



Master Thesis Finance

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Cash is King

Cash holdings of European firms between 1988 and 2010

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Abstract

This thesis examines the determinants of cash holdings of European firms in the period 1988-2010. The average cash ratio increased by fifty percent during the sample period. After 2006 the cash ratio decreased due to the financial crisis. The increase of cash holdings can be allocated to smaller firms, firms with negative income, dividend paying firms and firms with high idiosyncratic risk. Academic research found four motives for holding cash. The changes in net working capital and cash flow risk confirm the transaction motive. The R&D expenses, capital expenditures, acquisitions and again the net working capital and cash flow volatility confirm the precautionary motive. Little evidence is found for the agency motive, while the tax motive is not examined. Firm characteristics play an important role in the change of cash holdings. Market-to-book, dividend dummy and real size are the most important.

Table of contents

1. Introduction	3
2. Why firms hold a lot of cash	5
2.1 Transaction motive	6
2.2 Precautionary motive	9
2.3 Agency motive	12
2.4 Tax motive	14
3. Methodology	15
3.1 Variables	16
3.2 Summary Statistics	18
4. Results	19
4.1 The impact of debt	19
4.2 The impact of size	22
4.3 Determinants of the precautionary motive	23
4.4 Determinants of cash holdings	28
4.5 Attribution to specific firm characteristics	34
4.6 Value of cash holdings	38
5. Conclusion	41
6. References	43

1. Introduction

At the end of 2011 Bloomberg reported that European companies had almost 700 billion dollars in cash. This is a 16% increase compared to the cash holdings at the end of 2007; the year the housing bubble burst in the United States.¹ De Volkskrant reported that Dutch listed firms have 40 billion Euros in cash and suggested they hold cash to wait for better financial and political times². As the economist David Tomic stated in De Volkskrant: *“Cash is King”*, which means that companies who hold cash can act faster than companies who need to lend money from banks. This statement is interesting since holding cash is costly, but on the other hand lowers the risk. Part of the increase of cash holdings could be due to the financial crisis, as the article of Bloomberg suggests:

“Europe’s largest companies held back on acquisitions and payouts this year as the spreading sovereign debt crisis threatened to undermine earnings and revenue growth.”

The financial crisis started in September 2008 with the collapse of Lehman Brothers. One year earlier the housing bubble burst in the United States. Despite that this crisis started in the United States, the cash holdings of European firms also were immediately affected. The results of this thesis will show that the largest movements began at 2007 and therefore this thesis will examine the years 2007-2010 as crisis years.

Cash holdings are not a popular topic in academic papers. Most studies about cash holdings date back from the last decade. Opler et al. (1999) focused on publicly traded U.S. firms in the period 1971-1994 and expanded the evidence on the determinants of cash holdings. They found evidence supportive to the static tradeoff model. In particular, firms generally have higher cash holdings when they are smaller, have more volatile cash flows, better growth opportunities or lower credit ratings. In

¹ Total cash holdings of 691 billion dollar of 466 publicly listed European companies at the end of September 2010. See, R. Weiss and F. de Beaupuy. “European Companies With \$700 Billion Cash Ease Deal Dearth”. *www.bloomberg.com*. November 30, 2010.

² The cash holdings of Dutch listed firms within the AEX or Midkap exceed the 40 billion Euros in July 2012. See, “Bedrijven met stootkussen van ruim 40 miljard”. *www.volkskrant.nl*. July 19, 2012.

addition, these firms perform better. However, they did not find evidence supportive to the agency motive. In addition to the findings of Opler et al. (1999), Bates et al. (2009) investigated whether agency costs play a significant role in the increase of cash holdings. They did not find supporting evidence. While Jensen (1986) found that firms have higher cash holdings when there are more severe agency conflicts. Besides the agency motive, Bates et al. (2009) also examined the precautionary motive, the transaction motive and the tax motive. They used these motives to study how the cash holdings of U.S. firms evolved in the period 1980-2006. The results indicate that the average cash-to-asset ratio more than doubled during their sample period with an average yearly increase of a half percent. Most of this increase is based on firm characteristics which are consistent with the transaction and the precautionary motive. Foley et al. (2007) found evidence for the tax motive and showed that US multinational companies tend to hold more cash when they face higher tax charges associated with the repatriation of foreign earnings. This and most of the previous research were focused on U.S. firms.

This paper tests the cash holdings of European firms in the period 1988-2010 by following the methods of Bates et al. (2009) and compares the results to their findings about U.S. firms. The data is collected from the WRDS Compustat Global database. First, I describe the motives of cash holdings and their accompanying firm characteristics. Next, I examine the determinants of cash holdings and how their relations change over time. Special attention will be given to the crisis years. The dataset of Bates et al. (2009) ended before the crisis of 2007 and for that reason those years cannot be compared. Moreover, there are other differences to take into account. European companies could differ from U.S. companies due to regulation, taxation and risk aversion. According to Aernoudt (1999) the European culture is more risk averse than the United States culture and this leads to a more underdeveloped market. In addition, Nykvist showed that the access to capital markets is worse for European firms, implicating that European firms have more liquidity constraints than U.S. firms.

The results show that the average cash ratio of European firms increases by almost fifty percent over the sample period. The cash ratio increased every year until the crisis period. The cash holdings were mainly driven by the firm characteristics. Cash holdings show a positive relation with technology firms, cash flow volatility and R&D. Cash holdings decrease when firms have high leverage, acquisitions, capital expenditures and net working capital. And results show that the amount of excess cash increases when firms are smaller. These changes are mainly based on the precautionary and transaction motive. The tax motive is not investigated due to a lack of data. Slight evidence of the agency motive could be pointed out to the result that non-dividend paying firms have higher cash holdings. The regressions on the financial crisis show that the cash ratio decreases after 2006. This decrease may explain the large difference with the findings of Bates et al. (2009), who did not take the crisis years into account.

The remainder of this paper is organized as follows. Chapter 2 provides the theory about the four motives of excess cash holdings. Furthermore, I determine the firm characteristics that influence the cash holdings. Chapter 3 describes all the important variables. In Chapter 4 I show the empirical results and explain the reasons why European firms hold excess cash. In Chapter 5 conclusions and recommendations for future research are presented.

2. Why firms hold a lot of cash

Keynes (1936) argued that the liquidity preference of firms or people depends on three different kinds of motives: the transaction motive, the precautionary motive, and the speculation motive. Only the first two motives are still relevant, as companies today have different ways of speculating (e.g. options). Instead of the speculation motive, academic research added two other motives to clarify why firms have excessive cash holdings. Next to the transaction and the precautionary motive, academic research added the agency motive and the tax motive. At first there is the transaction motive, which stands for the transaction costs of converting non-cash assets into cash assets (Keynes, 1936), e.g. for new investment opportunities. Second, the precautionary motive is a security in cash against future shocks in cash flows

(Keynes, 1936). Third, there is the agency motive, which is caused by a lack of good investment opportunities and the refusal of manager to return it to shareholders (Jensen and Meckling, 1976). Finally, Foley et al. (2007) found prove for the existence of the tax motive in which multinationals hold cash in order to lower the tax from repatriating foreign earnings. All these motives implicate determinants for firms to hold a certain amount of cash and are supported by different academic papers which will be discussed below. After each motive the determinants of cash holdings, which are related to the specific motive, are defined.

2.1 Transaction motive

Keynes (1936) introduced the transaction motive and defined this first motive as the costs related to converting non-cash assets into cash. He made a distinction between the income motive and the business motive. The income motive states that a certain amount of cash is held in order to bridge the interval between the receipt and expenditures of income. The business motive states that firms hold cash balances in order to bridge the interval between the time of incurring costs and the receipt of sales. The extra time to hold on to cash during this interval can be determined as a cost. Coase (1937) defined transaction costs as the costs to buy goods and services on the market instead of financing them internally. He made a distinction between search and information costs, bargaining and decision costs and policing and enforcement costs. According to Coase, transaction costs are necessary to understand the economy properly.

Other classic studies such as Baumol (1952), Tobin (1956) and Miller and Orr (1966) found that the amount of cash a firm holds is dependent on the transaction costs a firm incurs when converting non-cash financial assets into cash, using cash as payment. Baumol (1952) created a model, which was extended by Tobin (1956), in which he tried to determine the optimal value of each cash withdrawal. Both studies found that, next to the cost of liquidating the assets, there also is an interest opportunity

cost. Miller and Orr (1966) extended this money demand model by adding the variability of cash flows and found that the demand for money is an increasing function on the cash flow volatility.

Next to these classic arguments, transaction costs incur more opportunity costs. Companies would expect assets that can be exchanged for cash to have a lower return (Amihud and Mendelson, 1986). When a firm immediately needs cash, they will have extra costs when they need to sell their assets below the market price, e.g. through an auction. This implicates that specific assets are more difficult to sell at the market price when they need to be sold quickly (Shleifer and Vishny, 1992). This expectation means that there is now a cost of holding liquid assets. This is called the liquidity premium by Opler et al. (1999).

Opler et al. (1999) showed that firms have an optimal amount of cash when marginal cost of cash holdings equals the marginal cost of cash shortage. The decrease in marginal cost of shortage in liquid assets is due to the fact that a larger shortage leads to higher costs for a firm. This is because the firm uses the least costly measure to gather funds first, but when this turns out to be insufficient, it will need to apply other more costly measures.

According to Opler et al. (1999), a firm has four options when they need cash: raise external funds, liquidate existing assets, reduce dividends or reduce investments. All these strategies involve costs that have both fixed and variable components. Therefore it is likely that firms, who have higher transaction costs, hold more liquid assets (Ozkan and Ozkan, 2004).

Mulligan (1997) discovered a difference in cash holdings as a percentage of sales. A large firm generally holds less cash compared to small firms and as a direct result benefits from economies of scale. The distinction in cash holdings between large and small firms was first suggested by Vogel and Maddala (1967), who found that larger firms showed lower cash-to-assets and cash-to-sales ratios. Petersen and Rajan (2002) found that the fees of borrowing money are fixed costs when there is not enough cash and therefore not correlated to the amount of the loan they need. This also implicates economies of scale

and is in line with the research of Mulligan (1997) and Lotti and Marcucci (2006). On the other hand the difference in the size of firms became less important as firms became more efficient.

The transaction motive is based on several firm characteristics. The transaction costs are the costs of converting non-cash into cash. Substitutes as net working capital and free cash flow also suffer this loss when they are converted into cash. Large firms face less transaction costs due to economies of scale and listed firms should have more easily access to capital markets. Most of the costs of the transaction motive are based on the risk-free rate. These determinants of the transaction motive are listed below.

Net working capital

Net working capital is calculated as current assets minus current liabilities. Important components are inventories, accounts receivable and payable and cash. The components can be seen as cash substitutes which are easily transformed into cash. Academic research excludes cash from the net working capital when they use it as cash substitute. Dittmar et al. (2003) found that firms with higher net working capital hold less cash, since working capital can easily be converted into cash. Bates et al. (2009) modeled a high negative correlation between net working capital and cash. Koller and Goedhart (2005) found a substitution effect of working capital, where companies with large amounts of working capital hold less cash. Net working capital may also be called a determinant of the precautionary motive since firms may keep working capital to protect themselves against future shocks.

Cash flows

Next to the net working capital, there is some evidence that free cash flows could function as a cash substitute. According to Kim et al. (1998) operating cash flows and even more free cash flows provide a source of liquidity to meet operating expenditures and maturing liabilities. As a result firms with high cash flows are able to keep lower levels of cash and marketable securities. On the contrary, Bates et al. (2009) and Jensen (1986) expected that firms with higher cash flows build up more cash.

Since cash flows can be seen as a cash substitute, it could also been placed between the determinants of the precautionary motive.

Economies of scale

Vogel and Maddala (1967) found that larger firms have lower cash-to-assets ratios. This is due to the fixed costs in, for example, fees of borrowing money (Petersen and Rajan, 2002). Mulligan (1997) supported these findings by concluding that large firms hold less cash relative to small firms and therefore have economies of scale. This is one of the reasons explained by the transaction motive, but the size of firms became less important due to efficiency.

Opportunity costs

In an imperfect capital market holding cash faces costs. Opler et al. (1999) describes this opportunity cost of cash as the lower return on liquid assets due to the occurrence of a liquidity premium. Both Zou (2009) and Bates et al. (2009) pointed out that the risk-free rate corresponds to this opportunity cost. A decrease in the risk-free rate therefore makes it cheaper to hold cash.

Debt rating

Opler et al. (1999) assumed that firms who have already accessed capital markets face lower transaction costs. This implicates that firms with a debt rating are expected to hold less cash.

2.2 Precautionary motive

The precautionary motive, also found by Keynes (1936), implies that firms hold cash to protect themselves against future cash flow shocks. Negative shocks may result in firms who need to forgo a valuable investment opportunity, because the external financing is too costly or not available. Whalen (1966) created a model to estimate the optimal precautionary cash holdings. This model is very similar to the transaction motive model of Baumol (1952) and Tobin (1956) and supported the findings of Keynes (1936).

Almeida et al. (2004) investigated the cash flow sensitivity for large manufacturing firms in the United States in the period 1971-2000. They concluded that for financially constrained firms a positive relation exists between the sensitivity of cash flows and cash holdings (although they did not find a reasonable relation for unconstrained firms). Han and Qiu (2007) showed, in line with the findings of Almeida et al. (2004), that constrained firms increase their cash ratio as a result of an increase in cash flow volatility. Han and Qiu (2007) used a two-period investment model to show that firms will have to make a trade-off between current and future investment. These studies are consistent with the results of Bates et al. (2009), who concluded that cash holdings have increased the most in industries which have experienced larger increases in cash flow risk.

Opler et al. (1999) found that firms hold cash to handle with adverse shocks in case access to capital markets is costly. Firms with better investment opportunities hold more cash as an adverse shock would be more costly for them. They investigated these opportunities by using the market-to-book and R&D expenses.

The costs for accessing the capital markets are a result of information asymmetry. When managers know more about the value of the firm's assets, they can forgo an investment opportunity (Myers and Majluf, 1984). Myers and Majluf explained the choice of managers between internal and external financing as the pecking order theory. This theory states that firms prefer the use of internal funds to finance investment first, followed by debt and new equity issuance at last. Opler et al. (1999) confirmed that information asymmetry is the reason why external funds are costly.

The precautionary motive played an important role in determining the increase of cash flows according to Bates et al. (2009). These determinants are explained below and separated in cash flow volatility, investment opportunities, asset tangibility and financially constrained firms.

Cash flow volatility

While there are some contradictions on the free cash flows, Bates et al. (2009) as well as Kim et al. (1998) proved that a higher volatility of these cash flows are the cause of higher cash holdings.

Negative cash flow shocks are more likely to occur in periods where cash flows are more uncertain.

Therefore firms with more volatile cash flows tend to have higher cash holdings (Opler et al., 1999).

Investment opportunities

Opler et al. (1999) found that, as already mentioned above, firms with better investment opportunities hold more cash as an adverse shock would bring a profitable investment opportunity in danger. They used market-to-book and R&D expenses as proxies and found a positive relationship. Dittmar et al. (2003) confirmed those findings by concluding that the opportunity cost of a lost investment is higher for firms with more investment opportunities and therefore those firms tend to hold more cash. They used capital expenditures as a proxy and also found a positive relationship. On the other hand, Bates et al. (2009) argued that capital expenditures can create assets that can be used as security, which increases the debt capacity and lowers the demand for cash. They also stated that acquisitions can be used as a substitution for capital expenditures. Drobetz and Gruninger (2006) could not detect a significant relationship between cash holdings and growth opportunities.

Asset tangibility

An example of an industry with firms with a lot of tangible assets is the manufacturing industry in which firms possess a lot of machines. Those firms can offer sufficient collateral on loans, which provide better access to capital markets. Firms who hold a lot of intangible assets are, for example, high-tech firms. These firms need higher cash holdings since it is more difficult for them to obtain cash (Martinez-Carrascal, 2010). Drobetz and Gruninger (2006) also found a negative relation between asset tangibility and cash holdings.

Financial constraints

A financially unconstrained firm has unrestricted access to external capital. This firm has no need to protect itself with excess cash because they have unlimited resources to the market. Cash holdings become irrelevant and they do not need to save cash out of cash flows (Almeida et al., 2004). However, Almeida et al. (2004) and Han and Qiu (2007) found only evidence that constrained firms hold more cash

and not that unconstrained firms have a negative relation. Their findings, supported by Bates et al. (2009), consider non-dividend paying firms to be financially constrained. Firms with negative net income are also more likely to be financially constrained. According to the financial distress theory a high market-to-book ratio measures the costs of financial distress. John (1993) argued that firms, subjected to high financial distress costs, hold more cash. He found that firms with many intangible assets and firms with a high market-to-book ratio hold more cash.

2.3 Agency motive

The agency problem is the conflict between managers and shareholders due to the separation of ownership and control. One of these conflicts is caused by the cash holdings of a firm. Jensen (1986) argues that managers may have incentives to hold large amounts of cash to pursue their own objectives, rather than to pay out cash to shareholders. For example, they can waste funds by making inefficient investment decisions (Jensen and Meckling, 1976). Payouts decrease the resources of managers, which diminish their power. Furthermore, managers' compensation is positively related to the sales growth of the firm (Murphy, 1985). As a result, Jensen (1986) found that firms have higher cash holdings when there are more severe agency conflicts.

Jensen (1986) also argued that the agency conflict between managers and shareholders regarding to cash payout policy becomes even worse when the firm generates substantial free cash flows. This free cash flow theory implies that managers have an incentive to build up cash in order to increase the amount of assets under their control and to obtain unrestricted power over the firm's investment decisions. Harford (1999) studied the relation between firms with high cash holdings and corporate acquisitions. He concluded that firms with a lot of cash attempted more acquisitions than other firms. However, the value of the firm decreased because of these transactions. Also mergers in which the bidder is a firm with a lot of cash created a decline in operating performance after the merger. His findings support the free cash flow theory of Jensen (1986).

For firms with a high leverage it is difficult to raise extra cash. These firms prefer risky projects, since shareholders may benefit from the higher return while debt holders keep the same return but with a higher risk (Jensen and Meckling, 1976). This phenomenon is called asset substitution. Managers forgo investment opportunities since the majority of their gains go to the debt holders; this is called the underinvestment or debt overhang problem. These problems are caused by the agency problem and firms will forgo on good investment opportunities.

Dittmar et al. (2003) found that firms in countries with weak shareholders rights have higher cash holdings. Firms hold more cash when access to capital is easier which is in line with the agency theory. Due to weaker shareholder rights, investors cannot force management to pay out the excess cash. Dittmar and Mahrt-Smith (2007) argued that cash holdings of firms with low corporate governance standards are less valuable and destroy value by wasting their excess cash. In well governed firms, which have less severe agency problems, it does not create or destroy reasonable value when they hold excess cash. Kalcheva and Lins (2007) found similar results and showed that when shareholder protection is weak, firm values are lower when managers hold more cash. And when the protection is weak, firm values are higher when managers pay less dividends. Furthermore, they confirmed the research of Dittmar and Mahrt-Smith (2007); in a situation where the external protection is strong there is no relation to the firm value.

The agency costs of cash holdings can be based on a few determinants. Managers refuse to pay out dividends and high leverage may lead to asset substitution. These determinants are listed below.

Dividend payments

Dividend paying firms are able to create cash by lowering their dividends and they are expected to hold less cash. Non-dividend paying firms therefore should have higher cash holdings (Bates et al., 2009 and Opler et al., 1999). This is a result of the precautionary motive, but dividends can also be seen in light of the agency motive. According to the agency motive, Jensen (1986) found that managers prefer to hold cash rather than to payout dividends to their shareholders.

Leverage

The pecking order theory implicates that when a firm has a lack of internal funds it raises their debts and decreases their cash holdings. And, as mentioned in the agency motive, firms with high leverage cannot easily increase their cash holdings which will lead to asset substitution (Jensen and Meckling, 1976). Drobetz and Gruninger (2006) found a non-linear relationship between the leverage ratio and liquidity holdings.

2.4 Tax motive

Foley et al. (2007) concluded that U.S. multinational companies tend to hold more cash when they face higher tax charges associated with the repatriation of foreign earnings. Repatriating refers to returning earnings on a foreign investment of a subsidiary to the country of their parent company. Their results are consistent with previous research done by Grubert (1998) and Grubert and Mutti (2001). They also concluded that the repatriation of cash in multinational U.S. firms is sensitive to tax considerations.

The tax motive also includes the extra tax when a firm pays dividend. Firms already paid their taxes and on top of that shareholders will face dividend tax when firms pay cash to shareholders. This will reinforce the agency motive of dividend paying firms, which says that non-dividend firms should have higher cash holdings.

Foreign income

Foreign income could lead to extra tax costs, due to the repatriation of foreign income (Foley et al., 2007 and Bates et al., 2009). When firms have a higher foreign income, they tend to hold more cash in order to avoid the double taxation when repatriating foreign income.

Table 1 summarizes all the determinants of cash holdings which are mentioned above. The second column shows the accompanying variable, the third whether it is a positive, negative or unknown effect and the fourth which motive is applied.

Table 1

Determinants of cash holdings			
Determinants	Variable	Effect	Motive*
Net working capital	Net working capital	-	T, P
Cash flows	Cash flows	?	T, P
Cash flow volatility	Industry sigma	+	P, T
Opportunity costs	Risk-free rate	-	T
Debt rating	Credit rating	-	T
Investment opportunities	Capital expenditures, acquisitions, R&D and market-to-book	?	P
Dividend payments	Dividend	-	A, P
Economies of scale	Size	-	T
Leverage	Leverage	?	A
Foreign income	Tax burdens	+	X
Asset tangibility	Asset tangibility	-	P
Financial constraints	Dividend, net income	+	P

* = T = transaction motive, P = precautionary motive, A = agency motive, X = tax motive

3. Methodology

To stay close to the dataset of Bates et al. (2009), I used a panel data set of the period 1988-2010. This data set includes most of the information of the WRDS Compustat Global database about the cash holdings of European firms. The advantage of a panel dataset is that it contains a cross-sectional and a time series dimension, which makes it possible to perform an analysis between industries over time. Bates et al. (2009) used the Compustat North America database and their data ranged from 1980 to 2006. However, the Compustat Global database only has useful data from 1988 and beyond. The advantage of extending the sample of Bates et al. (2009) is that it gave me the opportunity to put an extra regression on the crisis years. The data set includes all 25 countries that were part of the European Union in 2006; Romania and Bulgaria joined the Union in 2007 and are not part of my sample³. Following Bates et al. (2009) only firms with positive assets and sales in a particular year are included. Financial

³ The incorporated countries are Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.

firms (SIC-codes 6000-6999) are excluded, since historical research stated that capital requirements could have obliged these firms to maintain cash and they could have statutory capital requirements. Utilities (SIC-codes 4900-4999) are also excluded, since their cash holdings might be under regulation.

Datastream is used to collect the missing variables. These are the share prices and the number of common shares outstanding and the yearly data about Treasury bill yields, inflation and exchange rates. The exchange rates were needed to convert all variables to Euros. For the Treasury bill yield, the average yield for Euro T-bills with a maturity of three months is used. To measure inflation, the Harmonized Index of Consumer Prices is used with 2005 as the index base year. After these adjustments the sample consists of 70,224 observations with 6,950 unique firms.

3.1 Variables

The dependent variable of my model is cash holdings. Bates et al. (2009) identified four different definitions in previous literature. Cash to assets is the most traditional one, Opler et al. (1999) used the cash to net assets (net assets are the book value of assets minus cash), the log of cash to net assets is used to reduce the extreme outliers and the last possible description is cash to sales. I will follow Opler et al. (1999) and use the cash to net assets. The log of cash to net assets will be added to reduce the extreme outliers. The cash to net assets is analyzed by dividing the cash and marketable securities (Compustat data item #1) by the book value of total assets (#6).

The independent variables are determined by taking the determinants of cash. The net working capital (NWC) is defined as the working capital (#179) minus the cash and marketable securities divided by the book value of assets. The cash flows are calculated by dividing the operating income before depreciation (#13) minus the interest and related expenses (#15) minus the income taxes (#16) and minus the common dividends (#21) by the book value of assets. The cash flow volatility is measured by means of the industry sigma, which is the mean of the cash flows over a specified period within an industry (defined by the two-digit SIC-code). Opler et al. (1999) used a horizon of 20 years and Bates et

al. a horizon of 10 years. However, since my data is limited, I use an average of the volatility over the last 5 years. A broader horizon of means is not possible without losing useful data. The opportunity costs are defined using the 3-month European Treasury bill of Thomson Reuters. The debt rating should be based on the credit rating. Bates et al. (2009) called it a credit spread and measured the difference between the triple-A and triple-B rating. Opler et al. (1999) used a dummy which was 1 when the rating was triple-B or higher and 0 when it was lower or did not had a rating. Due to a lack of data about the credit rating of firms, the debt rating cannot be observed. I could instead of firms take the credit rating of countries (of 2010). However, since a lot of multinationals operate in more countries, it will not be a reliable comparison. The investment opportunities are calculated by several variables. R&D is the research and development expenses (#46) to sales (#12). Market-to-book is calculated by the book value of assets minus the book value of equity (#60) plus the share price times the number of common shares outstanding divided by the book value of assets. Another proxy of investment opportunities are capital expenditures (capex/ #128), which are divided by the book value of assets. The investment opportunities will also be measured by the acquisitions (#129), since the acquisitions are according to Bates et al. (2009) a substitute of capital expenditures. These are also divided by the book value of assets. To measure the dividend payout I created a dummy that equals 1 when the firms paid a common dividend and 0 otherwise. The economies of scale are based on the size, which is the natural logarithm of the book value of assets. The leverage is calculated as the long term debt (#9) plus the debt in current liabilities (#34) to the book value of assets. Foreign income is not examined in my survey, since there is no data available about tax burdens of multinational firms. Asset tangibility is also not examined as a result of insufficient data. As opposed to the eliminations, I will add some extra variables compared to the survey of Opler et al. (1999). As Bates et al. (2009) I add a loss dummy, which will be one if a firm has a negative net income and zero otherwise. They showed that firms with a negative net income hold more cash and are more likely to be financially constrained. Whether firms are financially constrained

will also be examined by the dividend dummy. Later, there will be dummies introduced for the years 2000 to 2006 (twothousands dummy) and 2007 to 2010 (crisis dummy). Next to these dummies I included the net equity issuance. This is the sales of common and preferred stock (#108) minus the purchases of these common and preferred stock (#115) divided by the book value of assets. Bates et al. (2009) also included the variables credit spread, initial public offering and net debt issuance but I was not able to examine these because the data set I used had insufficient data about respectively the credit rating, the IPO activity and the debt retirement.

The credit spread is a variable to measure the default risk and implies a positive relation to cash holdings. In line with the financial distress theory, market-to-book will be used as a proxy. The lack of research to initial public offerings will be substituted by the examination of technology firms. Most new firms are high-tech firms and a research to IPO activity will be less important by the change of proportion between manufacturing and high-tech firms. The asset tangibility will be driven by the technology; high-tech firms have more intangible assets than old manufacturing firms. R&D could also be used as a proxy.

3.2 Summary statistics

Table 2 shows the summary statistics of the key variables used in this sample between 1988 and 2010. Outliers of several variables are winsorized to delete the extreme outliers. Leverage is winsorized that it is between zero and one. R&D is winsorized that it is at least zero and at the 1% level at the top tail. Market-to-book is also winsorized at the 1% level at the top tail. Acquisitions, capital expenditures, industry sigma and the net equity issuance are winsorized at the 1% level at the top and bottom tail. Net working capital and the cash flow ratio are winsorized at the 1% level at the bottom tail.

Table 2 shows an average cash ratio of 14.2% with a standard deviation of 16.7%. The zero percentiles of acquisitions and R&D show that a small group of firms set their averages. The log of cash ratio, the Treasury bill, the market-to-book and the size have a standard deviation higher than 1.

Table 2**Summary Statistics**

The sample includes all firm-year observations on Compustat Global in the period 1988-2010 for firms incorporated in the European Union (excluding Romania and Bulgaria). Only observations with positive values for the book value of total assets and sales revenue are included. Financial firms and utilities are excluded from the sample. The sample consists of 70,224 observations for 6,950 unique firms. It includes all surviving and non-surviving firms for the given period. This table shows the descriptive statistics on the key variables. The second column (N) includes the number of non-missing observations.

	N	Mean	25th Percentile	Median	75th Percentile	Standard Deviation
Cash ratio	70224	0.142	0.032	0.082	0.185	0.167
Log of cash ratio	69201	-2.487	-3.370	-2.387	-1.466	1.691
NWC	70224	0.038	-0.071	0.035	0.156	0.201
Cash flow ratio	68079	0.032	0.018	0.059	0.097	0.169
Industry sigma	64197	0.071	0.033	0.048	0.092	0.062
Treasury bill	69956	3.788	2.350	3.500	4.270	2.261
Capex	57886	0.058	0.018	0.039	0.073	0.061
Acquisitions	70224	0.009	0.000	0.000	0.000	0.035
R&D	70224	0.038	0.000	0.000	0.000	0.193
Market-to-book	58659	1.831	1.030	1.323	1.920	1.665
Dividend dummy	70224	0.441	0.000	0.000	1.000	0.497
Size	70224	4.787	3.371	4.654	6.131	2.165
Net leverage	70224	0.084	-0.085	0.096	0.255	0.901
Loss dummy	70224	0.285	0.000	0.000	1.000	0.451
Net equity issuance	56238	0.059	0.000	0.000	0.007	0.173

4. Results*4.1 The impact of debt*

The first results of this empirical analysis are shown in Table 3. I first investigate the change in cash ratio and leverage of European companies in the sample period. The leverage is split up into two different definitions; leverage and the net leverage ratio. The leverage is calculated as long term debt plus debt in current liabilities to the book value of total assets. The net leverage subtracts the cash from the debt before dividing it by the total assets. The different valuations of leverage will be a result of the impact of cash holdings. Ceteris paribus, firms with large cash holdings will enlarge the difference between average leverage and net leverage.

Table 3
Average and Median Cash and Leverage Ratios from 1988 to 2010

The sample includes all firm-year observations on Compustat Global in the period 1988-2010 for firms incorporated in the European Union (excluding Romania and Bulgaria). Only observations with positive values for the book value of total assets and sales revenue are included. Financial firms and utilities are excluded from the sample. The sample consists of 70,224 observations for 6,950 unique firms. This table shows the average and median leverage and net leverage. The second column (N) includes the number of non-missing observations. The sample contains 70,224 observations with 6,950 unique firms. It includes all surviving and non-surviving firms for the given period.

Year	N	Cash ratio			Leverage		Net leverage	
		Aggregate	Mean	Median	Mean	Median	Mean	Median
1988	268	0.094	0.090	0.045	0.187	0.173	0.098	0.118
1989	1344	0.114	0.111	0.076	0.208	0.196	0.097	0.111
1990	1381	0.109	0.108	0.074	0.219	0.204	0.114	0.118
1991	1437	0.106	0.110	0.075	0.223	0.207	0.119	0.115
1992	1457	0.100	0.112	0.077	0.229	0.210	0.125	0.122
1993	1497	0.107	0.118	0.081	0.222	0.200	0.107	0.113
1994	1715	0.113	0.121	0.084	0.210	0.194	0.092	0.104
1995	1928	0.108	0.115	0.076	0.209	0.187	0.096	0.104
1996	3047	0.102	0.123	0.075	0.208	0.187	0.089	0.102
1997	3463	0.101	0.131	0.083	0.204	0.181	0.079	0.092
1998	3790	0.098	0.136	0.078	0.207	0.180	0.079	0.097
1999	4196	0.094	0.149	0.078	0.203	0.173	0.097	0.084
2000	4246	0.092	0.160	0.078	0.199	0.171	0.047	0.082
2001	4251	0.089	0.146	0.073	0.214	0.188	0.073	0.101
2002	4199	0.091	0.142	0.076	0.218	0.191	0.106	0.112
2003	4285	0.104	0.147	0.083	0.220	0.187	0.119	0.097
2004	4480	0.105	0.153	0.092	0.209	0.171	0.069	0.076
2005	4550	0.099	0.160	0.091	0.207	0.168	0.056	0.080
2006	4481	0.095	0.163	0.094	0.205	0.170	0.048	0.074
2007	4324	0.091	0.156	0.089	0.206	0.174	0.062	0.081
2008	4054	0.077	0.141	0.080	0.227	0.195	0.106	0.114
2009	3812	0.095	0.146	0.092	0.222	0.193	0.096	0.101
2010	2019	0.099	0.135	0.086	0.215	0.193	0.083	0.105

The average cash ratio increased from 9% in 1988 to 13.5% in 2010, reaching a peak in 2006 (16.3%). This inhibits a total increase from 1988 on, of 49.9%. The aggregate cash ratio slightly increased from 9.4% in 1988 to 9.9% in 2010, the median cash ratio shows a higher increase than the mean; 91.8%. These results are in line with the findings of Bates et al. (2009), who found also a lower increase of the

aggregate cash ratio for U.S. firms relative to the mean and median. The overall increase in cash ratio of U.S. firms was higher than the increase of European firms. Next to the cash ratio, the leverage also shows a change over time. The increase of leverage is very small (a 14.6% increase from 1988) compared to the increase of cash holdings, net leverage even shows a decrease. The results of Table 3 show two significant moments in the sample period. The first in 2001, when the average cash ratio of European firms fell by 8.5%. This can be pointed out to the burst of the internet bubble. The second moment can be pointed out to the financial crisis, started in 2008 with the collapse of Lehman Brothers. From the peak in 2006 (16.3%), the average cash holdings decreased by 16.9% to 13.5% in 2010.

To check the statistical significance of the cash ratio a regression of the cash ratio on a constant and time is examined (not reported). The trend is examined in years and the coefficient on the time trend for the average cash ratio corresponds to an annual increase of 0.22% with a p-value of 0.000. In line with Bates et al. (2009) I also investigated the time trend on the median. Here, the median cash ratio corresponds to an annual increase of 0.08% and again a p-value of 0.000. This means that both regressions are at least statistical significant at the 99%-level. According to these outcomes, there is a positive time trend in the average cash ratio of European firms in the period 1988-2010. The statistical significance of net leverage shows a decrease. The time trend of the average net leverage corresponds to an annual decrease of 0.14% with a p-value of 0.027. This means this time trend is significant at the 95%-level. The median net leverage ratio corresponds to a yearly decrease of 0.10% and has a p-value of 0.000. Therefore it is statistical significant at the 99%-level. Comparing these results to Bates et al. (2009) the movements are similar, they also regressed a positive trend in the cash ratio and a negative trend in the net leverage. However, they found a higher increase of the cash ratio and a higher decrease of the net leverage. Since my data suggests they would move the opposite way, these findings are reasonable. This is similar to Bates et al. (2009) who concluded that the decrease in net debt occurs because firms prefer to hold more money instead of lowering their debt.

4.2 The impact of size

After the clear trends between leverage and cash ratio in the previous section, this section will focus on firm size and the relation to cash holdings and net leverage. According to Vogel and Maddala (1967) economies of scale are the cause of different cash-to-asset ratios between different sizes of firms. Mulligan (1997) concluded that, due to economies of scale, large companies hold less cash.

Figure 1

Average cash ratio by firm size quintile from 1989 to 2010.

The sample includes all firm-year observations on Compustat Global in the period 1988-2010 for firms incorporated in the European Union (excluding Romania and Bulgaria). Only observations with positive values for the book value of total assets and sales revenue are included. Financial firms and utilities are excluded from the sample. The sample consists of 70,224 observations for 6,950 unique firms. This figure shows the average cash ratio by firm size quintile between 1989 and 2010. Firms are sorted into quintiles based on the book value of total assets of the previous year. The first quintile (Q1) exhibits the group with the smallest firms and the fifth quintile (Q5) exhibits the group with the largest firms. The sample contains 70,224 observations with 6,950 unique firms. It includes all surviving and non-surviving firms for the given period.

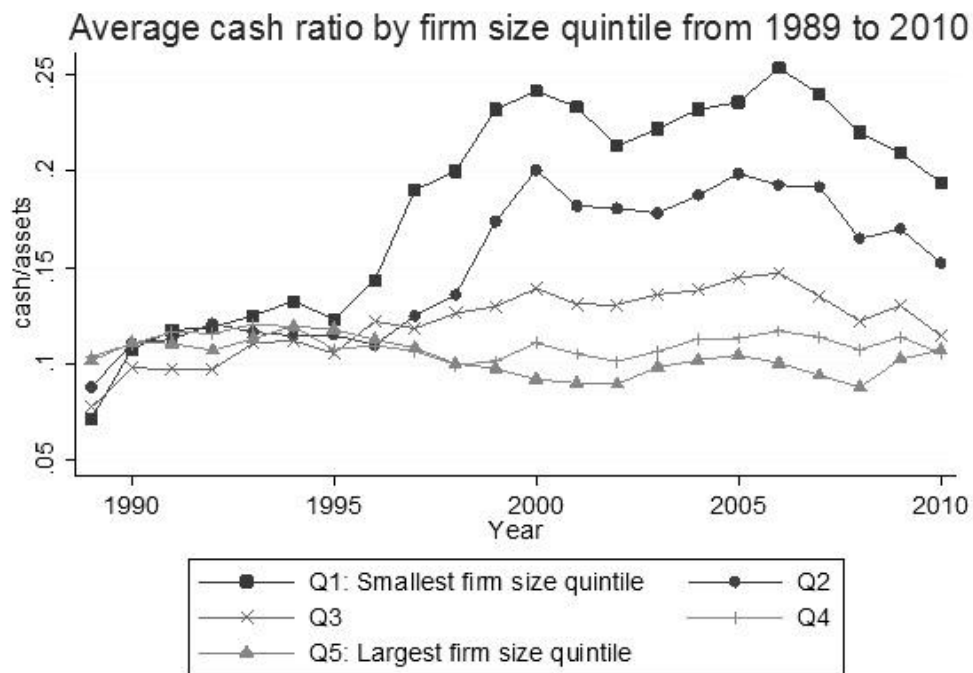


Figure 1 shows the trend of average cash ratios by different sizes of firms during the sample period. The sample firms are divided into five quintiles according to their book value of total assets from the previous year. Figure 1 shows interesting results. Mulligan's conclusion (1997) about economies of scale is confirmed by the graph, especially in the last years. Until 1995 the differences are marginal, thereafter the smaller firms show a strong increase in cash holdings. The two largest firm size quintiles remain at a comparable low level. Again peaks before the internet bubble and the financial crisis are visible. At the peak in 2000 and 2006 the first three quintiles more than doubled compared to the first years and thereafter decreased by more than 20%. Figure 1 shows that the increase in cash ratio is not driven by the largest companies but by the middle and smaller ones. This is in line with Bates et al. (2009), who showed that firms in the US in the period 1980-2006 were also driven by the smaller firms. However, opposed to this sample, Bates et al. (2009) showed a low but significant increase for the larger companies.

Bates et al. (2009) also investigated the change on the average net leverage by firm size. They found a sharp decrease in the average net debt for firms in the first three quintiles (the smaller firms). Figure 2 shows the results of European firms in the period 1989-2010. Also here the first differences start in 1995; here the lowest two quintiles of firm size decrease enormously. The highest two quintiles show a small increase, while the third group remains more or less constant. Between 2006 and 2010 there is a turnaround for all quintiles due to the financial crisis. The two smallest groups suddenly show an increase and the largest groups a decrease.

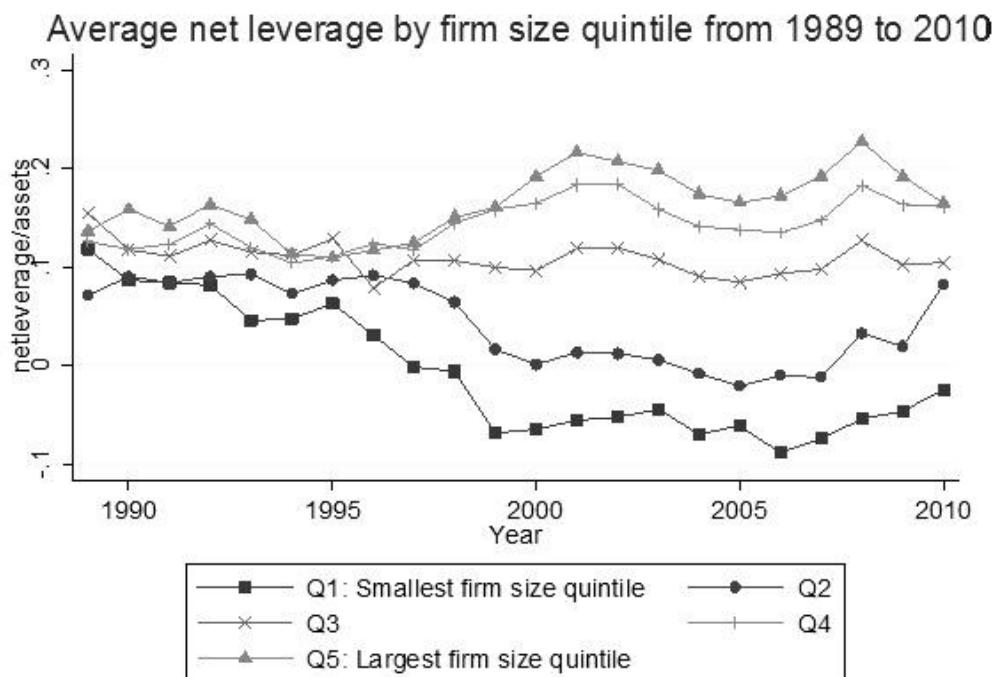
4.3 Determinants of the precautionary motive

In the previous sections I investigated the impact of cash holdings on leverage and size. All measurements were in line with the trends discovered by Bates et al. (2009). The largest contradiction was a result of the financial crisis and this is not examined in the sample of Bates et al. (2009). This

Figure 2

Average net leverage by firm size quintile from 1989 to 2010.

The sample includes all firm-year observations on Compustat Global in the period 1988-2010 for firms incorporated in the European Union (excluding Romania and Bulgaria). Only observations with positive values for the book value of total assets and sales revenue are included. Financial firms and utilities are excluded from the sample. The sample consists of 70,224 observations for 6,950 unique firms. This figure shows the average net leverage by firm size quintile between 1989 and 2010. Firms are sorted into quintiles based on the book value of total assets of the previous year. The first quintile (Q1) exhibits the group with the smallest firms and the fifth quintile (Q5) exhibits the group with the largest firms. The sample contains 70,224 observations with 6,950 unique firms. It includes all surviving and non-surviving firms for the given period.



section examines the impact of dividend payment, negative income, technology and idiosyncratic risk. Special attention will be given to the crisis years.

Table 4 shows the average cash ratio segregated in dividend paying and non-dividend paying firms, in firms with negative and nonnegative income and in manufacturing and high-tech firms. The last row gives the total number of observations. Column 2 shows the cash ratio of non-dividend paying firms and shows an increase of 15.5% of cash holdings over time. Again, the peaks exist before the internet bubble and the financial crisis. The cash ratio of dividend paying firms in column 3 shows, despite their

Table 4

Average Cash Ratio by Dividend Payment, Accounting Performance and Technology from 1988 to 2010

The sample includes all firm-year observations on Compustat Global in the period 1988-2010 for firms incorporated in the European Union (excluding Romania and Bulgaria). Only observations with positive values for the book value of total assets and sales revenue are included. Financial firms and utilities are excluded from the sample. The sample consists of 70,224 observations for 6,950 unique firms. It includes all surviving and non-surviving firms for the given period. This table shows the average cash ratio by dividend status, accounting performance and technology, all variables are treat as dummy. The last row (N) includes the number of non-missing observations.

Year	Dividend status		Accounting performance		Technology	
	Non-dividend paying	Dividend paying	Nonnegative income	Negative income	Manufacturing	High-tech
1988	0.122	0.086	0.188	0.083	0.084	
1989	0.118	0.108	0.132	0.107	0.108	0.145
1990	0.108	0.107	0.114	0.106	0.101	0.154
1991	0.105	0.112	0.107	0.111	0.100	0.157
1992	0.096	0.120	0.095	0.119	0.102	0.169
1993	0.110	0.123	0.103	0.125	0.111	0.182
1994	0.116	0.125	0.115	0.123	0.114	0.179
1995	0.112	0.117	0.116	0.115	0.109	0.170
1996	0.135	0.114	0.155	0.114	0.113	0.193
1997	0.142	0.123	0.173	0.122	0.119	0.205
1998	0.156	0.117	0.180	0.123	0.118	0.210
1999	0.177	0.113	0.196	0.130	0.115	0.244
2000	0.195	0.104	0.228	0.126	0.112	0.284
2001	0.168	0.107	0.185	0.122	0.108	0.246
2002	0.158	0.115	0.177	0.121	0.107	0.237
2003	0.160	0.122	0.177	0.130	0.115	0.231
2004	0.167	0.126	0.189	0.138	0.122	0.240
2005	0.181	0.127	0.209	0.141	0.135	0.233
2006	0.185	0.126	0.221	0.140	0.139	0.228
2007	0.179	0.122	0.200	0.141	0.140	0.216
2008	0.152	0.121	0.146	0.139	0.123	0.197
2009	0.148	0.140	0.136	0.151	0.133	0.197
2010	0.141	0.124	0.152	0.130	0.129	0.183
N	39221	31003	20010	50214	30427	10385

lower cash ratio, an even higher increase. Their cash holdings increased by 43.4% over the sample period. These firms do not have similar movements as the non-dividend paying firms and reaches its peak in 2009. There are more firms which did not pay dividend (55.9%) than firms that did pay dividend

(44.1%) in the sample period. My findings conflict with Bates et al. (2009), because they found the largest increase within the non-dividend paying firms. This contradiction is partially caused by the decrease in the crisis years, taking the cash ratio of 2006 it shows an increase of more than fifty percent. It seems to be that European firms who pay no dividend have higher cash holdings, but a flatter slope than dividend paying firms in the sample period. According to Opler et al. (1999) this is a result of the transaction motive; dividend paying firms can easily convert their dividends into cash and therefore they need less cash holdings. It may also confirm the agency motive; non-dividend paying firms hold more cash, because managers refuse to pay out dividends.

Column 4 and 5 represent the accounting performance and distinguish negative and positive income. Firms with a negative income in a particular year are more likely to be financially constrained. The cash holdings of nonnegative income decrease over time, while the cash holdings of negative income show a large increase. On average, firms with nonnegative income have higher cash holdings. Nevertheless, between 1988 and 2010 the cash holdings of European firms with negative income increased by more than fifty percent. The sample period have much more firms with a negative income (71.5%) than firms without a negative income (28.5%). Also here my findings conflict with Bates et al. (2009), since they found a small increase in cash holdings of firms with nonnegative income. The large increase of firms with negative income is comparable. In the crisis years, firms with nonnegative income show a small increase instead of the decrease in 2010. Since financially constrained firms tend to hold more cash (Almeida et al., 2004), firms with negative income should hold on average more cash. This hypothesis is not supported by the data and is in contradiction to the findings of Bates et al. (2009). According to Han and Qiu (2007) non-dividend paying firms are also more likely to be financially constrained, this is supported by Table 4.

I also investigated the contrast between traditional manufacturing firms and high-tech firms. The distinction in technology is based on firms' SIC codes described in Loughran and Ritter (2004).

Manufacturing firms are defined as firms with SIC codes 2000-3999, excluding the high-tech firms within this range. Column 6 and 7 in Table 4 illustrate the differences. It shows that the total number of manufacturing firms is much higher (43.3%) than the number of technology firms (14.8%). However, the percentage of the total observations of high-tech firms almost tripled during the sample period. The percentage of manufacturing firms is lowered by 10 points. The results also show higher cash holdings in high-tech firms for every year of the sample period. I excluded the results of 1988, since the number of observations (18) does not give enough unbiased information. The cash holdings show a peak in 2004 and a clear decrease in the crisis years. Also the internet bubble influences the cash ratio, while this bubble did not affect the cash ratio of manufacturing firms. This is not surprisingly since the bubble was based on technology firms. Manufacturing firms peaked in 2007 and have an increase of 53.8% over the sample period. The total increase of high-tech firms is remarkable lower with an increase of 25.6%. Bates et al (2009) also found a larger cash ratio in high-tech firms for all years. Although, they had a slightly higher increase in manufacturing to high-tech firms over their sample period.

Another part of the precautionary motive is that firms increase their cash holdings when the volatility of cash flows increases (Han and Qiu, 2007). Firms who move in industries with high idiosyncratic risk should have higher cash holdings than firms with low idiosyncratic risk. Figure 3 shows the results of the average cash ratio between five different quintiles of cash flow volatility. In 1990-1995, the average cash ratios in all quintiles stayed more or less the same. From 1995 on, the cash ratio of the three highest cash flow volatility quintiles increased a lot. The cash ratios of those three groups are doubled in 2006, but face a decrease afterwards. The lowest two quintiles remain relatively at a low level. Results of European firms deviate from the U.S. firms investigated by Bates et al. (2009). Again, part of the difference is caused by the crisis years, since until 2006 there are only a few small dropdowns. Also the movements of the cash ratios in Figure 3 are much more variable. For example the large peak in 2006 of the quintile with the highest cash flow volatility. The third quintile shows a lot more deviation

than the graph of Bates et al. (2009). The most important difference in Figure 3 is the higher cash ratio of the quintiles with the highest risk, this is consistent with the precautionary motive.

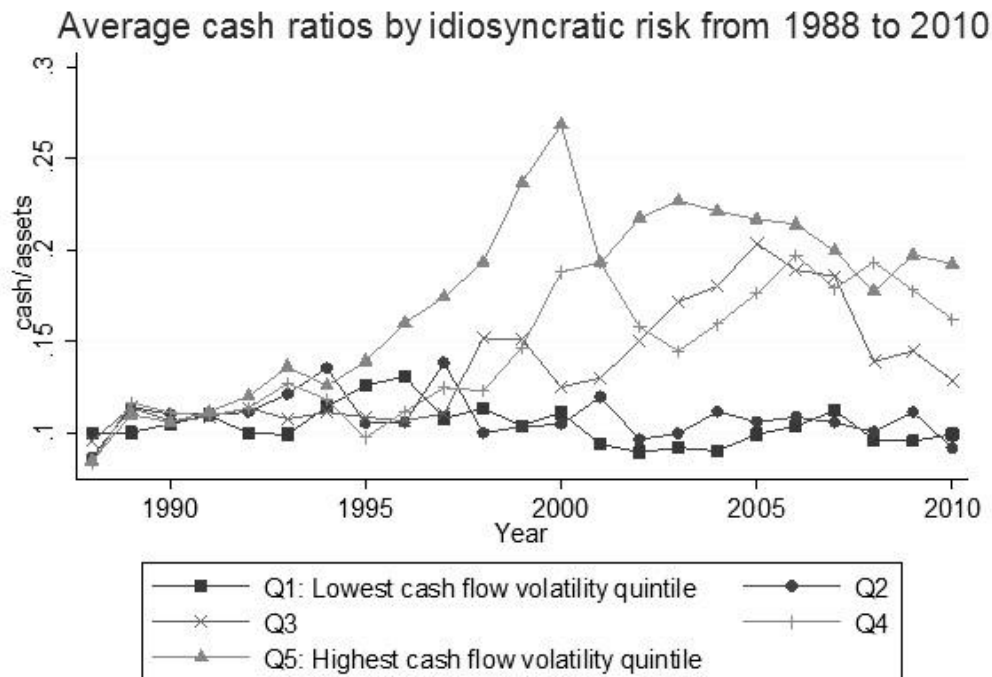
4.4 Determinants of cash holdings

The determinants of the precautionary motive in the previous section show different levels of increase of cash holdings. In this section the regressions of all the determinants are examined to check the relationship with cash holdings. Table 5 shows the results of the regressions to estimate the determinants of cash holdings. The p-values (in the parentheses) are based on standard errors robust to clustering by firm. The table consists of 70,224 observations for 6,950 unique firms. Model 1 to Model 4

Figure 3

Average cash ratios by idiosyncratic risk from 1988 to 2010.

The sample includes all firm-year observations on Compustat Global in the period 1988-2010 for firms incorporated in the European Union (excluding Romania and Bulgaria). Only observations with positive values for the book value of total assets and sales revenue are included. Financial firms and utilities are excluded from the sample. The sample consists of 70,224 observations for 6,950 unique firms. It includes all surviving and non-surviving firms for the given period. This figure shows the average cash ratios by the idiosyncratic risk of industries between 1988 and 2010. Firms are sorted into quintiles based on the increase in cash flow volatility of their industry. The first quintile (Q1) exhibits the group with the lowest idiosyncratic risk and the fifth quintile (Q5) exhibits the group with the highest idiosyncratic risk.



report the OLS regressions for all sample years. No firm or industry dummies are used in these models and in Model 3 and 4 a crisis dummy for the years 2007 to 2010 is added. This additional regression is made because all previous results showed large fluctuations from the year 2007.

Model 1 shows that the basic OLS regression and all explanatory variables are statistically significant. This is almost similar to the results of U.S. firms regressed by Bates et al. (2009), who only found an insignificant cash flow ratio. Their cash flow ratio is several times insignificant while I only have an insignificant cash flow ratio in Model 8; a regression with firm fixed effects. Since the regressions in Model 1 are statistically significant, the variables explain the change in cash ratio. The industry sigma, R&D and the market-to-book show a positive relation to cash holdings while the other variables show a negative relation. This means all coefficients of Model 1 are in line with the results of Bates et al. (2009). The movements of U.S. firms are stronger, except for the acquisitions and R&D. For these, European firms have a stronger relationship to cash holdings. Cash holdings increase when the cash flow ratio of firms decreases, this is in contrast with the precautionary motive and the theory of Chapter 2. Cash flow volatility of industries show a positive relation in line with the theory. Model 2 re-estimates Model 1 using the logarithm of cash to net assets. All variables are still significant and the R^2 is much lower than the R^2 of Model 1 (23.5 against 34.1%). All variables keep their coefficient, except size. The coefficient of size is too small to value. Bates et al. (2009) found a change of sign in capital expenditures, this is not supported in my findings. The negative coefficient of NWC confirms the transaction motive; net working capital is a substitute for cash. All models support this theory.

Next, a crisis dummy is added to re-estimate Model 1. The crisis dummy is chosen because the results in the previous sections showed that from 2007 on the largest variation occurred. According to Model 3, the results barely differ from the regression without the crisis dummy. All variables still remain significant. Model 4 re-estimates Model 3 using the log of cash to net assets and this time the crisis dummy is insignificant. The crisis dummy in Model 4 therefore cannot explain the change in cash

Table 5

Regressions Estimating the Determinants of Cash Holdings

The sample includes all firm-year observations on Compustat Global in the period 1988-2010 for firms incorporated in the European Union (excluding Romania and Bulgaria). Only observations with positive values for the book value of total assets and sales revenue are included. Financial firms and utilities are excluded from the sample. The sample consists of 70,224 observations for 6,950 unique firms. It includes all surviving and non-surviving firms for the given period. This table shows the regressions to estimate the determinants of cash holdings. The p-values of the OLS regressions and the fixed effects are reported in the parentheses and are based on standard errors robust to clustering by firm. The p-values of the Fama-MacBeth regressions are based on Newey and West (1987) standard errors to control for autocorrelation and heteroskedasticity.

	1	2	3	4	5	6	7	8
Model	OLS	OLS	OLS	OLS	FM (1991-2000)	FM (2001-2006)	FE (industry)	FE (firm)
Dependent variable	Cash/Assets	Log (Cash/Net Assets)	Cash/Assets	Log (Cash/Net Assets)	Cash/Assets	Cash/Assets	Cash/Assets	Cash/Assets
Intercept	0.200 (0.000)	-2.257 (0.000)	0.202 (0.000)	-2.258 (0.000)	0.179 (0.000)	0.206 (0.000)	0.204 (0.000)	0.232 (0.000)
NWC	-0.137 (0.000)	-1.233 (0.000)	-0.138 (0.000)	-1.232 (0.000)	-0.176 (0.000)	-0.121 (0.000)	-0.136 (0.000)	-0.140 (0.000)
Cash flow ratio	-0.060 (0.000)	-0.399 (0.000)	-0.060 (0.000)	-0.399 (0.000)	-0.094 (0.002)	-0.074 (0.007)	-0.057 (0.000)	0.006 (0.641)
Industry sigma	0.140 (0.000)	1.936 (0.000)	0.144 (0.000)	1.933 (0.000)	0.549 (0.000)	0.164 (0.000)	0.034 (0.044)	-0.043 (0.008)
Capex	-0.235 (0.000)	-2.157 (0.000)	-0.240 (0.000)	-2.153 (0.000)	-0.286 (0.000)	-0.249 (0.000)	-0.231 (0.000)	-0.147 (0.000)
Acquisitions	-0.194 (0.000)	-0.988 (0.000)	-0.188 (0.000)	-0.994 (0.000)	-0.092 (0.007)	-0.165 (0.000)	-0.205 (0.000)	-0.165 (0.000)
R&D	0.226 (0.000)	1.363 (0.000)	0.226 (0.000)	1.362 (0.000)	0.365 (0.000)	0.232 (0.000)	0.225 (0.000)	0.055 (0.002)
Market-to-book	0.014 (0.000)	0.148 (0.000)	0.014 (0.000)	0.148 (0.000)	0.010 (0.000)	0.016 (0.000)	0.013 (0.000)	0.006 (0.000)
Dividend dummy	-0.012 (0.000)	-0.175 (0.000)	-0.013 (0.000)	-0.174 (0.000)	-0.015 (0.011)	-0.008 (0.000)	-0.010 (0.000)	0.006 (0.002)
Size	-0.003 (0.000)	0.044 (0.000)	-0.003 (0.000)	0.044 (0.000)	0.000 (0.439)	-0.005 (0.000)	-0.003 (0.000)	-0.010 (0.000)
Leverage	-0.302 (0.000)	-3.171 (0.000)	-0.302 (0.000)	-3.172 (0.000)	-0.284 (0.000)	-0.316 (0.000)	-0.292 (0.000)	-0.200 (0.000)
Crisis dummy			-0.007 (0.000)	0.007 (0.750)				
R ²	34.1%	23.5%	34.2%	23.5%	32.2%	36.7%	35.6%	73.4%

holdings. All other outcomes lead to the same conclusions as Model 3.

Model 1 to 4 investigated the OLS regressions based on clustering by firm. Subsequently, I investigate the relation between the variables and the cash holdings by changes over time by means of the slope. To examine this, the Fama-MacBeth regressions for two different periods are used. These regressions are based on the model of Fama and MacBeth (1973). This model effectively estimates a cross-sectional regression for each year independent. It eliminates the problem of serial correlation in the residuals of a time series cross-sectional regression. Model 5 shows the results of the Fama-MacBeth regressions in the period 1991-2000. Real size is the only insignificant variable. All variables show similar outcomes as the first model. The R^2 of Model 5 is lower than the pooled regression of Model 1. On the contrary, Model 6 shows a higher R^2 than the pooled regression. Model 6 estimated the Fama-MacBeth regression between 2001 and 2006, in which all variables are statistically significant and similar to the results in Model 5. Industry sigma has a much smaller effect on cash holdings between 2001 and 2006 than in the period 1991-2000.

Finally, two models with fixed effects are added. Model 7 regresses the explanatory variables by industry fixed effects and Model 8 by firm fixed effects. These regressions are based on unobserved industry and firm characteristics that remain constant over time. All variables in Model 7 are significant at the 1% level, except industry sigma which is significant at the 5% level. This is also the only variable that deviates a lot from the output of Model 1. The relation with cash holdings is still positive but much smaller. Model 8 re-estimates the first model by firm fixed effects and shows a substantial higher R^2 . It also shows an insignificant cash flow ratio. The regressions of firm and industry fixed effects fluctuate, but most variables show a similar coefficient. Only the industry sigma changed from sign.

I also estimate a few extra analyses that are performed by Bates et al. (2009), which can be achieved within this data set. First I re-estimate Model 1 by changing the NWC to total assets into NWC to net total assets. This might capture the bias that a firm with higher cash holdings has a lower cash

ratio since the regression yields a negative coefficient. The result with the new equation of NWC is remarkable. The coefficient of NWC is six times smaller (-0.022) although still negative, while Bates et al. (2009) did not find a change. Next to a change in NWC I excluded leverage and NWC from the basic regression and performed a new analysis. Not surprisingly the R^2 drops (-10%), and there are some movements in the coefficients of the variables. The industry sigma almost doubles (0.267) as a result from the two deletions.

The determinants of cash holdings in European firms are estimated for the whole sample period as well as some extra regressions. Using the Fama-MacBeth regressions two periods are estimated until the beginning of the crisis. To examine the impact of the financial crisis, the change in relationship between cash holdings and firm characteristic is estimated, summarized in Table 6. It contains the interaction within the years 2007-2010 by adding the crisis dummy. Model 1 of Table 6 contains the same variables as Table 5. The only remarkable difference in Table 6 compared to Model 3 of Table 5 is the resulting higher coefficients. This could be a consequence of the high volatility during the crisis. Also the R^2 is slightly higher than reported in Table 5. The interaction terms therefore add little information to the clarification of the cash holdings. All coefficients of the regression are statistically significant and the interactions are often insignificant. Only the cash flow ratio, industry sigma, market-to-book ratio, dividend dummy and leverage are significant at the 1%-level. As expected the coefficient of the cash ratio shows a much higher volatile coefficient.

Model 2 re-estimates Model 1 by adding the variables net equity issuance, a loss dummy and the Treasury bill. The T-bill is the only insignificant p-value. The coefficient of the cash flow ratio is halved due to the added variables and the R^2 increased by 1.3%. Again most of the interaction terms are insignificant, only the cash flow ratio and leverage are significant. The cash flow volatility has also the highest coefficient of the interaction terms. Model 3 re-estimates Model 2 by using the log of cash to net assets, this time only the loss dummy of the estimates is insignificant. The T-bill shows a small negative

Table 6

The interaction of determinants of cash holdings between 2007 and 2010

The sample includes all firm-year observations on Compustat Global in the period 1988-2010 for firms incorporated in the European Union (excluding Romania and Bulgaria). Only observations with positive values for the book value of total assets and sales revenue are included. Financial firms and utilities are excluded from the sample. The sample consists of 70,224 observations for 6,950 unique firms. Due to missing observations the total number of this table is reduced to 46,798. This table shows the changes in relations between cash holdings and firm characteristics, every model interacts with the years 2007-2010.

Model	1		2		3	
	Cash/Assets		Cash/Assets		Log (Cash/Net Assets)	
Dependent variable	Estimate	Interaction crisis years	Estimate	Interaction crisis years	Estimate	Interaction crisis years
Intercept	0.207 (0.000)		0.197 (0.000)		-2.215 (0.000)	
NWC	-0.143 (0.000)	0.019 (0.093)	-0.139 (0.000)	0.018 (0.108)	-1.267 (0.000)	0.229 (0.065)
Cash flow ratio	-0.096 (0.000)	0.142 (0.000)	-0.046 (0.000)	0.122 (0.000)	-0.276 (0.005)	0.732 (0.000)
Industry sigma	0.155 (0.000)	-0.080 (0.005)	0.134 (0.000)	-0.054 (0.058)	1.806 (0.000)	-0.413 (0.167)
Capex	-0.251 (0.000)	0.057 (0.070)	-0.279 (0.000)	0.077 (0.013)	-2.440 (0.000)	0.885 (0.010)
Acquisitions	-0.175 (0.000)	-0.031 (0.248)	-0.228 (0.000)	-0.002 (0.932)	-1.452 (0.000)	0.412 (0.232)
R&D	0.236 (0.000)	-0.019 (0.290)	0.228 (0.000)	-0.018 (0.330)	1.360 (0.000)	-0.059 (0.604)
Market-to-book	0.013 (0.000)	0.006 (0.006)	0.012 (0.000)	0.005 (0.014)	0.136 (0.000)	0.025 (0.098)
Dividend dummy	-0.015 (0.000)	0.012 (0.002)	-0.007 (0.003)	0.009 (0.017)	-0.156 (0.000)	0.142 (0.001)
Size	-0.003 (0.000)	-0.001 (0.160)	-0.003 (0.000)	-0.001 (0.218)	0.050 (0.000)	-0.030 (0.005)
Leverage	-0.313 (0.000)	0.047 (0.000)	-0.307 (0.000)	0.043 (0.001)	-3.199 (0.000)	0.358 (0.009)
Net equity issuance			0.140 (0.000)	-0.042 (0.075)	1.012 (0.000)	-0.373 (0.022)
Loss dummy			0.009 (0.001)		0.019 (0.498)	
T-bill			0.000 (0.365)		-0.021 (0.000)	
R ²	34.8%		36.1%		24.6%	

relation, which means that a decrease of the risk-free rate leads to higher cash holdings. This supports the theory about the opportunity costs in Chapter 2.

Table 6 shows that most of the interaction terms of the crisis dummy are insignificant, meaning that there are just a few variables in the period 2007-2010 that have a reasonable impact on the cash holdings over the total sample period. Leverage and cash flow volatility have the largest shifts in the crisis years, both variables are negatively related to the cash holdings of European firms.

4.5 Attribution to specific firm characteristics

As described above, changes in firm characteristics determine the increase in cash holdings for the most part. Since it is still not obvious which particular characteristics have the strongest attribution, some extra regressions will be performed. Following Bates et al. (2009) I will examine the dividend status, the real size and the technology firms to investigate the change of the cash ratio.

First, a modified version of the Fama-MacBeth regressions is calculated by means of average coefficients from yearly cross-sectional regressions for the period 1993-1999⁴, these coefficients will make predictions for following years. Contrasted to the OLS regressions of Table 5 the net equity issuance is added to the variables. The results of these predictions are shown in the equation:

$$\begin{aligned} \text{Cash ratio} = & 0.175 - 0.174 \text{ NWC} - 0.041 \text{ cash flow ratio} + 0.402 \text{ industry sigma} \\ & - 0.317 \text{ CAPEX} - 0.146 \text{ acquisitions} + 0.438 \text{ R\&D} + 0.008 \text{ market to book} \\ & - 0.008 \text{ dividend dummy} + 0.000 \text{ real size} - 0.270 \text{ leverage} \\ & + 0.119 \text{ net equity issuance} \end{aligned}$$

The outcomes of the predicted cash ratio versus the results of the actual cash ratio in the period 2000-2010 are summarized in Table 7. Panel A of Table 7 shows the predicted cash ratio and the difference with the actual cash ratio of the whole sample and makes a distinction between dividend and non-dividend paying firms. According to column 2, there is an increasing ratio between 2000 and 2006 for the predicted cash ratio in the whole sample, followed by a decrease in the crisis years. Overall, there is an increase of 6.7%. The model consistently estimates the cash holdings of European firms too

⁴ No earlier period is possible since the cash flow ratio is based on the five prior years.

high. The t-statistic in column 4 estimates the significance of the difference and is only not significant at the 1%-level in 2000. The results of the dividend paying firms are summarized in columns 5-7 and consist of 20,816 observations, columns 8-10 represent the non-dividend paying firms and consist of 24,174 observations. Both subgroups estimated the predicted cash ratios higher than the actual ones for every year. The model predicts a higher increase for dividend paying firms over the sample period, due to the large decrease of non-dividend paying firms in the crisis years. Bates et al. (2009) showed a higher increase for non-dividend paying firms but their sample period last until 2006. The t-statistic for dividend paying firms is insignificant in 2009 at the 1%-level and the t-statistic of the non-dividend paying firms is insignificant in 2000. All other estimations are significant at the 1%-level.

Panel B estimates the predicted cash ratios differentiated in real size. Small firms are summarized in columns 2-4 and contain 19,882 firms, large firms are all firms with total assets exceeding 500 million Euros in 2005 and are shown in columns 5-7 with 11,981 observations. The predicted difference in the increase between large and small firms is similar, although the predicted averages of small firms lie much higher. Except for the estimate of small firms in 2000, all differences between actual and predicted cash ratios are negative. This exception is also the only insignificant statistic at the 1%-level. Panel C explains the predicted cash ratios of high-tech and manufacturing firms. High-tech firms contain 7,010 observations, manufacturing firms 19,353. High-tech firms have much higher cash holdings than manufacturing firms, although they did not face an increase in the period 2000-2010. It decreases as a result of the crisis. The cash holdings of manufacturing firms increase and are just little affected during the crisis years. The difference between actual and predicted cash holdings for high-tech firms is low and mainly positive until 2006. Since 2006, the predicted cash ratio is higher than the actual one. These findings are in line with Bates et al. (2009) since they found an underprediction of high-tech companies. The predicted cash ratio of manufacturing firms show an increase of almost 40% and is higher than the actual cash ratio for every year. The t-statistic of high-tech firms is insignificant at the

Table 7**Predicted cash holdings and their deviations over time**

The sample includes all firm-year observations on Compustat Global in the period 2000-2010 for firms incorporated in the European Union (excluding Romania and Bulgaria). Only observations with positive values for the book value of total assets and sales revenue are included. Financial firms and utilities are excluded from the sample. The predictions of the cash ratio, dividend status and real size contain 44,990 observations. The predictions of technology firms contain 26,453 observations. This table examines the predicted cash ratios of sample firms and the difference with the actual cash ratios. Predicted cash holdings are derived from a Fama-MacBeth model predicting cash ratios, the coefficients are estimated over the period 1993-1999. Difference is the outcome of the actual cash ratio minus the given predicted cash ratio. T-Stat is the t-statistic performed by a t-test between actual and predicted cash ratios.

Panel A

Whole Sample				Dividend Status					
Year	Predicted	Difference	T-Stat	Dividend paying	Difference	T-Stat	NonDividend Paying	Difference	T-Stat
2000	0.143	-0.005	-1.922	0.106	-0.009	-3.098	0.174	-0.002	-0.397
2001	0.155	-0.014	-4.95	0.116	-0.013	-4.210	0.181	-0.014	-3.390
2002	0.159	-0.020	-7.669	0.125	-0.012	-3.681	0.181	-0.025	-6.736
2003	0.160	-0.015	-5.719	0.128	-0.009	-2.728	0.181	-0.019	-5.032
2004	0.166	-0.021	-8.42	0.134	-0.010	-3.319	0.189	-0.029	-7.861
2005	0.172	-0.024	-9.809	0.136	-0.015	-5.089	0.201	-0.032	-8.407
2006	0.180	-0.029	-11.571	0.137	-0.015	-5.404	0.214	-0.040	-10.279
2007	0.178	-0.036	-15.049	0.139	-0.023	-8.582	0.208	-0.046	-12.496
2008	0.164	-0.036	-15.057	0.133	-0.019	-6.568	0.183	-0.046	-13.631
2009	0.159	-0.025	-10.536	0.138	-0.005	-1.576	0.171	-0.036	-11.242
2010	0.153	-0.026	-9.389	0.132	-0.014	-3.694	0.166	-0.034	-8.750

Table 7 -continued-**Panel B**

Real Size						
Year	Small	Difference	T-Stat	Large	Difference	T-Stat
2000	0.156	0.000	-0.093	0.105	-0.019	-5.696
2001	0.169	-0.010	-2.824	0.112	-0.025	-7.978
2002	0.173	-0.018	-5.316	0.116	-0.028	-8.624
2003	0.174	-0.013	-4.139	0.115	-0.019	-6.028
2004	0.179	-0.021	-6.629	0.122	-0.022	-6.915
2005	0.187	-0.024	-7.956	0.126	-0.023	-6.987
2006	0.199	-0.030	-9.243	0.127	-0.028	-9.001
2007	0.197	-0.038	-12.051	0.126	-0.032	-11.322
2008	0.183	-0.039	-12.271	0.116	-0.029	-10.984
2009	0.173	-0.027	-8.766	0.122	-0.019	-6.834
2010	0.173	-0.032	-7.736	0.123	-0.018	-5.496

Table 7 -continued-

Panel C						
Technology						
Year	High-tech	Difference	T-Stat	Manufacturing	Difference	T-Stat
2000	0.226	0.021	2.541	0.111	-0.009	-2.609
2001	0.236	-0.002	-0.176	0.128	-0.023	-6.858
2002	0.244	-0.012	-1.411	0.132	-0.028	-8.806
2003	0.230	0.002	0.244	0.136	-0.022	-6.513
2004	0.232	0.004	0.508	0.143	-0.028	-8.962
2005	0.228	0.001	0.137	0.149	-0.027	-8.010
2006	0.245	-0.026	-3.463	0.162	-0.033	-9.206
2007	0.234	-0.042	-5.681	0.164	-0.034	-9.551
2008	0.216	-0.040	-5.824	0.150	-0.038	-10.668
2009	0.208	-0.027	-3.905	0.154	-0.032	-9.298
2010	0.185	-0.011	-1.432	0.155	-0.034	-7.939

1%-level for the years 2001-2005 and 2010; the difference of the manufacturing firms is significant any year of the sample.

Table 7 estimated the distinction of the predicted model against the actual cash ratio, diversified into several firm characteristics. However, Table 7 did not show the interaction between all firm characteristics to predicted cash ratio. Table 8 shows the relation of the firm characteristics to the change in the predicted cash ratio in the period 2000-2006. Column 2 of Table 8 summarizes the different impacts of the determinants of cash holdings. The market-to-book ratio, real size and the dividend dummy have the largest coefficients, therefore explaining most of the change in the predicted cash ratio. These results are completely in contradiction to the findings of Bates et al. (2009) who found NWC, industry sigma, Capex and R&D as the largest contributors for the same period. NWC is the only insignificant determinant at the 1%-level. Taking only dividend paying firms into account again market-to-book and real size are the most important estimators, although real size changes from positive into negative. Large differences with the non-dividend paying firms are the change of sign of the real size (similar to the whole sample) and the much lower coefficient for the market-to-book of the non-dividend paying firms. Large firms also have the highest coefficients for the market-to-book and the real size (also

negative), the dividend dummy is strong for small firms only. Small firms have a positive coefficient for the real size. Technology firms show similar results.

Table 8 is re-estimated by changing the period into the crisis years (not reported). Too small estimations of firm characteristics are found to reveal. The largest estimations for the predicted cash ratio of the whole sample are NWC (0.004), R&D (0.004) and leverage (-0.004). R&D switches sign compared to the predictions of 2000-2006, NWC and leverage are similar to the results of Table 8.

4.6 Value of cash holdings

In this section the market value of cash holdings over time is introduced to measure whether an increase is explained by agency costs. Since the previous sections found some results which were in line with the precautionary and transaction motive, this section will look after a relationship between the agency motive and the value of corporate cash holdings within European firms. To make a regression for the market value, a valuation regression of Pinkowitz and Williamson (2004) is used, with cash holdings as the independent variable. The change in assets is split into a cash and noncash part. This analysis is similar to the formula of Bates et al. (2009) and was original developed by Fama and French (1998). The utilized regression is shown by the following equation:

$$V_{i,t} = \alpha + \beta_1 E_{i,t} + \beta_2 dE_{i,t} + \beta_3 dE_{i,t+1} + \beta_4 dNA_{i,t} + \beta_5 dNA_{i,t+1} + \beta_6 RD_{i,t} + \beta_7 dRD_{i,t} + \beta_8 dRD_{i,t+1} + \beta_9 I_{i,t} + \beta_{10} dI_{i,t} + \beta_{11} dI_{i,t+1} + \beta_{12} D_{i,t} + \beta_{13} dD_{i,t} + \beta_{14} dD_{i,t+1} + \beta_{15} dV_{i,t+1} + \beta_{16} L_{i,t} + \varepsilon_{i,t}$$

The market value of the firm is represented by V , calculated as the sum of the market value of equity and the book value of short- and long term debt. E stands for earnings before extraordinary items plus interest, deferred tax credits and investment tax credits. NA is the net assets, which are the total assets minus cash. RD is the R&D expense, I the interest expense, D represents the common paid dividends and L stands for the cash and marketable securities. When R&D is missing, it is set at zero. All variables are divided by total assets. For each independent variable X , X_t is the level in year t , divided by

Table 8

Determinants of Changes in predicted cash ratios between 2000 and 2006

The sample includes all firm-year observations on Compustat Global in the period 2000-2006 for firms incorporated in the European Union (excluding Romania and Bulgaria). Only observations with positive values for the book value of total assets and sales revenue are included. Financial firms and utilities are excluded from the sample. The whole sample consists of 22,192 observations. This table presents the determinants of the change in predicted cash between 2000 and 2006. The change in the cash ratio is examined as the difference between the actual cash holdings in the period 2000-2006 and the predicted ones. Predicted cash holdings are derived from a Fama-MacBeth model predicting cash ratios, the coefficients are estimated over the period 1993-1999. Difference is the distinction of the two options of the dummy variable. Within the parentheses the t-statistic of the t-test between the period 2000-2006 and 1993-1999 is given.

	Whole	Dividend Paying	Difference	Large firms	Difference	High Tech	Difference
NWC	0.006 (-0.412)	0.002 (-3.109)	-0.004	0.003 (-0.176)	-0.005	0.008 (-1.596)	0.004
Cash flow ratio	0.006 (3.267)	0.000 (-13.353)	-0.006	-0.001 (-21.379)	-0.008	0.010 (-3.821)	0.007
Industry sigma	-0.009 (-98.425)	-0.007 (-49.25)	0.003	-0.006 (-41.941)	0.003	-0.013 (-58.732)	-0.008
Capex	0.003 (-30.182)	0.002 (-5.786)	0.000	0.002 (-15.556)	-0.001	0.004 (-20.277)	0.001
Acquisitions	-0.001 (-28.361)	-0.001 (-16.731)	0.000	-0.001 (-13.884)	0.000	-0.001 (-15.439)	-0.001
R&D	-0.003 (-20.385)	0.000 (-11.562)	0.002	0.000 (-11.055)	0.004	-0.004 (-17.203)	0.001
Market-to- book	0.050 (-38.776)	0.073 (-5.542)	0.035	0.029 (-19.499)	-0.032	0.141 (-25.439)	0.095
Dividend dummy	0.035 (-21.799)	0.000 (-21.9333)	0.000	0.005 (-20.929)	-0.039	0.035 (-12.813)	0.008
Size	0.020 (-59.497)	-0.088 (-26.233)	-0.161	-0.042 (-29.465)	-0.058	0.016 (-31.134)	0.020
Leverage	-0.001 (-51.513)	-0.003 (-21.248)	-0.006	-0.005 (-28.539)	-0.005	0.005 (-24.469)	0.008
Net equity issuance	-0.002 (-23.925)	0.001 (2.048)	0.002	0.000 (-4.423)	0.003	-0.001 (-16.811)	0.000

the level of total assets in year t . dX_t is the change in the level of X from year $t-1$ to year t , divided by total assets in year t . dX_{t+1} is the change in the level of X from year $t+1$ to year t , divided by total assets in year t . Pinkowitz and Williamson (2004) use in their valuation regression lags and leads of two years, due to a limited dataset I use one-year lags and leads.

Table 9**OLS regressions for the market value of the firm**

The sample includes all firm-year observations on Compustat Global in the period 1988-2010 for firms incorporated in the European Union (excluding Romania and Bulgaria). Only observations with positive values for the book value of total assets and sales revenue are included. Financial firms and utilities are excluded from the sample. The first model is the whole sample and consists of 46,614 observations, the second model only includes firms with total assets that exceed 100 million Euros in 2005 and contains 26,458 observations. The dependent variable for the regressions is the market value of the firm in year t (V_t). For each independent variable X , X_t is the level in year t , divided by the level of total assets in year t ; dX_t is the change in the level of X from year $t-1$ to year t , divided by total assets in year t ($(X_t - X_{t-1}) / AT_t$); dX_{t+1} is the change in the level of X from year $t+1$ to year t , divided by total assets in year t ($(X_{t+1} - X_t) / AT_t$). P-values are based on standard errors robust to clustering by firm and are reported in the parentheses.

Model	1		2	
	Estimate	P-Value	Estimate	P-Value
Intercept	0.668	(0.000)	0.505	(0.000)
E_t	-1.399	(0.000)	2.286	(0.000)
dE_t	0.259	(0.003)	-0.604	(0.000)
dE_{t+1}	0.145	(0.272)	1.261	(0.000)
DNA_t	0.778	(0.000)	0.609	(0.000)
DNA_{t+1}	0.704	(0.000)	0.463	(0.000)
RD_t	4.802	(0.000)	6.326	(0.000)
dRD_t	4.179	(0.000)	3.926	(0.000)
dRD_{t+1}	7.815	(0.000)	8.350	(0.000)
I_t	6.820	(0.000)	5.554	(0.001)
dI_t	-2.539	(0.032)	-0.624	(0.676)
dI_{t+1}	5.313	(0.000)	2.184	(0.061)
D_t	16.187	(0.000)	11.944	(0.000)
dD_t	-3.400	(0.000)	-2.652	(0.002)
dD_{t+1}	10.169	(0.000)	6.974	(0.000)
dV_{t+1}	-0.177	(0.000)	-0.273	(0.000)
L_t	1.943	(0.000)	1.583	(0.000)
L_t * 2000s	0.000	(0.000)	0.000	(0.001)
L_t * crisis	0.000	(0.001)	0.000	(0.003)
R^2	19.4%		23.5%	

The results of the regressions are summarized in Table 9. Model 1 of Table 9 shows the estimations of the whole sample. I incorporated two interaction terms with the cash and marketable securities, these are the periods 2000-2006 and 2007-2010. Both terms are significant, although the coefficients are too small to provide a relevant change in the market value. Similar to Bates et al. (2009) the coefficient of earnings is negative and all other coefficients are as expected. This could be a result of agency motive but to check whether earnings are driven by the smaller firms, a second regression is performed. Model 2 re-estimates Model 1 by excluding all firms with total assets of less than 100 million Euros in 2005. In this new model earnings have the expected positive coefficient and it is reasonable to assume that smaller firms have a different cost of equity. The R^2 increases by 4% to 23.5%.

5. Conclusions

This thesis examined the determinants of cash holdings of European firms between 1988 and 2010. The average cash ratio over the total sample period increased by 49.9%. I documented an average yearly increase of 0.22%, this is less than half the increase of the US firms in the period 1980-2006 as reported by Bates et al. (2009). Part of this difference could be due to the financial crisis: the average cash ratio fell by 16.3% over the period 2006-2010. The theoretical literature provide four motives to hold cash. The transaction motive explains the costs of converting non-cash assets into cash. The precautionary motive is a buffer against future negative cash flow shocks. The agency motive explain the costs of the conflict between managers and owners. The fourth motive, the tax motive, is not examined in this thesis.

The increase of cash holdings can be allocated to smaller firms, firms with negative income, dividend paying firms and firms with high idiosyncratic risk. Non-dividend paying firms have a higher cash ratio but as a result of the large decrease during the crisis years, the increase of dividend paying firms is higher. This is contradicted to the results of Bates et al. (2009). The higher cash ratio of non-dividend paying firms does prove small evidence for the agency motive. Next, a regression analysis about the firm

characteristics on cash holdings is performed. The results are in line with the assumptions of the transaction and precautionary motive and similar to the estimations of Bates et al. (2009). The most important determinants of the increase of cash holdings are that net working capital has fallen, cash flow risk for firms has increased, capital expenditures and acquisitions have fallen, R&D expenditures have increased and the leverage ratio has fallen. These results are generally robust. An extra regression with a crisis dummy did not lead to significant different results.

Special attention was given to the crisis years. A fall of the cash ratio of non-dividend paying firms, nonnegative firms and high-tech firms contribute to the decrease in the period 2007-2010. This fall of the average cash ratio seems to be a contradiction of the precautionary motive. An additional research of the interaction with the crisis years does not show changes in the determinants of cash holdings, most of the determinants are insignificant. All determinants do have higher coefficients than without the interaction effect, this could be a result of the higher volatilities during the crisis.

As estimated play changes in firm characteristics an important role in the increase of cash holdings. The correlation between firm characteristics and cash holdings is analyzed using the Fama-MacBeth regressions for the period 2000-2010. The model constantly overestimated the cash ratios for the whole sample, the dividend as well as the non-dividend paying firms, the small and large firms and the manufacturing firms. This means that the model overestimates the period 2000-2010, again possibly the result of the financial crisis. The market-to-book ratio, dividend dummy and real size explain most of the change in cash holdings for the period 2000-2006. These are other determinants than those found by Bates et al. (2009) but they also confirm the transaction and precautionary motive. The period 2007-2010 does not show meaningful results.

The last paragraph of Chapter 4 tried to find more evidence about the agency motive by means of a valuation regression of Pinkowitz and Williamson (2004). Earnings have a negative relation with

market value when the smallest firms are included, but there is too little evidence to assign this to the agency motive.

The agency as well as the tax motive are therefore important topics for further research. Compared to Bates et al. (2009) I did not take the credit spread, initial public offering and net debt issuance into account. These determinants could also be included in further research about European companies.

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