC codes, and firm-specific ME/BE. Following logic by Faulkender and Wang (2006), I use the industry-level value which has not been affected by the firm's financing constraints or the likelihood of whether the firm will be able to capitalize on the investment opportunities. Although such an effect is likely to be incorporated by firm's market value, I use firm-specific ME/BE also as it commonly used in earlier literature as a proxy for growth options.

ME/BE is measured as market value of equity (item MarketValue in Datastream) over book value of equity (item TotalCommonEquity in Worldscope). Book value of equity is measured at the end of the previous fiscal year while the market value of equity is measured at the end of December in the year previous fiscal year ended. I use the BE/ME at the end of the previous year to divide the sample into two groups for industry-level and firm-specific BE/ME separately. Using the full sample, I assign to the high (low) ME/BE group those firms whose ME/BE are greater (less) than or equal to the ME/BE of the firm at the 70^{th} (30^{th}) percentile of the full sample ME/BE distribution.

The summary statistics for the high and low investment opportunity subgroups under both criteria are seen in Table 6. Unsurprisingly, most of the financial variables have consistently a larger positive change in high ME/BE firm-years than low ME/BE firm-years. This can be interpreted so that ME/BE is a good proxy for growth, and firms do, on average, capture the investment opportunities. Growth in net assets is significantly higher for high ME/BE firms than low ME/BE firms, and R&D expenditure, interest expense, and dividends all seem to grow faster in firms with good growth prospects. However, the growth in earnings does not differ much between the two groups, which imply that the earnings growth may or may not come later.

Table 6
Summary statistics for high and low investment opportunity groups

This table presents summary statistics for key variables across groups of high and low growth opportunity firms (see text for definitions) from 1997 to 2008. The first number corresponds to the mean and the medians are in brackets. High (low) refers to firms with high (low) market-to-book ratio. All variables except L_t and excess stock return are deflated by the lagged market value of equity (M_{t-1}). C_t is cash plus marketable securities, E_t is earnings before extraordinary items plus interest, and NA_t is total assets minus cash holdings. RD_t is R&D expenditure which is set to zero if missing. I_t is interest expense, total dividends (D_t) are measured as common dividend paid, L_t is market leverage, and NF_t is the total equity issuance minus repurchases plus debt issuance minus debt redemption. ΔX_t is compact notation for the 1-year change, $X_t - X_{t-1}$. The subscript $t-1$ means the value of the variable is at the beginning of fiscal year t or at the end of fiscal year $t-1$.

	Industry ME/BE		Firm ME/BE	
Financial criteria	High	Low	High	Low
ΔC_t	0.0063	0.0026	0.0162	-0.0122
	[0.0010]	[0.0000]	[0.0030]	-[0.0010]
C_{t-1}	0.1578	0.1903	0.0929	0.2841
	[0.0880]	[0.0930]	[0.0600]	[0.1440]
ΔE_t	0.0236	0.0200	0.0252	0.0328
	[0.0110]	[0.0070]	[0.0110]	[0.0050]
ΔNA_t	0.0699	-0.0274	0.1096	-0.1528
	[0.0380]	[0.0020]	[0.0460]	-[0.0860]
ΔRD_t	0.0003	-0.0006	0.0005	-0.0017
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
ΔI_t	0.0008	-0.0005	0.0011	-0.0024
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
ΔD_t	0.0003	-0.0021	0.0012	-0.0048
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
L_t	0.1565	0.2533	0.1296	0.2875
	[0.0850]	[0.2110]	[0.0680]	[0.2530]
NF_t	0.0720	0.0435	0.0623	0.0618
	[0.0020]	[0.0000]	[0.0040]	[0.0000]
Observations	2,729	2,719	2,473	2,473

The cash holdings appear to grow slightly more quickly in firms with good investment opportunities. This is especially so for firm-years with a high firm-specific ME/BE. The average, and median, cash holdings reveal that firms with less investment opportunities nevertheless tend

to hold more cash. This finding raises the obvious question, if a firm does not seem to have good investment opportunities, why do they hold so much cash? Part of the explanation may be due to managerial discretion which should reflect in agency costs and lower value placed on cash holdings by shareholders.

The regression results for the high and low ME/BE groups are presented in Table 7. The estimated coefficient corresponding to the change in cash is significantly larger for high investment opportunity group than low investment opportunity group under both criteria. The estimated marginal value of cash, controlling for interaction with leverage, is both statistically and economically higher for high ME/BE group than low ME/BE group. The difference between the coefficients for the two subgroups is significant at better than 1% under industy ME/BE criterion at better than 1% level and at better than 10% level under firm-specific ME/BE criterion. This suggests that the investment opportunity set is a significant factor when shareholders determine the value they place on firm's cash holdings. Good investment opportunities, measured with ME/BE, increase the probability that firm makes profitable use of its cash and reduces the agency costs and the risk of managers spending cash on value-destroying ventures.

The estimated coefficients for the variable interacting the change in cash and leverage are also consistent under both criteria. The interaction seems to be much stronger for high ME/BE group as the coefficients under both criteria are more negative. However, this is likely to be due to different mean leverage levels among groups (see Table 6). The high ME/BE are, on average, less levered, and should the leverage have similar effect on the value of cash among the groups, then the coefficient for the leverage interaction term should be higher for the high ME/BE groups. Nevertheless, generally the findings for the leverage interaction term for both subgroups are consistent with debt holders receiving the more of the value of an additional dollar the more leveraged a firm is.

Again, to measure the marginal value of cash in the average high ME/BE firm and in the average low ME/BE firm, and to confirm my fourth hypothesis that the value of cash is higher for firms

Table 7
Regression results for high and low investment opportunity groups

This table presents regression results across groups of high and low growth opportunity firms (see text for definitions) from 1997 to 2008. High (low) refers to firms with high (low) market-to-book ratio. The dependent variable in all regressions is $r_{i,t} - R_{i,t}$ the excess stock return, where $r_{i,t}$ is the annual stock return of firm i at time t (fiscal year-end) and $R_{i,t}$ is stock i's benchmark portfolio returns at time t. All variables except L_t and excess stock return are deflated by the lagged market value of equity (M_{t-1}). C_t is cash plus marketable securities, E_t is earnings before extraordinary items plus interest, and NA_t is total assets minus cash holdings. I use R&D expenditures (RD_t) which is set to zero if missing. I_t is interest expense, total dividends (D_t) are measured as common dividend paid, L_t is market leverage, and NF_t is the total equity issuance minus repurchases plus debt issuance minus debt redemption. ΔX_t is compact notation for the 1-year change, $X_t - X_{t-1}$. The subscript $t-1$ means the value of the variable is at the beginning of fiscal year t or at the end of fiscal year $t-1$. White heteroscedastic-consistent standard errors, corrected for correlation across observations of a given firm, are in parentheses (White (1980)).

	Industry ME/BE ratio		Firm ME/BE ratio	
Independent variables	High	Low	High	Low
ΔC_t	0.821***	0.370***	0.947***	0.468***
	(0.127)	(0.116)	(0.246)	(0.088)
p-value ($C - U \neq 0$)	0.00		0.05	
ΔE_t	0.203***	0.154***	0.350***	0.107***
	(0.047)	(0.041)	(0.118)	(0.030)
ΔNA_t	0.190***	0.103***	0.180***	0.117***
	(0.026)	(0.020)	(0.050)	(0.016)
ΔRD_t	1.021	-0.097	2.611***	-1.156*
	(0.636)	(1.245)	(0.990)	(0.632)
ΔI_t	-1.533**	-1.465**	-2.904*	-1.642***
	(0.717)	(0.651)	(1.492)	(0.471)
ΔD_t	0.237	1.362***	-0.446	1.093***
	(0.536)	(0.403)	(0.730)	(0.343)
C_{t-1}	0.009	0.050	0.047	0.054*
	(0.049)	(0.038)	(0.110)	(0.028)
L_t	-0.503***	-0.427***	-0.607***	-0.340***
	(0.048)	(0.038)	(0.060)	(0.038)
NF_t	-0.192***	-0.107**	-0.081	-0.124***
	(0.059)	(0.051)	(0.097)	(0.040)
$L_t * \Delta C_t$	-1.015***	-0.297	-1.119	-0.406***
	(0.268)	(0.222)	(0.737)	(0.154)
Intercept	0.090***	0.094***	0.116***	0.043**
	(0.015)	(0.014)	(0.018)	(0.017)
Observations	3,574	2,732	2,740	2,732
Adj R^2	0.12	0.11	0.09	0.12

* Corresponds to significant at 10%; ** significant at 5%; and *** significant at 1%.

with good investment opportunities than firms with worse investment opportunities, I must combine the estimates for the change in cash and its interaction with leverage. First, I measure the value of cash for the mean firm in both high and low industry ME/BE group. The mean leverage ratio for high ME/BE group in Table 6 is 15.65%, and therefore the value the shareholders place for cash in the mean high ME/BE firm equals to £0.66 (= £0.821 + (-

£1.015*0.1565), while shareholders in the mean low ME/BE firm only place a value of £0.30 (= £0.370 + (-£0.297*0.2533)). Under firm ME/BE ratio the value the shareholders place on cash in the mean firms are £0.80 and £0.35 for high and low ME/BE firm, respectively. The differences in the value of cash range from £0.37 to £0.45. This is consistent with the hypothesis that the value of cash is higher in firms with good investment opportunities than in firms with worse investment opportunities. Good investment opportunities do not only give a possibility to use cash profitably but also decreases the probability of wasting cash due to lack of investment opportunities.

There are also other interesting findings in Table 7 which are beyond the scope of this study, but support the analysis. First, the coefficient for the change in net assets is larger for firms with high ME/BE than firms with low ME/BE. This suggests that investors give more value to investments made by firms which are seen as having better investment opportunities. Having better investment opportunities can be considered as a proxy for making better investments, and investors seem to share this view. Second additional finding is that the market reacts much more positively to increased R&D expenditure in firms with better investment opportunities. This is consistent with the previous finding: the investors seem to view the increased R&D spending as firm's attempt to capitalize on the growth opportunities. Firm's with low ME/BE are typically more mature, and therefore increasing R&D spending seems to go unrewarded, even punished, by the market. Perhaps the most relevant observation is the estimated coefficient corresponding to the change in dividends. It is significantly higher for firms with less investment opportunities. Moreover, for firms with better investment opportunities the estimated coefficient for the change in dividends is statistically not significant from zero. This is consistent with the maturity hypothesis discussed by Grullon et al. (2002). They argue that in a growth phase, a firm has many positive NPV project available, for which I use M/BE as a proxy, has high capital expenditure, and low free cash flows. As the firm continues to grow, more competitors enter the market, the investment opportunity set start shrinking, capital expenditure decline, and the firm starts generating large amounts of free cash flows. As this transition happens, the risk of free cash flow problem (Jensen (1986)) increases, and hence the investors reward firms who consequently increase, or start to pay dividends, in form of higher equity valuation.

These findings are consistent with Pinkowitz and Williamson (2004) who document that firms with greater growth options will have larger values placed on their liquidity. Moreover, the results in this section support the theoretical prediction of Myers and Majluf (1984) that financial slack has value when firms have good growth options.

6.4. Combined financial constraints and investment opportunity results

So far I have examined financial constraints and investment opportunities separately to determine how they affect the value the shareholders place on firm's cash holdings. Yet, there is reason to believe these two factors combined would give even a better understanding of valuing liquidity. Denis and Sibilkov (2007) argue that cash is more valuable in constrained firms because it allows them to increase investment, and this marginal investment is more valuable than that of unconstrained firms. Although their findings support the link between financial constraints and investments, they do not investigate this further. Consider a financially constrained firm which has zero or only few good investment opportunities. The only reason this firm requires cash is to pay for operative transactions and serve debt. There is little reason to expect shareholders placing a premium on the cash holdings held by the firm compared to a financially unconstrained firm with similar investment opportunity set. Therefore, I move on to examine four subgroups based on their financial constraints and investment opportunities.

I first form two groups from the full sample based on whether the firm is financially constrained or unconstrained. I use payout ratio as a proxy for financial constraints and the groups are formed as described in Section 7.2. Then I form two subgroups from both the financially constrained and unconstrained groups based on their investment opportunities. I use industry, instead of firm-specific, ME/BE as a proxy for investment opportunities in order to limit the impact of firm-specific financial variables which are already incorporated in the financial constraint criterion. The groups are constructed as described in Section 7.3. This procedure gives me the following four subgroups: I) financially constrained firms with good investment opportunities, II) financially constrained firms with worse investment opportunities, III) financially unconstrained firms with good investment opportunities, and IV) financially unconstrained firms with worse

investment opportunities. All other observations (for example, constrained firms with average investment opportunity set) are excluded.

The regression results for the four financial constraints and ME/BE groups are presented in Table 8. The results seem to support the hypothesis that the marginal value of cash is the highest in financially constrained firms with good investment opportunities. The estimated coefficient corresponding to the change in cash is significantly higher for the first group: financially constrained firms with good investment opportunities. There is no significant difference in the magnitude of respective coefficient estimates among groups I-III. Note that the coefficient for the third group, financially unconstrained firms with good investment opportunities is not statistically significant at or better than 10% level likely due to the relatively small number of observations. The estimated coefficients for the leverage interaction term is statistically and economically most significant for the first group. This suggests that the investors view these firms as the most likely to become financially distressed if they leverage too much. This is expected as constrained firms are by definition less likely to be able to refinance their debt, and because high growth firms are typically seen as more risky.

Again, incorporating the estimated coefficients for the change in cash and the leverage interaction, and their respective average statistics yields a measure of the value of cash in a mean firm for each group.[7] The value the shareholders place on cash for firms in equals to £0.75 group I, £0.30 in group II, £0.35 in group III, and £0.30 in group IV. The values are consistent with my fifth hypothesis.

The results imply that not only is the cash valued highest in financially constrained firms with good investment opportunities, but there also seems to be no significant difference in the value of cash among financially constrained firms with worse investment opportunities and financially unconstrained firms regardless of their investment opportunities. This suggests that the combined effect of financial constraints and investment opportunities drives the results when both factors

[7] See appendix for summary statistics for the four different financial constraints and investment opportunity groups.

Table 8
Regression results for four different financial constraints and ME/BE groups

This table presents regression results across groups partitioned on financing constraints and investment opportunities (see text for definitions) from 1997 to 2008. The dependent variable in all regressions is $r_{i,t} - R_{i,t}$ the excess stock return, where $r_{i,t}$ is the annual stock return of firm i at time t (fiscal year-end) and $R_{i,t}$ is stock i's benchmark portfolio returns at time t. All variables except L_t and excess stock return are deflated by the lagged market value of equity (M_{t-1}). C_t is cash plus marketable securities, E_t is earnings before extraordinary items plus interest, and NA_t is total assets minus cash holdings. I use R&D expenditures (RD_t) which is set to zero if missing. I_t is interest expense, total dividends (D_t) are measured as common dividend paid, L_t i market leverage, and NF_t is the total equity issuance minus repurchases plus debt issuance minus debt redemption. ΔX_t is compact notation for the 1-year change, $X_t - X_{t-1}$. The subscript $t-1$ means the value of the variable is at the beginning of fiscal year t or at the end of fiscal year $t-1$. White heteroscedastic-consistent standard errors, corrected for correlation across observations of a given firm, are in parentheses (White (1980)).

Independent variables	I	II	III	IV
ΔC_t	0.956***	0.396***	0.355	0.288*
	(0.154)	(0.149)	(0.274)	(0.172)
ΔE_t	0.202***	0.100**	-0.018	0.470***
	(0.048)	(0.045)	(0.229)	(0.106)
ΔNA_t	0.172***	0.112***	0.090	0.007
	(0.031)	(0.026)	(0.059)	(0.041)
ΔRD_t	0.854	-0.657	2.749*	-2.567*
	(0.700)	(1.469)	(1.626)	(1.416)
ΔI_t	-1.152	-1.536*	-1.199	-3.465***
	(0.805)	(0.847)	(1.966)	(0.946)
ΔD_t	-0.318	0.834	-0.466	0.805*
	(0.819)	(0.744)	(0.698)	(0.476)
C_{t-1}	0.126*	0.104*	-0.071	-0.009
	(0.067)	(0.057)	(0.077)	(0.056)
L_t	-0.471***	-0.414***	-0.520***	-0.313***
	(0.062)	(0.063)	(0.089)	(0.055)
NF_t	-0.190***	-0.094	0.157	0.064
	(0.072)	(0.067)	(0.156)	(0.086)
$L_t * \Delta C_t$	-1.215***	-0.306	-0.021	0.058
	(0.322)	(0.261)	(0.620)	(0.483)
Intercept	0.009	0.021	0.107***	0.075***
	(0.024)	(0.031)	(0.026)	(0.019)
Observations	1,392	965	649	982
Adj R^2	0.13	0.11	0.08	0.10

* Corresponds to significant at 10%; ** significant at 5%; and *** significant at 1%.

are examined separately as in Sections 6.2. and 6.3. in this thesis, and in earlier literature (e.g. Faulkender and Wang (2006) and Pinkowitz and Williamson (2004)). Although Faulkender and Wang (2006) hypothesize that the value shareholders place on cash is higher in financially constrained firms is because higher internal cash holdings increase the likelihood of taking

positive NPV projects that would otherwise be foregone. However, they only find that the value of cash is higher in constrained firms than in unconstrained firms and do not test what is the effect of investment opportunities.

6.5. Cash regime results

Next, I examine three subsamples of firms which most resemble the three cash regimes described earlier and which should therefore differ in the value shareholders place on an extra pound of cash in the firm. Firm's need for raising cash is considered to depend on the investment opportunities. I follow Faulkender and Wang (2006) and use industry ME/BE because it signals the investment opportunities not affected by firm's financial characteristics. Interest coverage is used to determine whether the firm has excess cash to distribute to shareholders or, contrarily, difficulties in servicing debt. It should be noted that interest coverage does not measure for financial constraints but financial position.

I divide the firms into quartiles based upon their interest coverage and separately industry ME/BE. Interest coverage is defined as the sum of the firm's cash position at the end of the previous fiscal year and its earnings in the fiscal year over the interest expense in the fiscal year. A high (low) interest coverage firm has less (more) of its cash and cash obligated to debt and therefore has relatively more (less) funds available for investment or distribution.

The first group consists of firms with the highest interest coverage and lowest industry ME/BE. These firms resemble the most firms in the first cash regime, distributing cash. These firms have ample cash holdings and cash flows to serve debt, but do not have many investment opportunities. Therefore these firms are more likely to distribute cash back to shareholders who incur a dividend tax. In addition, these cash cow firms are more likely to suffer from agency costs described by Jensen (1986). Hence, shareholders in the first subgroup of firms should place a lower value on additional cash.

The second group of firms are in the bottom interest coverage and industry ME/BE quartiles. These firms do not have good investment opportunities, and moreover, most of their cash is obligated to serve debt. Hence, these firms relate to the second cash regime, servicing debt or

other liabilities. Since there firms seem unable to invest cash profitable, and most of the value of the firm is in hands of the debt holders, the marginal value of cash is expected to be low.

Third group is formed of firms with the lowest interest coverage but the highest industry ME/BE. These firms are likely to have good investment opportunities but not necessarily sufficient funding due to low amount of cash available after debt servicing. Therefore, they are likely to have to enter the external capital markets in order to take advantage of the investment opportunities. Consequently, internal cash should be higher valued by the shareholders in these firms because it reduces the amount of costly external financing the firm would need to raise, and increases the probability that the investments are made.

The regression results for the interest coverage and ME/BE subsamples, as seen in Table 9, support the theory on, and the existence of, cash regimes.[8] These results show that the value of cash is highest, and equal to £0.526, in the third subgroup which consists of firms with low coverage and high industry ME/BE ratio. Since these firms are most likely to be in need of raising cash from the external capital markets, an extra pound of cash holdings reduces the amount of costly external capital needed, and is therefore given a higher value by the shareholders than in other groups. Firms with high interest coverage and low ME/BE ratios form the first subgroup. These cash cows have a value of £0.381 placed on their cash holdings.[9] The

[8] Note that I no longer use the leverage interaction term in the specification because constructing the samples based on interest coverage means that the variation of leverage ratios within a group is already limited.

[9] The findings for groups I and III relate to my second hypothesis, previously unsupported by the insignificant cash level interaction term, that the marginal value of cash is decreasing with the level of firm's cash holdings. That the firms that seem to have least cash available despite the need for it (for both servicing debt and to make investments) have the highest value placed on cash holdings seem to suggest that the absolute cash level may not be so decisive on determining the value of cash but how much the firm has excess cash. The value of excess cash, typically defined as the cash not needed for operations or investments (see e.g. Dittmar and Mahrt-Smith (2007)), has been examined in a few value of cash studies focusing on the effect of corporate governance (e.g. Dittmar and Mahrt-Smith (2007) and Frésard and Salva (forthcoming). However, as I am not interested in the marginal value of excess cash but cash holdings I do not investigate this further.

Table 9
Results for three different coverage and M/B groups

This table presents the results of regressing the excess stock return $r_{i,t} - R_{i,t}$ on changes in firm characteristics over the fiscal year. All variables except L_t and excess stock return are deflated by the lagged market value of equity (M_{t-1}). C_t is cash plus marketable securities, E_t is earnings before extraordinary items plus interest, and NA_t is total assets minus cash holdings. I also use R&D expenditures (RDt) which is set to zero if missing. I_t is interest expense, total dividends (D_t) is measured as common dividend paid, L_t is market leverage, and NF_t is the total equity issuance minus repurchases plus debt issuance minus debt redemption. ΔX_t is compact notation for the 1-year change, $X_t - X_{t-1}$. The subscript $t-1$ means the value of the variable is at the beginning of fiscal year t or at the end of fiscal year $t-1$. Regression I is on the subset of firms in the top quarter of interest coverage and the bottom quarter of the industry market-to-book ratio. Interest coverage is defined to be (cash+earnings)/interest expense. Regression II is on firms in the bottom quarter of interest coverage and the bottom quarter of the industry market-to-book ratio. Regression III is on firms in the bottom quarter of interest coverage and the top quarter of the industry market-to-book ratio. White heteroscedastic-consistent standard errors, corrected for correlation across observations of a given firm, are in parentheses (White (1980)).

Independent variables	I	II	III
ΔC_t	0.381***	0.171*	0.526***
	(0.115)	(0.090)	(0.152)
ΔE_t	0.218**	0.116**	0.184***
	(0.110)	(0.045)	(0.057)
ΔNA_t	0.032	0.110***	0.107***
	(0.042)	(0.024)	(0.031)
ΔRD_t	3.202	0.643	1.778*
	(2.089)	(1.316)	(1.003)
ΔI_t	-2.268	-0.819	-0.852
	(1.516)	(0.830)	(0.810)
ΔD_t	0.841	0.840	-1.747*
	(0.932)	(0.520)	(0.969)
C_{t-1}	0.023	-0.037	-0.151
	(0.058)	(0.081)	(0.110)
L_t	-0.560***	-0.257***	-0.414***
	(0.125)	(0.062)	(0.079)
NF_t	-0.022	-0.152***	-0.099
	(0.135)	(0.042)	(0.076)
Intercept	0.100***	0.003	0.005
	(0.022)	(0.029)	(0.035)
Observations	928	788	729
Adj R^2	0.07	0.10	0.11

* Corresponds to significant at 10%; ** significant at 5%; and *** significant at 1%.

value of cash in the second group, which consists of firms with low coverage and low ME/BE, have the lowest value placed on the cash holdings. The shareholders in these firms only place a

value of £0.171 for an extra pound of cash supporting that most of the value goes to the debt holders.

Although these findings are not directly linked to my empirical hypotheses, they confirm the existence of cash regimes described in Faulkender and Wang (2006), and clearly demonstrate the cross-sectional variation among firms.

6.6. Change over time results

Now I move from cross-sectional variation in the value of cash to the variation in both the value of cash and cash levels over time. I hypothesize that the value of cash increases as the cost of accessing external capital markets increases while simultaneously the amount of cash held by a firm should go down. I first divide the full sample into 12 annual samples representing each year from 1997 to 2008. The year of fiscal year-end determines to which annual sample an observation belongs to. Next, I show summary statistics for each year separately in order find trends in the change of variables within the sample period, and moreover to test sixth hypothesis, whether the cash levels decrease when the cost of accessing external capital markets increases. Then, I run the baseline regression on each year separately to examine if the value of cash holdings does vary over time. Finally, I test whether the value of cash is dependent on the cost of accessing external capital markets.

I use Moody's Baa-Aaa spread as a proxy for the cost of accessing external capital markets which is not dependant on the interest rates. Baa-Aaa spread is measured as the difference between Moody's Baa-rated and Aaa-rated (MOODCBAA Index and MOODCAAA, respectively, from Bloomberg) long-term corporate bond yield averages. Gertler and Lown (1999) argue that a market determined measure, such as Baa-Aaa spread, is a plausible measure of the premium for external financing. Not only does it act as a better proxy than credit aggregates (Bernanke and Gertler (1995), but it is likely to be closely correlated with the premium on external funds that purely bank-dependant firms face (Gertler and Lown (1999)). Gertler and Lown (1999) prefer to use the high-yield/AAA spread because it is more sensitive to overall financial conditions than the BAA-AAA spread. Unfortunately, I did not have data for high-yield/AAA spread available, and therefore I use Moody's Baa-Aaa spread which is a simpler, yet slightly weaker proxy.

It should be noted though that the Baa-Aaa spread does not say much of the cost of external capital for the most financially secure companies which hold an Aaa rating. However, the Baa-Aaa spread tends to correlate with the spread of yields on Aaa-rated corporate bond and yields on government bonds. Therefore, despite that increase in Baa-Aaa spread predicts higher cost of external capital for firms below Aaa-rating, it should act as a sufficient proxy for the whole set of firms in the sample.

6.6.1 Descriptive statistics

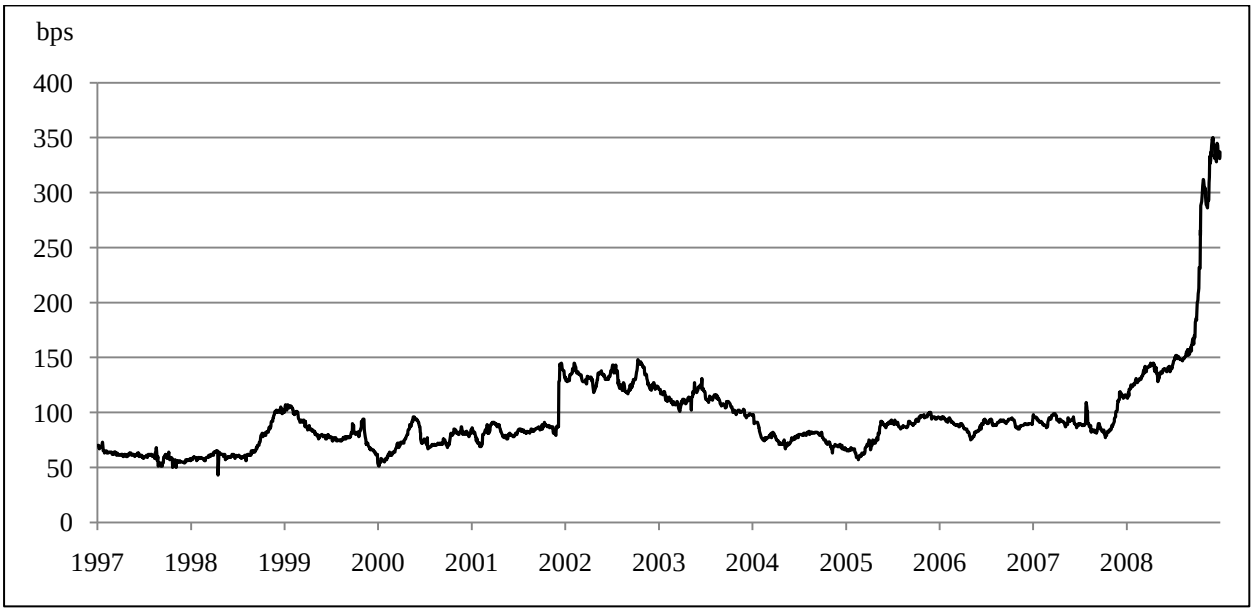
Figure 1 shows the spread between Moody's Baa-rated and Aaa-rated bond yields during the sample period. The average spread during the period equals to 95 basis points (bps). During the sample period, the spread notably exceeds the average for longer periods only in 2002 and 2003 in the aftermath of the IT bubble and then, much more dramatically, during the credit crunch of 2007-2008. Following the collapse of Long Term Capital Management in 1998 the spread had also briefly gone above the sample period average but decreased below 95 bps by March 1999. Using full year averages, measured as the average spread during the calendar year, the only years when the spread was above the sample period average were 2002, 2003 and 2008. Hence, I consider these years as years when external capital was expensive as I examine the statistics and empirical results on year-by-year basis.[10]

Table 10 presents the descriptive statistics year-by-year for the full sample. Recall that all variables except leverage are deflated by the one-year lagged market value of equity. Therefore, the magnitude of change in a variable is not only dependant on the numerator but also changes in

[10] The first signs of the 2007-2008 credit crunch were seen in the summer of 2007. In July, the Baa-Aaa spread went for the first time above the sample period average. However, it took until the end of November until the spread began to widen to its 2008 height. Therefore, the average spread for 2007 remained below the sample period average. Since quarterly data for UK firms is not available, I cannot examine whether the value of firms cash holdings increased already at the end of 2007. Hence, even though 2007-2008 began by definition already during 2007, I must exclude the year from years of costly external capital.

Figure 1
Spread between Baa-rated and Aaa-rated long-term corporate bond yields

This figure depicts the difference between Moody's Baa-rated and Aaa-rated long-term corporate bond yields measured in basis points (bps) from 01/01/1997 to 12/31/2008. The difference, or spread, is measured as yield of Baa-rated long-term corporate bond index minus yield of Aaa-rated long-term corporate bond index.



the market capitalization. However, a negative statistic always means that the variable has declined during the year in a mean firm.

The annual changes in cash seem to support my hypothesis that when the cost of external capital increases, firm's balances, on average, decline. The increased cost of raising capital typically coincides with a larger macroeconomic shock which also reduces profitability and internal cash flows. This double effect should then have an evident impact of decreasing the mean cash holdings. In 2002, 2003 and 2008 the average cash holdings decline by 1.53% to 3.09% of lagged market capitalization. These are the same years which I classified as years of expensive external capital based on average annual spread. Regressing the percentage change in cash on the basis point change in the spread reveals that 10 basis points increase in the Baa-Aaa corporate bond yield spread leads to 0.38% decrease in the average cash holdings deflated by lagged market

Table 10
Year-by-year summary statistics for the 1997–2008 sample

This table provides annual summary statistics for the variables in the sample of firm-years from UK-based publicly traded firms over the period 1997 to 2008. The number corresponds to the mean. $r_{i,t} - R_{i,t}$ is the excess stock return, where $r_{i,t}$ is the annual stock return of firm i at time t (fiscal year-end). $R_{i,t}$ is stock i's benchmark portfolio returns at time t. All variables except L_t and excess stock return are deflated by the lagged market value of equity (M_{t-1}) C_t is cash plus marketable securities, E_t is earnings before extraordinary items plus interest, and NA_t is total assets minus cash holdings. RD_t is R&D expenditure which is set to zero if missing. I_t is interest expense, total dividends (D_t) is measured as common dividend paid, L_t is market leverage, and NF_t is the total equity issuance minus repurchases plus debt issuance minus debt redemption. ΔX_t is compact notation for the 1-year change, $X_t - X_{t-1}$. The subscript $t-1$ means the value of the variable is at the beginning of fiscal year t or at the end of fiscal year $t-1$.

Variable	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
ΔC_t	0.0397	0.0069	0.0154	0.0243	-0.0002	-0.0153	-0.0309	0.0269	0.0060	0.0120	0.0053	-0.0291
C_{t-1}	0.1277	0.1390	0.1775	0.1294	0.1652	0.1951	0.2811	0.1757	0.1799	0.1547	0.1468	0.1767
ΔE_t	0.0416	0.0060	0.0167	0.0116	-0.0036	0.0140	0.0765	0.0682	0.0318	0.0219	0.0147	0.0086
ΔNA_t	0.2333	0.0585	0.1530	0.1512	0.0373	-0.1451	-0.2254	0.0441	0.0992	0.0850	0.0935	-0.1635
ΔRD_t	0.0017	0.0002	0.0022	0.0014	0.0017	0.0000	-0.0045	-0.0006	-0.0007	-0.0003	-0.0006	-0.0029
ΔI_t	0.0026	0.0017	0.0012	0.0021	0.0008	-0.0047	-0.0046	0.0003	0.0014	0.0017	0.0025	-0.0014
ΔD_t	0.0062	0.0013	0.0008	0.0007	-0.0021	-0.0045	-0.0058	0.0002	-0.0001	0.0008	0.0007	-0.0029
L_t	0.1598	0.2093	0.1744	0.1921	0.2177	0.2505	0.1913	0.1797	0.1705	0.1531	0.1890	0.3164
NF_t	0.0473	0.0173	0.0553	0.0538	0.0400	0.0299	0.0514	0.0744	0.0746	0.0812	0.0912	0.0515
Observations	378	408	519	561	579	639	691	732	789	902	1,016	1,029

value of equity. The estimated coefficient is significant at better than 10% level.[11] The results are robust for using the percentage change in spread. This further supports my sixth hypothesis.

In addition to the change in cash, there are a few other findings of interest in the summary statistics. The same years of expensive external capital were also the only years when the mean net assets declined significantly. This confirms the special environment during these years as firms have been, most likely, forced to shrink their balance sheets through selling or writing down assets. Moreover, in addition to 2001, these were the years when the total dividends paid by the mean firm decreased. The weakened financial and liquidity positions among the firms is the probable explanation for the cut in average dividends.

6.6.2 Findings for change over time

So far I have found support for that the value of cash seems to be higher for shareholders in firms which are financially constrained and hence likely to face higher costs of raising external capital. In addition, the cost of external capital, for which Moody's Baa-Aaa spread acts as a proxy, seems to vary significantly over time. Hence, it would be logical that also the value of firms' cash holdings would vary year-by-year depending on the state of the external capital markets.

The regression results for each year separately can be seen in Table 11. They give early support to my empirical prediction that the value of cash should be increase with the cost of raising capital. The coefficient estimate corresponding to the change in cash is significant at or better than 1% level in 9 of the 12 years in the sample. In 2001 the estimate is significant at or better than 5% level, in 2004 the estimate is significant at or better than 10% level, and in 1998 the estimated coefficient is statistically insignificant. Although the sample size is much smaller in the early years of the sample period, it does not however explain the low significance in 2004.

Estimated coefficients for the leverage interaction term are less consistent. Surprisingly, the estimates for 1998 and 2004 are positive implying that more leverage could increase the value of

[11] The results are not reported in a table. Adjusted R Square for the regression is 0.25.

Table 11
Year-by-year summary regression results

This table presents the results of regressing the excess stock return $r_{i,t} - R_{i,t}$ on changes in firm characteristics over the fiscal year for each calendar year separately. All variables except L_t and excess stock return are deflated by the lagged market value of equity (M_{t-1}). C_t is cash plus marketable securities, E_t is earnings before extraordinary items plus interest, and NA_t is total assets minus cash holdings. I use R&D expenditures (RDt) which is set to zero if missing. I_t is interest expense, total dividends (D_t) is measured as common dividend paid, L_t is market leverage, and NF_t is the total equity issuance minus repurchases plus debt issuance minus debt redemption. ΔX_t is compact notation for the 1-year change, $X_t - X_{t-1}$. The subscript $t-1$ means the value of the variable is at the beginning of fiscal year t or at the end of fiscal year $t-1$. White heteroscedastic-consistent standard errors, corrected for correlation across observations of a given firm, are in parentheses (White (1980)).

Independent variables	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
ΔC_t	0.773***	0.376	0.862***	0.926***	0.426**	0.801***	0.600***	0.425*	0.461***	0.717***	0.839***	0.999***
	(0.297)	(0.415)	(0.262)	(0.309)	(0.189)	(0.274)	(0.198)	(0.223)	(0.175)	(0.148)	(0.183)	(0.322)
ΔE_t	0.189	0.506***	0.200*	0.319**	0.310***	0.040	0.142*	0.164**	0.158*	0.114*	0.216***	0.130**
	(0.167)	(0.144)	(0.106)	(0.141)	(0.109)	(0.052)	(0.074)	(0.082)	(0.092)	(0.069)	(0.068)	(0.055)
ΔNA_t	0.143**	0.144**	0.082*	0.034	0.182***	0.239***	0.116***	0.246***	0.155***	0.285***	0.176***	0.135***
	(0.066)	(0.072)	(0.046)	(0.058)	(0.047)	(0.055)	(0.036)	(0.051)	(0.041)	(0.039)	(0.039)	(0.041)
ΔRD_t	1.658	8.195	3.658*	3.799	-0.485	2.489**	-0.178	-0.225	1.549	1.081	1.277	-1.438
	(2.428)	(6.236)	(2.012)	(3.624)	(2.010)	(1.068)	(1.110)	(1.258)	(1.072)	(1.095)	(1.080)	(1.100)
ΔI_t	0.312	2.588*	-1.873*	-0.085	0.454	-3.633**	-1.363	-5.811***	-0.514	-2.474*	-0.692	-0.675
	(2.177)	(1.450)	(1.055)	(1.639)	(1.422)	(1.425)	(1.451)	(1.861)	(1.307)	(1.427)	(1.007)	(0.956)
ΔD_t	3.162**	-1.938	0.814	0.619	0.285	2.512***	1.184	-0.838	0.706	1.551**	2.482***	2.297***
	(1.373)	(1.191)	(0.718)	(1.010)	(0.942)	(0.890)	(0.996)	(1.020)	(0.717)	(0.724)	(0.694)	(0.772)
C_{t-1}	-0.155	0.051	-0.073	-0.029	0.082	0.058	0.104	0.187**	-0.064	0.022	0.131	0.322***
	(0.102)	(0.093)	(0.073)	(0.098)	(0.060)	(0.102)	(0.078)	(0.084)	(0.074)	(0.075)	(0.091)	(0.110)
L_t	-0.696***	-0.610***	-0.633***	-0.994***	-0.419***	-0.253***	-0.493***	-0.295***	-0.438***	-0.297***	-0.398***	-0.526***
	(0.126)	(0.102)	(0.099)	(0.116)	(0.092)	(0.084)	(0.105)	(0.098)	(0.095)	(0.091)	(0.073)	(0.057)
NF_t	-0.171	-0.485***	0.081	0.217	-0.287***	-0.437***	-0.007	-0.215**	-0.168*	-0.268***	-0.134	-0.186**
	(0.109)	(0.148)	(0.119)	(0.136)	(0.081)	(0.098)	(0.112)	(0.092)	(0.100)	(0.067)	(0.092)	(0.087)
$L_t * \Delta C_t$	-1.588*	0.150	-1.603**	-1.704**	-0.617	-0.564	-0.594	0.198	-0.554	-0.803**	-1.378***	-0.717
	(0.886)	(0.759)	(0.709)	(0.842)	(0.395)	(0.421)	(0.389)	(0.464)	(0.404)	(0.325)	(0.431)	(0.442)
Intercept	0.064*	0.095***	0.100***	0.213***	0.058*	0.100***	0.110***	0.040	0.061**	-0.023	0.091***	0.146***
	(0.035)	(0.033)	(0.034)	(0.044)	(0.032)	(0.033)	(0.034)	(0.031)	(0.028)	(0.021)	(0.024)	(0.027)
Observations	378	408	519	561	579	639	691	732	789	902	1,016	1,029
Adj R^2	0.18	0.18	0.16	0.15	0.10	0.16	0.12	0.12	0.10	0.13	0.11	0.18

* Corresponds to significant at 10%; ** significant at 5%; and *** significant at 1%.

Table 12
Marginal value of cash in a mean firm for each year

This table presents the estimated marginal value of cash for year separately. The estimate for the marginal value of cash is a function of the estimated coefficient on the change in cash as seen in Table 11 and the interaction with leverage. The coefficient for leverage interaction term for each year is presented in Table 11 and the mean leverage ratio can be seen in Table 10.

	1997	1998	1999	2000	2001	2002
Marginal value of cash	0.519	0.407	0.582	0.599	0.292	0.660
	2003	2004	2005	2006	2007	2008
Marginal value of cash	0.486	0.461	0.367	0.594	0.579	0.772

cash held by the mean firm. There is some reason to believe why this could be the case. Debt is thought to discipline managers as they must have sufficient liquidity to serve the interest and principal payments, and hence they cannot invest excessively in value-destroying ventures. However, higher levels of debt increase the probability of financial distress and consequently transfer more of the value of additional cash from the shareholders to debt holders. Therefore, it is not certain whether the leverage interaction term should be positive under any conditions. However, whether leverage significantly reduces managerial discretion and hence increases the value of cash is beyond the scope of this thesis.

The year-by-year marginal values of cash in a mean firm are seen in Table 12. This value incorporates the value implied by the coefficient estimate for the change of cash and the value impact of the interaction of leverage in a mean firm with the change in cash. The marginal value of cash in an average firm is the highest in 2008 and 2002, both classified as years of expensive external capital. Figure 2 shows the development of the marginal value of cash and the Baa-Aaa spread from 1997 to 2008. The two lines seem to follow each other relatively closely. Figure 3

Figure 2
The marginal value of cash and Baa-Aaa corporate bond spread

This figure depicts the marginal value of cash in the mean firm and the average annual difference between Moody's Baa-rated and Aaa-rated long-term corporate bond yields from 1997 to 2008. The estimate for the marginal value of cash is a function of the estimated coefficient on the change in cash and the interaction with leverage. The difference between yields, or spread, is measured as yield of Baa-rated long-term corporate bond index minus yield of Aaa-rated long-term corporate bond index.

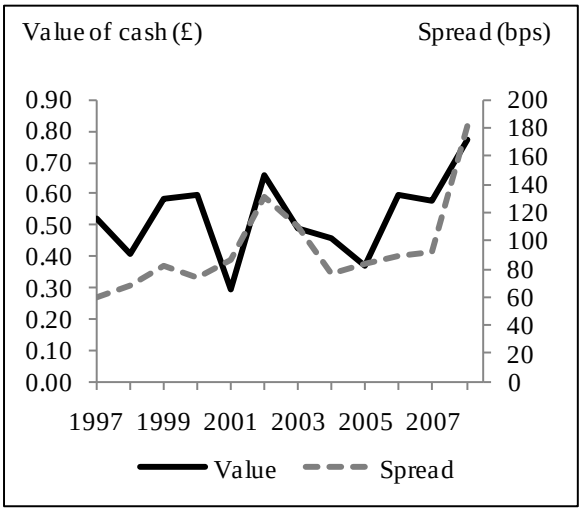
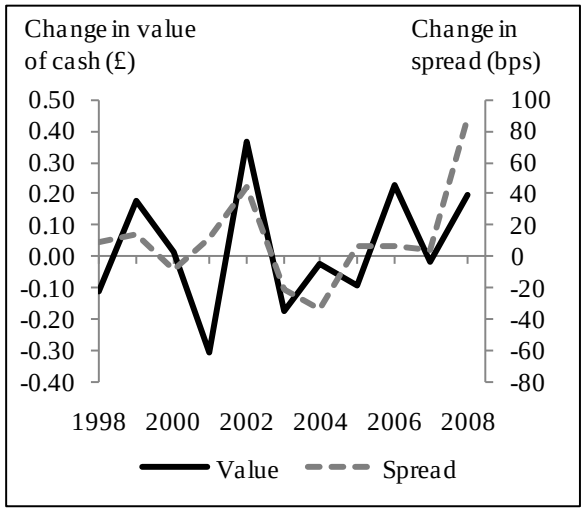


Figure 3
Changes in marginal value of cash and Baa-Aaa corporate bond spread

This figure depicts the changes in marginal value of cash in the mean firm and the average annual difference between Moody's Baa-rated and Aaa-rated long-term corporate bond yields from 1998 to 2008. The change in the marginal value of cash is measured as the marginal value of cash in year *t* minus the marginal value of cash in year *t*-1 in the mean firm for each year. The change in the difference between yields, or spread, is measured as the average spread in year *t* minus the average spread in year *t*-1.



then depicts the changes in the marginal value of cash and in the Baa-Aaa spread from 1998 to 2008.[12] Again, the lines are mostly overlapping.

[12] The changes are calculated only from 1998 onwards because I need the value of cash for the previous year to measure the change.

Table 13
Results for the relation between marginal value of cash and Baa-Aaa spread

This table presents the results for determining the relation between the marginal value of cash and Baa-Aaa spread. The estimate for the marginal value of cash is a function of the estimated coefficient on the change in cash and the interaction with leverage. The difference between yields, or spread, is measured as yield of Baa-rated long-term corporate bond index minus yield of Aaa-rated long-term corporate bond index. First column provides the results for regressing the marginal value of cash on the Baa-Aaa spread. The second column presents the results for regressing the absolute change in the marginal value of cash on the absolute change in the Baa-Aaa spread. The change in the marginal value of cash is measured as the marginal value of cash in year *t* minus the marginal value of cash in year *t-1* in the mean firm for each year. The change in the difference between yields, or spread, is measured as the average spread in year *t* minus the average spread in year *t-1*. The third column presents the results for regressing the percentage change in the marginal calue of cash on the percentual change in the Baa-Aaa spread. The percentual changes are measured as absolute change of a variable in year *t* over the absolute value of a variable in year *t-1*.

Independent variable	I	II	III
Baa-Aaa spread	0.003**		
	(0.001)		
Change (bps) in Baa-Aaa spread		0.003	
		(0.002)	
Change (%) in Baa-Aaa spread			0.674***
			(0.200)
Intercept	0.281**	-0.012	0.016
	(0.097)	(0.057)	(0.072)
Observations	12	11	11
Adj R^2	0.36	0.19	0.51

* Corresponds to significant at 10%; ** significant at 5%; and *** significant at 1%.

The economic and statistical significance of the relation is verified through three ordinary least squares regressions.[13] The results for the regressions can be seen in Table 13. First, I regress the absolute value of cash on the Baa-Aaa spread. The estimated coefficient corresponding to the Baa-Aaa spread equals to 0.003 while the estimated coefficient for intercept is 0.281. Both estimates are significant at or better than 5% level. This implies that during the sample period from 1997 to 2008 when the average spread is 95 basis points the marginal value of cash equals

[13] Although there are many other potential factors which may explain the variation in marginal value of cash over time, my purpose is to verify the link between the cost of external capital and the value of firms' cash holdings. Hence, I do not explore other factors further but concentrate on my main hypothesis.

to £0.526 (= £0.281 + £0.003*95). This is close to the mean value of £0.50 in the sample, the difference arising from the unequal number of observations across the sample years.

Second column in Table 13 shows the results of regressing the absolute change in the marginal value of cash on the absolute change in the spread. The coefficient estimate for the change in the spread is 0.003 and consistent with the results in the first column. This implies that, for example, 20 basis points change in the spread leads to a change of £0.06 in the marginal value of cash. However, it should be noted that the results for second specification are not statistically significant at or better than 10% level.

Yet, when I examine the percentage change in the value of cash and the spread the results as presented in the third column in Table 13 are much stronger. The estimated coefficient for the percentage change in the spread equals to 0.674, and is significant at or better than 1% level. Hence, the coefficient implies that 10% change in the Baa-Aaa spread leads to a 6.74% change in the marginal value of cash.

All told, the findings support my seventh hypothesis that the value of cash is higher when external capital is more costly. During the years of high cost for external capital, the value the shareholders' place on cash is higher than during the years of "normal" cost. Moreover, when the cost of capital increases, the value of cash increases accordingly.

Recalling that the proxy for the time-varying cost of external capital is the spread between Baa-rated and Aaa-rated corporate bond yields it should be so that the annual change in the value of cash for the whole sample is driven by financially constrained firms. The spread implies that the cost of raising external capital has, by definition, increased more for firms below the prime grade, i.e. Aaa-rating. Bond ratings are also considered as a proxy for whether a firm is financially constrained or not, hence the value of cash should be more dependent on the spread in financially constrained firms than in financially unconstrained firms.

To test whether this holds, I again divide my sample into financially constrained firms and financially unconstrained firms as described in Section 7.2., only this time for each year separately. Then I conduct the baseline regressions for each subsample and each year in order to

Table 14
Results for the relation of value of cash and spread for constraints subsamples

This table presents the results for the relation between the marginal value of cash and Baa-Aaa spread in financial constraints subsamples. I use letter (C) for constrained firms and (U) for unconstrained firms. The estimate for the marginal value of cash is a function of the estimated coefficient on the change in cash and the interaction with leverage. The difference between yields, or spread, is measured as yield of Baa-rated long-term corporate bond index minus yield of Aaa-rated long-term corporate bond index. First panel provides the results for regressing the marginal value of cash on the Baa-Aaa spread. The second panel presents the results for regressing the absolute change in the marginal value of cash on the absolute change in the Baa-Aaa spread. The change in the marginal value of cash is measured as the marginal value of cash in year t minus the marginal value of cash in year *t* -1 in the mean firm for each year. The change in the difference between yields, or spread, is measured as the average spread in year t minus the average spread in year *t* -1. The third panel presents the results for regressing the percentual change in the marginal calue of cash on the percentual change in the Baa-Aaa spread. The percentage changes are measured as absolute change of a variable in year t over the absolute value of a variable in year *t* -1.

	Payout ratio		Firm size	
Independent variable	(C)	(U)	(C)	(U)
(1)				
Baa-Aaa spread	0.003	0.001	0.006**	0.001
	(0.004)	(0.003)	(0.002)	(0.004)
Intercept	0.495	0.271	0.029	0.471
	(0.400)	(0.336)	(0.219)	(0.385)
Observations	12	12	12	12
Adj R^2	-0.03	-0.09	0.40	-0.10
(2)				
Change (bps) in Baa-Aaa spread	0.003	-0.006	0.007***	0.005
	(0.007)	(0.005)	(0.001)	(0.006)
Intercept	-0.042	0.118	-0.011	-0.026
	(0.233)	(0.174)	(0.049)	(0.200)
Observations	11	11	11	11
Adj R^2	-0.09	0.02	0.70	-0.04
(3)				
Change (%) in Baa-Aaa spread	0.068	-1.244	0.849*	5.391***
	(1.180)	(3.540)	(0.436)	(2.166)
Intercept	-0.437	0.020	0.090	0.034
	(0.423)	(1.270)	(0.156)	(0.777)
Observations	11	11	11	11
Adj R^2	-0.11	-0.10	0.22	0.34

* Corresponds to significant at 10%; ** significant at 5%; and *** significant at 1%.

determine the marginal value of cash for each subsample. Finally, I again regress these values on the Baa-Aaa corporate bond spread. The results are presented in Table 14. In five out of six regressions the estimated coefficient for the relation of the marginal value of cash and the spread is larger for constrained firms. The first regression uses the absolute marginal value of cash and Baa-Aaa spread. The estimated coefficient for the spread is larger for constrained firms, and statistically significant at or better than 5% level when firm size is used as a proxy for financial constraints. The second specification regresses the absolute change in the marginal value of cash on the basis point change in the spread. Again, the estimated coefficient for the change in spread is higher for the constrained firms, and using firm size as a proxy for financial constraints, significant at or better than 1% level. Using the percentage changes in both dependent and independent variables in the third regression, the results are mixed. For the samples partitioned on the payout ratio, the coefficient estimate for the change in spread is higher for constrained firms. However, using size as a proxy for financial constraints suggests that the relation would be much stronger for unconstrained firms than constrained firms. A possible explanation would be that when the spread is low and unconstrained firms have virtually perfect access to the external capital markets, the value of their cash holdings is very low. When the spread increases implying a higher cost of capital for the constrained firms but typically, to some extent, also for financially unconstrained firms, the impact on the value of cash is relatively much stronger for unconstrained than for constrained firms. However, due to the small sample, and despite statistically significant coefficients, I remain wary on making hasty conclusions based on one dissenting variable. Taken as a whole, the empirical evidence seems to support the notion that the variation of the value of cash over time is mainly driven by variation in the financially constrained firms.

7. Conclusion

The purpose of this thesis is to determine how firm's financial policy, investment opportunities, and the state of external capital markets affect the marginal value of firm's cash holdings. I find that the marginal value of an extra pound in cash in the average publicly listed UK firm equals to £0.50 during the sample period from 1997 to 2008, much lower than for an average U.S. firm (Faulkender and Wang (2006)). Firm's cash level seems to have slightly negative effect on the value of cash, but the impact is statistically significant. However, the value of cash does decrease

with leverage, and is valued the highest in firms whose access to external capital markets is constrained, consistent with findings of Faulkender and Wang (2006). The value of an extra pound is £0.27 to £0.32 higher in financially constrained firms than in financially unconstrained firms. Furthermore, the value of cash is £0.37 to £0.45 higher in firms with good investment opportunities than in firms with worse investment opportunities. Combining the financial constraint and investment opportunity criteria shows that the value of cash is highest, at £0.75, in financially constrained firms with good investment opportunities. Moreover, the value of cash in firms which are either only constrained or have good investment opportunities is not statistically different from financially unconstrained firms with worse investment opportunities. The value of cash in the three subgroups varies from £0.30 to £0.35. Finally, I confirm that the value of cash varies over time, and is dependent on the state of the external capital markets. Using Baa-Aaa corporate bond yield spread as a proxy, I show that during my sample period from 1997 to 2008 the value of cash was the highest in 2002 and 2008, when also the spread was at its highest levels. The results suggest that for 10 basis points increase in the spread, the value of cash increases by 3 cents. Table 15 reviews the hypotheses and the findings in my study. The last column shows whether the hypothesis has been studied and accepted earlier in the literature focusing on the U.S. firms.

My thesis contributes to the existing literature on the value of firm's cash holdings in two important ways. First, I establish a link between firm's financing constraints and investment opportunity set to examine how these two factors together impact the value of cash holdings in a firm. Faulkender and Wang (2006) hypothesized that the value of cash in financially constrained firms is even higher than in unconstrained firms, if the firm has positive NPV investment opportunities. However, they do not test whether this is the case. Pinkowitz and Williamson (2004) document that firms with good investment opportunities have a higher value placed on their cash holdings. I show that neither one of the factors alone leads to a higher valuation of cash by the shareholders, but the combined effect of being financially constrained while having good investment opportunities causes the higher valuation in separate subgroups. Logically, this implies that a firm with financial constraints but no good investment opportunities is not likely to need extra cash in any case, and hence it should not have a higher value placed on its cash

Table 15
Review of hypotheses and findings

	Hypotheses	Accepted?	Earlier studies
1	The marginal value of cash is decreasing in the level of the firm's cash position.	No	Faulkender and Wang (2006)
2	An extra pound of cash holdings is less valuable for shareholders in highly levered firms than in firms with low leverage.	Yes	Faulkender and Wang (2006)
3	An extra pound of cash holdings is more valuable for shareholders in financially constrained firms.	Yes	Faulkender and Wang (2006)
4	An extra pound of cash holdings is more valuable for firms with good investment opportunities.	Yes	Pinkowitz and Williamson (2004)
5	The marginal value of cash is the most for financially constrained firms with good investment opportunities.	Yes	None
6	When the cost of external capital increase, firms' cash holdings, on average, decrease.	Yes	Suggested by Opler et al. (1999)
7	An extra pound of cash holdings is more valuable when the cost of external capital is higher.	Yes	None

holdings than a financially unconstrained firm with similar investment opportunity set. On the other hand, a financially unconstrained firm with good investment opportunities should be able to raise external funding when it needs, hence the value of cash holdings should not be at premium to an unconstrained firm with no investment opportunities.

Second, I show that the value of cash does is not static but varies over time. To my knowledge, this is the first study connecting the value of cash with the changes in the state of the external capital market. Earlier studies have discussed how the cost of raising capital affects the value placed on cash, for example in the context of financing constraints. However, these studies have focused on the cross-sectional variation in the cost of raising capital among firms instead of the impact of economy-wide change in the external capital markets. My results suggest that in

addition to firm-specific variables the current state of the capital markets plays a significant role in determining the value placed on cash. The value the shareholders place on firms' cash holdings is the highest when the cost of raising external capital is at its height. During the latest credit crunch in 2008, which was also the inspiration for this thesis, the value of cash is higher than in any other year during the sample period.

This thesis lays the foundation for a new field of value of cash literature related to the time-varying nature of firms' cash holdings. After finding the link between the value of cash and the state of external capital markets, it would be worth to dig deeper. An interesting topic would be does the type of the financial system make any difference. For example, is there a difference how the value of cash changes depending on whether the financial system, and hence the capital market, is market-based, as in the U.S. and the UK, or bank-based. Although financial institutions are a major investor also in the market-based system there may be some differences during e.g. a credit crunch. Also, it would be worthwhile to examine further what is the dominant reason for the value of cash varying over time. I assume it is generally explained by the change in the cost of external capital, but to some extent it could also be explained by the increased risk of overinvestment and other agency costs due to cheaper funding during boom years. However, at this point I leave these issues for further research.

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Appendix A: Summary statistics for four different financial constraint and ME/BE groups

Table A.1
Summary statistics for four different financial constraint and ME/BE groups

This table presents summary statistics for key variables across subgroups based on financial constraints and market-to-book equity ratio from 1997 to 2008. The first number corresponds to the mean and the medians are in brackets. High (low) refers to firms with high (low) market-to-book ratio. All variables except L_t and excess stock return are deflated by the lagged market value of equity (M_{t-1}). C_t is cash plus marketable securities, E_t is earnings before extraordinary items plus interest, and NA_t is total assets minus cash holdings. RD_t is R&D expenditure which is set to zero if missing. I_t is interest expense, total dividends (D_t) are measured as common dividend paid, L_t is market leverage, and NF_t is the total equity issuance minus repurchases plus debt issuance minus debt redemption. ΔX_t is compact notation for the 1-year change, $X_t - X_{t-1}$. The subscript $t-1$ means the value of the variable is at the beginning of fiscal year t or at the end of fiscal year $t-1$.

Financial criteria	I	II	III	IV
ΔC_t	0.0036	-0.0035	-0.0068	-0.0111
	-[0.0010]	-[0.0030]	-[0.0010]	[0.0000]
C_{t-1}	0.1874	0.2560	0.1396	0.1600
	[0.1035]	[0.1320]	[0.0780]	[0.0880]
ΔE_t	0.0281	0.0200	0.0089	0.0052
	[0.0040]	-[0.0050]	[0.0060]	-[0.0010]
ΔNA_t	0.0150	-0.2470	0.0612	0.0418
	[0.0110]	-[0.1440]	[0.0290]	[0.0030]
ΔRD_t	0.0000	-0.0020	0.0000	0.0000
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
ΔI_t	0.0006	-0.0026	0.0005	-0.0001
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
ΔD_t	-0.0026	-0.0084	0.0026	0.0013
	[0.0000]	[0.0000]	[0.0020]	[0.0010]
L_t	0.1668	0.3046	0.1619	0.2458
	[0.0665]	[0.2700]	[0.1250]	[0.2230]
NF_t	0.1146	0.0834	0.0037	0.0099
	[0.0125]	[0.0000]	-[0.0020]	-[0.0020]
Observations	1,392	965	649	982