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Cash Holdings of EU Firms

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Abstract

Several studies have documented a significant increase in the average cash holdings of U.S. firms since the 1980s. This thesis tries to identify whether this trend is also present in the EU. We utilize a panel dataset of 7250 unique public firms from 25 EU countries, with a total of 73651 firm-year observations. We test the validity of 3 main motives for cash holdings, namely the transaction motive, the precautionary motive, and the agency motive. Furthermore, we explore the existence of time trends in firm cash holdings in our sample, and try to identify which changes in firm characteristics are responsible for them. Our methods are based on previous research by Bates et al. (2009), which utilize a sample of U.S. firms. Our results demonstrate that the average cash ratio of EU firms has increased from 10.9% in 1989 to 13.9% in 2010. This increase is most pronounced in small firms, firms in more risky industries, and non-dividend paying firms. We find that the change in cash ratios can be largely explained by changes in the underlying firm characteristics, and not so much by changes in the relationship between firm characteristics and the cash ratio. Our findings provide support for the precautionary and transaction motives for cash holdings, which tells us that firms hold cash to avoid transaction costs and as a defence mechanism against future cash shortfalls. Although we find some evidence of agency related factors which explain cash holdings, there is not enough evidence to fully accept the agency motive.

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Introduction

Cash holdings are an important item on firms' balance sheets, and therefore receive a lot of attention from companies, analysts, and investors. Several primary motives for firms to hold cash have been identified in economic literature. The transaction motive predicts that firms hold cash to avoid the higher transaction costs associated with raising outside capital or selling illiquid assets (Keynes, 1973). According to the precautionary motive, firms hold cash to be able to withstand future cash shortfalls (Han and Qiu, 2007). Another motive is the tax motive, which states that firms hold cash to avoid tax payments associated with repatriating income. Finally, the agency motive predicts that firms which face higher information asymmetries and agency problems will prefer internal cash financing to external financing(Myers and Majluf, 1984).

The currently unfolding global recession has served to make corporate cash holdings even more important. Ang and Smedema (2011) show that cash rich firms are better able to prepare for a recession when compared to firms which are low on cash, because the excess cash allows a higher degree of financial flexibility. An additional benefit provided by higher cash holdings is the possibility to take advantage of bargain acquisition opportunities in the current financial climate, without having to resort to costly outside capital. Indeed some cash rich firms such as Oracle, Merck, and Pfizer have used their cash reserves to finance acquisitions.[1]

This recent increase in cash holdings fits into the much broader trend of gradually increasing firm cash holdings in the U.S., which has been widely examined in economic literature. Bates et al. (2009) show that the average cash ratio of U.S. firms increases from 10.4% in 1980 to 23.2% in 2006. This increase is shown to be related to changes in specific firm character-

[1]"Technology firms sitting on mountains of cash", by Dan Gallagher, MarketWatch, February 13, 2009; "Oracle Foretells the Technology Sector's Future for Payouts", by Martin Peers, The Wall Street Journal, March 21, 2009; "Cash-Rich Oracle Scoops Up Bargains in Recession Spree", by Ben Worthen, The Wall Street Journal, 18 February 2009; "Buying time", The Economist, January 29th 2009; "Merck's manoeuvres", The Economist, March 12, 2009.

istics rather than changes in the relationship between these firm characteristics and the cash ratio. Bates et al. (2009) find that that this increase is concentrated among firms that do not pay dividends, firms which have gone public more recently, and firms in industries that have experienced the greatest increase in idiosyncratic volatility. After establishing the profound increase in cash holdings, Bates et al. (2009) utilize a model based on Opler et al. (1999) to examine which changes in firm characteristics have contributed most to the increase in cash holdings. Specifically, their findings show that the main reasons for the increase of the cash ratio are a decrease in inventories, increasing firm cash flow risk, falling capital expenditures, and a rise in R&D expenditures.

In contrast to the amount of research on cash holdings in the U.S., there have been relatively few papers published on this subject which are based on EU company data.[2] Since there are significant differences between the US and continental Europe in terms of the corporate environment, we are interested in the development of cash holdings in the EU and the comparison between US and EU cash holdings. One of the difference between the US and the EU is the fact that the EU is much more heterogenous in terms of legal origins, most of which offer less legal protection for investors when compared to the United States. This might imply that agency problems are more severe in EU firms, which consequently affects cash holdings as predicted by the theoretical cash holding motives. Another important point on which there are differences between the US and (continental) Europe is the availability of equity financing. Nykvist (2008) and Martinsson (2010) show that European capital markets are less developed than those in the US, leading to less equity financing, which is costlier to obtain. On a related note, Martinsson (2010) and Bottazzi et al. (2005) find that venture capital markets in the US are much more developed than those in the EU, which has an effect on corporate cash holdings.

Utilizing a dataset comprised of firm-year observations of EU firms for the period 1890-2010 we produce an analysis which draws heavily on the methods used by Bates et al. (2009).

Our main research question is: *Do the determinants of the cash ratio in the EU correspond to those established by prior literature for the US, and are there any significant time trends in our sample with regards to the cash ratio?*

The main interest is in seeing whether the results of previous empirical research are consistent with our EU sample or whether there are significant changes. Furthermore, we examine

[2]E.g. Ferreira and Vilela (2004) analyze cash holding determinants of EMU firms, but their data set spans the years 1987 to 2000, making it less current compared to Bates et al. (2009).

whether there are any significant time trends in the cash ratio during our sample, and whether or not these are different from previous research on U.S. firm data.

Our main results show us that the cash ratio of EU firms has steadily increased from 1989 to 2010, with a slight negative trend in the last few years of our sample. The cash ratio increase has been far more moderate in our sample when compared to the increase in the cash ratio of U.S. firms. The average cash ratio grows from 10.9% in 1989 to 13.9% in 2010 for our sample, whereas Bates et al. (2009) document an increase from 10.4% in 1980 to 23.2% in 2006 for U.S. firms. Consistent with the findings of Bates et al. (2009), we find that the increase in cash holdings can largely be explained by changes in firm characteristics rather than changes in the relationship between firm characteristics and cash holdings. Specifically, we find that the increase in cash holdings is largely driven by increases in industry cash flow volatility, an increase in the average R&D to sales ratio, as well as a decrease in the NWC to assets ratio. Our findings deviate somewhat from previous research by Bates et al. (2009), since the specific firm characteristics driving the increase in cash holdings for our sample are somewhat different from those found by Bates et al. (2009).

The rest of the paper is organized as follows: We start by examining the existing finance literature on the topic of cash holdings in chapter 1. In doing so, we establish the theoretical foundation for the specific firm characteristics which will later be used in our empirical analysis. Chapter 2 defines the variables we use in detail as well as describing the sources of our data. Furthermore, we begin with a broad overview of trends in our dataset, and show trends for specific sub populations of interest. Chapter 3 examines the determinants of the cash ratio in detail, as well as looking at the change in variables responsible for changes in the cash ratio throughout our sample period. We summarize our findings and conclude in chapter 4.

Chapter 1

Literature Overview

Firm cash holdings have been studied extensively in financial literature. This chapter will review the theoretical underpinnings of cash holdings and the corresponding empirical evidence. Specifically, we will take a look at some of the proposed theoretical motives for firm cash holdings.

The organization of this chapter is as follows: The first section of this chapter will examine the transaction motive for cash holdings. The 2nd section will look at the precautionary motive for holding cash. In the 3rd section we will look at the tax motive for holding cash. The 4th section will examine the agency motive for firm cash holdings, and the 5th section will look at pecking order theory and its implications for firm cash holdings.

1.1 The Transaction Motive

The transaction motive for cash holdings arises from the fact that firms try to minimize the transaction costs associated with raising cash when required for business operations. The transaction motive was introduced by Keynes (1973) in his magnus opus "The General Theory of Employment, Interest and Money". Keynes (1973) explains the transaction motive by way of 2 sub-motives, namely the (i) income motive and the (ii) business motive. The income motive arises from the fact that firms have to employ cash to bridge the interval between invoicing and collection of payments. The business motive comes from the temporal lag between firm investments and subsequent firm revenues. Due to the uncertainty of cash flows, both of these temporal differences can lead to a shortage of cash at hand which is needed to finance firm operations. When faced with such a shortfall, firms can do several things

to raise the appropriate cash amount: raise funds in the capital markets, liquidate assets, reduce investment/dividends, or renegotiate existing contracts (Opler et al., 1999). Under perfect capital markets, such as defined in the model of Modigliani and Miller (1958), there are no transaction costs and no liquidity premiums, hence firms can raise the needed funds at no cost, making the transaction motive irrelevant. However, in the real world, there are significant costs associated with raising cash through these methods, so it is often cheaper for firms to hold cash on hand rather than attempt to raise cash on demand. Holding cash is not free however, since the firm faces opportunity costs due to forgone interest on these cash holdings (Wrightsman and Terninko, 1971). The transaction motive is therefore often referred to as the trade-off motive, since firms face a trade-off between lower transaction costs on one hand, and the opportunity costs and other costs associated with holding cash (e.g. Kim et al. (1998)) on the other.

The transaction motive has been examined in depth in both theoretical and empirical research. Baumol (1952) and similarly Tobin (1956) are some of the first formal models which relate the demand for money with transaction costs. Miller and Orr (1966) further expand upon the Baumol (1952) model, and show that there are significant economies of scale with regards to the transaction costs. Empirical papers such as Opler et al. (1999), Kim et al. (1998) and Bates et al. (2009) build on these theoretical foundations and establish regression models which predict the optimal amount of cash holdings for firms. Specifically, Opler et al. (1999) show that the optimal level of cash holdings comes at the intersection between the marginal cost of liquid assets and the marginal cost of liquid asset shortage. In relation to the transaction motive, some firm characteristics examined in these and other related models are firm size, free cash flow and opportunity cost of cash. In particular, Mulligan (1997) finds that large firms do indeed have economies of scale in relation to transaction costs, as these large firms hold relatively low amounts of cash compared to smaller firms. Kim et al. (1998) find that firm free cash flow influences cash holdings, because firms can use free cash flow as a substitute to cash. Furthermore, non-cash liquid assets are found to be a substitute for cash by Ozkan and Ozkan (2004). The opportunity cost of cash, proxied by the T-Bill rate is shown to be a significant determinant of corporate cash holdings by Zhou (2009). Opler et al. (1999) show that the length of the cash conversion cycle influences cash holdings, as does the firms ability to raise (short-term) debt.

1.2 The Precautionary Motive

The precautionary motive, like the transaction motive, was first described by Keynes (1973). This motive stems from the fact that firms would like to have a safety measure against cash shortfalls in the future. Specifically, firms hold cash reserves which can be employed to nullify cash shortages due to adverse business shocks, which might otherwise cause heavy losses or even cause the firm to default. Firms which hold more cash are less likely to default in practice, when controlling for other economic factors as shown by Davydenko (2010). Likewise, cash reserves may be used to take advantage of unexpected investment opportunities, which would be unexploited otherwise due to temporal financing mismatches (Denis and Sibilkov, 2009).

The precautionary motive has been investigated by a large body of both theoretical and empirical academic research. Since the amplitude and frequency of the (un)favorable conditions which firms face hinges on firm and industry specific characteristics, a significant portion of literature has focused on firm and industry characteristics w.r.t. cash holdings. The classical theoretical model by Miller and Orr (1966) indicates that the demand for cash holdings increases along with cash flow variability. Opler et al. (1999) and Bates et al. (2009) find empirical evidence that firms with more risky cash flows, as well as firms with poor access to external capital, hold more cash. The work of Denis and Sibilkov (2009) corroborates this view, showing that higher cash holdings allow financially constrained firms to undertake positive NPV projects which might otherwise be ignored. Furthermore, it is shown by both Opler et al. (1999) and Bates et al. (2009) that firms with better investment opportunities, proxied by Research and development (R&D) spending and market-to-book values, have higher cash holdings. Another variable considered in this context is capital expenditures, which can create assets that increase debt capacity (Stulz, 2007), thereby reducing the need for cash. Furthermore, capital expenditures can be used as a proxy for investment opportunities and/or financial distress costs (Bates et al., 2009). The model of Almeida et al. (2004), which is later extended by Han and Qiu (2007) shows theoretically, that an increase in volatility increases firm cash holdings, if that particular firm is financially constrained. Additionally it is empirically shown by Opler et al. (1999) and Bates et al. (2009) that greater industry cash flow volatility leads to higher cash holdings for firms in that industry. Related to this, Subramaniam et al. (2011) show that highly diversified firms hold less cash, as the diversification smooths whole-firm volatility and provides an internal capital market which alleviates financial constraints. Brown and Petersen (2011) show that firms which have positive R&D

spending, and particularly firms which are also financially constrained, use cash to smooth their R&D costs. In addition to this, Hall (2002) finds that externally financing R&D is inherently difficult, which forces firms to utilize their own cash holdings to finance these expenses instead. More generally, Baum et al. (2006) shows that macroeconomic volatility negatively influences the firm manager's ability to adjust the cash holdings to the optimal cash level based on firm characteristics. Instead, in times of economic turmoil, managers tend hold more cash in general. Similarly, Ang and Smedema (2011) show that cash rich firms are better able to prepare for a recession when compared to firms which are low on cash, because the excess cash allows a higher degree of financial flexibility.

1.3 The Tax Motive

The tax motive for cash holdings arises from tax-based incentives which induce higher cash holdings in firms. Usually this motive concerns the repatriation of income of foreign subsidiaries, to the home country of multinational corporations. When the tax rate in the home country is higher than in the foreign subsidiaries' countries, a corporation may choose to hold the retained earnings as cash instead of repatriating them and facing the corresponding tax burden. This firm behavior is more likely when firms do not have immediate attractive investment opportunities and are financially unconstrained in the home country (Fritz Foley et al., 2007). Empirical research by Fritz Foley et al. (2007) suggests that for US firms facing high repatriation tax costs, cash holdings are indeed higher. However, this conclusion is not unanimous, as Bates et al. (2009) do not find evidence of higher cash holdings for firms with foreign pre-tax income. Furthermore, the tax motive in this case focusses solely on the US, which is problematic for our research since there are significant taxation differences between the US and EU countries. Due to these differences and the fact that EU countries are not homogeneous with respect to taxation of foreign income, the analysis of tax motives for cash holdings is outside of the scope of this paper.

1.4 The Agency Motive

The agency motive for firm cash holdings stems from problems posited by agency theory literature, such as information asymmetries and the differing interests of stakeholders. Agency problems lead to a different level of firm cash holdings from that which would result if there

are no agency problems. The most common conflicts of interest arise between managers and shareholders, and between shareholders and debt holders. Firm managers have an incentive to hoard cash, rather than payout cash to shareholders by way of dividends or share repurchases, because higher cash holdings give managers more influence over the company. (Jensen, 1986) Furthermore, using internal funds instead of external funds for investments, allows managers to avoid monitoring through capital markets. (Easterbrook, 1984) Myers and Majluf (1984) also posit that in the presence of asymmetric information, firms tend to prefer internal financing (i.e. cash or substitutes) above external financing. This effect is particularly pronounced when the firm has more investment opportunities.

A problem with the agency motive is that it is not always easy to extract and measure agency problems within firms. Most studies rely on proxy measures of agency problems, such as the level of shareholder protection and measures of corporate governance. The results of empirical literature on the agency motive are therefore expectedly somewhat mixed. For instance, Harford (1999) and Opler et al. (1999) do not find evidence of the fact that agency costs play an important role in determining firm cash holdings. Likewise, Bates et al. (2009) examine the contribution of agency factors to the increase of the cash ratio in their sample, but find that the results are inconsistent with the agency motive.

On the other hand, Harford et al. (2008) find that firms with poor expected governance actually hold less cash, but that managers of these firms spend cash quicker and primarily on acquisitions. Harford and Li (2007) confirm that managers engage in these acquisitions because the result of such empire-building activities is an increase in CEO pay. On a related note, Dittmar and Mahrt-Smith (2007) find the value assigned to an additional dollar of cash reserves is lower when agency problems are likely to be greater at the firm. Another factor which contributes to the agency motive for cash holdings, is the level of shareholder protection. Dittmar et al. (2003), and later Kalcheva and Lins (2007) find that in countries with poor shareholder protection firms hold far more cash, than in countries with good shareholder protection.

1.5 The Pecking Order Theory

The pecking order theory states that firms have a preference for one type of financing above others when financing investments (Myers, 1984). In particular, firms prefer retained earnings financing above safe debt and risky debt, which are themselves preferred over equity issuance.

This order of preference arises as a measure to minimize asymmetric information costs as well as other financing costs. The motives described in the previous sections of this chapter produce static models of capital structure. In contrast, the pecking order theory is a dynamic model for firm capital structure. Static models assume that firms optimize their capital structure by weighing the costs and benefits of cash holdings as well as debt, which leads to an optimal level of leverage and cash. In a dynamic model however, firms do not have target cash levels as in the static models, but use cash as a buffer between retained earnings and information costs. Firms therefore strive to have enough retained earnings to finance positive Net present value. (NPV) investments, and use additional operational cash flows to repay debt and build up liquid assets. The pecking order theory is examined empirically by a number of papers, with mixed results about its applicability to the real world. For instance, Shyam-Sunder and Myers (1999) find that the pecking order theory is better at explaining debt financing trends than static tradeoff models. Frank and Goyal (2003) on the other hand find that the pecking order theory only holds for large firms, and only in some respects. In regards to our central issue of cash holdings, the pecking order theory predicts that firms with higher cash flow should hold more cash, as these firms are more likely to have enough retained earnings to finance investments and build cash stockpiles. Bigger firm size should correspond to higher cash holdings, when controlling for investment (Opler et al., 1999), due to the fact that these firms tend to have been more successful. Leverage is expected to move in an inverse direction from cash holdings, because firms which are more levered will probably use any excess cash to reduce leverage.

Chapter 2

Data and Methodology

In this chapter, we describe the dataset used in this paper as well as our variables and methodology. This serves as a building block for the empirical analysis in later chapters.

The rest of this chapter is organized as follows: Section 2.1 provides a brief overview of the dataset used in this paper. Section 2.2 introduces and summarizes the variables used in our study. Section 2.3 examines the general time trends which emerge from the data. Finally, section 2.4 examines time trends in specific company variable based sub populations in the data.

2.1 General Data Description

In this paper we use a sample of company panel data from the WRDS Compustat Global database, with additional data from the Thomson Datastream Worldscope database. The sample consists of firm-year observations of EU firms in the period of 1989 to 2010, containing various company accounting and market variables which will be described in detail later. Both surviving and non-surviving firms are included in the sample. The bulk of the data-items comes from the WRDS Compustat Global database, and includes most company (accounting) fundamentals. The Thomson Datastream Worldscope database is additionally queried to provide market values and related data-items. An overview of the specific data-items used and their origins can be found in table A.3.

To make our data-set representative, as well as make it possible to compare the results to those of earlier studies, we introduce several constraints on our dataset. Only companies with non-missing ISIN codes are included, in order to merge the Worldscope data with the

Compustat Global data. We require that firms have positive assets and positive sales to be included in any given year. We exclude financial firms (Standard Industrial Classification (SIC) codes 6000-6999) from our sample, since they may carry cash due to capital requirements rather than due to economic reasons. Likewise utilities (SIC codes 4900-4999) are removed from our sample, since they may hold cash reserves on the basis of regulatory mandates rather than economic rationale. While Compustat Global provides data dating back to 1987, there are very few firm-year observations in 1987 and 1988, which prompted the use of 1989 as the starting year. Likewise, Worldscope provides a lot fewer datapoints before 2000 than after 2000, which makes the calculation of the market-to-book ratio less reliable for the first temporal half of the dataset. The Compustat data had a number of duplicate accounting-year observations, due to the fact that some companies changed the month of their annual report during our observation period. To remedy this, we have taken the latest possible observation within each particular year for these firms.

Of the 27 EU countries, 25 are represented in the sample. These are Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden and the United Kingdom. The 2 countries not present in the sample are Bulgaria and Romania, since Compustat Global does not provide data on these countries for our time period. Companies are assigned to countries by way of the incorporation variable (FIC). An overview of the number of observations per country, as well as the percentage of total observations can be seen in table A.1. In total, our sample consists of 73651 firm-year observations for 7250 unique firms. The total number of firm-year observations per year can be seen in table A.2.

2.2 Variables

The focus of this paper is on the time trends in corporate cash holdings, as well as the determinants of firm cash holdings in general. To aid in our examination of these, we construct a number of variables based on the data-items obtained from Compustat and Worldscope. An overview of all the variables we use in our analysis, as well as their definition and summary statistics can be found in table A.4.

Consistent with existing literature on the topic of cash holdings, we generally consider cash, marketable securities and short-term investments to be roughly equivalent for our purposes.

Therefore, we use cash interchangeably with this more broad definition of cash and equivalents. The main dependent variable of interest in this thesis is the cash ratio, which according to the finance literature can be defined in several ways. Ozkan and Ozkan (2004) define the cash ratio as cash and marketable securities divided by total assets. The same approach is taken by Bates et al. (2009) and Zhou (2009). Another way to define the cash ratio is cash divided by net assets, with net assets defined as the total book value of assets minus cash. This definition is used by Opler et al. (1999) and Ferreira and Vilela (2004) and is referred to as cash to net assets. The problem with this approach is that it tends to generate a lot of outliers. To remedy this outlier problem, Fritz Foley et al. (2007) proposes a 3rd definition of the cash ratio, which is the logarithm of cash to net assets. A fourth definition encountered in literature is cash divided by sales (Bates et al., 2009). For this thesis we follow Bates et al. (2009) and use cash to assets as the dependant variable in our models (calculated as cash and equivalents divided by total assets). We also use log of cash to net assets as a second cash ratio measure to see whether our results are consistent.

Consistent with existing literature, a number of variables describing firm, industry and country characteristics are used in our research. The summary statistics for all the variables described in this section are illustrated in table A.4. The variables used are mainly based on the motives for cash holdings identified in 1 and their constituents.

The transaction motive Keynes (1973) suggests that there are economies of scale in regards to the demand for cash, with larger firm size consequently correlated with lower cash holdings. As a measure of firm size we use the natural logarithm of total assets in 2007 euros (Real Size), using EU Consumer Price Index (CPI) data from the World Economic Outlook Database by the International Monetary Fund for the inflation correction. We create quintiles based on the aforementioned real size, in order to compare the smaller and larger firms in terms of cash ratio within our sample period. The transaction motive suggests that net working capital can act as a substitute for cash holdings. Following Bates et al. (2009) we use the net working capital to assets ratio, calculated as working capital minus cash and equivalents divided by total book assets.

The precautionary motive predicts that firms with better investment opportunities hold more cash, since the cost of a cash shortfall is higher. A commonly used measure for investment opportunities is the market-to-book ratio. Following Bates et al. (2009) we also use this measure, calculated by adding the book value of assets and the market value of equity, subtracting the book value of equity , and then dividing the result by the book value of assets.

All the data for this measure comes from the Worldscope database so as to have consistent figures.

Another variable used as a proxy for investment opportunities is the capital expenditures to assets ratio (Bates et al., 2009). We calculate this ratio by dividing capital expenditures by the book value of total assets. Higher capital expenditures should lead to higher cash holdings according to the precautionary motive. However, this relationship is not unambiguous, because capital expenditures can in theory create fixed assets which would increase debt capacity (Stulz, 2007). The increased debt capacity would then in turn lead to lower cash holdings, because firms have easier access to outside debt to use as a substitute for cash. A related variable is acquisition spending, which could be thought of as a substitute for capital expenditures (Bates et al., 2009). We include this variable in our analysis by calculating the acquisitions to assets ratio as acquisitions divided by the total book value of assets.

A third measure for firm growth opportunities along with financial distress costs used by various papers (e.g. Opler et al. (1999), Ozkan and Ozkan (2004), and Ferreira and Vilela (2004)) is the R&D to sales ratio. Once again following Bates et al. (2009), we calculate the R&D to sales ratio as R&D spending divided by sales. For observations where the R&D spending is missing, we set the ratio to be equal to zero. As an alternative to this ratio, we also use the R&D to assets ratio, calculated as R&D spending divided by total book assets. We however expect the results of this ratio to be similar to R&D/sales.

The next variable used in our analysis, leverage, has contradictory predictions for cash holdings, depending on the theory considered. In line with the precautionary motive, Ozkan and Ozkan (2004) propose that a higher leverage ratio leads to higher financial distress costs because of amortization pressures. In this light, firms would likely use cash to reduce their debt holdings to more bearable levels, which implies a negative relationship between leverage and cash holdings. On the other hand, Acharya et al. (2007) show that cash should not be seen as negative debt, but as a hedging tool instead. This leads to a positive relation between leverage and cash holdings, particularly for financially constrained firms. We measure leverage as long-term debt plus debt in current liabilities divided by total book assets. Additionally, we calculate net leverage, which is done by subtracting cash from total debt before dividing by total assets. This second definition more clearly illustrates the role of cash as negative debt, as established by Acharya et al. (2007).

The next variable we focus on are dividends. Firms that pay dividends are likely to be less risky and have greater access to capital markets (e.g. (Opler et al., 1999) and (Ferreira

and Vilela, 2004)), so the precautionary motive predicts lower cash holdings for these firms. We divide our dataset into dividend paying and non dividend paying firms by constructing a dummy variable which takes the value of 1 for observations in which a firm pays (common) dividends , and which is 0 otherwise.

Another positive relationship predicted by the precautionary motive is that between cash flow risk and cash holdings. Firms which face higher levels of industry cash flow volatility would be expected to keep higher cash balances, because they are exposed to bigger and/or more frequent cash flow shocks. This industry cash flow volatility is sometimes referred to as industry sigma or idiosyncratic industry-level risk, so we will use these names interchangeably with industry cash flow volatility. Multiple papers confirm the theoretical predictions empirically (e.g. Opler et al. (1999), Han and Qiu (2007) and Bates et al. (2009)), by using similar industry-wide approaches. Following Bates et al. (2009), we also calculate the cash flow risk as the standard deviation of cash flow to assets by industry (based on the two digit SIC code). This is done in several steps: 1) We calculate the cash flow to assets as operating income before depreciation minus interest, taxes and dividends, divided by total book assets. 2) Per firm-year observation, we calculate the standard deviation of cash flow to assets for the last 5 years, requiring at least 5 observations. 3) We average the annual firm cash flow standard deviations across each two-digit SIC code to get the industry cash flow risk. Since our sample is smaller compared to a sample of US firms, we use the 5 previous years instead of 10 years like Bates et al. (2009).

The precautionary motive seems to hold more for firms which are financially constrained as shown by Acharya et al. (2007) and Bates et al. (2009) among others. To measure the level of financial constraints experienced by a firm, net income is often used as a proxy. Following this methodology, we divide our sample into 2 sub samples by way of a net income dummy variable. The dummy takes a value of 1 if the net income is non-negative, and 0 if it is negative for a particular firm-year observation. We calculate net income as operating income before depreciation, minus depreciation, interest expenses and taxes.

The next motive we focus on is the agency motive. As this motive pertains to the influence of agency issues on cash holdings, we try to find firm and country variables which might be indicative of these issues. One variable which is used as a proxy for agency problems is the anti-director rights index (ADRI), which is a measure of shareholder protection on a country basis. The agency motive predicts that firms in countries with low shareholder protection, as indicated by a lower ADRI value, will hold relatively higher cash balances. We use the

ADRI values provided by Spamann (2009), which are a more recent correction based of the original values as calculated by Porta et al. (1998). A related measure is the creditor rights index (CR), which measures the level of creditor protection in a country. Similarly to the ADRI, lower creditor rights protection should correspond to higher cash holdings in firms. Our source of CR data is the paper by Brockman and Unlu (2009). The ADRI values as well as the CR for each specific country in our sample are detailed in table A.5. The next variable which we consider in our analysis of the agency motive is a measure of ownership concentration. Ferreira and Vilela (2004) posit that only large shareholders might be able to effectively monitor managers and thereby reduce agency problems. We expect that countries with higher ownership concentration would hold lower cash balances as a result. We use Gugler et al. (2008) as the source of our data. Specifically, we include the mean ownership percentage of the largest shareholder for each country as a proxy for ownership concentration.

We now turn to the analysis of the pecking order theory of capital structure. The pecking order theory (Myers, 1984) posits that firms with higher cashflows will have higher cash holdings, which is confirmed empirically by Opler et al. (1999) and Ferreira and Vilela (2004). However, mixed results have been reported in regards to the relationship between cash flow and and cash holdings. Bates et al. (2009) find sign changes within their sample timeframe, and a lack of explanatory significance in some of the used models. Since cash flows to assets have already been calculated, no new variables are needed.

Having established the variables to be used in our analysis, we perform several dataset wide measures to increase the reliability of our empirical conclusions. To reduce the influence of outliers on our analysis we winsorize several of our explanatory variables. Leverage is winsorized so that it falls between zero and one. The following ratios are all winsorized at the 1% level: R&D to sales, R&D to assets, acquisitions to assets, and captial expenditures to assets. Likewise cash flow volatility is winsorized at the 1% level. The bottom tails of NWC to assets and cash flow to assets are winsorized at the 1% level, and the top tail of the market to book ratio is winsorized at the 1% level as well. For the market to book ratio, also the observations with negative ratios are removed.

2.3 General Time Trends

This section looks at the time trends present in our data. Bates et al. (2009) find a significant positive time trend for firm cash ratios in their sample. Following their methodology, we look

at the overall time trends of the cash ratio and leverage ratios.

Table B.1 provides a detailed numerical overview of the changes in the cash and leverage ratios. The average cash ratio is 10.9% in 1989 and rises until the year 2000, in which the average ratio is 15.4%. After the year 2000 the ratio experiences a drop and then rises again to 15.3% in 2006. After 2006 the cash ratio seems to be decreasing, hitting 13.9% in 2010. However, we note that this decrease might be temporary due to the effects of the financial crisis. The median cash ratio follows the increase of the average cash ratio, although the increase is more steady and less extreme.

Our next metric of interest is the aggregate cash ratio, which we define as the sum of all cash and equivalents for all firms in a particular year, divided by the total of firm assets in that year. The aggregate cash ratio shows no clear upward trend in our sample period, and actually decreases from 13.7% in 1989 to 9.1% in 2010. If we exclude the first 2 years of our sample, which might be subject to outlier problems, we conclude that there is no clear trend in the data at all. The results from our EU sample give the hint that the increase in cash holdings is less pronounced than in the US, as Bates et al. (2009) find a much larger cash ratio increase in their sample (from 10.5% in 1980 to 23.2% in 2006). To verify whether there is a statistically significant trend in the cash ratio, we estimate regressions of the average and median cash ratios on a constant and time (measured in years). The regression results are reported in table B.2. The time coefficient in the average cash ratio model (model 1) corresponds to a yearly increase of 0.18% in the average cash ratio. The R^2 corresponding to this model is 55%. Similarly, the median cash ratio model (model 2) produces a time coefficient of 0.004, which indicates that the yearly increase in the median cash ratio is 0.04%. The R^2 of this model is 19%. In both estimated models the time coefficients have P-values which are below the 0.01 level, making them statistically significant. Generally speaking, these findings are consistent with a positive time trend in firm cash holdings over the time period.

Next, we focus on the trends in the leverage ratio of firms in our sample period. No clear trend in the average leverage ratio can be established, with the ratio starting at 20.3% in 1989, then decreasing slightly to 19.5% in 2000, before increasing again to 20.5% in 2010. On the other hand, median leverage does exhibit a slight downward trend, with the ratio starting at 19% in 1989 and slowly decreasing to 17.1% in 2010. We subsequently examine average and median net leverage, which we calculate by subtracting cash from debt before dividing by total assets, as explained in section 2.2. A clear downward trend is visible in the average net leverage ratio, with the ratio going from 11.1% in 1990 to 6.7% in 2010. A similar, although

more nuanced trend is present in the development of median net leverage over our sample period. Median net leverage starts at 11% in 1989, and declines with minor ups and downs along the way, until it is 8.5% in 2010. To verify the statistical significance of these trends, we regress both the average net leverage ratio and the median net leverage ratio on a constant and time (in years). The results of these regressions are reported in table B.2. For the average net leverage ratio (model 3), the time coefficient is -0.019 indicating a decrease of 0.19% drop in average net leverage per year. The R^2 for this model is 30%. Similarly, the median net leverage ratio (model 4) gives a coefficient on time of 0.014, which corresponds to a drop of 0.14% per year for median net leverage. The R^2 is 29% for this model. Both models are significant at the 1% level, with p-values far lower than 0.01.

The decrease in the net leverage ratio is likely to be caused by an increase in cash holdings, rather than changes in the debt holdings of firms. This is evidenced by the practically unchanged leverage ratio throughout our sample period, as well as a lack of clear trend in debt holdings (unreported). Another interesting observation is that all the leverage ratios increase rather significantly in 2008, which likely to be caused by the financial crisis.

2.4 Cohort Specific Trends

In this section we investigate trends in specific sub-populations of our sample, in order to find which factors may have influenced the general increase in cash holdings. We first look at country specific trends, and then examine trends in firms with specific levels of characteristics such as terms of size, cash flow volatility, and dividend payout policy.

2.4.1 Firm Size

In order to see if the increase in cash holdings can be attributed to a firm of a particular size, we divide our sample into quintiles based on firm size. Specifically, we assign firms in a specific year to a quintile based on the level of book assets. Quintile (1) represents the smallest firms and quintile (5) the largest firms correspondingly. Figure 2.1 shows the evolution of the average cash ratio by firm size quintile throughout our sample period. Consistent with the findings of Bates et al. (2009), the smallest firm quintiles seem to exhibit the largest increase in cash ratio during our sample period.

To verify our findings, we estimate a linear regression of the cash ratio on a constant and time (in years) for each quintile (independently). The result of these regressions is displayed

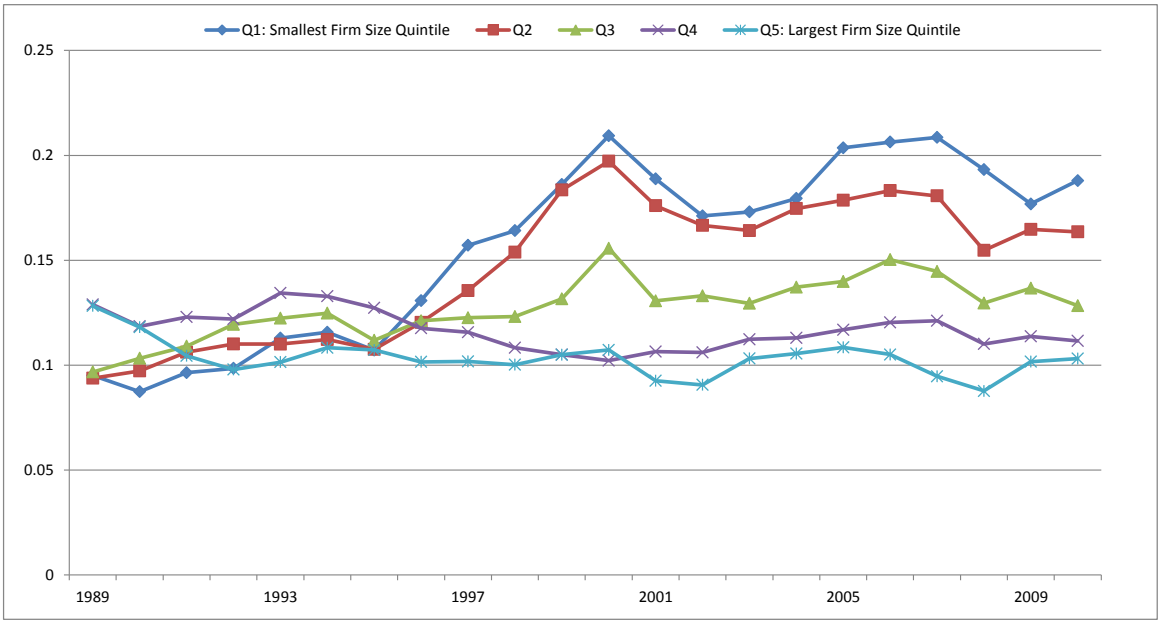

Figure 2.1: Average Cash Ratio by Year for Firm Size Quintiles.

in table B.3. We find the 2 smallest quintiles to have fairly large positive slope coefficients, in contrast to the 4th and 5th quintile, for which the slope coefficients are very small and slightly negative. This confirms our prediction that the increase in cash holdings is the most pronounced in smaller firms in our sample. Likewise, a clear trend is absent in the top 40% of firms. The regression results are significant at the 1% level for all quintiles.

2.4.2 Cash Flow Volatility

The next variable for which we examine time trends within our sample is cash flow volatility. Like we did with firm size, we divide our sample into quintiles based on the level of cash flow volatility. Note that our analysis extends from 1993 to 2010, as we require at least 5 prior years to calculate the standard deviation. Figure 2.2 shows the evolution of the time average cash ratio for each of the 5 industry cash flow volatility quintiles. The results seem to be in line with the precautionary motive for cash holdings, since the average yearly cash ratio for more risky industry quintiles is higher in our sample. As we can see, the quintiles with the highest industry sigma also exhibit a larger positive trend in the average cash ratio for our sample period. Our findings mirror Bates et al. (2009), who also find the strongest positive trends for the 2 highest risk quintiles. Contrary to their findings however, the 3rd quintile in our sample has a trend line which is much closer to that of the 4th and 5th quintiles.

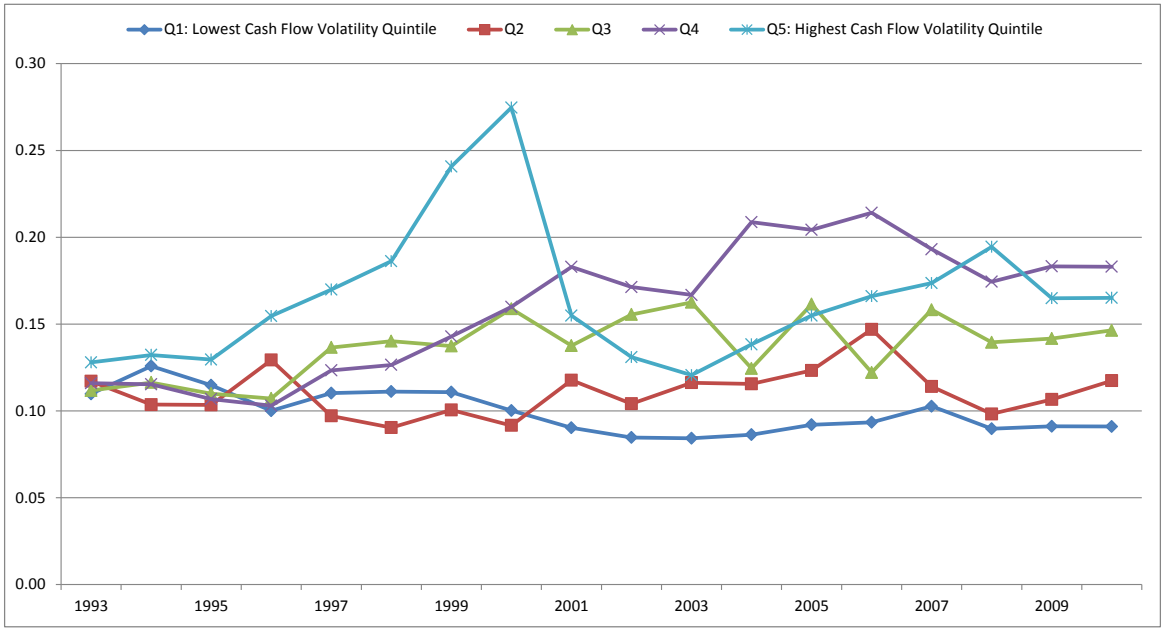

Figure 2.2: Average Cash Ratio by Year for the Industry Sigma Quintiles.

To determine whether these trends in our data are statistically significant, we run regressions for each quintile of the mean cash ratio (of that quintile) on a constant and time. The regression results can be found in B.4. The regression results show a significant (at the 1% level) positive time coefficient for the 4th quintile, corresponding to an increase in the average cash ratio of 0.57% per year. Likewise, the 3rd quintile has a coefficient representing an increase in the average cash ratio of 0.15% per year, which is also significant at the 1% level. The 5th quintile coefficient on the other hand, is only slightly positive (0.026% increase in cash ratio per year) but still significant at the 1% level.

2.4.3 Net Income

We now look at trends in net income based sub populations of our data set. Specifically, we divided the dataset in firms with negative and non-negative net income, as described in section 2.2. Figure 2.3 presents the time trends with respect to the average cash ratio in these 2 sub populations, and table B.5 provides the corresponding yearly average cash ratios. We find a pronounced upward trend in both sub populations, with the rise in cash ratio being more steep in the firms with negative net income. The trend in the negative net income firms is much more volatile than that of non-negative income firms. In line with the findings of Bates et al. (2009) we find that firms with negative net income have a high growth in the average

cash ratio throughout up until 2006. The increase in cash ratio is however less extreme in our sample (100% increase) compared to the increase in Bates et al. (2009) (200% increase) for the same period. Furthermore, we see that these firms exhibit a marked decrease in the cash ratio after 2007, which is presumably due to the start of the global financial crisis in that year.

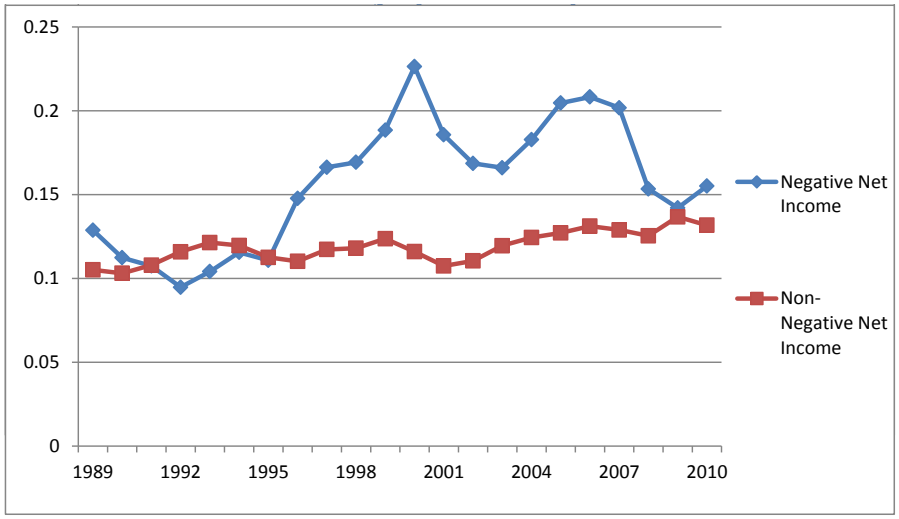

Figure 2.3: Average Cash Ratio by Year Based on Net Income Status

To examine whether the trends found in our data are statistically significant, we run regressions of the average cash ratio on a constant and time for both sub populations (separately). The results of these regressions are shown in table B.6. The regression results show significant positive trends in the cash ratio (at the 1% level) for both sub populations. Firms in the negative net income group have an average increase in the cash ratio of 0.22% per year while firms with non negative income have an average yearly increase in the cash ratio of 0.12%.

2.4.4 Dividend Policy

Now we look a trends within different firm sub populations based on their dividend payout policy. We divide the dataset into dividend paying and non dividend paying firms by way of a dummy dividend payment variable, as described in section 2.2. Figure 2.4 shows the trend in average cash ratio by year for these two sub populations. The time trends of both populations appear to be positive, with the non dividend paying firms showing a larger positive trend in

our sample. Furthermore, the trend lines for the two groups are very similar to the trend lines of the negative income and non-negative income groups discussed above.

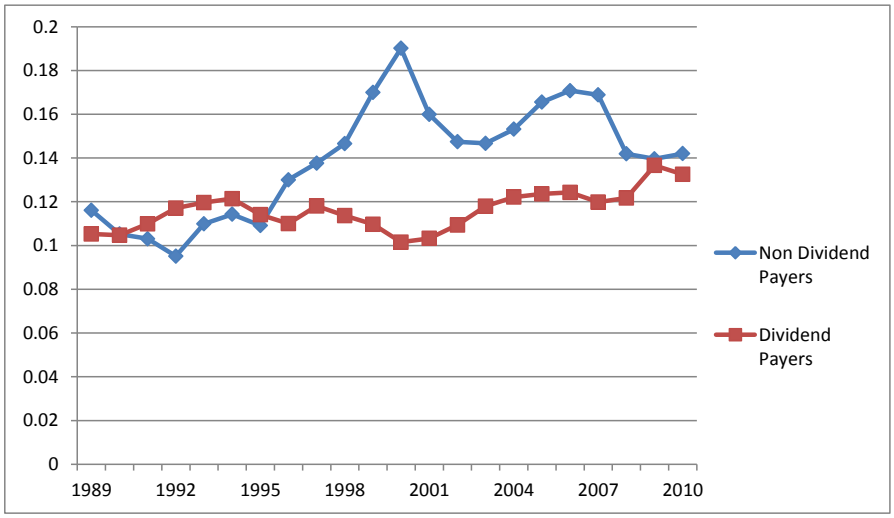

Figure 2.4: Average Cash Ratio by Year for Dividend Paying Firms and Non Dividend Paying Firms

Next, we estimate a linear regression of the cash ratio on a constant and time (in year) for the two groups (separately). Results of these regressions can be found in table B.7. The regressions show that there are minor, but significant trends in both the dividend paying firms and the non dividend paying firms. Dividend paying firms have an increase in the average cash ratio of about 0.09% per year, while non dividend payers have an increase in the average cash ratio of about 0.14% per year. All regression results are significant at the 1% level. These findings are consistent with Bates et al. (2009), who also document a markedly higher increase in the cash ratio for non dividend paying firms compared to dividend paying firms. Furthermore, these findings appear to be in line with the precautionary motive which predicts that dividend paying firms are less risky and therefore have lower predicted cash ratios (e.g. (Opler et al., 1999) and (Ferreira and Vilela, 2004)).

Chapter 3

Empirical Analysis

In this chapter, we perform empirical analysis on our data to estimate the determinants of firm cash holdings. Furthermore we try to identify whether there have been changes over time in the relationship between the determinants and the cash ratio. Specifically, we will investigate whether there has been a shift in the way firms determine their cash holdings.

The rest of this chapter is organized as follows: Section 3.1 will look at the determinants of the firm cash ratio. Section 3.2 will examine changes in the relationship between the explanatory variables and the cash ratio over time. Section 3.3 tries to determine which firm characteristics are the most important in explaining firm cash holdings. Finally, 3.4 looks at agency problems and their effect on the cash ratio

3.1 Determinants of the Cash Ratio

This section will examine the relationship between firm characteristics and the cash ratio of that firm. We will try to understand whether the observed increase in firm cash holdings can be explained by the firm characteristics. Before starting our analysis, we reiterate the list of variables to be included in our models, as well as our predictions about their effect on the cash ratio. The following variables are used in our analysis (more thorough explanations of the variables can be found in chapter 2):

1. **Real Size** According to the transaction motive, there are economies of scale with regards to firm cash holdings. We therefore predict that larger firms will have lower cash ratios. We use real size as a measure of firm size, which we calculate as the log of total assets in 2007 Euros.

2. **Market to Book Ratio** The market to book ratio is used as a proxy for investment opportunities. Our prediction in line with the precautionary motive is that firms with higher market to book ratios will hold more cash, since potential cash shortfalls are more costly for these firms.

3. **Net Working Capital to Assets Ratio** The transaction motive posits that net working capital can act as a substitute for firm cash holdings. We therefore expect firms with a higher net working capital to assets ratio to have a lower cash ratio.

4. **Cash Flow to Assets Ratio** Holding other factors constant, firms with higher cash flow will accumulate more cash and therefore have a higher cash ratio. Furthermore, the pecking order theory also predicts that firms with higher cash flow will have higher cash holdings. Although there are some mixed empirical results on this matter, we predict that this relation will hold true for our sample.

5. **Capital Expenditures to Assets Ratio** The relationship between capital expenditures and the cash ratio is ambiguous, since on the one hand the ratio serves as a proxy for investment opportunities. On the other hand more capital expenditure translate into more assets, which in turn increase debt capacity and thus a lower cash ratio. Since Bates et al. (2009) find an overall negative relationship between capital expenditures and the cash ratio, we predict that the same will be true for our sample.

6. **Acquisitions to Assets Ratio** The function of acquisitions in terms of the cash ratio is more or less the same as capital expenditures, with the same ambiguity in the relationship. We follow Bates et al. (2009) and predict that the acquisitions to assets ratio will have a negative relationship with the cash ratio.

7. **R&D to Assets Ratio** Since the R&D to assets ratio can be seen as an indicator for firm growth opportunities, the precautionary motive predicts that firms with a higher ratio will hold more cash.

8. **R&D to Sales Ratio** The R&D to sales ratio is an alternative to the R&D to assets ratio, which we include to compare which of the 2 provides more insight into the relationship with the cash ratio.

9. **Leverage** The relationship between leverage and the cash ratio is disputed. The precautionary motive predicts a negative relationship because higher leverage leads to higher

financial distress costs, which in turn prompt firms to use cash to reduce debt. Contrary to this view, Acharya et al. (2007) show that cash should not be seen as negative debt but as a hedging tool, which leads to a positive relationship between leverage and a cash ratio. Since Bates et al. (2009) find a significant negative relationship in their sample, our initial prediction is that this will also hold true in our sample.

10. **Net Leverage** Net leverage is used as an alternative measure to leverage, in order to better illustrate the role of cash as negative debt. We expect the the relationship between net leverage and the cash ratio to be negative.

11. **Dividend Dummy** Since firms which pay dividends are considered to be less risky than firms which do not, the precautionary motive predicts lower cash holdings for dividend paying firms. We set the dividend dummy to be 1 for each firm-year observation in which a firm pays a dividend, and 0 otherwise.

12. **Net Income Dummy**

    According to Acharya et al. (2007) among others, the precautionary motive is stronger for financially constrained firms. Since negative net income can be seen as a proxy for financial constraints, we expect a higher cash ratio for firms with negative net income. We set the net income dummy to 1 for each firm year observation in which the net income of the firm is non-negative, and 0 otherwise.

13. **Industry Cash Flow Risk** Firms with a higher cash flow risk are predicted to hold more cash by the precautionary motive. The calculation for the industry cash flow risk involves taking the standard deviation for the last 5 years of cash flows across each industry. The full procedure is described in chapter 2.

Having established our main dependent variables, we turn to the construction of our OLS regressions. The initial results of our OLS regressions are reported in table C.1. The number of unique firms in our data set is 7250 and the amount of observations used in each model is reported in table C.1. Using the approach by Miller et al. (2009) and Thompson (2011) we cluster our standard errors in the OLS regressions for time and firm simultaneously. This procedure makes our standard errors robust to arbitrary heteroscedasticity and within-panel autocorrelation as well as contemporaneous cross-panel correlation. Furthermore, we country dummies in our regressions to control for country specific factors not captured by the other

variables in our models. Model 1 in table C.1 shows the basic regression using all sample years. No industry or year dummies have been used in this model. As predicted by theory, the market to book ratio, industry sigma, cash flow to assets, and the R&D to sales ratio have positive coefficients in our basic model (model (1)) and are highly significant. Likewise, as predicted by theory and previous results, the real size, NWC to assets, CAPEX to assets, acquisitions to assets, leverage, and the net income dummy have negative coefficients which are highly significant. On the other hand, we find that the dividend dummy has a positive coefficient instead of a negative one predicted by the precautionary motive. In general the results from model (1) are similar to the the results obtained in Bates et al. (2009). As an alternative measure of cash holdings, model (2) uses the logarithm of the cash to net assets ratio. We find that except for the net income dummy, acquisitions to assets ratio, and real size, all coefficients are similar to model (1) in terms of sign and significance. In model (3) we attempt to eliminate the effect of constant unobservable firm characteristics. We do this by measuring the change in the cash ratio rather than the level by estimating an autoregressive model. The procedure for this follows Bates et al. (2009) and introduces the lagged cash ratio (Lag Cash) and lagged change in the cash ratio (Lagged dCash). As is evident from table C.1, there are no really significant differences between this model and model (1). Next we consider the possibility of changes in the intercepts of the models over time. Specifically, we re-estimate models (1) through (3) while including an additional time dummy variable (2000s Dummy), which takes the value of 1 if the observation is from the year 2000 or later, and 0 otherwise. The results of model (4) show that this dummy variable has a negative and significant coefficient, which means that the changes in the firm characteristics predict higher cash ratios after the year 2000 than actually observed in reality. Model (5), which re-estimates model (2) similarly adding a 2000s dummy, shows a positive but insignificant coefficient. Model (6) does the same for model (3) and displays a negative and significant coefficient similar to model (4). Taken together, these results do not give a firm answer about possible intercept shifts between the pre 2000 and the post 2000 period. Another possibility would be the occurrence of slope changes rather than intercept changes. This would be the case if the relationship between the cash ratio and the explanatory firm variables changes over time. To see if there is evidence for this phenomenon in our dataset, we estimate Fama-MacBeth regressions for 2 periods, namely the 1990s (1989 to 1999, model (7)) and the 2000s (2001 to 2010, model (8)). The methodology for these regressions is based on Fama and MacBeth (1973). The lag period for the Newey and West (1987) correction is chosen to be T-1, where T is the number of

periods in the sub sample, as recommended by Petersen (2008). As table C.1 shows, these regressions are mostly consistent with model (1). Model (7) shows a higher intercept term, which suggests that there might indeed have been a regime change during our timeframe. We investigate this possibility more in-depth in the next section of this chapter. The final two models which we estimate (models (9) and (10)) are fixed effects models, which treat some of the explanatory variables as non-random quantities, thereby trying to control for unobserved heterogeneity. Model (9) re-estimates model (1) while including firm and year fixed effects. Model (10) does the same, but adds industry and country fixed effects as well. The reported R^2 corresponds to changes within firms. In general, the coefficients of these two models are similar in size and significance to model (1), although the coefficient levels are lower in most explanatory variables. As is evident from C.1, the differences between model (9) and model (10) are very slight, suggesting small effects for industry and country characteristics.

In general, we can conclude from our results that relationship between the cash ratio and firm characteristics is consistent across our various model specifications.

3.2 Changes in the Relationship Between Firm Characteristics and the Cash Ratio

We now return to the issue of changes in the relationship between the explanatory variables and the cash ratio, which might have occurred during our time frame. Specifically, to see whether there have been changes in the slopes of the explanatory variables, we re-run our basic OLS models (models (1) and (2) of table C.1) with the addition of an indicator variable. The indicator variable is the 2000s dummy which is interacted with all of the other independent variables in our model. We report the results of these regressions in table C.2. Model (1) is the same OLS regression as model (1) from table C.1 but with the aforementioned interaction variables. Likewise, model (2) re-runs model (2) from table C.1 with added interaction variables. We include the interaction effect coefficients to illustrate the change in the slope of each particular variable between the two periods (pre and post 2000).

In general, our findings show that most of the interaction term coefficients are not statistically significant. The exception to this is the change in the slope coefficient of the NWC to assets ratio, which is indeed statistically significant and represents a decrease in the NWC to assets coefficient from -0.198 to -0.149. Our results are somewhat different from Bates et al. (2009), who do in fact find significant changes in the slopes within the timeframe of

their sample. Our two models with interaction terms have an only slightly positive effect on the adjusted R^2, which increases by only 0.002 and 0.003 for models (1) and (2) respectively. We conclude that there is little evidence of a regime shift in the relationship between the explanatory variables and the cash ratio during our timeframe. This effectively means that the changes in the cash ratio are largely due to changes in the underlying firm characteristics.

3.3 Most Important Determinants of the Cash Ratio

Having established the fact that the changes in the cash ratio are mainly due to changes in firm characteristics, we now proceed to examine which firm characteristics are the most significant determinants of the cash ratio. To do this, we follow the methodology of Bates et al. (2009) and proceed in three steps. The first step is the estimation of a Fama-MacBeth regression model with coefficients which are based on the average coefficients of annual cross-sectional regressions estimated over the period 1989 to 1997. The general algorithm of the Fama-MacBeth model is the same as in section 1 of this chapter, with the addition of two variables which add to the explanatory power of the model. These two variables are 1) Net Equity Issuance, which is calculated as equity sales minus equity purchases divided by the book value of total assets, and 2) Net Debt Issuance, which we calculate as debt issuance minus debt retirement divided by the book value of total assets. The full estimated model is as follows:

$$\begin{aligned}\text{Cash Ratio} = {} & 0.139 + 0.003\ \text{Real Size} + 0.009\ \text{Market to Book} \\ & - 0.188\ \text{NWC to Assets} - 0.061\ \text{Cash flow to Assets} - 0.195\ \text{CAPEX to Assets} \\ & - 0.747\ \text{Acquisitions to Assets} - 0.344\ \text{R\&D to Sales} - 0.231\ \text{Leverage} \\ & - 0.001\ \text{Dividend Dummy} + 0.248\ \text{Industry Sigma} + 0.070\ \text{Net Equity Issuance} \\ & + 0.039\ \text{Net Debt Issuance}\end{aligned} \tag{3.1}$$

Our second step is to compare the values predicted by the models of step one with the real world cash holdings in the years 1998 to 2010. The results of this comparison pertaining to the whole sample are shown in panel A of table C.3. The second column shows the predicted average cash ratio for a particular year. The third column displays the difference between the actual and the predicted average cash ratios. The fourth column shows the t-statistic pertaining to the statistical significance of differences between predicted and actual cash ratios for each particular year. While the actual average cash ratios are not shown, they can be easily calculated as the sum of columns 2 and 3. We find that the Fama-MacBeth

model consistently underpredicts the cash ratio for ever every year of our sample, except 2009 and 2010 for which the model overpredicts the cash ratio. The model predicts an increase in the cash ratio of 0.9% from 1998 to 2010 for the whole sample.

The following six columns of the table examine the predictions of the same model for sub populations categorized by dividend payment status. We find that for firms which do pay dividends, the model underpredicts the cash ratio for all years except 2000. For firms which do not pay dividends, the model underpredicts the cash ratio for most years. Only the last three years of the sample, 1998, 1999, and 2000 display an overprediction by the model. The model predicts that for dividend paying firms, the cash ratio increases by 1.6% from 1998 to 2010, while for non dividend paying firms the increase is predicted to be 2.0% in the same period.

We use the same Fama-MacBeth model procedure again in panel B of table C.3, this time focussing on the negative and non-negative net income sub populations within our sample. For firms with non-negative net income, we find that the model once again underpredicts the cash ratio for all years in our sample. Firms with negative net income have cash ratios which are too high in all years except the last three years of our sample, in which the predicted cash ratio is too high. Non-negative income firms have a predicted increase in the cash ratio of 2.0% from 1998 to 2010. In contrast, negative income firms are predicted to experience an increase of 3.5% in the same period.

Having estimated the determinants of the cash ratio, we can now look at the firm characteristics which have had the most effect in terms of the change in the cash ratio. Specifically, we divide our sample into 2 periods: 1989-1997 and 1998-2010, and calculate the average cash ratio for each. We find that the average cash ratio is 11.6% in the first period and 14.2% in the second period, which indicates that the cash ratio has grown by 22% between the two periods. To determine which of the explanatory variables were the most important drivers for the change in cash ratio, we calculate the average value of each explanatory variable for each of the two periods. Next, we determine the change in each of the explanatory variables between the 2 periods and the impact of this change on the cash ratio. The results of these calculations are displayed in table C.4.

We find that the most important drivers of change in the cash ratio are R&D to Sales, Industry Sigma, and NWC to Assets. Together these 3 variables correspond to an increase in the cash ratio of 3.1%. Our findings are very similar to those of Bates et al. (2009) who find these same 3 variables to be of high importance in explaining the changes in cash ratio. We

do however note that while Bates et al. (2009) find the change in capital expenditures to be the 3rd most important driver of change, this is not the case in our sample, where it plays a smaller role.

The high impact of cash flow volatility is not a surprise, as theory (e.g. Miller and Orr (1966), Opler et al. (1999), and Denis and Sibilkov (2009)) predicts that firms which face higher uncertainty will hold higher cash balances to be able to avoid cash shortfalls. R&D expenses to assets rise sharply between the 2 periods, which corresponds with the broader trend towards lower asset tangibility. Given this lower asset tangibility, firms which are R&D intensive find it harder to finance these investments with external capital, since they have less collateral. Also, as Hall (2002) posits, R&D expenses are inherently difficult to finance externally, leading to a higher demand for internal funds to finance these expenses. R&D expenses can also be seen as a proxy for growth opportunities, therefore making firms with higher R&D expenses more likely to hold higher cash balances to protect against adverse cash flow shocks, as predicted by the precautionary motive. The transaction motive suggests that net working capital can act as a substitute for cash holdings. Therefore, as NWC falls in proportion to assets throughout our sample, it is logical that firms hold higher cash reserves to make up for this loss of liquidity.

Generally speaking, our findings are very much inline with the precautionary and transaction motives of cash holdings.

3.4 Agency Motives and the Cash Ratio

Having examined firm cash holdings based on firm characteristics in combination with the transaction and precautionary motives, we now turn to the role of agency problems in determining the cash ratio. As argued in chapter 1, agency problems can have an effect on the cash holdings of firms due to suboptimal behaviour on the part of managers. Since it is difficult to measure agency problems directly, we employ several proxies in our analysis. Specifically, we add 3 variables to our analysis, namely the 1) Anti-Director Rights Index, 2) the Creditor Rights Index, and 3) a measure of ownership concentration.

We re-estimate the basic models of section 3.1 with the addition of these 3 variables, and show these results in table C.5. Model (1) and (2) are the re-estimated versions of models (1) and (2) from table C.1. Similarly, models (3) and (4) are re-estimations of models (7) and (8) C.1. As is evident from the results, the addition of the 3 variables hasn't improved

our models. All models have a lower R^2 compared with the original models. This remains true if we only add the variable with the highest beta, mean largest shareholder holdings (unreported). The coefficient on ADRI corresponds to our prediction that firms in countries with better shareholder protection hold less cash, although the effect is quite small (yet statistically significant). On the other hand, the coefficient on the creditor rights index is contrary to our predictions. We would expect its relationship with cash holdings to be similar to that of the ADRI and cash holdings. Once again the effect is fairly small though statistically significant. The indicator of ownership concentration we have chosen, measured as the mean ownership percentage of the largest shareholder per company, displays a negative coefficient as predicted by the agency motive. Firms with more concentrated ownership should be better able to deal with agency issues within the company.

In summary, we do not find a strong indication for the explanatory power of agency problems with respect to the cash ratio. Although the coefficients on some measures of agency problems are significant, they do not improve our general models on the whole. Further research might focus on looking specifically at the agency motive for cash holdings, by trying to identify more and better proxies for agency problems.

Chapter 4

Conclusion

Cash holdings play an important role in firms' capital structure decisions. In recent times, the financial crisis has made firm cash holdings even more important, because cash is a useful tool to protect against negative income shocks as well as prevent a default in a recession. Most financial literature on the subject of cash holdings has focussed on the cash holdings of U.S. firms. In this paper, we investigate whether cash holdings in European firms have the same determinants as those established in earlier literature for the U.S. Our aim is to confirm the conclusions of papers such as Bates et al. (2009) with respect to the determinants of cash holdings and the determinants of any changes in the average cash holdings over time. Furthermore, we try to isolate any significant time-trends pertaining to firm cash holdings in our sample of EU firms.

We show that the determinants of cash holdings in EU firms correspond largely to those established for US firms, thereby affirming the conclusions of previous literature on this subject. Our findings show trends which are fairly similar to those observed in US firm samples, although the main trend observed in the US is less pronounced in our sample.

Specifically, the data examined in this thesis shows evidence of a steady increase in the cash ratio of EU firm from 1989 to 2010, although there is a slight decrease in the last years of the sample. We attribute this decrease to the ongoing global financial crisis, which has put pressure on the cash flow and overall financial health of firms. The average cash ratio grows from 10.9% in 1989 to 13.9% in 2010, with 2 spikes in 2000 and 2006, of 15.4% and 15.3% respectively. Compared to earlier research on a sample of US firms by Bates et al. (2009), the increase is markedly less pronounced, although with a very similar general pattern. We find that firms which do not pay dividends and firms with negative net income show a bigger

increase in the cash ratio. Also, smaller firms, as well as firms with higher cash flow risk exhibit a steeper increase in cash holdings compared to to their counterparts. These findings mirror those of Bates et al. (2009), which leads us to believe that the aforementioned factors play a structural role in the determination of a firm's cash holding policy.

The results of our model estimations are generally in line with existing literature on the subject. Most factors predicted to be determinants of the cash ratio, do indeed exhibit statistically significant betas. In our sample, the 3 variables which have the greatest effect on the change in the cash ratio are R&D to Sales, Industry Sigma, and NWC to Assets. The industry sigma, which is a measure of industry cash flow volatility, grows throughout our sample, which corresponds to the broader trend of idiosyncratic risk increase as identified in various papers. However, there might be a prolonged decrease of the idiosyncratic risk due to a more risk-averse attitude following the financial crisis. This would likely cause the cash ratio to drop further in 2011 and beyond.

The growing R&D to Sales ratio as well as the decreasing NWC to Assets ratio are indicative of a structural trend towards lower asset tangibility. As Zhou (2009) stipulates, there has been a big expansion of the high-tech sector in terms of the number of new listings during the 1980s and 1990s. These newer firms rely much more on R&D expenses and have lower NWC to Assets ratios. To finance these increasing R&D expenses, firms are forced to utilize internal cash reserves, because their external financing of R&D is inherently difficult Hall (2002). Furthermore, firms with high R&D spending are thought of as having higher growth opportunities, which leads to higher cash holdings by these firms as predicted by the precautionary motive.

The trend of decreasing net working capital in relation to assets seems indicative of more efficient business organization over time. Since firms hold less net working capital, they will be less able to use the net working capital as as substitute for cash, and thus require larger cash reserves to compensate. This is in line with the transaction motive for cash holdings.

In conclusion, we find that the change in cash ratios can be largely explained by changes in the underlying firm characteristics, and not so much by changes in the relationship between firm characteristics and the cash ratio. Our findings are mostly consistent with the precautionary and transaction motives for cash holdings, which tells us that firms hold cash to avoid transaction costs and as an important defence against risk. Although we find some evidence of agency related factors which explain cash holdings, these do not improve our models. This suggests that more in-depth examination of these factors would be useful.

Finally, it should be noted that the models which are estimated here are based on the work of Opler et al. (1999) and Bates et al. (2009), and may not be the ultimate way of modeling firm cash holdings. Bates et al. (2009) themselves mention that there hasn't been enough progress in the literature to provide a model which is clearly superior to the alternatives.

Appendix A

Appendix A

Table A.1: Number of Observations by Country

This table shows the number of firm-year observations, as well as the number of unique firms by country. Our data set does include observations from Romania and Bulgaria, because there is no data available in Compustat Global for these countries.

Country	**Number of observations**	**Number of unique firms**	**% of total observations**
Austria	1305	121	1,76%
Belgium	1643	148	2,17%
Bulgaria	-	-	-
Cyprus	187	23	0,26%
Czech Republic	154	22	0,20%
Denmark	2158	187	2,89%
Estonia	156	16	0,20%
Finland	1915	153	2,50%
France	10407	978	13,77%
Germany	10322	940	13,75%
Greece	1915	222	2,52%
Hungary	250	26	0,34%
Ireland	1005	91	1,54%
Italy	3062	299	4,03%
Lithuania	213	26	0,28%
Luxembourg	313	34	0,46%
Latvia	222	25	0,29%
Malta	60	6	0,09%
Netherlands	2758	235	3,67%
Poland	2724	337	3,67%
Portugal	760	77	0,99%
Romania	-	-	-
Slovakia	70	10	0,09%
Slovenia	239	23	0,31%
Spain	1957	164	2,56%
Sweden	4937	519	6,72%
United Kingdom	24919	2574	34,93%
Total	73651	7250	100%

Table A.2: Number of Firm Observations Per Year

This table shows the number of unique firm-year observations for each year in our dataset.

Year	**Number of firm-year observations**
1989	1378
1990	1416
1991	1471
1992	1490
1993	1529
1994	1719
1995	1932
1996	3064
1997	3526
1998	3875
1999	4222
2000	4282
2001	4297
2002	4255
2003	4356
2004	4599
2005	4698
2006	4677
2007	4567
2008	4330
2009	4139
2010	3829

Table A.3: Data Items

This table shows all the data items used for the construction of the variables used in our analysis. The first column shows the original name of the item. The second column shows the item description. The last column shows the source of each particular data item. The 2 data sources we use for our data items are WRDS Compustat Global and Thomson Datastream Worldscope.

Data Item	**Description**	**Source**
SIC	Standard Industry Identification Code	Compustat Global
CHE	Cash and Short-Term Investments	Compustat Global
AT	Assets - Total	Compustat Global
DLTT	Long-Term Debt - Total	Compustat Global
DLC	Debt in Current Liabilities - Total	Compustat Global
CEQ	Common/Ordinary Equity - Total	Compustat Global
OIBDP	Operating Income Before Depreciation	Compustat Global
DP	Depreciation and Amortization	Compustat Global
XINT	Interest and Related Expense - Total	Compustat Global
TXT	Income Taxes - Total	Compustat Global
DVC	Dividends Common/Ordinary	Compustat Global
DVT	Total Dividends	Compustat Global
WCAP	Working Capital (Balance Sheet)	Compustat Global
CAPX	Capital Expenditures	Compustat Global
XRD	Research and Development Expense	Compustat Global
SALE	Sales/Turnover (Net)	Compustat Global
AQC	Acquisitions	Compustat Global
SSTK	Sale of Common and Preferred Stock	Compustat Global
PRSTKC	Purchase of Common and Preferred Stock	Compustat Global
IB	Income Before Extraordinary Items	Compustat Global
IDIT	Interest and Related Income - Total	Compustat Global
TXDITC	Deferred Taxes and Investment Tax Credit	Compustat Global
MV	Market Value of the Firm	Worldscope
BVEQUITY	Book Value of Common Shareholder's Equity	Worldscope
BVTA	Book Value of Total Assets	Worldscope

Table A.4: Variable Definitions and Summary Statistics

This table presents a definition and summary statistics for the most important variables used in our analysis. The following summary statistics are provided for each variable: number of observations (N), the mean value across our dataset, the standard deviation (SD), minimum value observed, maximum value observed.

Variable	Definition	N	Mean	SD	Minimum	Maximum
Cash ratio	The measure of a firms cash assets in relation to its assets. Calculated as cash and equivalents divided by total assets.	73,651	0.136	0.169	0.000	1.000
Real Size	A measure of the size of a company. Calculated as the natural logarithm of total assets in 2007 Euros.	73,651	7.819	3.112	-13.816	21.376
NWC to Assets	Calculated as net working capital minus cash and equivalents, divided by total assets.	73,651	0.039	0.203	-0.656	1.000
Market to Book	A commonly used ratio which serves as a proxy for investment opportunities. Calculated by adding the book value of assets and the market value of equity, subtracting the book value of equity, and then dividing the result by the book value of total assets.	59,008	1.838	1.912	0.003	15.294
CAPEX to Assets	Calculated by dividing the capital expenditures by the book value of total assets. Used as a proxy for investment opportunities.	60,521	0.052	0.064	0.000	0.357
Acquisitions to Assets	Calculated as the ratio of acquisitions to total book assets.	73,651	0.009	0.038	-0.022	0.304
R&D to Sales	Calculated as R&D spending divided by total sales.	73,651	0.036	0.188	0.000	1.591
Leverage	Calculated as long term debt plus debt in current liabilities, divided by total assets.	73,651	0.204	0.190	0.000	1.000
Net Leverage	An alternative measure of leverage. Calculated as long term plus current liabilities, minus cash, divided by total assets.	73,651	0.069	0.294	-1.000	1.000
Dividend Dummy	Takes the value of 1 if a firm pays a common dividend in a particular year, and the value of 0 otherwise.	73,651	0.438	0.496	0.000	1.000
Cash Flow to Assets	Calculated as operating income before depreciation, minus interest, taxes and dividends, the result of which is divided by total book assets.	73,549	0.032	0.188	-1.152	5.807
Cash Flow Risk	A measure of industry cash flow volatility. Calculated as the standard deviation of cash flow to assets for the previous 5 years, which is then averaged by year and 2-digit SIC code. Also referred to as industry sigma.	67,859	0.062	0.032	0.002	0.240
Net Income Dummy	Takes the value of 1 if net income in a particular firm year is non-negative, and the value of 0 otherwise.	73,651	0.700	0.458	0.000	1.000

Table A.5: ADRI, CRI, and Largest Shareholder by Country

For each country in our dataset, this table shows the Anti-Director Rights Index, the Credit Rights Index, and the average Largest Shareholder as a percentage of total firm value. Furthermore, in column (2) the legal tradition for each country is displayed. We use the ADRI values provided by Spamann (2009), which are a more recent correction based of the original values as calculated by Porta et al. (1998). Our source of Credit Rights data is the paper by Brockman and Unlu (2009). The data about the largest shareholder by country is obtained from Gugler et al. (2008).

Country	**Legal Origin**	**2005 ADRI**	**CR**	**LS**
Austria	German	4	3	0.62
Belgium	French	2	2	0.46
Czech Republic	German		3	
Denmark	Scandinavian	4	3	0.25
Finland	Scandinavian	4	1	0.26
France	French	5	0	0.49
Germany	German	4	3	0.53
Greece	French	3	1	0.45
Hungary	German		1	
Ireland	Common	4	1	0.20
Italy	French	4	2	0.44
Luxembourg	French			0.45
Netherlands	French	4	3	0.27
Norway	Scandinavian	4	2	0.32
Poland	German		1	
Portugal	French	4	1	0.44
Slovakia	German		2	
Spain	French	6	2	0.41
Sweden	Scandinavian	4	1	0.31
UK	Common	5	4	0.17

Appendix B

Appendix B

Table B.1: Average and Median Cash and Leverage Ratios from 1989 to 2010

The sample includes all Compustat firm-year observations from 1989 to 2010 with positive values for the book value of total assets and sales revenue for firms incorporated in the EU. Financial firms (SIC codes 6000-6999) and utilities (SIC codes 4900-4999) are excluded from the sample, yielding a panel of 73651 firm-year observations for 7250 unique firms. Variable definitions are provided in table A.4

Year	N	Aggregate Cash Ratio	Average Cash Ratio	Median Cash Ratio	Average Leverage	Median Leverage	Average Net Leverage	Median Net Leverage
1989	1,378	0.137	0.109	0.074	0.203	0.190	0.094	0.110
1990	1,418	0.123	0.105	0.072	0.214	0.202	0.111	0.114
1991	1,475	0.116	0.108	0.072	0.218	0.204	0.112	0.113
1992	1,497	0.078	0.110	0.075	0.225	0.207	0.120	0.121
1993	1,534	0.066	0.116	0.079	0.218	0.197	0.105	0.111
1994	1,729	0.102	0.119	0.082	0.207	0.192	0.094	0.104
1995	1,940	0.130	0.112	0.073	0.205	0.186	0.097	0.103
1996	3,084	0.121	0.118	0.071	0.202	0.182	0.090	0.098
1997	3,548	0.162	0.127	0.079	0.198	0.176	0.078	0.088
1998	3,900	0.144	0.130	0.073	0.200	0.172	0.077	0.091
1999	4,261	0.079	0.142	0.072	0.197	0.170	0.064	0.083
2000	4,335	0.119	0.154	0.073	0.195	0.167	0.053	0.083
2001	4,365	0.104	0.139	0.067	0.208	0.181	0.085	0.103
2002	4,324	0.082	0.134	0.066	0.211	0.184	0.093	0.111
2003	4,446	0.094	0.136	0.072	0.210	0.177	0.093	0.096
2004	4,680	0.091	0.142	0.078	0.198	0.157	0.073	0.067
2005	4,771	0.087	0.149	0.080	0.195	0.155	0.061	0.073
2006	4,745	0.101	0.153	0.083	0.193	0.158	0.055	0.066
2007	4,632	0.088	0.150	0.082	0.198	0.165	0.062	0.076
2008	4,382	0.085	0.135	0.072	0.219	0.187	0.096	0.113
2009	4,171	0.087	0.139	0.084	0.214	0.182	0.084	0.097
2010	3,829	0.091	0.139	0.084	0.205	0.171	0.067	0.085

Table B.2: Time Trend Regressions for the Cash Ratio and Net Leverage

This table summarizes the results from the regressions of the cash ratio and the net leverage ratio on a constant and time (measured in years). Corresponding P-values are reported in parentheses below the coefficients.

Dependent Variable	Average Cash Ratio	Median Cash Ratio	Average Net Leverage	Median Net Leverage
Model	(1)	(2)	(3)	(4)
Year	0.0018***	0.0004***	-0.0019***	-0.0014***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-3.4644***	0.0702***	0.0934***	0.1051***
	(0.000)	(0.000)	(0.000)	(0.000)
R^2	55%	19%	30%	29%

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.3: Time Trend Regressions for the Cash Ratio per Firm Size Quintile

This table shows the the results of the regressions of the average cash ratio on a constant and time in years for the firm size quintiles. The quintiles are based on total firm assets (#AT) and range from the smallest (1) to the largest quintile (5).

Dependent Variable	Average Cash Ratio				
Model	(1)	(2)	(3)	(4)	(5)
Firm Size Quintile	Q1	Q2	Q3	Q4	Q5
Year	0.00503***	0.00349***	0.00143***	-0.000423***	-0.000533***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.109***	0.115***	0.114***	0.120***	0.109***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N	14739	14730	14732	14729	14721
R^2	0.652	0.487	0.411	0.094	0.160

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.4: Time Trend Regressions for the Cash Ratio per Industry Cash Flow Risk Quintile

This table shows the the results of the regressions of the average cash ratio on a constant and time in years for each industry cash flow risk quintile. The quintiles are based on yearly standard deviations of the industry-wide cash flow to assets, going from the lowest risk quintile (1) to the highest risk quintile (5). A more in-depth discussion of the procedure to generate the industry cash flow risk is found in chapter 2

Dependent Variable	Average Cash Ratio				
Model	(1)	(2)	(3)	(4)	(5)
Firm Size Quintile	Q1	Q2	Q3	Q4	Q5
Year	-0.00149***	0.000875***	0.00147***	0.00572***	0.000257**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.005)
Constant	0.117***	0.0992***	0.121***	0.0924***	0.176***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N	14431	14086	13651	17587	8107
R^2	0.440	0.080	0.168	0.617	0.001

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.5: Average Cash Ratios for 1989 to 2010 by Dividend Status and Accounting Performance Sub Populations

This table shows the average yearly cash ratios for 4 different sub-populations of our dataset. These sub populations are 1) firms which do not pay dividends in a particular year, 2) firms which do pay dividends in a particular year, 3) firms with negative net income in a particular year, 4) firms with non-negative net income in a particular year.

	Dividend Status		Accounting Performance	
Year	Non Dividend Payer	Dividend Payer	Negative Net Income	Non-Negative Net Income
1989	0.1160825	0.105303	0.1288069	0.1050972
1990	0.1052279	0.1047385	0.1123473	0.1030621
1991	0.1030858	0.1099427	0.1074597	0.1079165
1992	0.095105	0.1171107	0.094759	0.1159087
1993	0.1098634	0.1196406	0.1040429	0.1213341
1994	0.1142819	0.1213836	0.1154843	0.1196345
1995	0.1091054	0.1140475	0.1108067	0.1125751
1996	0.1300488	0.1100308	0.1476991	0.1102229
1997	0.1376395	0.118052	0.1663084	0.1172453
1998	0.1465821	0.113681	0.1692358	0.1179839
1999	0.170014	0.1096972	0.1884082	0.1237164
2000	0.190156	0.1015423	0.2263477	0.1159342
2001	0.1598835	0.1032276	0.1856072	0.107441
2002	0.1474253	0.1093895	0.1686038	0.1104659
2003	0.1466853	0.1179567	0.1660431	0.1195325
2004	0.1531496	0.1221023	0.1827784	0.1243496
2005	0.1655068	0.1235505	0.2046467	0.1271162
2006	0.1707843	0.1242915	0.2082198	0.1311966
2007	0.1688821	0.1198699	0.2018158	0.1289267
2008	0.141872	0.1217292	0.1533683	0.1254079
2009	0.1396455	0.1366131	0.1420323	0.1367444
2010	0.1419993	0.1324998	0.1551517	0.1317202

Table B.6: Time Trend Regressions Based on Net Income

This table shows the results of two separate regressions based on a constant and time, for firms with negative net income and firms with non-negative net income.

Dependent Variable	Average Cash Ratio	
Model	(1)	(2)
	Negative Net Income	Non-Negative Net Income
Year	0.00219***	0.00121***
	(0.000)	(0.000)
Constant	0.142***	0.106***
	(0.000)	(0.000)
N	22079	51572
R^2	0.126	0.623

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.7: Time Trend Regressions Based on Dividend Policy

This table shows the results of two separate regressions based on a constant and time, for firms which do not pay dividends and firms which do.

Dependent Variable	Average Cash Ratio	
Model	(1)	(2)
	Non Dividend Paying	Dividend Paying
Year	0.00144***	0.000900***
	(0.000)	(0.000)
Constant	0.131***	0.106***
	(0.000)	(0.000)
N	41371	32280
R^2	0.132	0.370

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix C

Appendix C

Table C.1: Cash Ratio Determinants Regressions

We use a sample of company panel data from the WRDS Compustat Global database, with additional data from the Thomson Datastream Worldscope database. The sample consists of firm-year observations of EU firms in the period of 1989 to 2010. Both surviving and non-surviving firms are included in the sample. 25 of the 27 EU countries are included in our sample. We require that firms have positive assets and positive sales to be included in any given year. We exclude financial firms (SIC codes 6000-6999) from our sample, since they may carry cash due to capital requirements rather than due to economic reasons. Likewise utilities (SIC codes 4900-4999) are removed from our sample, since they may hold cash reserves on the basis of regulatory mandates rather than economic rationale. This yields a sample of 73651 firm-year observations for 7250 unique firms. Variable definitions are provided in table A.4. Corresponding P-values are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Model	OLS	OLS	Changes	OLS	OLS	Changes	F-M(1990's)	F-M(2000's)	FE	FE
Dependent Variable	Cash Ratio	Log(Cash Ratio)	Cash Ratio	Cash Ratio	Log(Cash Ratio)	Cash Ratio	Cash Ratio	Cash Ratio	Cash Ratio	Cash Ratio
Real Size	-0.002*	0.320***	-0.002**	-0.002***	0.326***	-0.003**	-0.004**	-0.003**	-0.001	-0.001
	(0.010)	(0.000)	(0.003)	(0.000)	(0.000)	(0.000)	(0.004)	(0.002)	(0.366)	(0.358)
Market to Book	0.011***	0.100***	0.011***	0.011***	0.102***	0.011***	0.028	0.012***	0.006***	0.006***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.054)	(0.000)	(0.000)	(0.000)
NWC to Assets	-0.152***	-2.145***	-0.151***	-0.154***	-2.124***	-0.153***	-0.245**	-0.141***	-0.164***	-0.165***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)
CF to Assets	0.008	0.312	0.008	0.009	0.296	0.010	-0.280	-0.000	0.029	0.031
	(0.737)	(0.351)	(0.720)	(0.679)	(0.373)	(0.667)	(0.170)	(0.993)	(0.119)	(0.093)
CAPEX to Assets	-0.217***	-0.216	-0.233***	-0.225***	-0.139	-0.241***	-0.213**	-0.231***	-0.168***	-0.169***
	(0.000)	(0.678)	(0.000)	(0.000)	(0.797)	(0.000)	(0.008)	(0.001)	(0.000)	(0.000)
Acquisitions to Assets	-0.200***	0.710	-0.209***	-0.199***	0.700	-0.208***	-0.326**	-0.205***	-0.156***	-0.156***
	(0.000)	(0.182)	(0.000)	(0.000)	(0.185)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
R&D to Sales	0.240***	2.589***	0.241***	0.241***	2.586***	0.241***	0.399**	0.257***	0.065***	0.066***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.007)	(0.000)	(0.001)	(0.001)
Leverage	-0.305***	-4.486***	-0.298***	-0.302***	-4.512***	-0.296***	-0.289***	-0.300***	-0.186***	-0.187***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Dividend Dummy	0.007**	0.309***	0.007**	0.008***	0.302***	0.008**	0.013**	0.010***	0.009***	0.009***

Table C.1: (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Model	OLS	OLS	Changes	OLS	OLS	Changes	F-M(1990's)	F-M(2000's)	FE	FE
Dependent Variable	Cash Ratio	Log(Cash Ratio)	Cash Ratio	Cash Ratio	Log(Cash Ratio)	Cash Ratio	Cash Ratio	Cash Ratio	Cash Ratio	Cash Ratio
	(0.002)	(0.000)	(0.002)	(0.001)	(0.000)	(0.001)	(0.004)	(0.000)	(0.000)	(0.000)
Net Income Dummy	-0.005	0.415***	-0.005	-0.005	0.412***	-0.004	0.011	-0.004	0.005*	0.005*
	(0.087)	(0.000)	(0.103)	(0.109)	(0.000)	(0.142)	(0.217)	(0.175)	(0.041)	(0.049)
Industry Sigma	0.350***	7.482***	0.376***	0.401***	7.000***	0.424***	0.523**	0.390***	0.231**	0.223**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.002)
Lagged Cash			0.000***			0.000***				
			(0.001)			(0.001)				
Lagged dCash			0.179***			0.179***				
			(0.000)			(0.000)				
2000's Dummy				-0.016***	0.148	-0.017***				
				(0.000)	(0.132)	(0.000)				
Constant	0.204***	-5.386***	0.203***	0.218***	-5.526***	0.220***	0.210***	0.181***	0.148***	0.149***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N	34303	34097	31895	34303	34097	31895	5251	29052	34303	34258
R^2	0.341	0.154	0.360	0.342	0.154	0.361	0.356	0.356	0.729	0.730

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table C.2: Cash Ratio Interaction Regressions

The models shown in this table include separate slopes and interaction for two OLS interaction models which are expansions on models (1) and (2) of C.1. We use a sample of company panel data from the WRDS Compustat Global database, with additional data from the Thomson Datastream Worldscope database, as further detailed in the description of table C.1 as well as chapter 2

Model	(1)		(2)	
	Cash/Assets		Log(Cash/Net Assets)	
Dependent		Interaction		Interaction
Variable	Estimate	2000s	Estimate	2000s
Real Size	-0.002*	-0.001	0.132***	0.238***
	(0.037)	(0.545)	(0.000)	(0.000)
Market to Book	0.010***	0.000	0.078	0.026
	(0.000)	(0.817)	(0.092)	(0.618)
NWC to Assets	-0.198***	0.049**	-3.127***	1.058**
	(0.000)	(0.004)	(0.000)	(0.010)
CF to Assets	-0.041	0.055	-0.810*	1.059*
	(0.132)	(0.123)	(0.029)	(0.043)
CAPEX to Assets	-0.295***	0.085	-1.767**	1.647*
	(0.000)	(0.023)	(0.004)	(0.037)
Acquisitions to Assets	-0.210***	0.013	-0.671	1.464
	(0.000)	(0.621)	(0.499)	(0.127)
R&D to Sales	0.265***	-0.024	2.015***	0.605*
	(0.000)	(0.532)	(0.000)	(0.018)
Leverage	-0.287***	-0.016	-4.182***	-0.489
	(0.000)	(0.390)	(0.000)	(0.255)
Dividend Dummy	0.012**	-0.005	0.237*	0.045
	(0.005)	(0.282)	(0.010)	(0.650)
Industry Sigma	0.260*	0.148	12.052***	(0.059)
	(0.043)	(0.278)	(0.000)	-4.905
Net Income Dummy	0.003	-0.009	0.299*	0.122
	(0.582)	(0.144)	(0.015)	(0.344)
Constant	0.227***	-0.023	-3.341***	-2.334***
	(0.000)	(0.183)	(0.000)	(0.000)
Observations	34303		34097	
Adjusted R^2	0.343		0.157	

Table C.3: Predicted Cash Ratios and Deviations From Actual Cash Ratios

This table shows the cash ratios predicted by our Fama-MacBeth model based on the years 1989-1997 as well as the deviation of the predicted model from the actual cash ratio recorded in the years 1998-2010. We repeat this analysis for the sub-populations of dividend paying and non dividend paying firms, as well as the sub-populations of negative net income and non-negative net income firms. The full model used for the analysis is as follows: Cash Ratio = 0.139 + 0.003 Real Size + 0.009 Market to Book - 0.188 NWC to Assets - 0.061 Cash flow to Assets - 0.195 CAPEX to Assets - 0.747 Acquisitions to Assets - 0.344 R&D to Sales - 0.231 Leverage - 0.001 Dividend Dummy + 0.248 Industry Sigma + 0.070 Net Equity Issuance + 0.039 Net Debt Issuance. A detailed explanation of the model is provided in Section 3.3 Detailed variable definitions are provided in in table A.4. Given T-values show the statistical significance of each deviation.

Panel A									
	Whole Sample			Firms Paying a Dividend			Firms Not Paying a Dividend		
Year	Predicted	Actual - Predicted	t-statistic	Predicted	Actual - Predicted	t-statistic	Predicted	Actual - Predicted	t-statistic
1998	0.130	0.014	4.622	0.110	0.004	1.127	0.123	0.024	4.861
1999	0.142	0.025	7.628	0.100	0.009	2.656	0.132	0.038	7.404
2000	0.154	0.021	5.935	0.108	-0.006	-1.619	0.150	0.040	7.540
2001	0.139	0.040	11.325	0.087	0.016	3.861	0.106	0.053	10.827
2002	0.134	0.011	3.358	0.107	0.002	0.547	0.132	0.016	3.496
2003	0.136	0.003	1.135	0.117	0.001	0.242	0.142	0.005	1.156
2004	0.142	0.001	0.350	0.121	0.001	0.304	0.152	0.001	0.242
2005	0.149	0.011	3.465	0.114	0.009	2.560	0.153	0.012	2.643
2006	0.153	0.014	4.154	0.110	0.014	3.773	0.157	0.013	2.849
2007	0.150	0.014	4.298	0.110	0.010	2.881	0.152	0.017	3.451
2008	0.135	0.001	0.335	0.112	0.010	2.499	0.145	-0.003	-0.778
2009	0.139	-0.003	-0.996	0.127	0.010	2.323	0.148	-0.008	-2.105
2010	0.139	-0.005	-1.660	0.126	0.006	1.490	0.153	-0.011	-2.492

Table C.3 (continued)

Panel B						
	Firms With Non-Negative Income			Firms With Negative Income		
Year	Predicted	Actual - Predicted	t-statistic	Predicted	Actual - Predicted	t-statistic
1998	0.107	0.011	4.004	0.147	0.023	2.593
1999	0.103	0.021	7.039	0.155	0.033	4.065
2000	0.107	0.009	2.816	0.182	0.044	5.601
2001	0.074	0.033	9.787	0.136	0.050	7.210
2002	0.106	0.004	1.375	0.148	0.021	3.211
2003	0.117	0.002	0.704	0.160	0.006	0.907
2004	0.123	0.001	0.363	0.182	0.001	0.161
2005	0.118	0.009	3.067	0.188	0.017	2.057
2006	0.117	0.014	4.987	0.197	0.012	1.363
2007	0.114	0.015	5.385	0.191	0.011	1.307
2008	0.117	0.009	2.977	0.167	-0.014	-1.915
2009	0.127	0.010	3.062	0.166	-0.024	-3.737
2010	0.127	0.004	1.466	0.182	-0.027	-3.335

Table C.4: Determinants of Changes in Predicted Cash Holdings

This table summarizes the determinants of the change in predicted cash ratios between the periods of 1989-1997 and 1998-2010, where the change in the cash ratio is measured as the difference between the average cash ratio from 2000 through 2006 and the average cash ratio from 1989 through 1997. The predictions are based on the following model: Cash Ratio = 0.139 + 0.003 Real Size + 0.009 Market to Book - 0.188 NWC to Assets - 0.061 Cash flow to Assets - 0.195 CAPEX to Assets - 0.747 Acquisitions to Assets - 0.344 R&D to Sales - 0.231 Leverage - 0.001 Dividend Dummy + 0.248 Industry Sigma + 0.070 Net Equity Issuance + 0.039 Net Debt Issuance. Variables ordered from highest to lowest change. Detailed variable definitions are provided in table A.4.

Panel A					
Variable	Coefficient	Mean in Period 1	Mean in Period 2	Change in Variable	Change in Cash Ratio
R&D to Sales	0.344	0.012	0.044	0.032	0.011
Industry Sigma	0.248	0.024	0.067	0.043	0.011
NWC to Assets	-0.188	0.074	0.028	-0.046	0.009
Market to Book	0.009	1.239	1.545	0.306	0.003
Cash Flow to Assets	-0.061	0.065	0.022	-0.043	0.003
Leverage	-0.231	0.208	0.203	-0.005	0.001
Dividend Dummy	-0.001	0.630	0.379	-0.251	0.000
Net Debt Issuance	0.039	0.003	-0.013	-0.016	-0.001
CAPEX to Assets	-0.195	0.033	0.045	0.012	-0.002
Real Size	0.003	9.122	7.412	-1.710	-0.005
Net Equity Issuance	0.070	0.020	-0.060	-0.080	-0.006
Acquisitions to Assets	-0.747	0.002	0.012	0.010	-0.007

Table C.5: Cash Ratio Determinants Regressions with Agency Variables

We use a sample of company panel data from the WRDS Compustat Global database, with additional data from the Thomson Datastream Worldscope database. The sample consists of firm-year observations of EU firms in the period of 1989 to 2010. Both surviving and non-surviving firms are included in the sample. 25 of the 27 EU countries are included in our sample. We require that firms have positive assets and positive sales to be included in any given year. We exclude financial firms (SIC codes 6000-6999) from our sample, since they may carry cash due to capital requirements rather than due to economic reasons. Likewise utilities (SIC codes 4900-4999) are removed from our sample, since they may hold cash reserves on the basis of regulatory mandates rather than economic rationale. This table features a restricted sample due to data availability pertaining to the 3 included agency variables, ADRI, Creditor Rights, and Mean Largest Shareholder percentage.

	(1)	(2)	(3)	(4)
Model	OLS	OLS	F-M(1990's)	F-M(2000's)
Dependent Variable	Cash Ratio	Log(Cash/Net Assets)	Cash Ratio	Cash Ratio
Real Size	-0.002**	0.332***	-0.001	-0.003***
	(0.003)	(0.000)	(0.649)	(0.001)
Market to Book	0.008***	0.145***	0.009***	0.009***
	(0.000)	(0.000)	(0.000)	(0.000)
NWC to Assets	-0.171***	-2.899***	-0.193***	-0.150***
	(0.000)	(0.000)	(0.000)	(0.000)
Cash Flow to Assets	-0.027	-0.913**	-0.043**	-0.008
	(0.089)	(0.004)	(0.003)	(0.806)
CAPEX to Assets	-0.190***	0.730	-0.153**	-0.168***
	(0.000)	(0.106)	(0.007)	(0.000)
Acquisitions to Assets	-0.190***	1.424***	-0.483	-0.170***
	(0.000)	(0.001)	(0.127)	(0.000)
R&D to Sales	0.235***	2.497***	0.330***	0.239***
	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-0.300***	-4.278***	-0.260***	-0.298***
	(0.000)	(0.000)	(0.000)	(0.000)
Dividend Dummy	-0.002	0.286***	0.011*	-0.000

Table C.5: (continued)

	(0.580)	(0.000)	(0.015)	(0.915)
Net Income Dummy	-0.009**	0.491***	-0.006	-0.010**
	(0.002)	(0.000)	(0.071)	(0.003)
Industry Sigma	0.331***	7.956***	0.332*	0.472***
	(0.000)	(0.000)	(0.040)	(0.000)
ADRI	-0.030**	-0.906**	-0.018***	-0.005
	(0.003)	(0.002)	(0.000)	(0.063)
Creditor Rights	0.064***	1.555***	-0.011***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
Mean Largest Shareholder	-0.402***	-9.036***	-0.002	0.059***
	(0.000)	(0.000)	(0.930)	(0.000)
Constant	0.398***	-1.174	0.284***	0.197***
	(0.000)	(0.446)	(0.000)	(0.000)
N	69063	68041	25114	43949
Adjusted R^2	0.290	0.141	0.249	0.306

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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