Cash Holdings of European Companies

Master Thesis in Finance

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Abstract

This paper investigates the evolution and the determinants of corporate cash holdings in five European countries from 1980 to 2011. The results show that the average cash ratio increases from 7.1% in 1980 to 14.5% in 2011. This increase is concentrated among smaller firms, non-dividend payers, firm with negative income and firms with high cash flow volatility. The cash ratio is positively related to market-to-book ratio, industry cash flow risk and R&D expenditures. There is a negative relation between cash and leverage, capital expenditures, net working capital and cash flows. Remarkably, the relation between dividends and cash changes from positive to negative in 1995. The most important determinants of cash holdings are the net working capital, the capital expenditures and the R&D. Consistent with the precautionary motive, an upward trend in the cash ratio is observed during the financial crisis. This increase is caused by a regime shift in the demand for cash rather than by change in the relation between cash and its determinants. The findings of the study support the transaction motive, the tax motive and precautionary motive for holding cash, and provide partial evidence for the agency motive.

1. Introduction

US non-financial corporations held more than $1.7 trillion in cash and other liquid assets at the end of March 2012.[1] The largest amount of cash is held by the information technology sector (Apple Inc., Microsoft, Cisco, and Google) and the pharmaceuticals (Pfizer, Johnson & Johnson, and Amgen).[2] The reasons for these high cash holdings have been extensively studied by the financial literature. Keynes (1936) introduced two major motives for holding cash: the transaction motive and the precautionary motive. The transaction motive states that firms hold liquid assets to avoid the costs of raising funds. The precautionary motive, on the other hand, refers to the benefit of holding cash in case of adverse financial shocks. In this regard the precautionary motive for holding cash is extremely significant during a financial crisis. The third motive for holding cash is associated with the taxes that multinational firms face when they repatriate foreign income. Therefore, U.S. multinationals, for instance, have an incentive to keep earnings abroad. Finally, firms that experience agency problems have more cash because to a large extent this cash is accumulated by entrenched managers who pursue their personal interests.

Because of these reasons the average cash holdings of firms around the world have significantly increased over the past decades. Bates et al. (2009) show that the average cash to assets ratio of U.S. firms increased from 10.5% in 1980 to 23.2% in 2006. The increase in cash is more pronounced among non-dividend paying firms, firms in more recent IPO listing cohorts and firms in industries with greatest increase in idiosyncratic volatility. Using the model of Opler et al. (1999), Bates et al. (2009) find that the decrease in inventories and capital expenditures, and the increase in cash flow risk and R&D spending are the major causes for the upward trend in cash holdings. Recent studies have examined the trends in cash holdings in other industrialized countries, such as Canada, United Kingdom, Germany, and Japan (e.g., Iskandar-Datta and Jia (2012), Ozkan and Ozkan (2004)). As for Europe, Ferreira and Vilela (2004) do not find any clear trend in cash holdings in the EMU countries for the period from 1987 to 2000. Therefore, the need for further research on cash holding of European firms emerges.

The aim of this study is to investigate the trend of European corporate cash holdings, and more specifically, whether the cash holdings of European firms have increased in the past thirty two years as much as those in the U.S. Generally speaking there are significant differences between U.S. and Europe which can contribute to a different corporate cash management and different evolution of cash holdings. For instance, European investors are less protected as compared to the

[1] Federal Reserve statistical release, Flow of Funds Accounts of the United States, First Quarter 2012, Board of Governance of the Federal Reserve System, Washington DC 20551.

[2] Lane, R.J., Gray, M. 2012. Moodys: US Corporate Cash Pile at $1.24 Trillion, Over Half located Overseas, Moody's Investors service, 14 March 2012. The source is available at: http://www.moodys.com/research/Moodys-US-Corporate-Cash-Pile-At-124-Trillion-Over-Half-PR_240419.

U.S. investors. Therefore, the agency problems in European firms can be more severe and firms may hold more cash as a result. In this regard, the study intends to investigate the evolution of cash of European firms and compare it with the trends in the U.S. Besides, this study examines the reasons for the change in cash, namely whether the change in cash can be attributed to certain types of firms, changes in firm characteristics or changes in the relation between cash and firm characteristics.

This paper extends the existing literature in two ways. First, it studies the cash holding of European firms for a long period (1980-2011). Second, it focuses on the cash levels during the financial crisis and examines the impact of the recession on firm characteristics, which in turn attribute to a change in cash.

Following Bates et al. (2009), I measure the cash as the ratio of cash and marketable securities to total assets. In some regressions, however, I use the natural logarithm of the ratio of cash and marketable securities to net assets. The latter definition of cash follows Foley et al. (2007) and intends to remove the impact of outliers.

I use a large sample of European firms drawn from Datastream over the period 1980-2011. Specifically, I employ financial data of publicly traded firms in France, Germany, Italy, Spain and UK to test the theoretical determinants for holding cash. Additionally, I use the proxy variables suggested by La Porta et al. (1998) to investigate the agency motive.

The results of the study show that the cash ratio of European firms increased from 7.1% in 1980 to 16.8% in 2006 but the trend is negative in the last few years. In 2011 the average cash ratio is 14.5%. The cash holdings of U.S. firms documented by Bates et al. (2009) are slightly higher (10.4% in 1980 and 23.2% in 2006). Consistent with Bates et al. (2009), I find that the increase in cash can be explained by changes in firm characteristics rather than changes in the relationship between firm characteristics and cash. I find that the increase of cash can be attributed to a decrease in net working capital and capital expenditures and an increase in R&D expenditures. The increasing average cash ratio during the financial crisis is in line with the precautionary motive. The most important determinants for the change in cash during the recession are market-to-book ratio, NWC and leverage.

The remainder of the paper proceeds as follows. Section 2 gives an overview of the theoretical motives for holding cash and establishes the empirical hypotheses. Section 3 provides information about the data set and defines the major variables used in the empirical analysis. The trends in cash ratio for the whole sample and specific subsamples are shown in Section 4. Sections 5 and 6 investigate in depth the determinants of cash for the whole sample period and for the financial crisis. Section 7 concludes.

2. Literature Background and Testable Hypotheses

The financial literature has emphasized four major motives for holding cash, which are extensively examined in the following section. Based on the existing theories on cash holdings determinants, I establish the empirical hypotheses.

2.1 The transaction motive

According to the transaction motive, companies use cash for their transactions and business exchanges (Keynes (1936)). If a firm has insufficient internal resources to cover current business expenses, it can raise funds by selling assets, raise external funds in the capital market, cut dividends, or reduce investments. In a Modiliani-Miller world firms would be able to raise funds at no cost and therefore they would be indifferent between holding cash and borrowing money. However, in the real world raising funds is costly. On the one hand, there is a substantial fixed expense of accessing outside markets. On the other hand, there is a variable expense that depends on the amount raised. Firms avoid these costs when accumulating large amounts of cash. It is important to note, however, that holding large amounts of cash is associated with opportunity costs due to the forgone interest on the cash. In this regard, Opler et al. (1999) show that the optimal amount of cash reserves is given when the marginal costs of holding liquid assets are equal to the marginal costs of cash shortage. Since the marginal costs of liquid assets are constant, they can be graphically represented as a horizontal line. The marginal costs of liquid assets shortage increase as shortage increases because in case of shortage firms have to cut investments or raise more external finance. Because these actions lead to higher costs, the marginal costs of liquid assets shortage can be represented as a downward sloping curve. As a result, one can expect companies that incur higher transaction costs to be more likely to accumulate cash. In a nutshell, the transaction costs should be considered as an important factor for holding cash. In this context, the classical paper of Baumol (1952) emphasizes the transaction costs of transferring high interest-bearing assets into cash. Specifically, an increasing demand for cash is found when the transaction costs of selling interest-bearing assets increase. Similarly, Miller and Orr (1966) study the transaction motive for holding cash and show that higher brokerage costs lead to higher corporate cash holdings.

A considerable number of other papers study the transaction motive for holding cash. The model of Mulligan (1997) shows, for instance, that due to economies of scale it is less costly for large firms to obtain external finance. A recent study by Peterson and Rajan (2002) also supports the hypothesis that borrowing money is more expensive for smaller firms. Specifically, the results of their study show that the costs associated with raising external funds are not correlated with the borrowed amount of money, suggesting that these costs are fixed. Hence, it is expected that

smaller firms would hold more cash to avoid these fixed costs. In other words, there should be a negative relationship between firm size and cash holdings.

H1a. Firm size: *Larger firms hold less cash than smaller firms.*

Furthermore, the amount of cash held due to transaction reasons depends on how easily firms can liquidate assets in case of shortage. Schleifer and Vishny (1992) show that a firm selling firm-specific assets faces substantial transaction costs, whereas if the firm has noncash liquid assets, it can use them at a low cost in case of a shortfall. Therefore, firms with more noncash assets hold less cash (Ferreira and Vilela (2004), Opler et al. (1999)). To determine the relation between noncash assets and cash, financial researchers (for example, Opler et al. (1999), Ferreira and Vilela (2004), Bates et al. (2009)) use the net working capital, net of cash. The net working capital mirrors the ability of a firm to cover its current liabilities and operating expenses and that is why it can be used as a proxy of the liquid assets substitutes. According to Bates et al. (2009), one of the main reasons for the increase in cash ratio in their sample is the fall in net working capital. Taken together, I expect a negative relationship between cash substitutes and cash holdings.

H1b. Noncash liquid assets: *Firms with sufficient noncash liquid assets hold less cash.*

Besides, Kim et al. (1998) argue that firms with high cash flow have a ready source of liquidity. Consequently, such firms do not need to accumulate large amounts of cash.

H1c. Cash flow: *Firms with more cash flow hold less cash.*

2.2 The precautionary motive

Like the transaction motive, the precautionary motive for holding cash was first introduced by Keynes (1936). It states that firms accumulate cash to avoid financial distress costs. Accordingly, firms benefit from holding cash in the sense that they can invest in profitable projects when external financing is costly or even not available (Pinkowitz and Williamson (2006)).

Among the financial researchers who have studied the factors of the precautionary demand for cash, Opler et al. (1999) emphasizes the role of cash flow volatility for holding precautionary cash. They find evidence that firms hold substantial cash amounts when cash flows are more volatile. The explanation is that more volatile cash flows are riskier and adverse financial shocks are more likely to occur. In that respect, it is important to note that Campbell et al. (2001) record an increase in idiosyncratic risk over the sample period from 1962 to 1997. Similarly, Irvine and Pontiff (2008) document an increase in idiosyncratic return volatility over the period 1964-2003.

They explain that this increase in idiosyncratic return volatility reflects an increase in idiosyncratic volatility of fundamental cash flows. Most importantly, since this risk cannot be hedged through the use of derivatives, only holding more liquid assets can prevent companies from unfavorable financial shocks. Consequently, the predicted relationship between cash flow volatility and cash holdings is positive.

H2a. Cash flow volatility: *Firms with more volatile cash flows and higher frequency of cash flow shortfalls accumulate more cash.*

If firms do not accumulate more cash to hedge this risk, adverse financial shocks may have a significant impact on their future growth. This concerns mainly firms with better investment opportunities because of the losses that may occur from forgone profitable projects and investments (Ferreira and Vilela (2004)). This prediction is supported by Opler et al. (1999), who identify the market-to-book ratio and the R&D costs as proxies for the investment opportunities. In addition, firms which value depends on growth options incur higher financial distress costs. Ozkan and Ozkan (2004) and Ferreira and Vilela (2004) explain that because of the intangible nature of the growth options, their value drops suddenly in case of bankruptcy. Hence, the investment opportunity set is namely another important factor in determining the precautionary motive for holding cash. It is expected that firms with better investment opportunities use cash as a buffer against bankruptcy losses and such firms are more likely to accumulate precautionary cash.

H2b. Investment opportunities: *Firms with better investment opportunities hold more cash.*

Financial researchers use several proxies to measure the investment opportunity set. As already mentioned, the market-to-book ratio is one of the most widely used variables for that purpose. The higher the market-to-book ratio of a company is, the better the investment opportunities it has and the greater the losses it would incur in case of bankruptcy. Following this, there should be a positive relation between market-to-book ratio and cash holdings.
Another frequently used proxy for the amount of investment opportunities and financial distress costs is the capital expenditure (as is used in the study of Kalcheva and Lins (2007) and Bates et al. (2009)). Firms with more capital expenditures are expected to have greater investment opportunities and to hold larger amount of liquid assets.
Finally, Opler et al. (1999) use research and development costs to proxy the investment opportunities. The R&D expenditures have been identified as a major contributor of information asymmetries (Aboody and Lev (2000)) because of their intangible nature (see, for example, Barth and Kasznik (1999)). Therefore, the problem with the higher R&D expenses is that they may

involve larger financial distress costs (Opler and Titman (1994)). To avoid high bankruptcy costs, firms with higher R&D expenditures hold more cash. The research papers of Opler et al. (1999), Dittmar et al. (2003) and Bates et al. (2009) confirm the positive relation between R&D costs and cash.

Another important factor in determining the precautionary demand for holding cash is the access to capital markets. Financially unconstrained firms have no restrictions to access the external capital and to get sufficient external funds for their investments. Such firms do not need to hold precautionary cash. Nevertheless, in the real world most of the firms have to take into account the availability and costs of external financing in their investment decisions. When it is difficult to obtain external funds, firms accumulate cash reserves. Therefore, financial researchers consider the financial constraints as an important factor affecting the demand for liquid assets. Almeida et al. (2004) relate the financial constraints to the firm's propensity to save cash out of cash inflows, referred to as the cash flow sensitivity of cash. Using a large sample of manufacturing firms over the period 1971–2000, they find a strong support for their hypothesis, namely that financially constrained firms show a systematic propensity to save cash. Following the approach of Almeida et al. (2004), Han and Qiu (2007) separate the firms in their sample into financially constrained and financially unconstrained based on the dividend payout ratio, firm size, bond ratings and commercial paper ratings. Their model shows that financially constrained firms hold more cash in the presence of cash flow volatility. As for the unconstrained firms, they do not find a link between cash holdings and cash flow volatility. Further, Campello et al. (2010) survey 1050 Chief Financial Officers in the U.S., Europe and Asia to investigate financially constrained during the global financial crises and find that financially constrained firms used their cash savings as a buffer against adverse financial shocks.

To measure whether a firm is financially constrained, financial researchers use different proxy variables.

First, Fazzari et al. (1988) consider the dividend payout ratio as a proxy for the financial constraints. The researchers assume that firms with lower payout ratio have more difficulties in obtaining external finance. Similarly, Opler et al. (1999) and Bates et al. (2009) argue that firms that do not pay dividends are more risky and have limited access to capital markets. Hence, such firms should have a precautionary motive for holding more cash. In contrast to this theory prediction, Guney et al. (2007) find a positive relation between dividend payout and cash holding in German companies for the period 1996-2000. And according to their research, dividend payout has no impact on corporate cash holdings in France, UK and Japan. Nevertheless, following Bates et al. (2009), I expect a negative relation between dividends and cash holdings.

Second, researchers use the firm size to sort companies into financially constrained and unconstrained categories (see for example, Gilchrist and Himmelberg (1995)). Smaller firms are assumed to be younger, less well known, and thus more likely to be financially constrained.

Titman and Wessels (1988) consider larger firms to be more diversified and less likely to experience bankruptcy. Since such firms would have lower financial distress costs, they are expected to hold less cash for precautionary motives, which in turn suggests a negative relation between firm size and corporate cash holdings.
Finally, I turn to the net income. Since researchers consider the negative net income as an indicator for financial constrains, firms with negative net income should have higher levels of cash.

H2c. Financial constraints: *Financially constrained firms hold more cash*

The increase in precautionary cash can also be attributed to the level of leverage. The relation between leverage and cash holdings, however, is still an empirical issue. On the one hand, Ferreira and Vilela (2004) argue that firms with higher leverage are more likely to experience financial distress. Thus, such firms are expected to hold more cash in order to reduce the probability of bankruptcy. Moreover, Acharya et al. (2007) state that financially constrained firms with high hedging needs, i.e. if the correlation between operating income and investment opportunities is low, hold more cash instead of reducing their debt levels. Accordingly, cash holdings might be positively related to leverage. On the other hand, some researchers argue that there might be a negative relation between corporate cash levels and leverage. For instance, Bates et al. (2009) explain that firms hold more cash to reduce the level of debt, when debt is already enough constraining, and in turn to reduce the probability of financial distress. Ferreira and Vilela (2004) also provide a strong evidence for a negative relation between cash holdings and leverage. Further, Gunay et al. (2007) analyse in depth the nature of the relationship between cash levels and leverage. Although they are not the first to study the impact of leverage on cash holdings, they find, in contrast to prior research, that the relation between cash holdings and leverage is non-monotonic. That is, leverage is negatively related to cash at low levels of leverage but the relation becomes positive when the levels of leverage are higher. The reason is that firms are more likely to experience financial distress at high levels of leverage and that is why they hold more cash to avoid eventual bankruptcy costs. At lower levels, leverage acts as a proxy for the ability of firms to issue debt, meaning that borrowings can be a substitute of cash.
Since Bates et al. (2009) find a negative relation between leverage and cash, I expect that this relation will hold true in my sample also.

H2d. Leverage: *There is a negative relation between leverage and cash.*

2.3 The tax motive

The tax motive for holding cash stems from the incentives created by the taxes that multinational firms face. This motive is associated with the taxes of foreign income, repatriated to the home country. Firms facing higher repatriation taxes hold more cash abroad. Generally, U.S. multinational firms pay taxes for their operations abroad. If the foreign earnings are repatriated to the U.S., firms pay the difference between the U.S. tax rate and the tax credits that they get for the taxes paid abroad (Foley et al. (2007)). Because of these tax burdens and the lack of profitable projects, U.S. multinationals retain their earnings abroad. In their empirical work Foley et al. (2007) analyze detailed financial data on the domestic and foreign operations of a large sample of U.S. firms for the period 1982-2004. They confirm the theoretical predictions and find four main results on the tax-based explanation for holding cash. First, firms that are subject to higher tax costs of repatriated earnings have higher cash levels. Second, the repatriation tax burdens are the reason that multinational firms hold more cash abroad. Third, incorporated affiliates in lower tax jurisdictions hold more cash than branch affiliates. Since U.S. taxes the foreign branch earnings as they are earned, branches do not have a tax motive to retain high levels of cash. Finally, firms that have high levels of debt are less sensitive to the tax costs triggered by repatriation and hold less cash.

To measure the effect of taxes associated with repatriation, Bates et al. (2009) use firms with nonmissing foreign pretax income. Following Bates et al. (2009), I expect that firms with more foreign income hold more cash due to the tax costs of repatriation.

H3. Foreign income: *Firm with higher foreign income hold more cash.*

2.4 The agency motive

The agency motive for holding cash stems from agency conflicts. The agency problems arise when controlling shareholders' interests do not align with the interests of outside shareholders. This is the case when, for instance, controlling shareholders and managers extract private benefits at the expense of outside investors. Specifically, managers accumulate more cash that benefit them personally. Therefore, agency problems are of great importance in determining corporate cash holdings.

Most of the conflicts between managers and shareholders are associated with the payout policies. Jensen (1986) argues that these conflicts are especially serious when firms generate large amounts of free cash and entrenched managers retain the cash and invest it in even not profitable projects. By doing so, managers increase their power and compensation. Opler et al. (1999) provide a fundamental framework to study the agency motive for holding cash and discuss two important agency factors that contribute to higher cash holdings. First, risk averse managers accumulate more cash. Second, managers who seek private benefits from investment projects

hold more cash. The accumulated cash provides managers with the flexibility to invest in any risky project from which they can extract more personal benefits.
Financial researchers use proxies based on firm characteristics to represent the agency costs of free cash flow, and thus to identify the impact of agency conflicts on the cash holdings. For instance, the investment opportunity set, measured by the market-to-book-ratio (see, for example, Ferreira and Vilela (2004)), can be used as an indicator for generated free cash flow. Bates et al. (2009) argue that firms with weaker growth opportunities generate more free cash flow to ensure ready cash for future growth projects, even if these projects are not always profitable. Hence, using the market-to-book ratio, there should be a negative relationship between investments opportunities and accumulated cash.

H4a: Investment opportunity set: *Firms with poor investment opportunity set hold more cash.*

The next variable used to proxy for agency conflicts is the firm size. Larger firms have larger shareholders dispersion (Ferreira and Vilela (2004), which means that managers of larger firms have more power to decide on the corporate cash policies and to accumulate more cash. Consequently, firm size should be positively related to corporate cash reserves.

H4b. Size: *Larger firms hold more cash.*

Finally, superior managerial discretion can easily arise in low leverage companies because capital markets do not monitor them (Ferreira and Vilela (2004)). Hence, the free cash flow theory predicts a negative relationship between leverage and cash holdings.

H4c. Leverage: *Less levered firms hold more cash.*

It is important to note, however, that controlling shareholders and managers can extracts more private benefits in countries with weak shareholder protection (see, for example, La Porta et al. (2002), Claessens et al. (2002), Lins (2003), Lemmon and Lins (2003), and Klapper and Love (2003)). In that respect, Dittmar et al. (2003) examine the role of corporate governance in determining the corporate cash levels. For a large sample of companies from 45 countries, they find strong evidence for higher cash levels in countries where shareholder rights are not well protected. Consistently, Ferreira and Vilela (2004) and Guney et al. (2003) find that firms in countries with better investment protection accumulate less cash. In related vein, a recent cross-country research of Kalcheva and Lins (2007) shows that entrenched managers are more likely to stockpile cash especially when country-level external shareholder protection is weak. All these empirical studies (Dittmar et al. (2003), Kalcheva and Lins (2007), Ferreira and Vilela (2004))

use international data to study the impact of corporate governance and agency costs on corporate cash levels. The cross-country data provides strong supportive evidence on the theoretical predictions because it captures the differences across countries in legal environment, investor protection, ownership structure, and capital markets development – factors related with different levels of agency costs.

In contrast, the empirical evidence on the agency motive for holding cash in U.S. firms is weak. For example, Opler et al. (1999) and Bates et al. (2009) do not provide supportive evidence for the agency motive in the U.S. Dittmar et al. (2003) explain that this is due to the good shareholder protection in the U.S. However, recent empirical work is beginning to challenge this belief. More specifically, Harford et al. (2008) shed light on the impact of agency problems on the propensity to accumulate cash in the U.S. by showing that firms with weaker corporate governance hold less cash.

Financial researchers are also interested in investigating the impact of agency conflicts on the value of corporate cash holdings. It is argued that in the presence of agency costs, the value of corporate cash holdings is less because of two reasons: the small amount of cash that outside investors own and the private benefits that controlling shareholders extract. Dittmar and Mahrt-Smith (2007) study the value effect of corporate governance on cash holdings in U.S. firms and show that the value of excess cash is substantially less in poorly governed firms. The explanation for their finding is that poorly governed firms spend excess cash and as a result destroy firm value. Pinkowitz et al. (2006) show that minority shareholders discount corporate cash more in countries with weaker investor protection. In addition, Kalcheva and Lins (2007) provide evidence that the firm value is lower in the presence of entrenched managers and weaker external country-level shareholder protection. Thus, the value of the cash decreases in the presence of agency conflicts and there should be a negative relationship between the amount of cash holdings and the level of investor protection.

H4d. Investor protection: *Firms hold more cash if they are located in countries with lower investor protection.*

One of the most widely used proxies for shareholders protection in cross-country empirical studies (see, for example, Pinkowitz et al. (2006), Kalcheva and Lins (2007)) is the La Porta et al. (1998) measure of anti-director rights (*ADRI*). The original index has been criticized for mistakes and has been revised by Djankov et al. (2006) and Spamann (2010). This index can take values between zero and five, with higher values representing a better shareholders protection. Also, the *ADRI* should be negatively related to the level of cash.

H4e. Anti-director rights index: *The higher the anti-director rights index, the less cash should be accumulated.*

Further, the creditor rights index (*CR*) by La Porta et al. (1998) measures the creditor protection. Brockman and Unlu (2009) revised and updated it. The index ranges from zero to four, with higher values indicating better creditor rights protection. Bates et al. (2009) and Ferreira and Vilela (2004) use it in their studies to identify the effect of agency problems on corporate cash holdings. Using it to measure the creditor protection, I expect a negative relation between cash holdings and the creditor rights index.

H4f. Creditor rights index: *Higher creditor rights index is associated with less cash.*

The next variable is the rule of law index (*RL*). It is produced by the country risk rating agency International Country Risk (ICR). This index represents an estimate of the law and order tradition in a given country and ranges from zero to ten. Higher values of the rule of law index indicate more tradition for law and order. Thus, I expect a negative relationship between *RL* and the corporate liquid assets.

H4g. Rule of Law index: *There should be a negative relation between the RL and the corporate cash levels.*

Finally, Ferreira and Vilela (2004) find strong evidence for a negative relation between cash holdings and ownership concentration. One possible explanation for this finding is that concentrated corporate ownership structures are associated with poorer shareholder protection (La Porta et al. (1998)). When the country's legal protection is weak, large shareholders monitor managers and prevent them from keeping large amounts of cash. Therefore, I control for ownership concentration in studying the relation between investor protection and cash holdings. I expect a negative relationship between ownership concentration and cash holdings.

H4h. Ownership concentration indicator: *Ownership concentration should be negatively related to cash.*

2.5 The pecking order theory

The pecking order theory by Myers (1984) states that firms follow a particular financing order in order to cope with the asymmetric information problems. In the first place, firms should use retained earnings to finance their investments. If the retained earnings are not enough to cover the investment needs, firms should issue safe debt or risky debt and lastly issue equity. Following

this financing order, firms accumulate the retained earnings to finance profitable future projects and eventually to repay debt. In this regard, firms with higher cash flows are more likely to have enough retained earnings for their investment and debt repayment. And all the rest is accumulated cash.

H5a. Cash flows: *Firms with higher cash flows hold more cash.*

If the investments exceed the retained earnings, firms use their cash reserves and issue debt. Thus, in the pecking order world, cash holdings and leverage move in an opposite direction.

H5b. Leverage: *There should be a negative relation between cash and leverage.*

Finally, according to the pecking order theory, larger firms are more likely to be successful. Evidently, larger firms should hold more cash, after controlling for investments (Opler et al. (1999)).

H5c. Size: *There should be a positive relation between cash and firm size.*

3. Data Description

This section describes the dataset and the methodology for conducting the research. Also, the dependent and independent variables are defined and summary statistics of all variables are provided.

3.1 Sample construction

For the empirical investigation on the cash holdings of European firm I construct a panel data set of publicly traded European firms from 1980 to 2011. The initial data set contains all surviving and non-surviving firms for which financial data is available on Datastream for the sample period. The main data set has been constructed as follows. First, financial firms (SIC codes 6000-6999) were dropped from the sample because they may keep cash to meet capital requirements. Utilities (SIC codes 4900-4999) were also excluded because their cash holdings can be under regulatory supervision. Second, firm-year observations with negative total assets and sales were removed from the sample. Finally, missing firm-year observations for any variable were dropped. The study focuses on analyzing the trends in corporate cash holdings in five industrialized European countries, namely UK, Germany, France, Spain, and Italy. The final sample consists of 53,195 observations for 4,786 unique firms from five sample countries.

3.2. Cash ratio

Financial researchers define the cash ratio in different ways (Bates et al. (2009)) but the most common measure is the ratio of cash and marketable securities to total assets. Opler et al. (1999) subtract cash and marketable securities from total asset in the denominator, arguing that the firm's ability to generate future profits depends on the available assets. This ratio is therefore referred to as cash-to-net-assets ratio.[3] It generates a lot of outliers, however. To improve this approach, Foley et al. (2007) define the cash as the natural logarithm of cash to net assets. Finally, the cash holdings can be computed as the ratio of cash and marketable securities to sales (Bates et al. (2009)). In this research I follow Bates et al (2009) and define the cash ratio as the ratio of cash and marketable securities to total assets. Moreover, in some regressions I use the log of the cash-to-net-assets ratio in order to reduce the impact of outliers and to confirm the consistency of the results.

Table 1 shows descriptive statistics for the cash ratio in five European countries over the sample period from 1980 to 2011. The mean cash ratio in most of the countries lies between 12% and 14%. Spain exhibits the lowest levels of cash relative to total assets (9.1%) in the sample. Consistent with Ferreira and Vilela (2004), Spain has also the lowest cash-to-net-assets ratio for the period 1987-2000 (see Table B.1. in the Appendix B). Ferreira and Vilela (2004) explain that these differences in the average cash holdings across countries can result because of differences in the accounting standards. Different levels of shareholder protection, different bankruptcy laws and different state of development of capital markets can be also reasons for the small variations of the cash ratio across countries. Table 1 shows also that about half of the observations in the sample stems from UK. The large number of observations explains why the standard deviation in the UK is slightly higher.

[3] Kalcheva and Lins (2007) also use the cash-to-net-assets ratio in their research.

Table 1
Cash ratio by country

This table presents summary statistics for cash holdings across five European countries. The sample includes all firm-year observations of EU publicly traded firms with positive book value of total assets and sales for the period 1980-2011. Financial firms (SIC codes 6000-6999) and utilities SIC codes (4900-4999) are excluded. Firm-year observations with missing values for any variable are also removed from the sample. Cash ratio is defined as cash and marketable securities divided by total assets. N is the number of observations.

Country	Mean	SD	25^{th} Pctl	Median	75^{th} Pctl	N
France	0.135	0.129	0.046	0.095	0.183	10,773
Germany	0.125	0.151	0.026	0.069	0.165	9,516
Italy	0.123	0.123	0.040	0.083	0.161	3,475
Spain	0.091	0.102	0.023	0.058	0.121	2,192
UK	0.132	0.161	0.023	0.075	0.178	27,239
All countries	0.129	0.149	0.029	0.079	0.173	53,195

3.3. Explanatory variables

Having discussed the transaction and precautionary motives for holding cash in Section 2, this section reveals the variables related to these motives.

The first variable is the market-to-book ratio. It is used as a proxy for the investment opportunity set because the market value of firm's assets increases relative to its book value in the presence of more growth options. The market-to-book ratio is calculated as book value of assets minus book value of equity plus market value of equity divided by book value of total assets.

Another variable used as a proxy for growth opportunities is the R&D ratio. It is measured as R&D spending divided by revenues. The ratio is set to zero if R&D is missing.

The ratio of capital expenditures to assets is also used to measure investment opportunities. It is estimated by dividing capital expenditures by total assets. Bates et al. (2009) use the acquisition spending as a substitute for capital expenditures. Since data on acquisitions activity is hard to get, I use only the capital expenditures.

Firm size is used to test both the transaction motive and the precautionary motive for holding cash. Following Foley et al. (2007), I define the firm size as the natural logarithm of total assets for the previous year.

To estimate the impact of liquid assets substitutes on cash holdings, I use the net working capital. The net working capital is measured as the ratio of current assets minus current liabilities and minus total cash and equivalents to total assets minus cash and equivalents ((current assets-current liabilities-total cash and equivalents)/(total assets-cash and equivalents)).

I employ the leverage ratio as a proxy for firm's debt. The leverage ratio is given by long-term debt plus debt in current liabilities divided by book value of assets (Opler et al. (1999)).

The industry cash flow risk is seen as a determinant for holding precautionary cash because mainly firms with higher cash flow volatility are exposed to financial shocks. Following Opler et

al. (1999), I measure the cash flow volatility as the mean of the cash ratio standard deviations of firms in the same two-digit SIC-code industry over the sample period (at least four years if data is not complete).

Another variable used for the analysis of the precautionary motive is the dividend dummy. It is set to one if a firm pays a common dividend in a particular year, and zero otherwise.

To reduce the influence of outliers, I winsorize the outliers in firm-year explanatory variables as follows. Extreme values of the leverage ratio are removed so that it lies between zero and one. Market-to-book ratio, capital expenditures to assets, and R&D are winsorized at 1% level. Finally, the bottom tail of the cash flow-to-total-assets ratio is winsorized at 1% level.

Table 2 provides summary statistics on the explanatory variables that are computed from Datastream. The overall mean of the market-to-book ratio is 1.56 and about 68% of the firm year observations include common dividends. The results also show that 24% of the observations report firms with negative net income.

Table 2
Summary statistics of the explanatory variables

The table presents descriptive statistics on key variables for this research. The sample includes all firm-year observations of EU publicly traded firms with positive book value of total assets and sales for the period 1988-2011. Financial firms (SIC codes 6000-6999) and utilities SIC codes (4900-4999) are excluded. Firm-year observations with missing values for any variable are also removed from the sample. Definitions of the explanatory variables are provided in Table A.1., Appendix A. N is the number of observations.

Variable	Mean	SD	25^{th} Pctl	Median	75^{th} Pctl	N
Leverage	0.226	0.133	0.131	0.212	0.295	53,119
MB	1.567	0.961	1.018	1.269	1.742	53,119
Real size	11.954	2.084	10.362	11.782	13.243	48,844
NWC	0.039	0.209	-0.074	0.037	0.161	52,152
Capex	0.061	0.070	0.020	0.042	0.077	53,119
Industry sigma	0.053	0.018	0.045	0.061	0.068	53,119
Cash flow	0.033	0.221	0.027	0.064	0.099	50,649
Dividend dummy	0.679	0.467	0.000	1.000	1.000	53,119
R&D/sales	0.016	0.059	0.000	0.000	0.001	53,119
Net income dummy	0.761	0.427	1.000	1.000	1.000	53,119

4. The Evolution of Cash Holdings over Time

4.1 Trends in cash holdings and leverage ratios

This section examines the trends in cash holdings of public firms in five European countries for the sample period 1980-2011. Furthermore, the section provides also the evolution of leverage and net leverage ratio.

Table 3 shows the evolution of the average cash ratio and the changes in the aggregate cash ratio and the median cash ratio over the sample period. The second column of the table gives the number of observations in each year. The third column reports the yearly aggregate cash ratio, defined as the sum of cash ratios of all firms in each year. The aggregate ratio increases from 8.7% in 1980 to 13% in 1987 and lies between 8% and 10% in the last ten years from the sample period. The average cash ratio, shown in the fourth column, is 7.1% in 1980. Although it increases to 16.8% in 2006, it is on average lower than the average cash ratio of U.S. firms, reported by Bates et al. (2009). However, from 2001 to 2006 the trend in the average cash ratio is upward for both European and U.S. firms. Turning next to the median cash ratio, I find similar results. The ratio increases from 3.8% in 1980 to 10% in 2011 (see also Figure B.1. in Appendix B for a graphical representation of the trends in mean and median cash ratios). The largest value of the median ratio is 10.7% in 2006, which decreases in the following years.

A regression on a constant and time examines whether the observed trend in the cash ratios is statistically significant. The time coefficient for the average cash ratio indicates that it increases by 0.28% per year on average (see Table B.2. in Appendix B). The R^2 of the regression model is 79%. For the median cash ratio, the time coefficient corresponds to a yearly increase of 0.18%. Most importantly, both time coefficients are statistically significant meaning that there is a positive time trend in the cash holdings of European firms in the sample period. However, this increase is lower than the annual increase of cash holding in US firms. Bates et al. (2009) find a 0.46% yearly increase in the average cash ratio and a 0.27% yearly increase in the median cash ratio.

Next, I focus on the evolution of the leverage ratio in the sample period. Columns 6 and 7 of Table 3 report the evolution of the mean and median leverage ratios. The results show that these two ratios decrease over the sample period. The average leverage ratio is 25.8% in 1980 and falls to 14.8% in 2011. Further, I examine the trend in the net leverage ratio, shown in the last two columns of Table 3 (see also Figure B.2. in Appendix B). The net leverage ratio is measured as long term debt plus debt in current liabilities minus cash and marketable securities, divided by the book value of total assets. This variable shows the role of cash as negative debt because cash can be used to pay off outstanding debt (Acharya et al. (2007)). According to the results shown in Table 3, the net leverage ratio decreases over the sample period. It starts at 18.7% in 1980, changes a lot over the sample period and becomes even negative (-0.1%) in 2011. In 2007 and 2008 it increases drastically, but decreases again in the following years. The median net leverage ratio is 18.7% in the beginning of the sample period and 4.7% in the last year of the sample period. Like the average net leverage ratio, the median net leverage ratio increases in 2007 and 2008. The reason for this increase might be the financial crisis. The impact of the crisis on cash and leverage is extensively discussed in Section 5.4.

Regressions of the leverage ratios on a constant and time examines the statistical significance of their patterns (see Model 3 and Model 4 in Table B.2. in Appendix B). The time coefficient of the average net leverage ratio indicates an average yearly decrease of 0.53%. The R^2 in this model is 85%. Similarly, the time coefficient of the median net leverage ratio corresponds to an average yearly decrease of 0.36%. The R^2 is 84%. Both models are statistically significant at the 1% level.

Table 3
Average and Median Cash and Leverage Ratios

The sample includes all Datastream firm-year observations of European publicly traded firms with positive book value of total assets and sales for the period 1988-2011. Financial firms (SIC codes 6000-6999) and utilities SIC codes (4900-4999) are excluded. Firm-year observations with missing values for any variable are also removed. The cash ratio is measured as cash and marketable securities divided by the book value of total assets. The leverage ratio is measured as long-term debt plus debt in current liabilities divided by the book value of total assets. N is the number of observations per year.

Year	N	Aggregate Cash Ratio	Average Cash Ratio	Median Cash Ratio	Average Leverage	Median Leverage	Average Net Leverage	Median Net Leverage
1980	301	0.087	0.071	0.038	0.255	0.238	0.191	0.197
1981	312	0.082	0.076	0.044	0.266	0.243	0.193	0.193
1982	330	0.085	0.083	0.053	0.263	0.242	0.181	0.174
1983	356	0.095	0.092	0.060	0.252	0.240	0.160	0.161
1984	450	0.104	0.097	0.069	0.234	0.228	0.138	0.141
1985	512	0.110	0.101	0.075	0.224	0.220	0.124	0.129
1986	597	0.127	0.113	0.084	0.213	0.212	0.103	0.123
1987	1,080	0.130	0.123	0.085	0.179	0.288	0.069	0.092
1988	1,453	0.123	0.114	0.077	0.182	0.299	0.082	0.011
1989	1,622	0.116	0.108	0.067	0.190	0.207	0.097	0.127
1990	1,736	0.109	0.104	0.064	0.193	0.213	0.103	0.138
1991	1,814	0.101	0.099	0.057	0.194	0.212	0.109	0.139
1992	1,825	0.100	0.103	0.058	0.192	0.202	0.102	0.128
1993	1,877	0.103	0.108	0.065	0.182	0.190	0.087	0.116
1994	1,905	0.113	0.112	0.073	0.182	0.195	0.082	0.114
1995	1,887	0.107	0.108	0.066	0.184	0.198	0.086	0.119
1996	2,045	0.099	0.113	0.066	0.176	0.191	0.074	0.111
1997	2,147	0.097	0.121	0.076	0.176	0.185	0.064	0.103
1998	2,181	0.088	0.123	0.073	0.178	0.189	0.065	0.101
1999	2,132	0.086	0.124	0.068	0.170	0.184	0.055	0.107
2000	2,353	0.079	0.148	0.076	0.151	0.174	0.012	0.091
2001	2,438	0.081	0.150	0.076	0.153	0.172	0.011	0.085
2002	2,348	0.082	0.150	0.082	0.165	0.181	0.024	0.090
2003	2,203	0.093	0.151	0.088	0.169	0.183	0.027	0.091
2004	2,208	0.096	0.159	0.100	0.162	0.174	0.011	0.068
2005	2,273	0.094	0.164	0.104	0.160	0.177	0.004	0.069
2006	2,358	0.091	0.168	0.107	0.152	0.166	-0.008	0.062
2007	2,338	0.089	0.160	0.101	0.156	0.168	0.003	0.062
2008	2,231	0.086	0.151	0.093	0.165	0.177	0.022	0.081
2009	2,091	0.100	0.156	0.107	0.152	0.159	0.004	0.050
2010	1,974	0.102	0.159	0.111	0.151	0.161	-0.001	0.046
2011	1,849	0.094	0.145	0.100	0.148	0.160	0.001	0.047

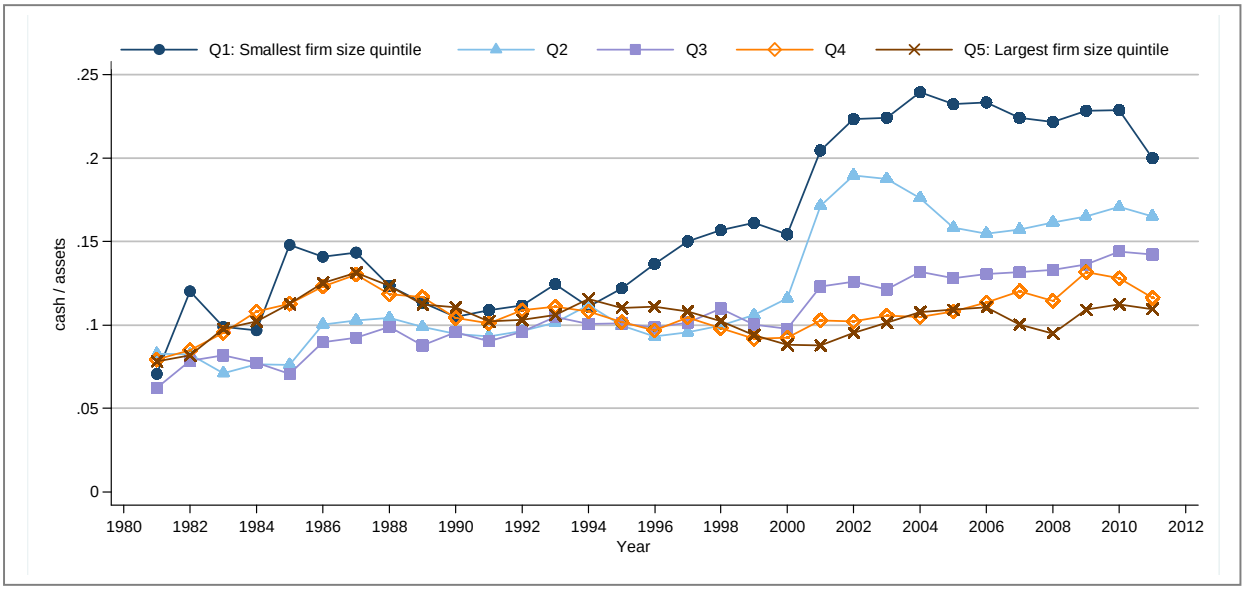
4.2 Cash ratio by firm size

In this section I investigate whether the trend in the cash levels differs across firms of particular size. In order to do this, I divide the sample into quintiles in each year according to the book value of total assets in the prior year. Thus, the sample for this analysis expands from 1981 to

2011. Quintile 1 represents the smallest firms, whereas the largest firms are assigned to quintile 5. Figure 1 shows the evolution of the cash ratio for each size quintile over the sample period. Similar to the findings of Bates et al. (2009) for U.S. firms, there is a clear positive trend in the average cash ratio of the three smallest quintiles. Remarkably, the average cash ratio of the two largest quintiles is fairly low and stable over the sample period.

Figure 1
Cash ratio by firm size quintile from 1980 to 2011

The figure presents the average cash ratio by firm size over the sample period. The sample includes all Datastream firm-year observations of European publicly traded firms with positive book value of total assets and sales for the period 1988-2011. Financial firms (SIC codes 6000-6999) and utilities SIC codes (4900-4999) are excluded. Firm-year observations with missing values for any variable are also removed. The cash ratio is measured as cash and marketable securities divided by the book value of total assets. Firm year observations are divided into quintiles based on the book value of total assets in the prior fiscal year. The first quintile (Q1) represents the smallest firms, while the fifth quintile (Q5) represents the largest firms in the sample.



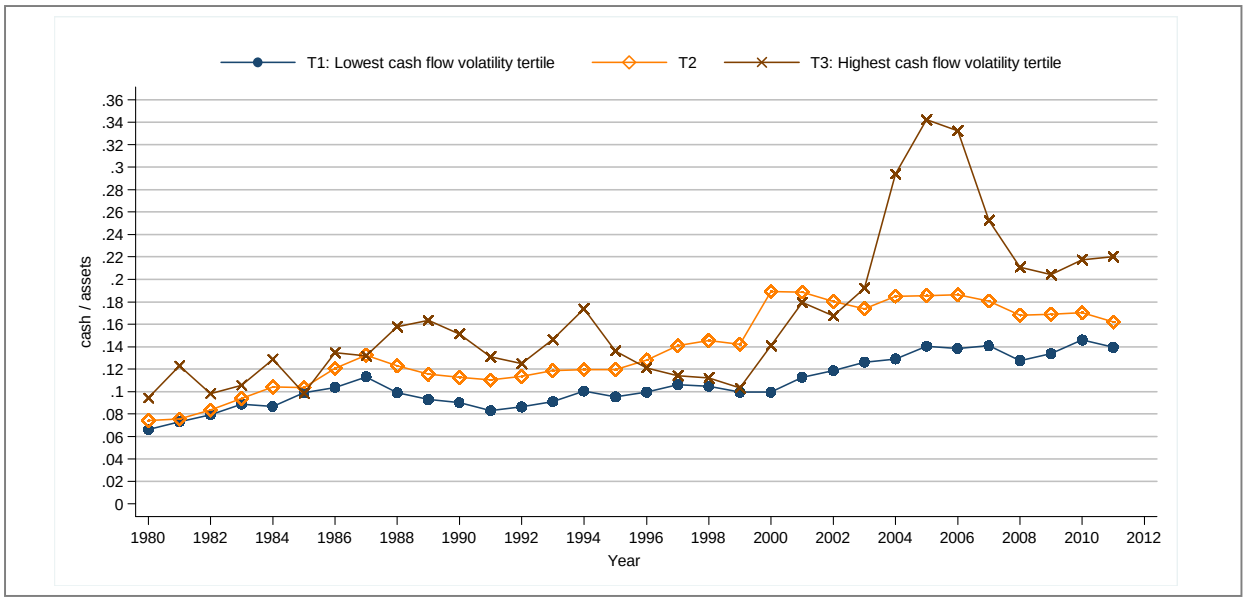
To confirm these findings, I estimate a regression of the cash ratio on a constant and time (in years) for each quintile separately. The time coefficients for the two smallest quintiles are positive and fairly large (see Models 1 and 2 of Table B.3. in Appendix B). In contrast, the time coefficients for the two largest quintiles are smaller and, in Model 5, even negative. All coefficients are significant at 1% level. These results confirm the prediction that smaller firms accumulate more cash.

4.3 Cash ratio by cash flow volatility

The precautionary motive for holding cash predicts that firms in industries with high cash flow volatility hold more cash. To either confirm or reject this prediction, in this section I examine the relation between cash flow volatility and cash levels of European firms. I divide the two-digit SIC code industries into tertiles according to the volatility of cash flow. The cash flow volatility is measured as follows. First, for each firm I compute the standard deviation of the cash flow to total assets for the previous three years. I require at least four observations. Second, I calculate the mean standard deviation in each year for each two-digit SIC-code industry. Figure 2 plots the evolution of the average cash ratio for each cash flow volatility tertile per year. Firms in the smallest cash flow volatility quintile hold low levels of cash. Similarly, the average cash of firms from the second cash flow volatility tertile is fairly low and stable throughout the sample period. In contrast, the mean cash ratio in the highest cash flow volatility tertile fluctuates a lot and in 2003 increases from about 20% to 33%.

Figure 2
Cash ratio by idiosyncratic risk from 1980 to 2011

The figure presents the average cash ratio for tertiles of industries sorted by increases in idiosyncratic risk. The sample includes all Datastream firm-year observations of European publicly traded firms with positive book total assets and sales for the period 1980-2011. Financial firms (SIC codes 6000-6999) and utilities SIC codes (4900-4999) are excluded. Firm-year observations with missing values for any variable are also removed from the sample. The cash ratio is measured as cash and marketable securities divided by the book value of total assets. Firm year observations are divided into tertiles based on the cash flow volatility. T1 represents the lowest cash flow volatility tertile, while T3 shows the highest cash flow volatility tertile.



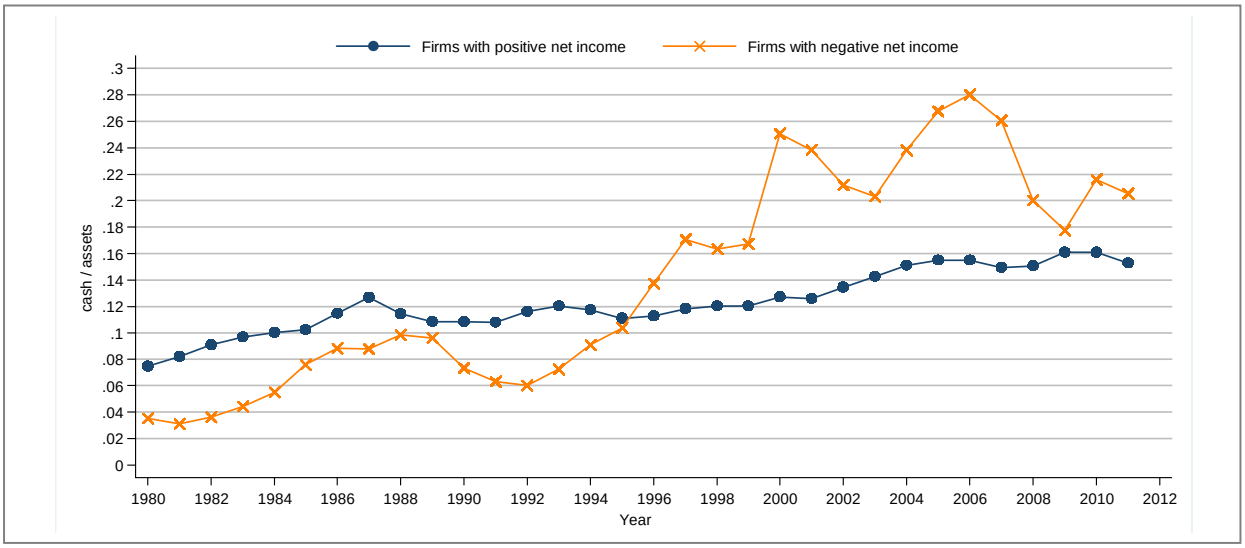
I regress the average cash ratio of each tertile on a constant and time to assess whether these trends are statistically significant (see Table B.4. in Appendix B). The results show that the average cash ratio of firms in industries with high cash flow volatility (T3) has a yearly increase of 0.54%. The R^2 is 42%. In contrast, the yearly increase of the average cash ratio of firms from industries with low cash flow volatility (T1) is 0.22%. The R^2 for this model is 77%. The time coefficients for all tertiles are statistically significant at 1% level. Hence, these findings are in line with the findings of Han and Qiu (2007) and Bates et al. (2009) and confirm the precautionary motive for holding cash.

4.4 Cash ratio by net income

In this section I divide the firms from the sample into two subsamples according to their net income. This allows a further analysis of the evolution of the average cash ratio throughout the sample period. Specifically, I look how cash levels differ between firms with negative net income and firms with non-negative net income. Figure 3 presents the pattern of the average cash ratio for the two subsamples. Although the average cash ratio of both subsamples increases over the sample period, the liquid assets of firms with negative net income show a more pronounced rise after 1995. However, the average cash ratio of European firms with negative net income sharply decreases between 2007 and 2010, whereas that of firms with non-negative net income increases. This pattern can possibly be explained by the financial crises.

Figure 3
Cash ratio by net income from 1980 to 2011

This figure summarizes the average cash ratio for firms with negative and firms with nonnegative net income. The sample includes all Datastream firm-year observations of European publicly traded firms with positive book value of total assets and sales for the period 1980-2011. Financial firms (SIC codes 6000-6999) and utilities SIC codes (4900-4999) are excluded. Firm-year observations with missing values for any variable are also removed. The cash ratio is measured as cash and marketable securities divided by the book value of total assets.



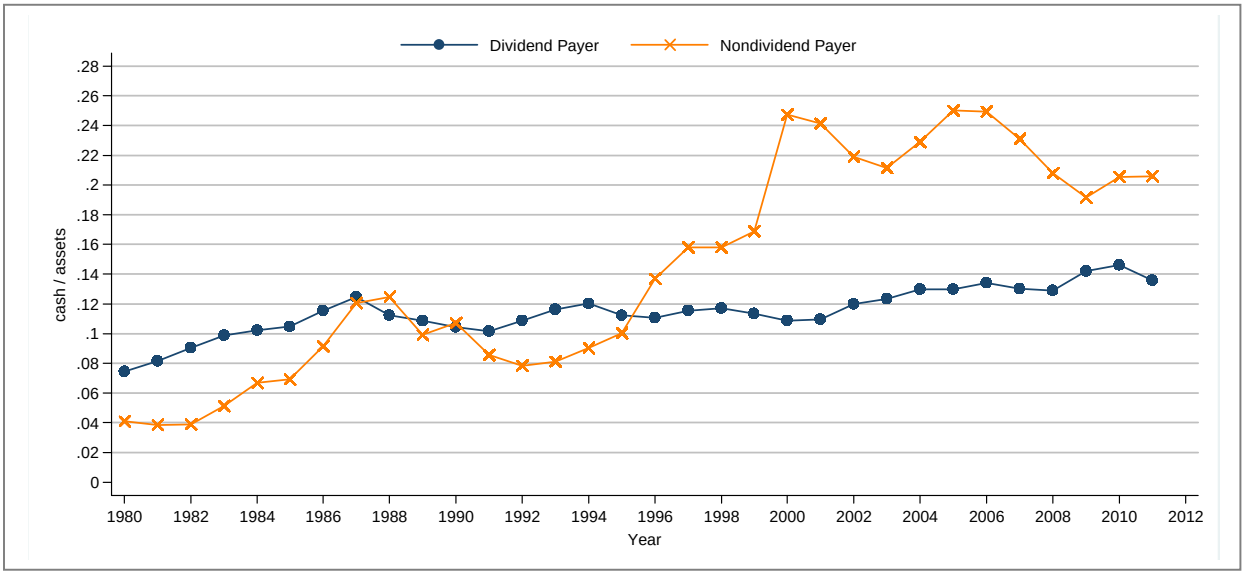
Time regressions on a constant and time confirm the positive trend in the average cash ratio (see Table B.5. in Appendix B). While the average yearly increase of the cash ratio in firms with non-negative net income is 0.23%, that in firms with negative net income is 0.76%. The time coefficients of both regressions are significant at 1% level.

4.5 Cash ratio by dividend policy

In this section I investigate the role of dividends on the cash ratio. I use a dummy variable equal to one for dividend payers, and zero for non-dividend payers. Figure 4 shows the average cash ratio for the two subsamples from 1980 to 2011. The average cash ratio of firms that do not pay dividends is fairly high and increases dramatically after 1996. Although it fluctuates a lot in the following years, it exhibits a positive pattern from 2008 onwards presumably because of the financial crisis. This evolution is in line with the theoretical prediction that non-dividend payers hold more cash for precautionary motives. Figure 3 shows also that the average cash ratio of dividend paying firms is fairly low and stable over the sample period.

Figure 4
Cash ratio by dividend policy from 1980 to 2011

This figure summarizes the average cash ratio for dividend and nondividend payers. The sample includes all Datastream firm-year observations of European publicly traded firms with positive values for book value of total assets and sales for the period 1980-2011. Financial firms (SIC codes 6000-6999) and utilities SIC codes (4900-4999) are excluded. Firm-year observations with missing values for any variable are also removed from the sample. The cash ratio is measured as cash and marketable securities divided by the book value of total assets.



To confirm these findings, I estimate a regression of the cash ratio on a constant and time for both subsamples (see Table B.6. in Appendix B). The time coefficient for the cash ratio of dividend payers corresponds to a yearly increase of 0.13% and it is statistically significant at 1% level. The time coefficient of the cash ratio in firms that do not pay dividends is also statistically significant and represents a yearly increase of 0.62%. These results not only confirm the precautionary motive for holding cash, but they are in line with the findings of Bates et al. (2009) that non-dividend payers accumulate more cash than dividend payers.

5. Empirical Analysis

5.1 The determinants of the cash ratio

Having discussed the trends in cash for the total sample and for various subsamples, I turn to the determinants of European cash holdings in this section. Specifically, I perform a regression analysis to determine which firm characteristics explain the pronounced increase in the average cash ratio of European firms. The dependent variable in the regressions is the ratio of cash and marketable securities to total assets. For some regressions, however, I use the natural logarithm

of the ratio of cash and marketable securities to net assets (net assets is the difference between total assets and cash and marketable securities) to reduce the impact of outliers. As discussed in Section 3.3, I winsorize the leverage ratio, the market to book ratio, the capital expenditures to assets and the cash flow to assets and the R&D ratio to remove outliers.

The results from the initial regressions are reported in Table 4. The standard errors of the OLS regressions are clustered by firm and year, using the method of Cameron et al. (2006) and Thompson (2009). Thus, the standard errors are robust to heteroscedasticity. Moreover, I include a country dummy variable in the first six regression models (Model 1 to Model 6) to control for eventual country-specific effects.

Model 1 in Table 4 shows the results of a basic ordinary least squares regression using all sample years. The market-to-book ratio, the industry cash flow risk, and the R&D ratio have positive and statistically significant coefficients which are in line with the theoretical predictions. Further, the negative coefficients of the NWC, leverage, dividends, Capex, and firm size confirm the results obtained in Bates et al. (2009) and are in line with the theoretical predictions. In contrast to Bates et al. (2009), the negative coefficient of the cash flow to assets ratio is here significant and the negative coefficient of the dividend dummy is insignificant.

Model 2 re-estimates Model 1 using the ratio of the log of cash to net assets as a dependent variable. Remarkably, the coefficient of the firm size remains statistically significant but it switches from negative to positive. To assess whether the positive relation between firm size and cash is robust across firm size quintiles, I re-run Model 2 for each firm size quintile separately (results are not reported). The coefficient of firm size for the smallest firms in the sample is negative (-0.1354) and statistically significant (p-value is 0.007). Similarly, the coefficient of firm size for the fifth quintile (the largest firms in the sample) is negative (-0.0299) but statistically insignificant (p-value is 0.314). Although the coefficients for the other three quintiles are positive (0.0724, 0.0584, 0.0703 for the second, third, and fourth quintile, respectively), they are not statistically significant (p-values are equal to 0.369, 0.499 and 0.314 for the third, fourth and fifth quintile, respectively). Similar variation in the sign of the coefficient of size is found by Ferreira and Vilela (2007).

Further, the cash flow to assets ratio becomes insignificant, whereas the dividends remain insignificant. The coefficients of all other variables are similar to those in Model 1. Nevertheless, Model 1 has a higher adjusted R^2, indicating that it explains variations in the cash holdings better than Model 2.

Model 3 re-estimates Model 1 but includes the lagged change in the cash ratio and the lagged cash ratio to allow for partial adjustment of the cash ratio to the equilibrium level (Bates et al. (2009)). This model eliminates the effect of unobservable firm characteristics on the cash.

Table 4
Regressions estimating the determinants of cash holdings

The sample includes all Datastream firm-year observations of European publicly traded firm with positive book value of total assets and sales for the period from 1980 to 2011. Financial firms (SIC codes 6000-6999) and utilities SIC codes (4900-4999) are excluded. Firm-year observations with missing values for any variable are also removed from the sample. The cash ratio is measured as cash and marketable securities divided by the book value of total assets. Definitions of the explanatory variables are given in Table A.1, Appendix A. N indicates the number of observations. P-values in the OLS regressions are based on standard error robust to clustering by firm and year are reported in parentheses. P-values in the Fama-MacBeth regressions use Newey and West (1987) standard errors to control for autocorrelation.

Model	1 OLS	2 OLS	3 Changes	4 OLS	5 OLS	6 Changes	7 F-M (1980s)	8 F-M (1990s)	9 F-M (2000s)	10 FE	11 FE
Dependent Variable	Cash/ Assets	Log (Cash/Net Assets)	Cash/ Assets	Cash/ Assets	Log (Cash/Net Assets)	Cash/ Assets	Cash/ Assets	Cash/ Assets	Cash/ Assets	Cash/ Assets	Cash/ Assets
Intercept	0.2251 (0.000)	-32.7490 (0.000)	0.0588 (0.000)	0.2204 (0.000)	-2.8491 (0.000)	0.0604 (0.000)	0.0859 (0.001)	0.1214 (0.001)	0.2265 (0.000)	0.3068 (0.000)	0.2851 (0.000)
Lag dcash			-0.0869 (0.000)			-0.0876 (0.000)					
Lag cash			0.7707 (0.000)			0.7716 (0.000)					
MB	0.0263 (0.000)	0.3359 (0.000)	0.0054 (0.000)	0.0263 (0.000)	0.3348 (0.000)	0.0054 (0.000)	0.0383 (0.000)	0.0306 (0.000)	0.0265 (0.000)	0.0137 (0.000)	0.0132 (0.000)
Real Size	-0.0031 (0.011)	0.0598 (0.000)	-0.0005 (0.052)	-0.0035 (0.000)	0.0568 (0.000)	-0.0005 (0.070)	0.0025 (0.000)	-0.0002 (0.912)	-0.0043 (0.000)	-0.0121 (0.000)	-0.0128 (0.000)
Cash flow/assets	-0.0471 (0.003)	-0.2027 (0.161)	0.0319 (0.000)	-0.0478 (0.002)	-0.2188 (0.113)	0.0326 (0.000)	0.0414 (0.194)	-0.0509 (0.007)	-0.0386 (0.117)	-0.0142 (0.000)	-0.0139 (0.190)
NWC	-0.1425 (0.000)	-1.4156 (0.000)	-0.0497 (0.000)	-0.1393 (0.000)	-1.3469 (0.000)	-0.0507 (0.000)	-0.2642 (0.000)	-0.1519 (0.000)	-0.1038 (0.000)	-0.1154 (0.000)	-0.1156 (0.000)

Table 4 - *Continued*

Model	1 OLS	2 OLS	3 Changes	4 OLS	5 OLS	6 Changes	7 F-M (1980s)	8 F-M (1990s)	9 F-M (2000s)	10 FE	11 FE
Dependent Variable	Cash/ Assets	Log (Cash/Net Assets)	Cash/ Assets	Cash/ Assets	Log (Cash/Net Assets)	Cash/ Assets	Cash/ Assets	Cash/ Assets	Cash/ Assets	Cash/ Assets	Cash/ Assets
Capex	-0.2731 (0.000)	-3.1272 (0.000)	-0.1878 (0.000)	-0.2585 (0.000)	-2.8188 (0.000)	-0.1934 (0.000)	-0.5566 (0.000)	-0.2767 (0.000)	-0.2309 (0.000)	-0.1677 (0.000)	-0.1680 (0.000)
Leverage	-0.3439 (0.000)	-3.3151 (0.000)	-0.0876 (0.000)	-0.3434 (0.000)	-3.3040 (0.000)	-0.0873 (0.000)	-0.1396 (0.012)	-0.2869 (0.000)	-0.3451 (0.000)	-0.2194 (0.000)	-0.2181 (0.000)
Industry cash flow risk	0.3572 (0.000)	5.6687 (0.000)	0.0227 (0.412)	0.3257 (0.000)	5.0133 (0.000)	0.0331 (0.218)	-0.0457 (0.684)	0.3366 (0.001)	0.2681 (0.000)	0.3472 (0.880)	0.4849 (0.000)
Dividend dummy	-0.0001 (0.982)	-0.0406 (0.379)	-0.0002 (0.899)	0.0024 (0.564)	0.0109 (0.820)	-0.0009 (0.444)	0.0301 (0.014)	0.0227 (0.000)	-0.0076 (0.013)	0.0046 (0.001)	0.0056 (0.008)
R&D/sales	0.3975 (0.000)	3.2800 (0.000)	0.0637 (0.000)	0.3904 (0.000)	3.1323 (0.000)	0.0664 (0.000)	0.2815 (0.008)	0.3944 (0.000)	0.3557 (0.000)	0.1965 (0.000)	0.1928 (0.000)
2000s dummy				0.0102 (0.006)	0.2124 (0.000)	-0.0034 (0.059)					
Adj. R^2	0.2420	0.1641	0.6931	0.2432	0.1675	0.6932	0.2760	0.2099	0.2512	0.0933	0.0964
N	46,198	45,453	41,174	46,198	45,453	41,174	5,112	16,943	24,143	46,198	46,198

Except for the industry cash flow risk and dividends, the coefficients of all other variables are significant and similar to those obtained in Model 1. But the adjusted R^2 of Model 3 (69.31%) is much higher than the adjusted R^2 of Model 1 (24.20%).

In the next step, I examine whether the intercepts of the models change over time. Specifically, Models 4, 5 and 6 include the dummy variable *2000s dummy* and re-estimate Model 1 through Model 3. The dummy variable takes the value one for observations in year 2000 or later, and zero otherwise. The coefficient of this dummy variable is positive and statistically significant in Model 4 and Model 5. This suggests that the observed increase in the average cash ratio results from a regime shift in the demand for cash. Model 6 re-estimates Model 3 with the *2000s Dummy*, which coefficient becomes negative with a p-value greater than 0.05. Bates et al. (1999) find similar variation in the sign of this dummy variable.

Further, it could be the case that the intercepts do not change but the slopes do. Thus, to assess whether the relation between firm characteristics and the cash ratio changes over time, I estimate a Fama-MacBeth regression for three different subsamples, namely for the periods 1980-1989, 1990-1999, and 2000-2012. The results of these regressions are shown in Models 7, 8 and 9, respectively. The p-values are based on Newey and West (1987) standard errors to control for autocorrelation. The reported R^2 is the average R^2 from the cross-sectional regressions. Remarkably, the coefficient of the cash flow ratio, which is negative and statistically significant in Model 1, becomes positive and insignificant in Model 7. The industry cash flow risk also has a different sign, compared to Model 1, but it is not statistically significant. The coefficient of the dividend dummy in Models 7 and 8 is positive and significant. In contrast, considering a Fama-MacBeth regression for the 2000s (Model 9), the sign of the dividend dummy switches to negative and statistically significant. This result indicates that the relation between cash holding and dividends change after 2000 and is in line with the findings of Figure 4. Model 9 has a higher intercept which is consistent with the results in Model 4 regarding the evidence for a regime shift. I investigate the changes in the slope coefficients more extensively in Section 5.2.

The final two models in Table 4 (Models 10 and 11) re-estimate Model 1 with fixed effects. These models limit the influence of unobservable firm and industry characteristics that remain constant over time. Model 10 includes industry fixed effects. The coefficient of the industry cash flow risk in this model is 0.347 but insignificant. I include year and firm fixed effects in Model 11. In this specification, the industry sigma has a positive and significant coefficient which is similar to that in Model 1. The coefficient of the cash flow to assets is not significant but the coefficients of all other variables confirm the results of Model 1. The reported R^2 corresponds to changes within firms.

Finally, I discuss some additional regressions that are reported in Table 5. Model 1 and Model 2 examine the tax motive for holding cash, which has been discussed in Section 2.3.

Table 5
Additional regressions estimating the determinants of cash holdings

The sample includes all Datastream firm-year observations of European publicly traded firm with positive book value of total assets and sales for the period from 1980 to 2011. Financial firms (SIC codes 6000-6999) and utilities SIC codes (4900-4999) are excluded. Firm-year observations with missing values for long term debt, debt in current liabilities and cash and marketable securities are also removed from the sample. The cash ratio is measured as cash and marketable securities divided by the book value of total assets. The definitions of the explanatory variables are given in Table A.1, Appendix A. N indicates the number of observations.

	1	2	3	4	5
Model	OLS	OLS	OLS	OLS	OLS
Dependent Variable	Cash/Assets	Log (Cash/ Net Assets)	Cash/Assets	Log (Cash/ Net Asset)	Cash/Assets
Intercept	0.2146	-2.8626	0.2238	-2.7807	0.1575
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MB	0.0289	0.3637	0.0267	0.3431	0.0322
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Real Size	-0.0039	0.0484	-0.0034	0.0586	-0.0077
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Cash flow/assets	-0.0177	-0.0504	-0.0482	-0.2251	-0.0190
	(0.047)	(0.541)	(0.002)	(0.114)	(0.054)
NWC	-0.1235	-1.4835	-0.1405	-1.3757	
	(0.000)	(0.000)	(0.000)	(0.000)	
Capex	-0.2835	-3.0605	-0.2662	-2.9889	-0.2731
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-0.3303	-3.5401	-0.3435	-3.3078	
	(0.000)	(0.000)	(0.000)	(0.000)	
Industry cash flow risk	0.4653	7.1466	0.3411385	5.3506	0.7809
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Dividend dummy	-0.0034	-0.1150	0.0009	-0.0220	-0.0026
	(0.535)	(0.097)	(0.831)	(0.645)	(0.657)
R&D/sales	0.4280	3.1140	0.3943	3.2193	0.4981
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Foreign income	0.0147	0.6801			
	(0.000)	(0.000)			
Crisis dummy			0.0122	0.2398	
			(0.000)	(0.000)	
Adj. R^2	0.2560	0.1932	0.2429	0.1663	0.1720
N	19,300	18,847	46,198	45,453	19,802

Specifically, these models re-estimate Model 1 and Model 2 of Table 4 but add the ratio of foreign income to total assets. It is expected that international firms would hold more cash abroad due to tax costs associated with repatriation. The coefficients of the foreign income in both models are positive and statistically significant. Thus, the model confirms the tax motive for holding cash.

Generally, firms keep more cash in order to survive during a recession. Therefore, adding a dummy variable for the crisis years, I intend to answer the question whether the demand for cash changed during the financial crisis. Models 3 and 4 also re-estimate Model 1 and 2 of Table 4, adding a dummy variable for the crisis years (*Crisis dummy)*. The variable is equal to one for observations in the period 2008-2010, and zero otherwise. The coefficients of the crisis dummy are positive and significant in both models, suggesting a regime shift in the demand for cash. The coefficients of the other variables are very similar to those reported in Models 1 and 2 of Table 4.

The final model of Table 5 excludes leverage and NWC and re-estimates Model 1 of Table 4. The reason for the exclusion of these variables is that they respond to the same variables as the cash ratio (Bates et al. (2009)). The results of show that, except for the coefficient of the industry sigma, which almost doubles, all other coefficients are very similar to those shown in Model 1 of Table 4.

5.2 Changes in the relation between cash holdings and firm characteristics

This section investigates whether the relation between cash ratio and firm characteristics changes over the sample period. The approach re-estimates Model 1 and Model 2 of Table 4 but adds an indicator variable *2000s Dummy* allowing the intercept to change. The indicator variable interacts with all explanatory variables. The coefficients of these interactions show the change in the slope of each variable between the two subperiods (1980-1999 and 2000-2011). Table 6 reports the results from these regressions. Model 1 shows that some of the interactions have not the same sign as the corresponding coefficient for the whole period. For example, this is the case for the NWC. It has a slope coefficient of -0.1719. Since the coefficient of the interaction is positive (0.0615), the absolute value of the slope coefficient of the NWC decreases. It equals -0.1104 after 2000. Considering the R&D, the model reveals a weaker positive relation between R&D and cash after 2000. Further, the sign of the dividends becomes negative and significant after 2000, which is in line with the results from the Fama-MacBeth regressions (Models 7 to 9 of Table 4) and Figure 4. Finally, the interaction coefficients of the cash flow to assets ratio and the industry cash flow risk are not statistically significant.

Model 2, which also re-estimates Model 1 of Table 4, incorporates the dummy variable *net income dummy*. The additional dummy variable examines the theoretical prediction that firms with negative net income hold more cash (as shown in Figure 3). The positive and statistical coefficient of the net income dummy supports this prediction and confirms the findings of Figure

3. All other coefficients in Model 2 are very similar to those in Model 1. Further, the adjusted R^2 increases only by 0.0034 from Model 1 to Model 2. This means that Model 2 does not explain the variation in cash much better than Model 1. Therefore, the inclusion of the dummy variable does not change the conclusions drawn from Model 1.

The third Model reported in Table 6 uses the natural logarithm of the cash-to-net-assets ratio as a dependent variable and also includes a dummy variable for net income. The coefficient of the net income dummy is again positive and significant. The results for the real size and Capex are interesting because the absolute values of the slope coefficients of these variables change a lot after 2000. Namely, the coefficient of the real size decreases from 0.1123 to 0.0058 after 2000. Similarly, the slope coefficient of the capital expenditures is -3.2973 and that of the interaction is 0.8176. Hence, the capital expenditures have a slope coefficient of -2.4797 in the 2000s.

In sum, the results of Table 6 show that changes in firm characteristics are an important reason for the increase in the cash ratio. Further, Model 1 has a slightly higher adjusted R^2 than that in Models 4 to 6 of Table 4. Thus, adding the indicator variables and the dummy variable for net income adds little to the explanatory power of the model. Also, the positive relation between dividends and cash breaks down from year 2000 onwards. Finally, the positive and significant interactions with the intercepts suggest an upward trend in the demand for cash not explained by changes in the firm characteristics.

Table 6
Changes in the relation between firm characteristics and cash holdings

The sample includes all Datastream firm-year observations of European publicly traded firm with positive book value of total assets and sales for the period from 1980 to 2011. Financial firms (SIC codes 6000-6999) and utilities SIC codes (4900-4999) are excluded. Firm-year observations with missing values for any variable are also removed from the sample. The cash ratio is measured as cash and marketable securities divided by the book value of total assets. The log(cash/net assets) is the logarithm of the ratio of cash and marketable securities to total assets minus cash and marketable securities. Definitions of the explanatory variables are given in Table A.1, Appendix A. N indicates the number of observations.

Model	1		2		3	
Dependent Variable	Cash/Assets		Cash/Assets		Log(Cash/Net Assets)	
	Estimate	Interaction 2000s	Estimate	Interacton 2000s	Estimate	Interaction 2000s
Intercept	0.1669	0.0908	0.1578	0.0921	-4.0593	1.9915
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MB	0.0284	-0.0033	0.0276	-0.0039	0.4376	-0.1920
	(0.000)	(0.016)	(0.000)	(0.005)	(0.000)	(0.000)
Real Size	-0.0014	-0.0036	-0.0017	-0.0036	0.1123	-0.1065
	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash flow/assets	-0.0502	-0.0020	-0.0797	0.0142	-0.5931	-0.1538
	(0.000)	(0.856)	(0.000)	(0.188)	(0.000)	(0.270)
NWC	-0.1719	0.0615	-0.1757	0.0560	-1.7563	0.7081
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Capex	-0.2923	-0.0552	-0.2917	-0.0525	-3.2973	0.8176
	(0.000)	(0.004)	(0.000)	(0.006)	(0.000)	(0.001)
Leverage	-0.2954	-0.0587	-0.2876	-0.0626	-3.0982	0.0389
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.759)
Industry cash flow risk	0.2755	0.0599	0.2721	0.0743	5.0438	0.1467
	(0.000)	(0.365)	(0.000)	(0.261)	(0.000)	(0.862)
Dividend dummy	0.0271	-0.0354	0.0199	-0.0353	0.2040	-0.3810
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R&D/sales	0.4386	-0.0664	0.4463	-0.0647	3.9012	-0.8264
	(0.000)	(0.029)	(0.000)	(0.033)	(0.000)	(0.033)
Net income dummy			0.0156		0.2899	
			(0.000)		(0.000)	
Adj. R^2	0.2501		0.2535		0.1821	
N	46,198		46,198		45,453	

5.3 Most important determinants of cash holdings

Having shown that the changes in the firm characteristics account for the change in cash ratio, in this section I determine which firm characteristics are the most important determinants of the

cash ratio. Following the approach of Bates et al. (2009), I first estimate a Fama-MacBeth regression, the coefficients of which are the average coefficients from annual cross-sectional regressions estimated for the period 1980 to 1997. This model includes all explanatory variables from Model 1 of Table 4 and the net income dummy. The estimated Fama-MacBeth model is the following:

$$\begin{aligned} \textit{Cash Ratio} = {} & 0.0856 + 0.0340\,MB + 0.0014\,\textit{Real Size} - 0.0271\,\textit{Cash Flow} - 0.2131 \\ & NWC - 0.4224\,\textit{Capex} - 0.2023\,\textit{Leverage} + 0.1628\,\textit{Industry Cash Flow Risk} \\ & +0.3326\,R\&D + 0.018\,\textit{Dividends} + 0.0246\,\textit{Net Income} \end{aligned}$$

In the next step, the cash holdings that the Fama-MacBeth model predicts for the period 1998-2011 are compared with the actual cash holdings. Finally, the increase in predicted cash holdings is attributed to changes in firm characteristics. Figure 5 shows the predicted average cash ratio using this model. The graph shows that the predicted ratio increases in the period 2000-2006 and decreases sharply in 2008. Having examined the evolution of the actual mean cash ratio in Section 4.1, I next compare the actual cash ratio with the predicted cash ratio. Columns 3 and 4 show the differences between these two ratios for each year of the sample period and the t-statistics, respectively. Except for the years 2007 and 2011, the difference between actual and predicted cash ratio is statistically significant. The model underpredicts the cash ratio in all years after 2011. In 2000 the predicted cash is 1.66% more than the actual. However, the largest difference between actual and predicted cash ratio is in 2002 when the predicted cash is 1.91% less than the actual cash.

The rest of Table 7 investigates the differences between actual and predicted cash for different subsamples. Specifically, columns 5 and 8 report the predicted cash holdings of firms that pay dividends and firms that do not pay dividends, respectively. Most of the results for the dividend paying firms are not statistically significant. However, in the years prior to 2001 and also in 2007, the model overpredicts the cash ratio of the European firms that pay dividends. In contrast, when non-dividend paying firms are considered, the actual cash ratios are much higher than predicted after 1998. Remarkably, the model predicts an 8.7% cash ratio in 2004, whereas the actual cash of the non-dividend payers is 6.03% higher.

Similarly, the model underpredicts the cash holdings of firms with negative net income (the last three columns of Table 7). While the Fama-MacBeth model predicts a 7.4% increase in cash for the period 1998-2011, the cash holding of the European firms with negative net income actually rise by 24.5% in that period.

For the firms with non-negative net income, the Fama-MacBeth model overpredicts the average cash ratios in each year from 1998 to 2011. The largest difference between predicted and actual cash is in 2006 when the actual cash is 1.01% less than the predicted cash.

Although not reported in Table 7, I examine the predicted cash ratio for small and large firms. Regarding the small firms, the model predicts a 22.52% increase of the cash ratio for the period 1998-2011, which is 0.25% less than the actual increase.

Figure 5
Predicted versus actual cash ratios for the period 1998-2011

The figure shows the evolution of the predicted and the average cash ratio for the period 1998-2011. Predicted cash holdings are obtained from a Fama-MacBeth model, the coefficients of which are the average coefficients from annual cross-sectional regressions estimated over the period 1980-1997. The model is as follows: cash ratio=0.0856 + 0.0340 MB + 0.0014 Real size - 0.0271 Cash flow - 0.2131 NWC - 0.4224 Capex - 0.2023 Leverage + 0.1628 Industry cash flow volatility + 0.3326 R&D + 0.018 Dividends + 0.0246 Net income. The sample includes all Datastream firm-year observations of European publicly traded firms with positive book value of total assets and sales for the period 1988-2011. Financial firms (SIC codes 6000-6999) and utilities SIC codes (4900-4999) are excluded. Firm-year observations with missing values for any variable are also removed. The cash ratio is measured as cash and marketable securities divided by the book value of total assets.

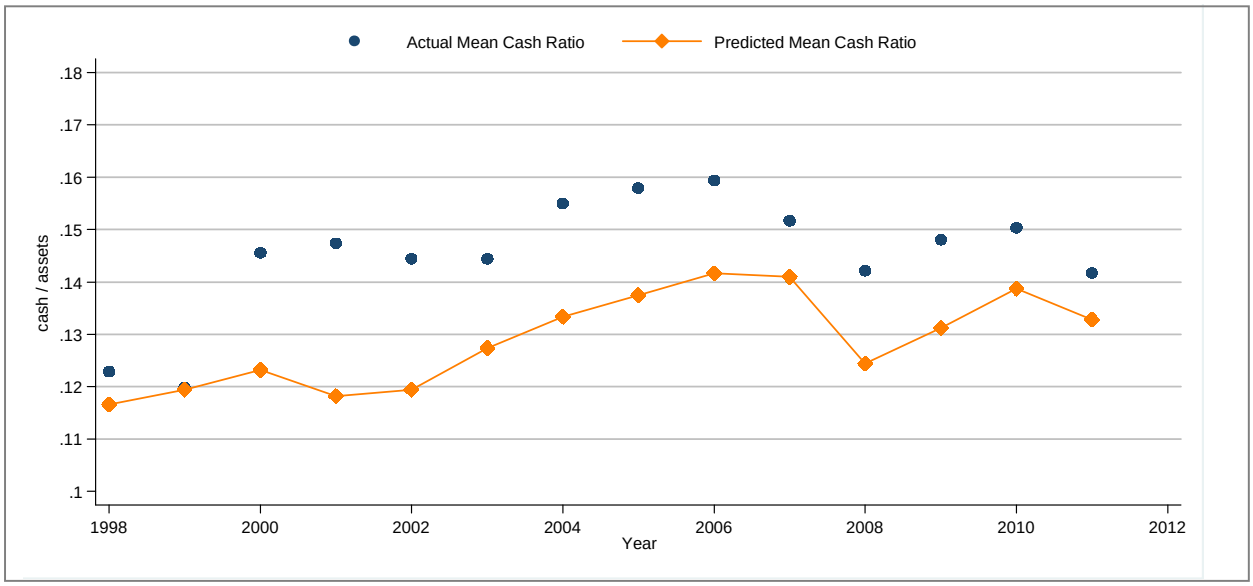


Table 7

Predicted cash ratios and their deviations from actual cash holdings over time

The table presents the predicted cash ratios for a sample from 1998 to 2011, and deviations of the actual cash ratio from those predicted by a Fama-MacBeth model. Predicted cash holdings are obtained from the Fama-MacBeth model, the coefficients of which are the average coefficients from annual cross-sectional regressions estimated over the period 1980-1997. The model is as follows: cash ratio=0.0856 + 0.0340 MB + 0.0014 Real size - 0.0271 Cash flow - 0.2131 NWC - 0.4224 Capex - 0.2023 Leverage + 0.1628 Industry cash flow volatility + 0.3326 R&D + 0.018 Dividends + 0.0246 Net income. The sample includes all Datastream firm-year observations of European publicly traded firm with positive book value of total assets and sales for the period from 1980 to 2011. Financial firms (SIC codes 6000-6999) and utilities SIC codes (4900-4999) are excluded. Firm-year observations with missing values for any variable are also removed from the sample. The cash ratio is measured as cash and marketable securities divided by the book value of total assets.

	Whole Sample			Firms Paying a Dividend			Firms Not Paying a Dividend			Firms With Non-Negative Income			Firms With Negative Income		
Year	Predicted	Actual - Predicted	*t*-Statistic	Predicted	Actual - Predicted	*t*-Statistic	Predicted	Actual - Predicted	*t*-Statistic	Predicted	Actual - Predicted	*t*-Statistic	Predicted	Actual - Predicted	*t*-Statistic
1998	0.1166	-0.0054	-1.9908	0.1212	-0.0100	-3.6602	0.0748	0.0364	12.9838	0.1231	-0.0119	-4.3678	0.0733	0.0380	13.1615
1999	0.1195	-0.0113	-4.0888	0.1247	-0.0166	-5.9857	0.0750	0.0332	11.4528	0.1266	-0.0185	-6.6435	0.0740	0.0342	11.5214
2000	0.1232	-0.0166	-5.9657	0.1299	-0.0234	-8.2942	0.0768	0.0298	10.7365	0.1322	-0.0257	-9.0290	0.0741	0.0324	11.5518
2001	0.1182	0.0109	3.2947	0.1280	0.0011	0.3273	0.0801	0.0489	14.5360	0.1324	-0.0033	-1.0190	0.0738	0.0553	15.7929
2002	0.1194	0.0191	5.7245	0.1310	0.0076	2.2928	0.0846	0.0540	15.9352	0.1362	0.0024	0.7255	0.0732	0.0654	18.5067
2003	0.1274	0.0125	3.7932	0.1387	0.0011	0.3446	0.0865	0.0535	15.9412	0.1427	-0.0028	-0.8506	0.0750	0.0649	18.7270
2004	0.1334	0.0138	4.3435	0.1448	0.0024	0.7595	0.0870	0.0603	18.1851	0.1466	0.0007	0.2143	0.0766	0.0707	20.5124
2005	0.1375	0.0069	2.2388	0.1494	-0.0050	-1.6014	0.0880	0.0564	17.6202	0.1507	-0.0064	-2.0307	0.0773	0.0672	20.2756
2006	0.1417	0.0069	2.1381	0.1547	-0.0061	-1.9231	0.0880	0.0605	18.2907	0.1556	-0.0071	-2.2065	0.0778	0.0708	20.6083
2007	0.1410	0.0034	1.0934	0.1538	-0.0094	-3.0852	0.0883	0.0561	17.9858	0.1544	-0.0101	-3.2608	0.0781	0.0663	20.6699
2008	0.1245	0.0143	4.6768	0.1352	0.0035	1.1441	0.0892	0.0495	16.1866	0.1378	0.0009	0.2897	0.0764	0.0623	19.6896
2009	0.1313	0.0157	4.9524	0.1433	0.0036	1.1238	0.0906	0.0564	17.6504	0.1472	-0.0003	-0.0845	0.0775	0.0695	21.2343
2010	0.1387	0.0115	3.5807	0.1512	-0.0010	-0.3092	0.0936	0.0565	17.3326	0.1516	-0.0014	-0.4190	0.0786	0.0716	21.5054
2011	0.1328	0.0057	1.8710	0.1430	-0.0044	-1.4592	0.0913	0.0472	15.2535	0.1445	-0.0059	-1.9012	0.0787	0.0599	18.9138

The model underpredicts the cash of small firms in each year of the sample period. Similarly, actual cash levels of large firms are higher than those predicted by the model. However, only in 2000 the estimated cash is 1.6% larger than the actual cash ratio of large European firms.

Further, using the Fama-MacBeth model, I investigate the firm characteristics that attribute most for the change in the cash ratio. The change in the cash ratio is computed as the difference between the average cash ratio in the period 1998-2011 and the average cash ratio in the period 1980-1997. The average cash ratio is 10.74% in the first period and 14.52% in the second period. Next, I calculate the change in the average value of each explanatory variable between these two periods to determine which firm characteristics are most important drivers for the increase in cash. For instance, the average MB in the first period is 1.4831 and 1.6264 in the second period (see Table B.7., Appendix B). Thus, the MB increased by 14.33% and explains 0.49% of the increase in the cash ratio (0.1433*0.0344). Table 8 reports how the change in each explanatory variable affects the change in the cash ratio. The second column reports the results for the whole sample. Consistent with Bates et al. (2009), the largest contributor to the increase in cash ratio is NWC, which explains 1.36% of the increase in cash ratio. The NWC ratio decreased from 7.62% in the period 1980-1997 to 1.25% in the period 1998-2011 (see Table B.7., Appendix B). A possible explanation for this could be a decrease in accounts receivables or a decrease in inventories. However, the finding that the decline in the NWC explains most of the increase in the cash ratio supports the transaction motive for holding cash.

Further, in the period 1980-1997 the average Capex ratio is 7.37%. It decreased by 2.12% in the 2000s, resulting in a 0.89% increase in the cash ratio. Remarkably, the R&D ratio, which is the third most important contributor to the increase in the cash ratio, increased from 0.068% to 2.19%. This huge increase explains 0.50% of the increase in the average cash ratio. As already discussed, the investment opportunities of R&D intensive firms are intangible in nature. To avoid high financial distress costs such firms accumulate higher cash levels. In contrast, capital expenditures represent tangible assets that are easier to finance because they can be used as collateral. Consequently, firms may spend larger amounts of cash for capital expenditures and acquisitions, which explains the negative relation between Capex and cash.

The next three columns of Table 8 report the change in the cash ratio and its determinants in dividend paying firms and non-dividend paying firms, respectively. Considering the non-dividend paying firms, the 2.5% increase in R&D explains most of the increase in the cash ratio. The average R&D ratio is 0.88% in the period 1980-1998 and 3.45% in the 2000s. Because of this change, the cash ratio increases by 0.86%. Further, the MB increase of 22.17% and the 3.75% decrease of the leverage explain together a 1.52% increase in the cash ratio. For the dividend paying firms, the average leverage ratio increases by 2.07% and as a result, the average cash ratio decreases by 0.42%. However, the most important determinants of the increase in the cash ratio of dividend paying firms are NWC, Capex and MB. The NWC decreases from 8.41%

in the first period to 3.91% in the second period. The capital expenditures decrease by 2.04% and the market-to-book ratio increases by 7.81%. Together these changes explain roughly a 2.1% increase in the cash ratio. Similarly, the most important determinants in firms with non-negative net income are NWC, Capex and MB. By decreasing from 8.72% to 3.98%, the NWC contributes 1.01% to the increase in the cash ratio of firms with non-negative net income. Further, the 2.11% decrease in the portion of capital expenditures relative to total assets and the 12.46% increase of the market-to-book ratio together correspond to a 1.32% increase of the cash ratio.

Table 8
Determinants of changes in predicted cash between 1998 and 2011

This table shows the determinants of the change in predicted cash ratios from 1998 to 2011. The change in the cash ratio is measured as the difference between the average cash ratio in the period 1998-2011 and the average cash ratio in the period 1980-1997. The sample includes all Datastream firm-year observations of European publicly traded firm with positive book value of total assets and sales for the period from 1980 to 2011. Financial firms (SIC codes 6000-6999) and utilities SIC codes (4900-4999) are excluded. Firm-year observations with missing values for any variable are also removed from the sample. The cash ratio is measured as cash and marketable securities divided by the book value of total assets. P-values are given in parentheses and show the statistical significance of the differences between average firm characteristics in the period 1998-2011 and 1980-1997. Definitions of the explanatory variables are given in Table A.1., Appendix A.

	Whole Sample	Nondividend Paying Firms	Dividend Paying Firms	Difference	Firms with Negative Income	Firms with Non-Negative Income	Difference
MB	0.0049	0.0076	0.0027	0.0049	0.0089	0.0043	0.0046
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
Real Size	-0.0001	-0.0009	0.0008	-0.0017	-0.0007	0.0003	-0.0010
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
Cash flow/assets	0.0008	0.0009	0.0000	0.0009	0.0016	-0.0001	0.0017
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
NWC	0.0136	0.0061	0.0096	0.0035	0.0144	0.0101	0.0043
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
Capex	0.0089	0.0072	0.0086	-0.0014	0.0066	0.0089	-0.0024
	(0.000)	(0.000)	(0.000)		(0.000)	(0.005)	
Leverage	-0.0013	0.0076	-0.0042	0.0118	0.0075	-0.0026	0.0101
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
Industry cash flow risk	0.0008	0.0010	0.0004	0.0006	0.0010	0.0006	0.0004
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
Dividend	-0.0042	0.0000	0.0000	0.0000	-0.0035	-0.0028	-0.0007
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
R&D/sales	0.0050	0.0086	0.0021	0.0065	0.0098	0.0027	0.0071
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
Net Income	-0.0036	-0.0017	-0.0010	-0.0007	0.0000	0.0000	0.0000
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
Total	0.0249	0.0836	0.0190	0.0174	0.0456	0.0214	0.0242

The last three columns of Table 8 show that the average cash ratio increases more in firms with negative net income than in firms with non-negative net income. The last column of the Table 8 reports the difference in the change in predicted cash ratio between firms with negative net income and firms with non-negative net income. For firms with negative net income, the net working capital to assets is 1.63% in the first period but it decreases by 6.77% in the second period. Thus, the cash ratio increases by 1.44%. Further, a 25.85% increase in MB and a roughly 3% increase in R&D together explain a 1.9% increase in the average cash ratio of firms with negative net income.

5.4 Cash holdings during the crisis

Table 3 shows that the average and median cash ratios drop sharply in 2008 and increase in the subsequent years (see also Figure B.1. in Appendix B). This pattern can be attributed to the financial crisis. I now investigate whether the financial crisis affects the determinants of the cash holdings. Specifically, I employ the procedure used in Section 5.3 estimating a Fama Mac-Beth model. The coefficients of the model are the average coefficients from annual cross-sections estimated for the period 2003-2007. I choose this period because I want to assess whether firms hold as much cash during the crisis as they would if they held cash in the same way as they did prior to the crisis. The estimated Fama-MacBeth model is the following:

$$\begin{aligned} \textit{Cash Ratio} = {} & 0.2170 + 0.0238\,\textit{MB} - 0.0042\,\textit{Real Size} - 0.0698\,\textit{Cash Flow} - 0.1183 \\ & \textit{NWC} - 0.2734\,\textit{Capex} - 0.3638\,\textit{Leverage} + 0.4228\,\textit{Industry Cash Flow Risk} \\ & +0.3915\,\textit{R\&D} - 0.0164\,\textit{Dividends} + 0.0225\,\textit{Net Income} \end{aligned}$$

The second column of Table 9 reports the cash that the model predicts for the crisis years for all sample firms. The differences between the predicted and the actual cash ratios are very small. For nondividend payers and firms with non-negative net income, the model overpredicts the cash ratios from 2008 to 2010. Using the Fama-MachBeth model, I examine the firm characteristics that attributed most for the change in the cash ratio during the crisis. Table 10 shows that the model predicts a 0.53% decrease of the cash ratio compared to the period 2003-2007 due to changes in firms' characteristics. Obviously, the most important determinant of the change in cash ratio is the market-to-book ratio. It decreases by 35.42%, resulting in a 0.84% decrease in the average cash ratio during the crisis. This is not surprising since the investment opportunities during a recession are relatively poor. Similarly, firms reduce their R&D commitments in case of economic pressure and accumulate more cash. Thus, the 0.22% decrease in R&D spending corresponds to a 0.09% decrease in the cash ratio. Finally, the decrease in leverage from 22.74% in the pre-crisis period to 22.29% during the crisis contributes to a 0.16% increase in cash.

Table 9

Predicted cash ratios and their deviations from actual cash holdings during the financial crisis

The table presents the predicted cash ratios for a sample from 2008 to 2010, and deviations of the actual cash ratio from those predicted by a Fama-MacBeth model. Predicted cash holdings are obtained from the Fama-MacBeth model, the coefficients of which are the average coefficients from annual cross-sectional regressions estimated over the period 2003-2007. The model is as follows: cash ratio=0.2170 + 0.0238 MB – 0.0042 Real size – 0.0698 Cash flow - 0.1183 NWC - 0.2734 Capex - 0.3638 Leverage + 0.4228 Industry cash flow volatility + 0.3915 R&D - 0.0164 Dividends + 0.0225 Net income. The sample includes all Datastream firm-year observations of European publicly traded firm with positive book value of total assets and sales for the period from 1980 to 2011. Financial firms (SIC codes 6000-6999) and utilities SIC codes (4900-4999) are excluded. Firm-year observations with missing values for any variable are also removed from the sample. The cash ratio is measured as cash and marketable securities divided by the book value of total assets.

	Whole Sample			Firms Paying a Dividend			Firms Not Paying a Dividend			Firms With Non-Negative Income			Firms With Negative Income		
Year	Predicted	Actual - Predicted	*t*-Statistic	Predicted	Actual - Predicted	*t*-Statistic	Predicted	Actual - Predicted	*t*-Statistic	Predicted	Actual - Predicted	*t*-Statistic	Predicted	Actual - Predicted	*t*-Statistic
2008	0.1344	0.0044	1.5214	0.1337	0.0051	1.7113	0.1482	-0.0094	-3.2507	0.1459	-0.0071	-2.3607	0.1276	0.0111	3.8125
2009	0.1394	0.0075	2.5007	0.1400	0.0070	2.2222	0.1517	-0.0047	-1.5677	0.1546	-0.0077	-2.4095	0.1314	0.0156	5.0961
2010	0.1464	0.0038	1.2260	0.1460	0.0042	1.3152	0.1580	-0.0078	-2.5439	0.1593	-0.0091	-2.8067	0.1342	0.0160	5.1520

Table 10
Determinants of changes in predicted cash between 2008 and 2010

This table shows the determinants of the change in predicted cash ratios from 2008 to 2010. The change in the cash ratio is measured as the difference between the average cash ratio in the period 2008-2010 and the average cash ratio in the period 2003-2007. The sample includes all Datastream firm-year observations of European publicly traded firm with positive book value of total assets and sales for the period from 1980 to 2011. Financial firms (SIC codes 6000-6999) and utilities SIC codes (4900-4999) are excluded. Firm-year observations with missing values for any variable are also removed from the sample. The cash ratio is measured as cash and marketable securities divided by the book value of total assets. P-values are given in parentheses and show the statistical significance of the differences between average firm characteristics in the period 2008-2010 and 2003-2007. Definitions of the explanatory variables are given in Table A.1., Appendix A.

	Whole Sample	Nondividend Paying Firms	Dividend Paying Firms	Difference	Firms with Negative Income	Firms with Non-Negative Income	Difference
MB	-0.0084	-0.0100	-0.0070	-0.0030	-0.0108	-0.0074	-0.0034
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
Real Size	-0.0011	-0.0011	-0.0012	0.0002	-0.0022	-0.0008	-0.0015
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
Cash flow/assets	-0.0007	-0.0040	0.0001	-0.0041	-0.0025	-0.0003	-0.0022
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
NWC	0.0025	0.0024	0.0027	-0.0004	0.0024	0.0023	0.0001
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
Capex	0.0017	0.0011	0.0022	-0.0010	0.0017	0.0016	0.0001
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
Leverage	0.0016	0.0015	0.0017	-0.0001	0.0016	0.0010	0.0000
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
Industry cash flow risk	0.0005	0.0005	0.0006	0.0000	0.0001	0.0006	-0.0005
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
Dividend	-0.0001	0.0000	0.0000	0.0000	-0.0009	0.0000	-0.0009
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
R&D/sales	-0.0009	-0.0026	0.0007	-0.0033	-0.0057	0.0010	-0.0066
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
Net Income	-0.0005	-0.0001	-0.0009	0.0008	0.0000	0.0000	0.0000
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	
Total	-0.0053	-0.0127	-0.0012	-0.0111	-0.0163	-0.0013	-0.0150

For non-1dividend paying firms, the picture is similar. A 42.19% decrease in the market-to-book ratio and a 0.67% decrease in the R&D spending result in a 1.27% decrease in the cash ratio. Considering dividend paying, however, the predicted decrease in the cash ratio can be attributed to an almost 30% decrease in the market-to-book ratio. In contrast to non-dividend paying firms, dividend paying firms increase their R&D investments during the crisis which result in a 0.07% increase in cash. Similarly, the R&D ratio of firms with non-negative net income increases from

1.61% to 1.86%. Remarkably, the leverage ratio of these firms decreases by 0.4% which results in a 0.15% increase in cash.
Taken together, the predicted decrease in the cash ratio during the financial crisis can be explained mainly by the decrease in the market-to-book ratio. The decrease in the R&D spending and the increase in leverage also play an important role for the change in cash in some of the subsamples.

6. Agency Motives for Holding Cash

Having investigated the role of the transaction and precautionary motives for holding cash in the previous section, in this section I examine the impact of the agency conflicts on the levels of corporate cash holdings in Europe. As discussed in Section 2.4, I employ some proxy variables to measure the agency problems. More specifically, I use the Anti-director Rights Index (*ADRI*), the Creditor Rights Index (*CRI*), the Rule of Law Index (*RLI*) and the Ownership Concentration Indicator (*OCI*) in the regression models. I re-estimate the basic OLS and the Fama-MacBeth regressions of Table 4 with the inclusion of these four proxy variables. The results are presented in Table 11. The findings on the impact of firm characteristics on the levels of cash are unchanged. The negative coefficients of ADRI, credit rights, rule of law, and ownership concentration in Model 1 indicate that firms in countries with better investor protection, better law enforcement and concentrated ownership hold less cash. Although the rule of law index and the ownership concentration indicator have insignificant signs, the model supports the agency motive for holding cash. The results of Model 2, which uses the natural logarithm of the cash to net assets ratio as a dependent variable, confirm also the theoretical predictions for holding cash due to agency conflicts. The coefficients of the four proxy variables are again negative. Moreover, except for the rule of law index, the other three variables have significant coefficients. However, Model 1 has a higher adjusted R^2. Models 3, 4 and 5 re-estimate Models 7, 8 and 9 of Table 4. In Model 4 all proxy variables for agency conflicts are negative and statistically significant. Although the rule of law index and the ownership concentration indicator have a positive sign in Model 5, they are not statistically significant.
It is important to note that Bates et al. (2009) control for managerial entrenchment using the GIM Index (Gompers, Ishii, and Metric (2003) index). They find that entrenched managers hold less cash, which is inconsistent with the theoretical predictions. Although I do not control for managerial entrenchment, my model partially supports the agency motive for holding cash.

Table 11
Regressions estimating the determinants of cash holdings with agency variables

The sample includes all Datastream firm-year observations of European publicly traded firm with positive book value of total assets and sales for the period from 1980 to 2011. Financial firms (SIC codes 6000-6999) and utilities SIC codes (4900-4999) are excluded. Firm-year observations with missing values for any variable are also removed. Cash ratio is measured as cash and marketable securities divided by the book value of total assets. P-values in the OLS regressions are based on standard error robust to clustering by firm and year are reported in parentheses. P-values in the Fama-MacBeth regressions use Newey and West (1987) standard errors to control for autocorrelation. Definitions of the explanatory variables are given in Table A.1., Appendix A. N is the number of observations. Table A.3., Appendix A summarizes the agency variables by country.

Model	1 OLS	2 OLS	3 F-M (1980s)	4 F-M (1990s)	5 F-M (2000s)
Dependent Variable	Cash/Assets	Log (Cash/ Assets)	Cash/Assets	Cash/Assets	Cash/Assets
Intercept	0.3175	-0.4907	0.1449	0.6267	0.1263
	(0.010)	(0.723)	(0.169)	(0.000)	(0.319)
MB	0.0263	0.3359	0.0390	0.0336	0.0269
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Real Size	-0.0034	0.0598	0.0009	-0.0017	-0.0053
	(0.000)	(0.000)	(0.106)	(0.075)	(0.000)
Cash flow/assets	-0.0471	-0.2027	0.0598	-0.0628	-0.0380
	(0.003)	(0.161)	(0.080)	(0.000)	(0.043)
NWC	-0.1425	-1.4156	-0.2701	-0.1524	-0.1094
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Capex	-0.2731	-3.1272	-0.5466	-0.2612	-0.2312
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-0.3439	-3.3151	-0.1845	-0.3078	-0.3500
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Industry cash flow risk	0.3572	5.6687	0.0187	0.3246	0.3318
	(0.000)	(0.000)	(0.854)	(0.000)	(0.000)
Dividend dummy	-0.0001	-0.0406	0.0389	0.0248	-0.0054
	(0.982)	(0.379)	(0.000)	(0.000)	(0.019)
R&D/sales	0.3975	3.2800	0.2524	0.3722	0.3572
	(0.000)	(0.000)	(0.009)	(0.000)	(0.000)
ADRI	-0.0171	-0.2873	-0.0163	-0.0373	-0.0011
	(0.029)	(0.002)	(0.025)	(0.000)	(0.886)
Credit Rights Index	-0.0091	-0.1776	-0.0098	-0.0156	-0.0043
	(0.000)	(0.000)	(0.001)	(0.000)	(0.016)
Rule of Law Index	-0.0001	-0.0768	0.0084	-0.0272	0.0138
	(0.990)	(0.295)	(0.212)	(0.000)	(0.131)
Ownership concentration	-0.0330	-0.5519	-0.0327	-0.0999	0.0179
	(0.120)	(0.021)	(0.056)	(0.000)	(0.422)
Adj. R^2	0.2421	0.1641	0.3047	0.2329	0.2585
N	46,198	45,453	5,112	16,943	24,143

7. Conclusion

In this paper I show that the cash holdings of European publicly traded firms have increased from 1980 to 2011. However, compared to the research on U.S. firms by Bates et al. (2009), the increase is less pronounced. I focus on five major countries in Europe and find that the average cash ratio, measured as cash and marketable securities divided by total assets, grows from 7.1% in 1980 to 14.5% in 2011, with a peak of 16.8% in 2006 and a sharp drop in 2008. Nevertheless, the increase in cash is not uniform across firms. Overall, the results indicate that the upward trend is concentrated among smaller firms, firms in industries with more volatile cash flows, and firms with negative net income. An interesting finding is that dividend paying firms hold more cash relative to non-dividend paying firms in the period 1980-1995. In the period 1995-2011, however, firms that do not pay dividends accumulate more cash. The exact reason for the change in the relation between dividends and cash requires further investigation.

The reasons for holding cash that I find are generally in line with the existing literature and confirm the theoretical predictions for holding cash. Specifically, European firms become smaller with riskier cash flows over the sample period. Furthermore, firms invest in R&D rather than inventories and the non-dividend paying firms tend to become more. Consequently, this change in European firms' characteristics has forced firms to accumulate more cash for transactions and precautionary reasons. Thus, the most important determinants of the change in cash are the net working capital, the capital expenditures and the R&D spending. These firm characteristics contribute to a 2.75% increase in cash.

In line with the precautionary motive for holding cash, I find that the average cash ratio increased during the financial crisis. An interesting observation, however, is that more firms paid common dividends because they aimed to signal financial health during the crisis, which in turn resulted in a slight decrease in cash reserves. Additionally, as the investment opportunity set decreases during a recession, a fall in R&D spending contributed to a small reduction of the average cash level.

I use approaches implemented by Opler et al. (1999) and Bates et al. (2009) to investigate the reasons for the upward trend in cash. However, my paper has some limitations that require additional research on the cash holdings in Europe. First, the lack of data on IPO activity does not allow me to investigate the relation between cash holdings and recently publicly listed firms. Second, my approach uses only the capital expenditures to measure the opportunity set of the firms. However, incorporating acquisitions would contribute to a stronger evidence for the relation between cash and investment opportunities. Finally, although I find some evidence on the agency motive, my model does not control for legal origin since the sample does not include a country with Scandinavian civil law. It would be interesting to find how the cash ratio differs across countries with different legal origins.

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Appendix A

Table A.1.
Variable definitions

This table defines the most important variables used in the analysis.

Variable	Definition
Dependent Variables	
Cash Ratio	The ratio of cash and marketable securities to book value of total assets.
Log Cash to Net Assets	Natural logarithm of the ratio of cash and marketable securities to book value of total assets minus cash and marketable securities.
Independent Variables	
Market to Book (MB)	A proxy for investment opportunities. It is measured as follows: (book value of total assets - book value fo equity + market value of equity)/book value of total assets.
Real Size	The natural logarithm of the book value of total assets.
Capex	Capital expenditures divided by book value of total assets.
NWC	Net working capital minus cash and marketable securities, divided by book value of total assets.
R&D	R&D spending divided by book value of total assets.
Cash Flow to Assets	Operating income before depreciation minus interest, taxes and dividends, divided by book value of total assets.
Industry Sigma	Measure of the industry cash flow volatility. It is calculated as follows: Standard deviation of the cash flow to assets for the previous three years, which is then averaged by year and the two-digit SIC code.
Leverage	Long term debt plus debt in current liabilities, divided by book value of total assets.
Dividend Dummy	A dummy variable equal to one if a firm pays a common dividend in a particular year, and zero otherwise.
Net Income Dummy	A dummy variable equal to one if the net income of a particular firm year is non-negativ and zero otherwise.
Crisis Dummy	A dummy variable equal to one for observations during the financial crisis (2008-2010), and zero otherwise.

Table A.2.
Number of observations by year and country

This table shows the number of firm-year observations by country in each year from 1980 to 2011. The last row shows the total number of observations for each country.

	Country				
Year	France	Germany	Italy	Spain	UK
1980	64	65	7	4	161
1981	70	65	8	4	165
1982	69	65	12	8	176
1983	81	72	14	7	182
1984	94	81	19	11	245
1985	96	92	27	10	287
1986	115	100	43	14	325
1987	204	141	92	24	619
1988	256	193	107	38	859
1989	287	217	122	47	949
1990	318	243	121	67	987
1991	350	275	125	72	992
1992	363	288	125	81	968
1993	378	321	111	88	979
1994	376	333	109	89	998
1995	367	339	106	88	987
1996	403	356	107	98	1,081
1997	434	363	107	100	1,143
1998	477	391	111	97	1,105
1999	473	422	110	99	1,028
2000	517	515	142	107	1,072
2001	543	514	154	102	1,125
2002	522	467	156	101	1,102
2003	498	435	145	93	1,032
2004	473	422	141	93	1,079
2005	465	416	152	88	1,155
2006	455	416	164	91	1,232
2007	438	422	177	94	1,207
2008	433	407	171	95	1,125
2009	409	383	166	93	1,040
2010	395	358	163	96	962
2011	376	345	161	94	873
Total	10,799	9,522	3,475	2,193	27,240

Table A.3.
Investor protection and ownership concentration by country

This table shows the Anti-director rights index (ADRI), the creditor rights index, the rule of law index and the ownership concentration indicator by country. The ADRI measures shareholder protection. It takes values from 0 to 6. The source of the ADRI is Spamann (2009). Creditor rights index measures the creditor protection of a country. It takes values from 0 to 4. Rule of law is an assessment of the law and order tradition in a country produced by International Country Risk. It ranges from 0 to 10. Ownership concentration is the median percentage of common shares owned by the largest three shareholders in the ten largest privately owned non-financial firms. The final three variables are taken from La Porta et al. (1998).

Country	ADRI	Creditor Rights	Rule of Law	Ownership Concentration
France	5	0	8.98	0.24
Germany	4	3	9.23	0.5
Italy	4	2	8.33	0.6
Spain	6	2	7.5	0.5
UK	5	4	8.57	0.15

Table A.4.
Summary of the testable hypotheses

This table summarizes all testable hypotheses in the research.

Motive	Variable	Relation
H1. Transaction motive	Firm size	Negative
	Noncash liquid assets	Negative
	Cash flow	Positive
H2. Precautionary motive	Cash flow volatility	Positive
	Investment opportunity set	Positive
	Financial constrains	Positive
	Leverage	Negative
H3. Tax motive	Foreign income	Positive
H4. Agency Motive	Investment opportunity set	Negative
	Firm size	Positive
	Leverage	Negative
	Investor protection	Negative
	Anti-director rights	Negative
	Creditor rights	Negative
	Rule of law	Negative
	Ownership concentration	Negative
H5. Pecking Order Theory	Cash flows	Positive
	Leverage	Negative
	Firm size	Positive

Appendix B

Figure B.1
Evolution of the mean and median cash ratio from 1980 to 2011

The sample includes all Datastream firm-year observations of European publicly traded firms with positive book value of total assets and sales for the period 1988-2011. Financial firms (SIC codes 6000-6999) and utilities SIC codes (4900-4999) are excluded. Firm-year observations with missing values for long term debt, debt in current liabilities and cash and marketable securities are also removed from the sample. The cash ratio is measured as cash and marketable securities divided by the book value of total assets.

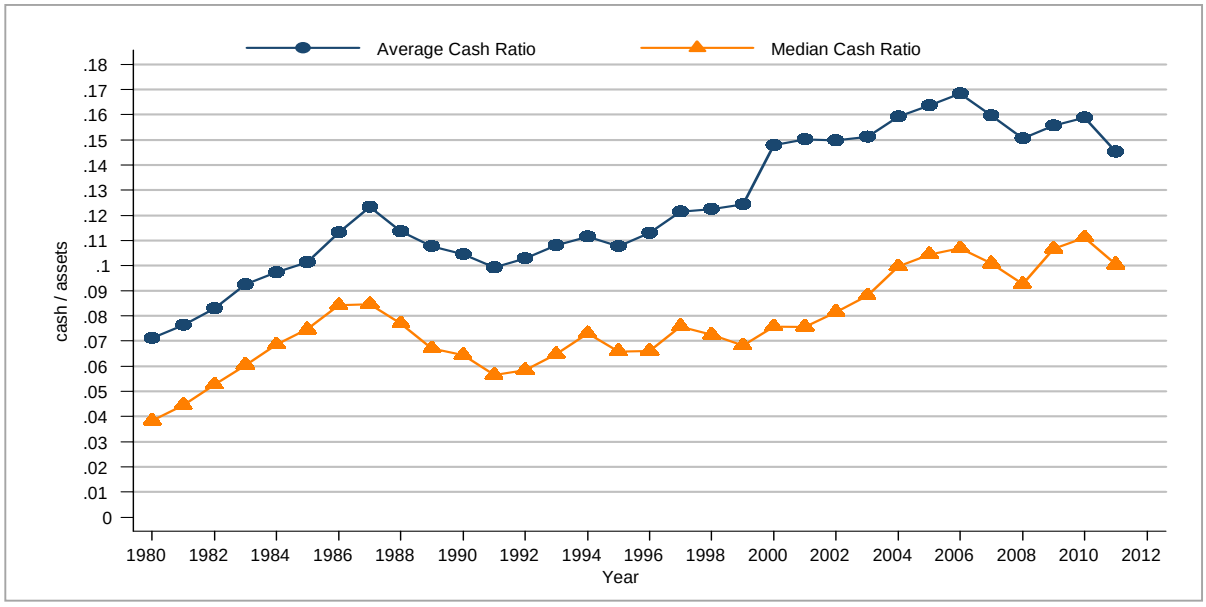

Figure B.2.
Evolution of the mean and median net leverage ratio from 1980 to 2011

The sample includes all Datastream firm-year observations of European publicly traded firms with positive book value of total assets and sales for the period 1988-2011. Financial firms (SIC codes 6000-6999) and utilities SIC codes (4900-4999) are excluded. Firm-year observations with missing values for long term debt, debt in current liabilities and cash and marketable securities are also removed from the sample. The net leverage ratio is measured as long term debt plus debt in current liabilities minus cash and marketable securities, divided by the book value of total assets.

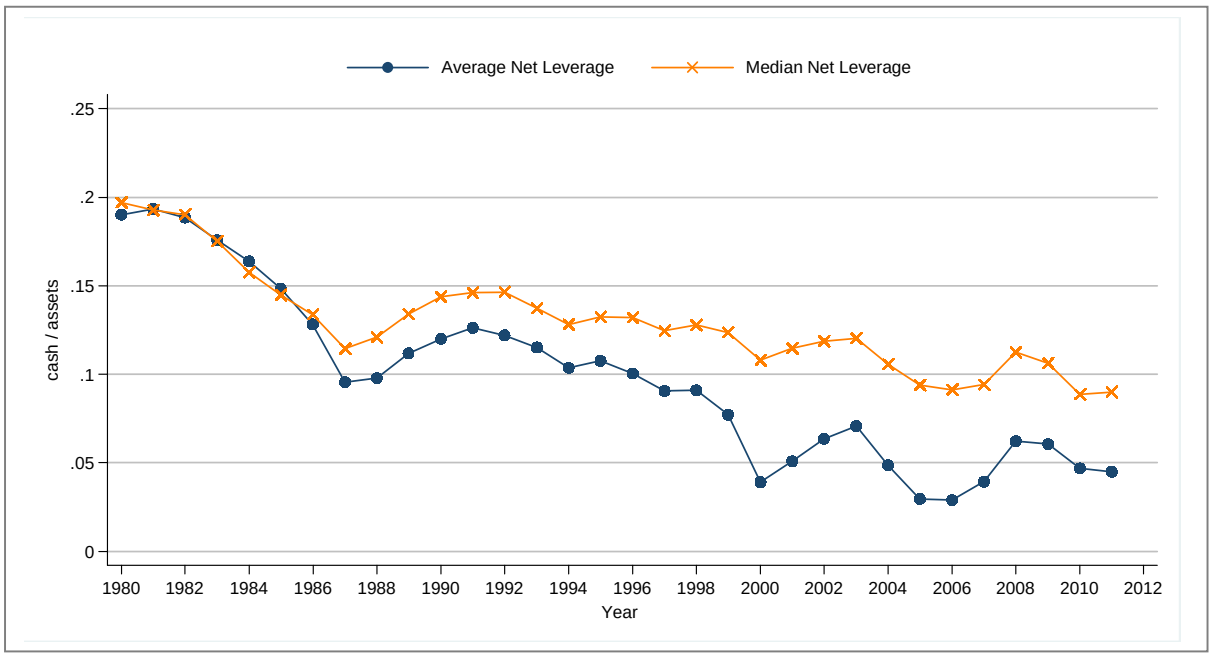

Table B.1
Cash ratio by country for the period 1987-2000

This table compares the summary statistics on the cash ratio per country of my sample with those reported by Ferreira and Vilela (2004). Panel A of the table presents descriptive statistics on the cash ratio by country for the sample period 1987-2000. The sample includes all Datastream firm-year observations of European countries with positive values for total assets and sales. Financial firms (SIC codes 6000-6999) and utilities (SIC codes 4900-4999) are excluded. Panel B presents the summary statistics on the cash ratio reported by Ferreira and Vilela (2004) for the sample period 1987-2000. The cash ratio in both panels is defined as cash and cash equivalents divided by total assets minus cash and cash equivalents.

Country	Mean	25 Pctl	Median	75 Pctl	SD	N
Panel A						
France	0.213	0.046	0.102	0.220	1.527	5,184
Germany	0.166	0.019	0.055	0.149	0.818	4,394
Italy	0.184	0.039	0.099	0.229	0.268	1,593
Spain	0.102	0.020	0.049	0.131	0.139	1,094
Panel B: Ferreira and Vilela (2004)						
France	0.159	0.050	0.107	0.204	0.176	1,583
Germany	0.148	0.035	0.091	0.194	0.211	1,587
Italy	0.219	0.067	0.175	0.334	0.182	614
Spain	0.089	0.016	0.048	0.114	0.114	571

Table B.2
Time trend regressions for the cash ratio and net leverage ratio

This table shows the results from the regressions of the cash ratio and the net leverage ratio on a constant and time (measured in years). The cash ratio is measured as the ratio of cash and marketable securities to total assets. The net leverage ratio is measured as long term debt plus debt in current liabilities minus cash and marketable securities, divided by the book value of total assets. The p-values are reported in parentheses.

Model	(1)	(2)	(3)	(4)
Dependent variable	Average cash ratio	Median cash ratio	Average net leverage	Median net leverage
Time	0.0028	0.0018	-0.0053	-0.0036
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-5.4871	-3.6283	10.8353	7.298
	(0.000)	(0.000)	(0.000)	(0.000)
R^2	79%	69%	85%	84%

Table B.3
Time trend regressions for the cash ratio per firm size quintile

This table shows the results of the regression of the average cash ratio on a constant and time (in years) for five firm size quintiles. The cash ratio is measured as the ratio of cash and marketable securities to total assets. The quintiles are based on the book value of total firm assets for the prior year. Q1 represents the smallest firm size quintile and Q5 corresponds to the largest firm size quintile. The p-values are reported in parentheses.

Model	(1)	(2)	(3)	(4)	(5)
Firm size quintile	Q1	Q2	Q3	Q4	Q5
Dependent Variable	Average Cash Ratio				
Year	0.0066	0.0042	0.0024	0.0005	-0.0002
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-8.4652	-5.4938	-4.6298	-0.9039	0.4124
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R^2	81%	65%	88%	13%	16%

Table B.4
Time trend regressions for the cash ratio per industry cash flow volatility

This table shows the results of the regression of the average cash ratio on a constant and time (in years) for industry cash flow volatility tertiles. The cash ratio is measured as the ratio of cash and marketable securities to total assets. The cash flow volatility is measured as the mean of the cash flow ratio standard deviation of firms in the same two-digit-SIC-code industry over the sample period. The tertiles are based on the industry cash flow volatility. T1 represents the lowest cash flow volatility tertile and T3 corresponds to the highest cash flow volatility tertile. The p-values are reported in parentheses.

Model	(1)	(2)	(3)
Industry cash flow volatility tertile	T1	T2	T3
Dependent Variable	Average Cash Ratio		
Year	0.0022	0.0039	0.0054
	(0.000)	(0.000)	(0.000)
Constant	-4.3125	-7.5653	-10.6903
	(0.000)	(0.000)	(0.000)
R^2	77%	74%	42%

Table B.5
Time trend regressions for the cash ratio based on the net income

This table shows the results of the regression of the average cash ratio on a constant and time (in years) for firms with negative net income and firms with nonnegative net income. The cash ratio is measured as the ratio of cash and marketable securities to total assets. The p-values are reported in parentheses.

Model	(1) Negative Net Income	(2) Non-negative Net Income
Dependent Variable	Average Cash Ratio	
Year	0.0076 (0.000)	0.0023 (0.000)
Constant	-15.0553 (0.000)	-4.4962 (0.000)
R^2	56%	84%

Table B.6
Time trend regressions for the cash ratio based on the dividend policy

This table shows the results of the regression of the average cash ratio on a constant and time (in years) for dividend payers and non-dividend payers. The cash ratio is measured as the ratio of cash and marketable securities to total assets. The p-values are reported in parentheses.

Model	(1) Dividend Payer	(2) Nondividend Payer
Dependent Variable	Average Cash Ratio	
Year	0.0013 (0.000)	0.0062 (0.000)
Constant	-2.5602 (0.000)	-12.3050 (0.000)
R^2	67%	55%

Table B.7.
Determinants of changes in predicted cash between 1980 and 2011

This table summarizes the determinants of the change in predicted cash between the period 1980-1997 and 1998-2011. The change in cash ratio is measured as the difference between the average cash ratio in the period 1998-2011 and the average cash ratio in the period 1980-1997. The predictions are based on a Fama-MacBeth model, discussed in Section 5.3.

	Coefficient	Mean in 1980-1997	Mean in 1998-2011	Change in Variable	Change in Cash Ratio
Panel A: Whole Sample					
MB	0.0344	1.4831	1.6264	0.1433	0.0049
Real Size	0.0014	11.9867	11.9351	-0.0516	-0.0001
Cash flow/assets	-0.0271	0.0468	0.0163	-0.0304	0.0008
NWC	-0.2131	0.0762	0.0125	-0.0637	0.0136
Capex	-0.4224	0.0737	0.0525	-0.0212	0.0089
Leverage	-0.2023	0.2219	0.2282	0.0063	-0.0013
Industry cash flow risk	0.1628	0.0498	0.0544	0.0047	0.0008
Dividend	0.0180	0.8150	0.5809	-0.2341	-0.0042
R&D/sales	0.3326	0.0068	0.0219	0.0151	0.0050
Net Income	0.0246	0.8445	0.7001	-0.1444	-0.0036
Panel B: Nondividend Paying Firms					
MB	0.0344	1.5005	1.7222	0.2217	0.0076
Real Size	0.0014	11.4577	10.8325	-0.6251	-0.0009
Cash flow/assets	-0.0271	-0.0090	-0.0416	-0.0326	0.0009
NWC	-0.2131	0.0041	-0.0246	-0.0287	0.0061
Capex	-0.4224	0.0660	0.0490	-0.0170	0.0072
Leverage	-0.2023	0.2567	0.2192	-0.0375	0.0076
Industry cash flow risk	0.1628	0.0516	0.0579	0.0063	0.0010
Dividend	0.0180	0.0000	0.0000	0.0000	0.0000
R&D/sales	0.3326	0.0088	0.0345	0.0257	0.0086
Net Income	0.0246	0.5271	0.4564	-0.0707	-0.0017
Panel C: Dividend Paying Firms					
MB	0.0344	1.4792	1.5573	0.0781	0.0027
Real Size	0.0014	12.1007	12.6717	0.5710	0.0008
Cash flow/assets	-0.0271	0.0575	0.0566	-0.0009	0.0000
NWC	-0.2131	0.0841	0.0391	-0.0449	0.0096
Capex	-0.4224	0.0754	0.0551	-0.0204	0.0086
Leverage	-0.2023	0.2140	0.2346	0.0207	-0.0042
Industry cash flow risk	0.1628	0.0494	0.0519	0.0026	0.0004
Dividend	0.0180	1.0000	1.0000	0.0000	0.0000
R&D/sales	0.3326	0.0064	0.0126	0.0063	0.0021
Net Income	0.0246	0.9166	0.8760	-0.0406	-0.0010

Table B.7. – *Continued*

	Coefficient	Mean in 1980-1997	Mean in 1998-2011	Change in Variable	Change in Cash Ratio
Panel D: Firms with Negative Net Income					
MB	0.0344	1.3584	1.6164	0.2580	0.0089
Real Size	0.0014	11.5689	11.0624	-0.5065	-0.0007
Cash flow/assets	-0.0271	-0.0423	-0.1014	-0.0591	0.0016
NWC	-0.2131	0.0163	-0.0513	-0.0677	0.0144
Capex	-0.4224	0.0637	0.0481	-0.0155	0.0066
Leverage	-0.2023	0.2712	0.2340	-0.0373	0.0075
Industry cash flow risk	0.1628	0.0509	0.0572	0.0063	0.0010
Dividend	0.0180	0.4374	0.2403	-0.1971	-0.0035
R&D/sales	0.3326	0.0095	0.0390	0.0295	0.0098
Net Income	0.0246	0.0000	0.0000	0.0000	0.0000
Panel E: Firms with Non-negative Net Income					
MB	0.0344	1.5061	1.6306	0.1246	0.0043
Real Size	0.0014	12.0669	12.2981	0.2312	0.0003
Cash flow/assets	-0.0271	0.0622	0.0665	0.0043	-0.0001
NWC	-0.2131	0.0872	0.0398	-0.0474	0.0101
Capex	-0.4224	0.0755	0.0544	-0.0211	0.0089
Leverage	-0.2023	0.2128	0.2257	0.0129	-0.0026
Industry cash flow risk	0.1628	0.0496	0.0533	0.0037	0.0006
Dividend	0.0180	0.8846	0.7269	-0.1577	-0.0028
R&D/sales	0.3326	0.0063	0.0146	0.0082	0.0027
Net Income	0.0246	1.0000	1.0000	0.0000	0.0000
Panel F: Small Firms					
MB	0.0344	1.5313	1.6345	0.1033	0.0036
Real Size	0.0014	10.6913	10.5367	-0.1546	-0.0002
Cash flow/assets	-0.0271	0.0461	-0.0012	-0.0473	0.0013
NWC	-0.2131	0.0909	0.0220	-0.0689	0.0147
Capex	-0.4224	0.0740	0.0498	-0.0242	0.0102
Leverage	-0.2023	0.2092	0.2016	-0.0076	0.0015
Industry cash flow risk	0.1628	0.0506	0.0553	0.0046	0.0008
Dividend	0.0180	0.8010	0.4671	-0.3339	-0.0060
R&D/sales	0.3326	0.0055	0.0261	0.0206	0.0069
Net Income	0.0246	0.8205	0.6313	-0.1892	-0.0047
Panel G: Large Firms					
MB	0.0344	1.4296	1.6156	0.1860	0.0064
Real Size	0.0014	13.8641	14.0825	0.2184	0.0003
Cash flow/assets	-0.0271	0.0476	0.0392	-0.0084	0.0002
NWC	-0.2131	0.0600	0.0001	-0.0599	0.0128
Capex	-0.4224	0.0733	0.0561	-0.0172	0.0073
Leverage	-0.2023	0.2360	0.2634	0.0274	-0.0056
Industry cash flow risk	0.1628	0.0489	0.0534	0.0045	0.0007
Dividend	0.0180	0.8306	0.7319	-0.0988	-0.0018
R&D/sales	0.3326	0.8306	0.7319	-0.0988	-0.0329
Net Income	0.0246	0.8713	0.7913	-0.0799	-0.0020