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The determinants of cash holdings and its effect on the performance of European listed firms

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Contents

Abstract

Using OLS, fixed effect and Fama-MacBeth regressions I examine the determinants of cash holdings for listed firms in Denmark, France, Germany, and the Netherlands and find support for the precautionary motive for cash. Firms build cash reserves to spend on R&D and hold more cash if they expect good growth opportunities. Furthermore, it is evident that firms follow the pecking-order theory and prefer to build cash internally from cash flow as opposed to issuing debt. Given the corporate governance and financial system differences between the selected European countries and the US and UK, I find that the firms follow a similar cash policy. After an estimated target cash level is obtained I find that deviating from this target is associated with lower future accounting and market performance. This implies that investors are unable to anticipate the lower future performance associated with deviating from an estimated target cash level. Statistical evidence of an implementable buy-and-hold investment strategy is not found.

Key words: Cash holdings, Precautionary motive, R&D expenses, Performance, CAGR

1. Introduction

1.1. Background and identifying the problem

Empirical studies and media reports show that over the past two decades there has been a dramatic increase in the cash holdings of companies across the world (Bates, Kahle, & Stulz, 2009). Researchers have attempted to explain it using capital structure theories, such as pecking order theory and agency theory, and using motive theory, such as transaction cost motive, agency motive, and the precautionary motive. Bates et al. (2009) document that the cash ratio of US firms more than doubled to around 23% from 1980 to 2006 and Ferreira and Vilela (2004) report that at the end of 2000 European Monetary Union (EMU) firms held 15% of their assets in cash. Empirical studies of the motives and determinants of cash holdings have produced mixed results (Amess, Banerji, & Lampousis, 2015). Although various motives and determinants have been identified, it is not clear whether this increase in cash holdings has been to the benefit of the firm and its shareholders and whether firms with higher cash holdings perform better over the long term than firms with lower cash holdings. On the one hand cash can equip managers to steer the firm through difficult economic times to improve the performance of the firm (Mikkelson & Partch, 2003), but critics argue that high cash holdings is a result of entrenched management which leads to fewer profitable projects being pursued at the expense of inefficient cash earning a low return and not being paid out to shareholders in the form of dividends (Jensen, 1986). According to Dittmar and Mahrt-Smith (2007), the argument for agency problems and entrenched managers date as far back as 1937 when Adam Smith first expressed the phenomena. An extensive literature has since been published on agency costs and the potential damage to shareholder return (see for examples Chen & Chuang, 2009; Dittmar & Mahrt-Smith, 2007; Harford, Mansi, & Maxwell, 2008). Although Bates et al. (2009) find that agency problems does not seem to be the cause for the substantial increase in cash holdings, Dittmar and Mahrt-Smith (2007) and Harford et al. (2008) find that cash holdings are wasted in firms with poor governance and that it has a negative effect on the performance of these firms. What is the situation then in countries with characteristics conducive to agency problems? Do the firms in these countries have the same determinants of cash holdings as the firms in countries characterised as having better corporate governance and investor protection? Lastly, how does cash holdings affect firm performance and investor return in these countries?

1.2. Research objective

The objective of this paper is to examine the determinants of cash holdings of listed firms in selected European countries, and to investigate the effect of cash holdings on their performance. The selected countries are Denmark, France, Germany, and the Netherlands. These countries are all regarded as having bank-based financial systems (Hillier, Grinblatt, & Titman, 2012) and have a two-tier board structure with the supervisory board making additional decisions on behalf of shareholders (de Jong, DeJong, Mertens, & Wasley, 2005)[1]. Firstly, I examine whether firms from the European sample have the same determinants of cash holdings as predicted by theory. Secondly, I compare the determinants of cash holdings in the European sample with empirical results from the US, a country regarded as having a market-based financial system (Hillier et al., 2012) and strong shareholder rights protection (Harford et al., 2008). Finally, I investigate the effect of cash holdings in the four countries characterised as having corporate governance structures that may induce managerial entrenchment, agency costs and hinder shareholder rights (de Jong et al., 2005). Establishing the determinants first helps to estimate a target cash level which is used determine the effect on performance if firms deviate from this target. Figure 1 shows the research questions to be answered in this study.

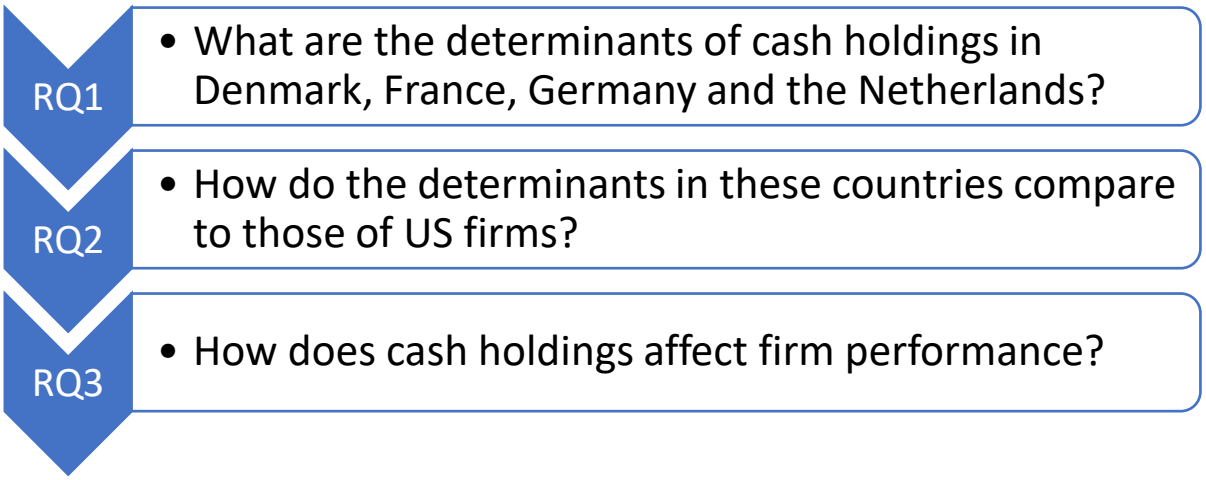


FIGURE 1: RESEARCH QUESTIONS

[1] In France firms have the option to implement a two-tier structure

1.3. Relevance of the research

Deciding on the level of cash holdings is important in every business. On the one hand, cash can improve firm performance because it increases flexibility and enables a firm to finance projects internally without having to use costly external financing. Additionally, in times of financial distress or limited available funding it acts as a buffer and enables a firm to fund projects (Ferreira & Vilela, 2004). On the other hand however, excess cash may lead to overinvestment, inefficient spending, agency conflicts, and managerial entrenchment (Nason & Patel, 2016). It is therefore important for shareholders to know whether the custodians of their investments are managing and spending cash appropriately and in their best interest and whether they are maintaining an appropriate cash level. Although the importance of the cash holding decision is acknowledged, research has been relatively limited to specific samples, with most of the previous research done on US and UK public firms and on datasets from previous decades. In an in-depth review of extant research on various aspects of corporate cash holdings Weidemann (2017) finds that out of 52 studies almost 70% are on US and UK samples, with the remaining studies based on Asian, European and global samples. Limited research, therefore, has been conducted on Continental European countries - many of which have a bank-based financial system which have different characteristics to those of US and UK firms (Amess et al., 2015).

Apart from the financial system and corporate governance characteristics, another similarity between the four countries in this study is their level of innovation, with Denmark and Germany classified as innovation leaders in Europe, and France and the Netherlands as innovation followers (Veugelers, 2016). Their cash requirements may therefore be higher to maintain a higher level of innovation, generally through R&D. Focussing this study on the selected European countries enables me to investigate how cash holdings effect a firm's performance in these types of economies. This study will use a more recent dataset from the past 9 years, including the 2009 global financial crises and 2012 European debt crises. In this study I show why firms in these countries build cash reserves and what the implications are if a firm deviates from an estimated target cash level.

1.4. Approach and outline of the study

Firstly, I study and report the relevant theories explaining the level of corporate cash holdings. These include capital structure decisions and the motives for cash holdings and provides insight and knowledge of the expected relationships, concepts, and significant variables. In combination herewith, I study empirical literature on the determinants and effect of cash holdings

and formulate three main hypotheses. Thirdly, I gather and prepare data and perform univariate, bivariate, and multivariate analyses to test the hypotheses. Lastly, I report results and form a conclusion. The next section contains a discussion of key research forming the theoretical framework for this study and report on empirical research. Section 3 provides an explanation of the research method and model used in this study and a description of the variables. Section 4 contains the results from the empirical research and section 5 provides the conclusion, limitations and suggested future research.

2. Literature review and hypotheses development

The level of cash which a firm holds can be explained from two points of view. On the one hand, managers select between a combination of the three major sources of finance – internal financing, debt financing, or equity financing – to obtain the optimal structure. Internal financing stems mainly from retained earnings which increases the level of cash a company holds. On the other, motive theory can be used to explain the level of cash in a firm and is closely related to the availability of finance and the intended usage of cash. Firstly, I discuss the theories used to explain the level of cash in firms, thereafter I discuss empirical evidence showing the major determinants of high cash holdings and the effect of high cash holdings on firm performance. Finally, I combine it all to develop the hypotheses to be investigated in this study.

2.1. Theories explaining the level of cash

When managers decide on the appropriate capital structure for the firm they take several factors into consideration. These may include factors such as corporate taxes, risk and cost of bankruptcy, cost of capital, flexibility, control and information sharing, and access to finance (Frank & Goyal, 2008). Furthermore, Harford, Klasa, and Maxwell (2014) show that characteristics such as debt maturity have an important impact on a firm's financial policy decision and how much cash a firm holds. Three predominant theories can explain the importance given to these factors – trade-off theory, pecking order theory, and agency theory:

- The trade-off theory is based on the belief that managers compare the benefits and costs related to their capital structure decisions. Initially introduced by Modigliani and Miller (1963) they argue that an increase in debt shields the firm from corporate taxes and therefore 100% debt financing will lead to zero corporate taxes, a very satisfactory outcome for a firm. Their theory is based on the key assumption that there are no transaction costs related to increasing debt excessively. Myers (1984) builds on the theory and shows that an offsetting cost exists, the cost of bankruptcy. Increasing the level of debt increases the bankruptcy cost for the firm and therefore managers will strive for a balance between the benefit of the debt tax shield and the bankruptcy cost associated with high debt levels. Obtaining external finance in the form of equity and debt will increase the equity and liabilities side of the balance sheet. This requires an equal increase on the assets sides which will mean that the funds are either invested in current- or non-current assets or reserved in cash for future spending.
- Proponents of the pecking order theory argue that it is not a simple trade-off between benefits and costs, but that there exists a hierarchy for financing and that the cost of

capital predominantly determines this hierarchy. Managers will opt for the cheapest source of financing and only once it is depleted will they move to the second cheapest source. Internal financing (from retained earnings) is the cheapest, followed by debt financing and thereafter equity financing as the most expensive source. The key factor determining the cost of capital is asymmetric information (Myers, 1984). Managers possess information which external parties, such as investors, do not and by opting for the various sources of finance managers provide signals of firm prospects. Issuing equity signals that management believes the firm is overvalued which will lead to investors demanding a higher return and therefore a higher cost of capital. Issuing debt generally provides a signal of good prospects, but still, come at a cost higher than internal financing. Using internal financing would avoid this asymmetric information problem and is, therefore, the preferred choice of financing (Frank & Goyal, 2008). Pecking order theory therefore supports the argument that firms retain earnings and build cash resources to fund projects when required. This leads to higher cash levels.

- Agency theory argues that managers dislike sharing information because it exposes them to the monitoring of investors and limits their control and flexibility and they, therefore, opt for internal funding (Frank & Goyal, 2008). Jensen and Meckling (1976) are important contributors to this theory and argue that managers may engage in activities to pursue personal gain at the expense of shareholders and that this is easiest when monitoring is low. They may, for example, spend excessively for short-term gain or inefficiently on poor investments. This can be exacerbated in the event of high cash holdings (Harford et al., 2008). Agency theory therefore explains why firms will opt to build cash reserves to internally fund projects rather than using external sources of finance.

Extant research has also developed theories to explain four important motives for firms to hold cash – tax motive, transaction cost motive, agency motive, and the precautionary motive.

- The tax motive explains that firms will hold large cash reserves to limit the tax burden of repatriating foreign earnings. It has however received limited theoretical support and empirical evidence suggest that it is mainly prominent in large US multinationals preferring to hold cash reserves in lower-taxed countries as opposed to repatriating it to the US where the corporate tax rate is higher (Foley, Hartzell, Titman, & Twite, 2007). This is not particularly a problem for the sample of European countries if you consider

that France, at 14th place, was the only country in the twenty highest top marginal corporate tax rates in the world in 2016[2].

- In the transaction motive, Miller and Orr (1966) show that firms prefer to hold cash because of the high brokerage costs involved in converting non-cash financial assets into cash for payments. Having liquid cash reserves firstly reduces transaction costs because firms do not have to liquidate assets, and secondly reduces the requirement and cost of raising outside funds. Holding cash, however, comes at a cost, the opportunity cost of not investing it in higher-return investments. Firms will, therefore, hold a level of cash where the marginal cost of liquid assets (opportunity cost) is equal to the marginal cost of a shortage of liquid assets (transaction cost) (Opler et al., 1999). Due to more efficient cash management and hedging strategies transaction costs have reduced over time. Furthermore, benefits of scale transactions have reduced the importance of this motive. It may however still be applicable to smaller firms who do not have the capabilities of cash management and hedging strategies or do not benefit from economies of scale with large transactions.
- The agency motive relates to the agency theory of capital structure which explains the separation between business owners and their appointed agents. Shareholders appoint managers (or a board of directors) to plan and oversee the business operation in their (the shareholders') best interests. Theory suggests that managers will prefer to hold large cash reserves. Proponents of the agency motive argue that managers will act in their own interests and that firms with entrenched management and weak corporate governance measures will hold higher levels of cash. Cash is easier to access and its discretionary spending does not attract many inquiries (Dittmar & Mahrt-Smith, 2007). Managers are more likely to retain cash than award shareholders with dividend pay-outs or invest in the best projects (Jensen, 1986). The agency motive offers various reasons for why managers would prefer not to pay out cash to shareholders, for example, executive remuneration structures may be linked to the growth or size of the business and therefore managers spend excess cash on acquisitions to build empires. They may also employ risk management tactics and avoid investing in risky projects to protect their career, or it may be a result of poor corporate finance decisions.
- The precautionary motive possibly has the strongest theoretical arguments and has in recent years received frequent empirical support. Underpinning this motive is that firms

[2] Study by Kyle Pomerleau for the Tax Foundation published on 18 August 2016 at https://taxfoundation.org/corporate-income-tax-rates-around-world-2016

build cash reserves in good times to help them through future bad times. This not only enables them to continue spending on operational costs but also to continue sufficiently investing in R&D and other projects. Opler et al. (1999) show that firms with more volatile cash flows hold more cash and Han and Qiu (2007) build on this theory to show that the relationship is stronger for firms that are financially constrained or have limited access to external funding.

2.2. Empirical support for the determinants of cash holdings

Various studies have investigated the high cash holdings phenomenon to try and explain the reasons for the dramatic increase in cash holdings and especially the relationship between high cash holdings and R&D expenses. Bates et al. (2009) determine that, over the period from 1980 to 2006, cash in US firms has increased mostly due to a decrease in inventories, an increase in cash flow, lower capital expenditure and higher R&D expenses and their key finding is that the increase is not due to agency problems. Consistent with the precautionary motive, they state that cash holdings increase due to higher risks firms face. An interesting finding is that where cash holdings are positively related to R&D expenses, it is negatively related to capital expenditure (CapEx) and acquisition costs. They explain that, unlike R&D, CapEx and acquisitions usually result in an increase in tangible assets which can be used as collateral and leads to an increase in leverage. Most studies show that leverage is a substitute for cash and therefore negatively related to cash holdings. Brown and Petersen (2011), with their studied data spanning from 1970 to 2006, find that US manufacturing firms use their higher cash holdings to smooth R&D costs over periods when there is a lack of available finance. This is particularly visible during the boom and bust of 1998 to 2002 and mostly applicable to younger firms. Their findings are consistent with the precautionary motive and bring new insight with regards to the relationship between the level of cash holdings and capital and financial market conditions.

Harford et al. (2008) take a similar approach to investigate the determinants of high cash holdings. In line with the precautionary method, they find a positive relationship between cash and R&D expenses. They also include cashflow volatility, a proxy for firm risk, as an explanatory variable and report a positive relationship with cash holdings. This finding strengthens the argument that firms increase their cash holdings when its risk increases. Another interesting addition to their analyses is lagged cash holdings, where the positive relationship with cash indicates that high cash holdings seem to be persistent instead of temporary. Similarly, Opler et al. (1999) investigate US publicly traded firms over the period 1971-1994 and find that managers have a greater preference for cash because it reduces firm risk. They report that an

increase in cash holdings leads to relatively small increases in CapEx, acquisitions, and pay-outs, which means that high levels of cash are persistent. Finally, they conclude that firms use excess cash to fund the business when it experiences negative operating cashflow. Here too, the precautionary motive seems to dominate the findings.

As noted in several of the extant literature R&D is one of the major determinants of high cash holdings. One can, therefore, expect that it would be most pronounced in high-tech firms spending large resources on R&D to remain competitive. Qiu & Wan (2015) take this focus in their research of US firms from 1982-2001. They hypothesise that firms operating in high-tech industries will hold more cash and that it is more pronounced for firms with limited access to finance. They find support for their hypotheses and show that high-tech firms experience technology spill-overs amongst their industry peers. Once this occurs a firm obtains new valuable information or knowledge and want to act on it as soon as possible. High cash reserves are crucial in these circumstances. In line with other studies (such as Brown & Petersen, 2011; Chiu, Wang, & Peña, 2016) they find that the precautionary motive for high cash holdings is more pronounced for firms facing financial constraints. Han and Qiu (2007) were first to specifically investigate the difference in the impact of cashflow volatility on the cash holdings of financially constrained versus financially unconstrained firms. They find that a firm experiencing financial constraints will increase their cash holdings when they experience, or expect to experience in the future, cashflow volatility. If a firm, therefore, expects that they will experience cashflow volatility in the following year, they will decrease their investments in the current year to build cash reserves.

Figure 2 shows the financial variables most often cited as determinants for high cash holdings and their expected effect. The precautionary motive is dominant and R&D expenses and risk management factors are the major determinants. Risk management factors include: cashflow volatility – the more volatile the cashflows, the more cash a firm will hold to prepare for adverse economic times; growth opportunities – more growth opportunities proxied by the market to book ratio and R&D expenses increases the risk of the business because of more projects that will be pursued, this demands a higher level of cash; capital expenditure – higher capital expenditure results in more assets for the business to sell in the event of difficult financial times and therefore lowers the risk and requires less cash; leverage – debt increases the risk if a firm is unable to meet its obligations, in firms where managers want to decrease the risk they will substitute debt with cash. Additionally, debt is seen as a substitute for cash. Furthermore, size can also be an influencing factor on risk management strategies, because a smaller firm will find it more difficult to obtain external finance or would not be able to easily

adjust to price cuts from larger competitors and must, therefore, build cash internally as a precautionary action.

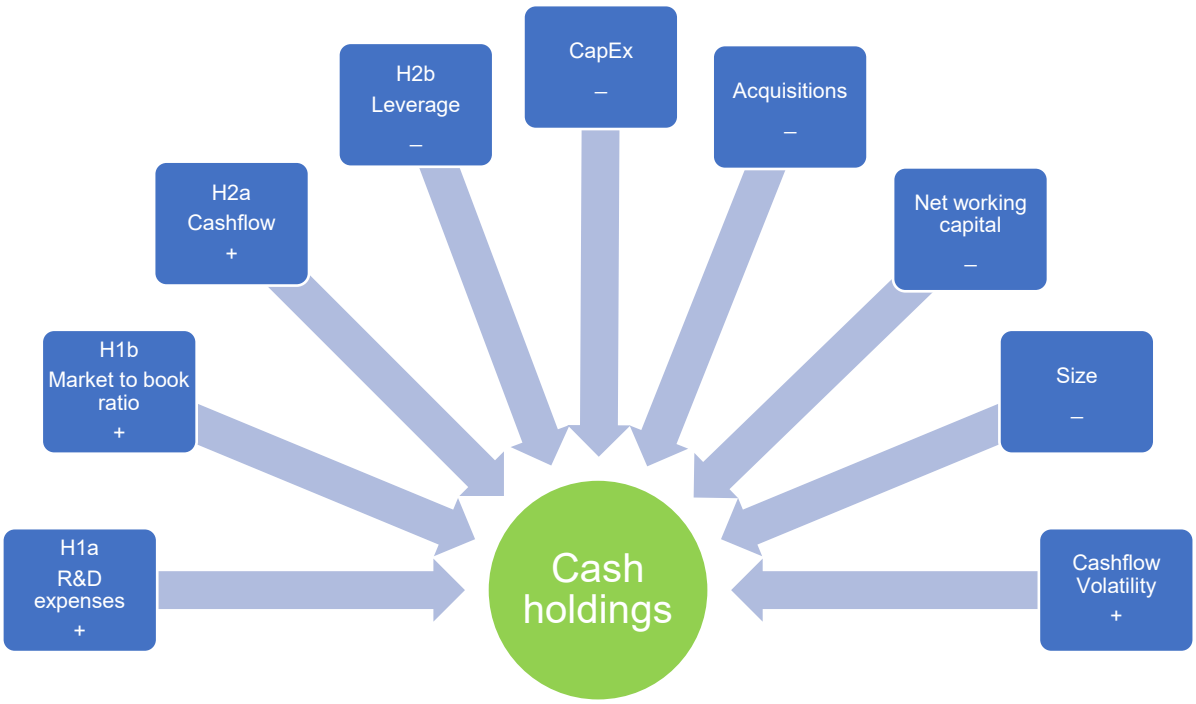


FIGURE 2: DETERMINANTS OF HIGH CASH HOLDINGS

2.3. Effect of cash holdings on firm performance

The precautionary motive theory explains to a large extent the positive relationship between cash holdings and R&D expenses. Firms prepare for future expenses, of which R&D is a large proportion, by building cash reserves in good financial times. Furthermore, the intangible nature of R&D increases a firm's reliance on cash because creditors are less likely to provide finance due to the lack of tangible collateral related to the project (Lerner & Hall, 2010). Although the positive relationship between R&D and firm performance have received contrasting empirical support, Kostopoulos, Papalexandris, Papachroni, & Ioannou (2011) provide several theoretical arguments for this relationship. Firstly, innovative firms are better prepared to forecast and adapt to customers' changing demands with appropriate products and services. Secondly, innovative firms can earn more from their existing customers by adding to existing prod-

ucts and services, thereby saving costs on seeking and attracting new customers. Lastly, continuous, and consistent R&D and innovation leads to successive product and service development which leads to consistent financial benefits over time. For the last-mentioned argument, cash resources are particularly important to maintain continuous R&D spending. Cash holdings therefore may not directly affect the firm performance but enables the firm to invest for future performance and, therefore, R&D may act as a mediating variable between cash holdings and firm performance.

Agency theory, however, warns that the disconnect between shareholders and managers may lead to irresponsible managing that may have a negative effect on long term firm performance and it is stated that shareholders should be concerned about large cash holdings because it may increase agency costs (Harford et al., 2008). Agency costs may include both underinvestment due to risk management strategies and overinvestment due to short termism and empire building strategies of managers. They argue that it is especially a combination of high cash holdings and weak corporate governance that result in lower profitability and that the problem is not significant in firms with good corporate governance structures. In their research on US publicly traded firms spanning from 1990-2003, Dittmar and Mahrt-Smith (2007) investigate the effect of cash holdings on share returns and operating income to determine whether the change in a firm's value is equal to a change in cash holdings. They find that in a well-governed firm an increase in cash holdings leads to an equal change in the firm's value, but in a poorly governed firm, the change in value is much less. In contrast, Mikkelson and Partch (2003) investigate a relatively small sample of 89 US publicly traded firms holding cash in excess of 25% of total assets and find that the relationship between operating performance and persistent high cash holdings over a five-year period is not negative, but rather that it enables managers to employ cash reserves when required. This relates to the theoretical argument for continuous and consistent R&D and innovation.

Simutin (2010) and Lee & Powell (2011) in their respective studies investigate the relationship between excess cash holdings and share returns. As part of their research, both studies first regress cash holdings on the popular determinant variables identified by theory to obtain a measurement of excess cash. Simutin (2010), studying US firms over the period 1960-2006, finds as previously mentioned studies that cash holdings are positively related to R&D. His main finding is that firms build cash reserves for future investments and that excess cash positively affects share performance, however, it depends on the type of equity market. In a bull market, the effect is positive and firms with excess cash perform better than firms with normal levels of cash, but in a bear market, he finds that the firms with excess cash perform worse. Lee & Powell (2011) research Australian firms over the period 1990-2008. Their main

finding is that persistently high levels of excess cash, lasting for two consecutive years or longer, has a negative effect on share performance. These studies, therefore, indicate troubling results for the precautionary motive - that excess cash holdings are negative for shareholders during times of poor equity market performance and when excess cash holdings are persistent. Chiu et al. (2016), however, reach a contrasting result when investigating the benefit of high cash holdings in the event of a market crash. They find that firms with high cash holdings can manage their risk profile and limit negative stock returns in the event of a crash. Their data spans from 2003 to 2011 and therefore includes the 2007/2008 financial crash. Oler and Picconi (2014) investigate the effect of excess and insufficient cash on future performance. In their sample of US firms from 1989 to 2008 they find that the next year's return on operating assets is decreasing for positive or negative deviations from an estimated target cash level. Where excess cash leads to inefficient spending on projects, insufficient cash leads to a lack of spending on projects. In addition, they show that the future share return follows the operating return and their findings suggest that investors do not fully anticipate the decrease in return on operating assets associated with a firm having excess or insufficient cash. This, however, is not a long-term occurrence and changes in future years as the consequences of suboptimal cash levels become clear and the share price adjusts accordingly.

In summary, there are theoretical arguments in support of cash holdings having an indirect positive effect on firm performance through R&D investments as mediating variable. Empirical results of studies investigating the effect of cash holdings on firm performance and share performance vary considerably and it is especially positive (excess cash) or negative (insufficient cash) deviations from target cash levels that negatively impact performance.

2.4. Developing the hypotheses

2.4.1. Determinants of cash holdings

Western Europe, and in particular Denmark, France, Germany, and the Netherlands, are strong in the field of innovation and R&D (Veugelers, 2016). Theory explains why R&D investments require more cash reserves compared to tangible investments that provide collateral or security to the lenders/investors. I therefore expect that firms in these innovative countries will hold cash reserves because of R&D investment requirements and that firms with higher R&D spending will hold more cash reserves. This is in line with the precautionary motive theory and as observed in US and UK empirical studies. Furthermore, R&D spending can proxy as a measure for growth opportunities (Bates et al., 2009) and should therefore have similar characteristics as the M/B ratio. Firms with good growth opportunities need to be able to finance

future positive net present value (NPV) projects when they arise. The precautionary motive argues that these firms will hold more cash because it is very costly for them to forego investments in the event of financial constraints (Bates et al., 2009; Opler et al., 1999). Considering the period under investigation which includes financial crises and periods of limited available funding, and the economic characteristics of the European countries, I expect that firms with more growth opportunities will hold more cash reserves. The book value of assets does not take account of future growth opportunities and therefore the M/B ratio is seen as a proxy for growth opportunities (Opler et al., 1999). The M/B ratio is influenced by investors' expectations regarding future firm performance and these expectations are usually derived from management's disclosures regarding future projects. As such, if investors believe that the disclosed information will lead to better firm performance it may drive up the share price which would then increase the M/B ratio. I formulate and test the following hypotheses regarding the relationship between growth opportunities and cash holdings:

H1a: Firms with higher R&D expenses will hold a higher level of cash.

H1b: Firms with a higher market to book (M/B) ratio will hold a higher level of cash.

In a bank-based or credit oriented financial system the largest intermediaries and providers of capital are banks, whereas in a market-based economy there are other institutional investors in the financial market that invest in firms that issue debt or equity (Hillier et al., 2012). Financial crises originating in the banking sector will have a larger negative impact on firms operating in a bank-based financial system (Schmukler et al., 2001). Following the 2009 financial crisis and 2012 European debt crisis, firms in these credit-oriented European countries would have been severely impacted in terms of financial constraints. They would therefore have had to keep larger cash reserves to be able to fund positive NPV projects and R&D. Due to the lack of available finance, they would have had to build these cash reserves internally from retained earnings. Furthermore, the precautionary motive theory supports the argument for internal funding and that firms build cash reserves in good economic times to prepare them for bad economic times. I therefore expect that firms with higher cash flows will hold more cash because they retain more earnings. In addition, because of the preference to generate funding internally combined with the lack of external funding, I expect that firms with lower leverage will hold more cash. I formulate and test the following two hypotheses regarding the accumulation and source of cash reserves:

H2a: Firms with higher cashflows will hold a higher level of cash.

H2b: Firms with lower leverage will hold a higher level of cash.

2.4.2. Effect of cash holdings on performance

Extant research regularly mentions the importance of R&D spending for firm performance and economic growth and that it indicates innovation and technological progress. This has become more critical as the global economy evolves to a more knowledge-based and innovation-driven system (Lerner & Wulf, 2007; Shen & Zhang, 2013; Koh & Reeb, 2015). Given the positive relationship between cash holdings and R&D expenses as explained by the precautionary motive, it can be argued that firms with higher cash holdings will be in a better position to continue funding projects during good and poor economic conditions and that they should perform better over the long term than firms with lower cash holdings. The caveat however, as argued by Dittmar and Mahrt-Smith (2007) and Harford et al. (2008), is good corporate governance. It has been reported that the Dutch corporate legal system is such that shareholders are afforded much less voting power compared to their US or UK counterparts (de Jong & Veld, 2001; de Jong et al. 2005; Duffhues & Kabir, 2008). One of the characteristics causing this is the two-tier board structure with a supervisory board having additional decision-making powers. A two-tier board structure is implemented, albeit to a different degree, in Denmark, France, Germany, and the Netherlands (de Jong et al., 2005). In addition, all four countries score relatively low on an anti-director index measuring shareholder rights (de Jong et al., 2005; La Porta, Lopez-de-Silanes, Shleifer, & Vishny, 1998). This creates an environment where entrenched managers can thrive, leaving shareholders vulnerable to agency costs such as excessive spending and inefficient investments which leads to lower performance.

Performance can be measured in various ways, such as accounting performance taken directly from the annual financial statements and market performance which is calculated from the share price movement. If a firm can successfully deploy the cash reserves in year t, it should enhance future accounting performance such as return on assets (ROA). If they, however, have excess cash and spend inefficiently it will negatively affect ROA. Oler and Picconi (2014) argue that it is not purely the level of cash holdings, but the deviation from an estimated target cash level that impacts performance. They find that it is not only with excess cash that performance decreases, but with insufficient cash too because firms are not able to invest sufficiently in positive NPV projects. Where accounting performance is backward looking based on results, market performance is forward looking and reacts to expectations. Investors derive expectations for the share price from analysing financial reports, trading statements,

and various economic conditions. Oler and Picconi (2014) find that investors are unsuccessful in anticipating the detrimental effect of excess or insufficient cash and that the market performance therefore follows the negative accounting performance. Simutin (2010) argues that firms build cash reserves in expectation of future investment opportunities and shows a positive relationship between excess cash and stock returns in the following year. This is, however, limited to a bull market which may obscure the negative implications of excess cash. Following Oler and Picconi (2014) I formulate and test the following hypotheses:

H3a: Future ROA decreases with cash holdings that deviate from an estimated target level.

H3b: Future Share Return decreases with cash holdings that deviate from an estimated target level.

3. Research method

3.1. Methods

A popular research method in financial studies is multiple regression models (linear and non-linear). With this method, it is possible to determine the relationship between two or more independent, metric variables and one dependent, metric variable. If there are any variables that are non-metric (such as nominal or ordinal) they must be changed to metric variables before they can be used in the multiple regression. Transformation of non-metric variables is usually done by creating dummy variables with a value of 1 should it meet a specific criterion and a value of 0 should it not. Every value for the dependent variable is related to the independent variable based on a positive or negative parameter predicted by the regression (Hair, Black, Babin, & Anderson, 2009). In the majority of the studied papers, the researchers used an ordinary least squares regression to investigate the relationship between cash holdings and the independent variables and to determine which independent variables have a significant impact on cash holdings. Petersen (2009) however reports that in many finance studies the method used to estimate standards errors in panel data is incorrect and provides biased results. He specifically refers to the correlation between years (time-series dependence) and the correlation between firms (cross-sectional dependence) in panel data as a cause for the mistakes. In their study Harford et al. (2008) use the solutions proposed by Petersen (2009) and report t-statistics for the pooled results using standard errors which are corrected for clustering at the firm level, thereby solving for the time-series dependence problem. However, Harford et al. (2008) also report that although correcting for clustered errors leads to reduced t-statistics, in a study without the correction the results remain similar and significant. To account for the potential biased estimates, I not only use pooled OLS regressions, but firm fixed effect, and Fama-MacBeth regressions too.

Alternative methods employed in some studies include generalised method of moments (GMM) estimators and two-stage ordinary least square (2SLS) regressions. These methods are often used when it is believed that fixed effect or random effect estimators may be biased due to endogeneity problems. With 2SLS estimation it is important to identify independent variables in the first stage that are not related to the second-stage dependent variable. Previous research provides little information in determining appropriate instrument variables to perform 2SLS.

Firstly, I analyse the univariate statistics (descriptive statistics) looking at the mean, median, standard deviation, and quartiles. This provides an overview of the variables and its characteristics and it helps to discover any potential problems or missing data. Next, I examine

the bivariate statistics which includes pair-wise correlation coefficients of the dependent and independent variables to determine positive or negative relationships. In addition, the correlation coefficients between independent variables indicates whether there is multicollinearity present in the data. I run a variance inflation factor (VIF) test as part of the multiple regression to test for multicollinearity. To test H1 and H2 I first estimate pooled ordinary least squares (OLS) regression models on the data where cash holdings is a function of the main determinant variables identified by theory. The following model, as used to a different degree by Opler et al. (1999), Bates et al. (2009), Ferreira & Vilela (2004), and Oler & Picconi (2014), is estimated:

$$Cash_{it} = \beta_0 + \beta_1(R\&D)_{it} + \beta_2(MB)_{it} + \beta_3(Cashflow)_{it} + \beta_4(Leverage)_{it} + \beta_5(NWC)_{it} + \beta_6(Investments)_{it} + \beta_7(Size)_{it} + Year_t + Industry_t + Country_t + \varepsilon_{it} \quad (1)$$

Where $Cash_{it}$ is the cash to net asset ratio of firm i in year t, $Year_t$ is a dummy variable (with 2008 as reference year) used to capture yearly effects, $Industry_t$ is a dummy variable (with Machinery, Equipment, Furniture and Recycling industry as reference category) used to capture industry effects, and $Country_t$ is a dummy variable (with France as reference category) to capture country effects. β_1, β_2, β_3, and β_4 are the main coefficients of interest and they will be tested separately first and then together with the control variables. I expect that β_1, β_2, and β_3 will have positive values and β_4 a negative value. Secondly, following Opler et al. (1999), Bates et al. (2009), and Oler & Picconi (2014), I estimate a fixed effect regression model using only year dummies. Thirdly, following the approach of Opler et al. (1999), Bates et al. (2009), Ferreira & Vilela (2004), and Oler & Picconi (2014), I also estimate a Fama-MacBeth model which gives the average of coefficients from annual cross-sectional regressions. Nine cross-sectional OLS regressions are estimated after which the averages of estimated coefficients are calculated. This model does not include any dummy variables for year, industry, or country.

Next, to investigate the relationship between cash holdings and firm performance, I follow the approach of Oler and Picconi (2014) and run pooled ordinary least square regressions on two performance measures. Firstly, I calculate an Absolute Cash $Deviation_{it}$ which is the absolute value of the difference between the actual cash to net asset ratio of firm i in year t and the cash to net asset ratio of firm i in year t as predicted by equation 1. Secondly, performance in year t+1 is estimated as a function of the absolute cash deviation and control variables associated with firm performance. The following model is estimated:

$$Performance_{i\,t+1} = \beta_0 + \beta_1(Absolute\ Cash\ Deviation)_{it} + \beta_i Controlvariables_{it} + Year_t + Industry_t + Country_t + \varepsilon_{it} \quad (2)$$

The two performance measures investigated is one accounting return measure and one market return measure. Return on assets (ROA) is used for accounting return and the market return measure is based on annual share performance. The main coefficient of interest, β_1, is expected to be negative for next year's ROA, following that an excess or insufficient cash level impacts performance negatively. If the market is unable to anticipate the negative impact on ROA the coefficient of β_1 for next year's share performance should be negative as well. Additional variables used in equation 2 are R&D, M/B (in the share return regression), Cashflow, Leverage, Size, Investments, and NWC to control for the effect of these variables on firm performance. This model provides information about the direction, strength, and significance of the short-term effect of cash holdings on firm performance, but it does not indicate whether there is a difference in the long-term performance of firms with different levels of cash.

To investigate the long-term effect, I follow an approach based on Simutin (2010) and divide the firms into quintiles based on their 2008 cash to net assets ratio with each quintile containing 129 firms. I compile equally-weighted buy-and-hold portfolios of the quintiles to compare the long-term compound annual growth rate from 2008 to 2016 between quintiles. I repeat this for 10 equally-weighted buy-and-hold portfolios formed with firms ranked according to their cash to net asset ratio decile. Lastly, to compare these findings with Oler & Picconi (2014), I repeat it dividing the firms into quintiles based on their deviation from the estimated target cash level.

3.2. Variable definitions

3.2.1. Dependent variables

- Cash holdings: The majority of studies measure cash holdings as the ratio of cash to net assets. Cash includes cash and cash equivalents such as marketable securities and short-term deposits and assets are measured net of cash (Dittmar & Mahrt-Smith, 2007; Ferreira & Vilela, 2004; Harford et al., 2008; Lee & Powell, 2011; Oler & Picconi, 2014; Opler et al., 1999). In some studies, cash is measured as cash to total assets (Bates et al., 2009; Han & Qiu, 2007; Qiu & Wan, 2015) and also as the natural logarithm of cash to net assets (Bates et al., 2009; Foley et al., 2007). These alternative measures are mainly used to limit extreme outliers for firms that have a very large portion of their assets in cash. This study will use the cash to net assets ratio and perform robustness checks using cash to total assets and the natural log of cash to net assets as a measure of cash holdings.

- Return on Assets (ROA): The studies which investigate firm performance use ROA as the preferred accounting measure for firm performance. Dittmar and Mahrt-Smith (2007) and Simutin (2010) measure ROA as operating income before depreciation divided by total assets net of cash. Mikkelson and Partch (2003) on the other hand measures performance as operating income before interest, taxes, depreciation, and extraordinary items divided by operating assets. I follow Mikkelson and Partch (2003) and measure ROA_1 as earnings before interest, tax, depreciation, and amortisation (EBITDA) divided by total assets.
- Share performance: I also investigate the impact of cash holdings on the financial market performance of a firm. Here I use the adjusted closing price of the companies share which considers the effect of dividends and stock splits. The annual share return is calculated by dividing the share price at t by the share price at t-1 for each year except 2008. In addition, for the buy-and-hold portfolio calculations I calculate the average annual return in 2016 relative to the 2008 share price giving a compounded annual growth rate.

3.2.2. Independent variables

The following independent and control variables are included with the expected relationship with cash holdings indicated as well:

- R&D expenses: Measured as the ratio of R&D expenses divided by total sales. All observation without reported R&D expenses is changed to zero (Bates et al., 2009; Harford et al., 2008; Opler et al., 1999). This related to approximately 0.5% of all observations and should not affect the results. As predicted by the precautionary motive, a firm will increase cash holdings for R&D expenses.
- Market-to-book ratio: Measured as the book value of assets minus the book value of equity plus the market value of equity, divided by the book value of assets (Bates et al., 2009; Ferreira & Vilela, 2004; Harford et al., 2008; Opler et al., 1999). This ratio is used as a proxy for growth opportunities and a positive relationship with cash holdings is expected.
- Cashflow: Measured as earnings after interest, dividends, and taxes, but before depreciation, divided by net assets (total assets less cash and cash equivalents), as used in Opler et al. (1999). A positive relationship with cash holdings is expected following pecking order theory that firms prefer to build cash reserves internally from retained earnings.

- Leverage: Measured as total debt (short- and long-term) divided by total assets (Bates et al., 2009; Harford et al., 2008; Lee & Powell, 2011; Opler et al., 1999). Debt and cash are generally seen as substitutes and therefore a negative relationship is expected. Furthermore, as per the pecking order theory firms will prefer to build cash through retained earnings rather than issue debt.
- Firm size: Measured as the natural logarithm of real (inflation-adjusted) total assets[3] (Bates et al., 2009; Harford et al., 2008; Opler et al., 1999; Simutin, 2010). This is a control variable included to account for the increased cash trend that is particularly visible in small firms with financial constraints or limited access to finance. The expected relationship to cash holdings is therefore negative.
- Investments: Bates et al. (2009) explain why capital expenditures and acquisition costs would both act similarly and have a negative relationship with cash holdings. I use the approach of Simutin (2010) and measure Investments as the ratio of capital expenditures plus acquisition costs less sale of property, plant, and equipment divided by total assets. As firms invest more in capital assets, they have more assets available as collateral and therefore may require less cash. Furthermore, acquisitions may use cash and therefore result in lower cash holdings.
- Net working capital (NWC) is measured as the ratio of current assets less current liabilities less cash and marketable securities to total assets, as used in the majority of studies (Bates et al., 2009; Harford et al., 2008; Lee & Powell, 2011; Opler et al., 1999). Cash is excluded to account for potential endogeneity issues.
- Year dummy: There are 9 years of data. 2008 will be used as reference category and 8 other year categories created as dummy variables. This is to control for the correlation between variables over time.
- Industry dummy: I use the 2-digit SIC industry code to classify the firms into industries. There are 55 categories represented in the sample. I create 54 dummy variables to use in the industry fixed effect regressions with SIC code 73 (business services[4]) as reference category. This is to control for the effect that the industry characteristics may have on some variables.

[3] Each year's assets are recalculated by deflating it to 2008 euros using the annual Harmonised Index of Consumer Prices for the euro area. This rate is obtained from the European Central Bank website.
https://www.ecb.europa.eu/stats/macroeconomic_and_sectoral/hicp/html/inflation.en.html?hasFlash=true&.

[4] https://siccode.com/en/siccodes/73/business-services: This group includes firms primarily engaged in rendering services not elsewhere classified, such as advertising, credit reporting, collection of claims, mailing, reproduction, stenographic, news

- Country dummy: France is used as reference category leaving three country dummy variables for Denmark, Germany, and the Netherlands.
- Cashflow volatility: Due to data restrictions cash flow volatility, a variable regularly reported as a determinant of high cash holdings, cannot be included in my analyses.

All dependent and independent variables are winsorised at the 1% and 99% levels to decrease the effect of extreme outliers (Bates et al., 2009; Dittmar & Mahrt-Smith, 2007; Lee & Powell, 2011; Qiu & Wan, 2015). All variables are defined in table 1.

TABLE 1: VARIABLE DEFINITIONS

Variable	Definition
Cash to NA	Cash and cash equivalents scaled to the book value of net assets
Cash to TA	Cash and cash equivalents scaled to the book value of total assets
Log (Cash to NA)	Natural logarithm of Cash and cash equivalents scaled to the book value of net assets
NWC	Current assets less current liabilities less cash and marketable securities scaled to the book value of total assets
Leverage	Total short- and long-term debt scaled to the book value of total assets
R&D to Sales	R&D expenses scaled to total sales
Investments	Capital expenditures plus acquisitions less sale of property, plant, and equipment scaled to the book value of total assets
Cashflow	Earnings after interest, dividends, and taxes, but before depreciation, scaled to the book value of net assets
M/B	Book value of assets minus the book value of equity plus the market value of equity, scaled to the book value of total assets
Log Size	Natural logarithm of the book value of total assets in 2008 euros
ROA_1	Earnings before interest, tax, depreciation, and amortisation (EBITDA) scaled to the book value of total assets
Annual Share return	End of year share price scaled to the end of previous year's share price
CAGR 2008-2016	Compounded annual growth rate of a firm's stock from 2008 to 2016

syndicates, computer programming, photocopying, duplicating, data processing, services to buildings, and help supply services. Firms which provide specialised services closely allied to activities covered in other industries are classified in those divisions.

3.3. Data

The sample includes listed firms from Denmark, France, Germany, and the Netherlands over the period from 2008 to 2016. The firms had to be listed throughout the period because of the share price data that is required to measure the long-term compound annual growth rate. This requirement may cause survivorship bias which influences the results, but Simutin (2010) reports that his findings were similar when using all firms or only survivors in his analyses. As in previous studies (see for example Bates et al., 2009; Harford et al., 2008; Lee & Powell, 2011; Mikkelson & Partch, 2003; Opler et al., 1999), I exclude financial firms and utilities due to their specific legislative cash requirements that may alter the results. Financial year end data, including key income statement items, balance sheet items, and cash flow data are collected from the Orbis database maintained by Bureau van Dijk. Share data in the form of the adjusted closing prices are collected from Yahoo! Finance. Adjusted closing prices takes all stock splits and dividends into account, which makes it possible to calculate the total return[5]. After excluding firms missing key data which could not be collected manually from the annual reports available on their websites, 646 firms remain. This leads to a total of 5,814 firm-year observations over the 9-year period. This data is imported to SPSS to be analysed.

Table 2 shows a breakdown of the industry classification groups with a more detailed breakdown provided in Appendix 1. More than half of the sample firms fall in the manufacturing industry group. I suspect that this may influence the results and therefore perform additional regressions on the manufacturing firms as part of the robustness tests. Table 3 shows a breakdown of the number of firms from each country. The majority of firms in the sample are from Germany and France with far less firms registered in Denmark and the Netherlands. As robustness check I perform additional regressions on a subsample of French firms only to see whether the findings are in line with the full sample.

[5] The adjusted closing price is a stock's closing price on any given day of trading that has been modified to include any distributions and corporate actions that occurred in the past. The adjusted closing price is mostly used when investigating historical returns or performing analyses on historical returns. Yahoo explains their process in calculating the adjusted close here https://sg.help.yahoo.com/kb/finance-for-desktop/adjusted-close-sln28256.html

TABLE 2: INDUSTRY CLASSIFICATION

Industry	2-digit SIC	Number of firms	Percentage
Agriculture, Forestry, Fishing and Mining	01-14	15	2.32%
Construction	15-17	21	3.25%
Manufacturing	20-39	344	53.25%
Transportation and Communication	40-49	53	8.20%
Wholesale and Retail Trade	50-59	55	8.51%
Services	70-89	158	24.46%
		646	**100%**

TABLE 3: COUNTRY CLASSIFICATION

	Code	Frequency	Percent
Germany	DE	232	35.91%
Denmark	DK	57	8.82%
France	FR	308	47.68%
Netherlands	NL	49	7.59%
Total		646	100%

4. Results

4.1. Descriptive Statistics

Table 4 provides the descriptive statistics for all variables. These include the number of observations, mean, standard deviation, 25th, median and 75th percentiles. The mean cash to net assets ratio is 19.5%, which is lower compared to the US sample of Bates et al. (2009) at 23% and higher compared to the EMU sample of Ferreira and Vilela (2004) at 15%. This may indicate that over the past decade European listed firms have increased their cash holdings closer to the level of US firms. However, comparing the cash to net asset ratio of the sample over the period 2008-2016, the aggregate ratio has not increased significantly as can be seen in figure 1A. Figure 1B shows the cash to net asset ratio per country over time and indicates that firms from Denmark, France and the Netherlands have increased their cash over the period, whilst firms from Germany have decreased their cash over the period. NWC has a mean of 3.8%. The mean for leverage is 19.3%, which is slightly lower than a US sample of 20.5% (Harford et al., 2008), and much lower than an EMU sample of 24.8% (Ferreira & Vilela, 2004). This may indicate the characteristics of the sample period where access to (bank)finance was limited. R&D has a mean of 2.4%, almost half of a US sample of 4.3% (Harford et al., 2008). CapEx and acquisitions have a mean of 5.4%. Cashflow, with a mean of 9.2% is similar to an EMU sample of 10.5% (Ferreira & Vilela, 2004). The mean M/B ratio is 0.82, showing that on average the market values firms in this sample less than their book assets. This compares to 1.71 for the EMU sample (Ferreira & Vilela, 2004) and 1.95 for the US sample (Harford et al., 2008), clearly showing the contrasting to the pre- and post-financial crisis periods. The mean ROA_1 is 10.5%, however ROA_2 is much lower at 2.8% indicating a relatively low after-tax income for the mean firm. Although the mean firm produced a relatively low after-tax income, the investors were rewarded with a mean annual share return of 20.6%. A buy-and-hold investment equally divided between all firms in the sample would have produced a mean compound annual growth rate of 14.8% over the period.

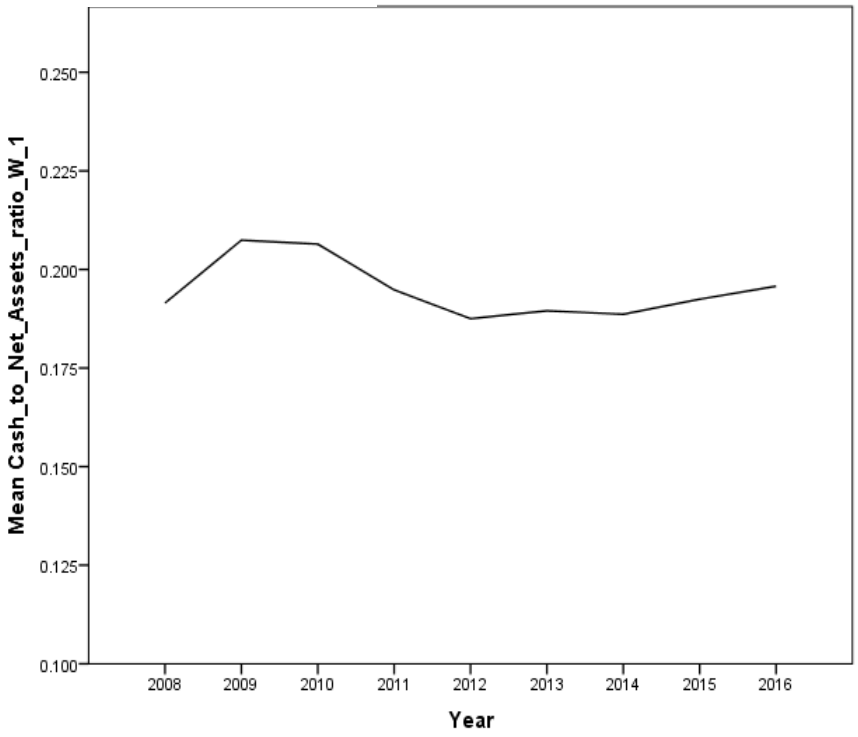
TABLE 4: DESCRIPTIVE STATISTICS

Descriptive statistics on key variables for the sample of firm years from 2008-2016. N is the number of firm year observations, and 25th and 75th are the percentiles. All variables are defined in table 1.

	N	Mean	Std. Deviation	25th	Median	75th
Cash to NA	5814	0.195	0.248	0.053	0.112	0.226
Cash to TA	5814	0.138	0.124	0.051	0.100	0.184
Log (Cash to NA)	5814	-2.257	1.199	-2.929	-2.192	-1.487
Absolute Cash Deviation	5814	0.128	0.145	0.041	0.088	0.162
NWC	5814	0.038	0.159	-0.067	0.040	0.138
Leverage	5814	0.193	0.145	0.076	0.176	0.291
R&D to Sales	5814	0.024	0.049	0.000	0.000	0.024
Investments	5814	0.054	0.066	0.020	0.043	0.078
Cashflow	5814	0.092	0.106	0.039	0.082	0.130
M/B ratio	5814	0.818	0.830	0.327	0.565	0.976
Size in EUR Mil	5814	4896.1	15802.7	67.7	272.9	1632.8
Log Size	5814	5.945	2.252	4.214	5.609	7.398
ROA_1	5814	0.105	0.081	0.062	0.104	0.143
Annual Share return	5168	0.206	0.436	-0.062	0.136	0.384
CAGR 2008-2016	646	0.148	0.155	0.055	0.149	0.241
CAGR 2010-2016	646	0.094	0.160	-0.005	0.089	0.194

Figure 3A provides a graphical representation of the mean cash to net assets ratio over the sample period. There was a sharp increase in 2009 following the global financial crisis, where after it decreased from 2010 to 2012 and has slowly increased until 2016. Panel B of figure 3 provides a breakdown per country of the mean cash to net assets ratio over the sample period. Here we observe a decline for German firms from 2008 to 2016, whereas the firms from Denmark, France and the Netherlands have all increased over the same period.

3 A: AGGREGATE OF ALL COUNTRIES



3 B: BREAKDOWN PER COUNTRY

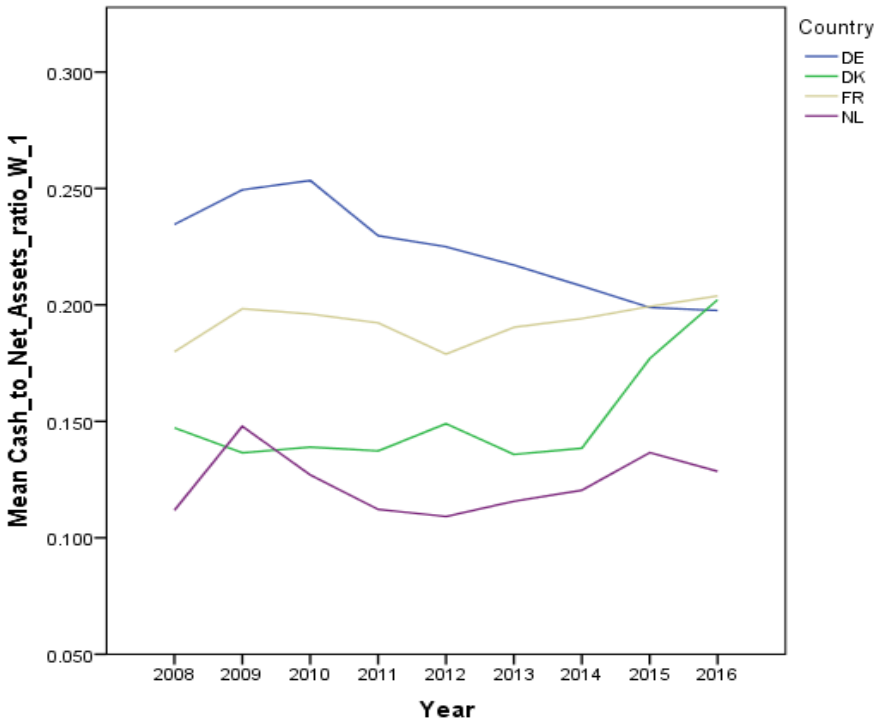


FIGURE 3: MEAN CASH TO NET ASSET RATIO, 2008-2016

Table 5 provides the pairwise correlation coefficients between all main variables (excluding variables used for robustness tests). The positive coefficients between cash and R&D and cash and M/B (24.4% and 33% significant positive correlation respectively) indicates that firms that have more growth opportunities are inclined to hold more cash. Furthermore, it also shows that firms with higher cashflows tend to hold higher cash and issue less debt (33.4% and -40.9% significant correlations between cash and cashflow and leverage respectively). Lastly, the significant positive correlations between cash and ROA (10.7%), annual share return (7%) and CAGR (11%) indicates that firms that hold more cash tend to have higher performance. The pairwise correlation coefficients also indicate that there is significant correlation between many of the independent variables (variables 2 – 8) which may indicate the presence of multicollinearity between independent variables. Although these are within recommended limits, <0.50 (Lee & Powell, 2011), I test for multicollinearity by measuring the variance inflation factor of the independent variables, specifically R&D, M/B, Cashflow, Leverage, NWC, Investments and Size as used in equation 1. The highest VIF measure is 1.605 for NWC and it confirms that they are all below the recommended maximum of <5 as proposed by Hair et al. (2009).

TABLE 5: PEARSON CORRELATION COEFFICIENTS

The table provides the pairwise Pearson correlation coefficients between all variables. **, and * indicates a significance at 1% and 5% respectively. All variables are defined in Table 1.

	Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	Cash to NA	1										
(2)	Log Size	-0.257**	1									
(3)	NWC	-0.091**	-0.228**	1								
(4)	Leverage	-0.409**	0.275**	-0.202**	1							
(5)	R&D to Sales	0.244**	-0.012	0.022	-0.189**	1						
(6)	Investments	-0.069**	0.033*	-0.063**	0.105**	0.056**	1					
(7)	Cashflow	0.334**	0.001	-0.052**	-0.164**	0.104**	0.245**	1				
(8)	M/B	0.330**	-0.095**	0.135**	-0.324**	0.286**	0.101**	0.386**	1			
(9)	ROA_1	0.107**	0.090**	0.070**	-0.106**	-0.005	0.207**	0.588**	0.439**	1		
(10)	Annual Share return	0.070**	0.007	0.034*	-0.057**	0.022	0.021	0.214**	0.130**	0.177**	1	
(11)	CAGR 2008-2016	0.110**	0.175**	0.093*	-0.160**	0.070	0.183**	0.282**	0.435**	0.461**	0.164**	1

4.2. The determinants of cash holdings

Table 6 presents the results of the OLS, fixed effects and Fama-MacBeth regressions for the determinants of cash holdings in the sample of European firms. Models 1 and 2 contain only the main variables of interest for H1 and H2 and model 3 expands to the full OLS model, adding control variables and year-, industry- and country dummy variables. Model 1 confirms the positive relationship between cash holdings and R&D and M/B ratio as determinant variables. Model 2 also confirms the expected relationship between cash holdings and cashflow, as a significant positive determinant, and leverage, as a significant negative determinant. Expanding these models with control variables and dummy variables in model 3 do not affect the significance of the variables. Model 3 indicates that a 1% increase in the R&D to Sales ratio will result in a 0.621% increase in the cash to NA ratio. Considering the standard deviation of the R&D ratio (4.9%) it shows that a one standard deviation increase in the R&D ratio will translate to approximately a 15.60% (= 4.9 x 0.621 / 19.5) increase in the mean cash ratio, an economically significant determinant variable. The M/B ratio coefficient in model 3 indicates that a one unit increase in the ratio would lead to the cash ratio increasing by 4.6%. Therefore, a one standard deviation increase in the M/B ratio would translate to approximately a 19.58% (= 0.83 x 4.6 / 19.5) increase in the mean cash ratio, also an economically significant determinant variable. This indicates the importance of growth opportunities as a determinant of a firm's cash holdings and provides support for H1.

Turning our attention to the source of finance, model 3 indicates that a 1% increase in the cashflow ratio will lead to a 0.59% increase in the cash ratio. Therefore, a one standard deviation increase in the cashflow will lead to a 32.1% (= 10.6 x 0.59 / 19.5) increase in the mean cash ratio. A 1% decrease in leverage will lead to a 0.422% increase in the cash ratio. This translates to a 31.4% (= 14.5 x 0.422 / 19.5) increase in the mean cash ratio should leverage decrease by one standard deviation. The results indicate the importance of cashflow and leverage as statistically and economically significant determinants of cash holdings. It also strengthens the argument for pecking order theory in terms of the sample firms' financial policy and the precautionary motive for building cash reserves and provides support for H2.

The firm fixed effects (model 4) and Fama-MacBeth (model 5) regressions presents a stricter analysis of the relationship between cash holdings and the independent variables. Previous methods are followed regarding the inclusion of dummy variables (Bates et al., 2009; Lee & Powell, 2011; Opler et al., 1999). They confirm the findings of the OLS regressions. All variables remain statistically significant with the same direction (positive or negative) as in the OLS model. In the FE model, however, the economic significance decreases. Similar to previous comparable studies the adjusted R^2 measure decreases from the OLS model to the FE and FMB models (Bates et al., 2009; Lee & Powell, 2011; Opler et al., 1999).

These results provide support for hypotheses H1 and H2 regarding the determinants of cash holdings and corresponds to previous empirical studies on US and EMU samples (Bates et al., 2009; Ferreira & Vilela, 2004; Harford et al., 2008; Lee & Powell, 2011; Opler et al., 1999; Simutin, 2010). Given their economic and corporate governance characteristics, this sample of European countries increase their cash holdings for the same reasons as firms in the US operating in a different environment.

TABLE 6: REGRESSIONS ESTIMATING THE DETERMINANTS OF CASH HOLDINGS

The table presents OLS, firm fixed effect (FE) and Fama MacBeth (FMB) regressions of Cash to NA on the independent variables. t-Statistics with Hubert-White robust standard errors are reported in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively. All variables are defined in Table 1.

	OLS			FE	FMB
Independent Variable	(1)	(2)	(3)	(4)	(5)
R&D to Sales	0.654***		0.621***	0.317***	0.633***
	(9.73)		*(10.26)*	*(4.12)*	*(4.13)*
M/B	0.087***		0.046***	0.035***	0.038***
	(22.08)		*(11.98)*	*(8.11)*	*(3.59)*
Cashflow		0.647***	0.590***	0.357***	0.514***
		(23.95)	*(21.18)*	*(22.39)*	*(6.78)*
Leverage		-0.538***	-0.422***	-0.139***	-0.417***
		(-25.54)	*(-19.80)*	*(-5.66)*	*(-7.58)*
NWC			-0.292***	-0.342***	-0.294***
			(-14.35)	*(-17.39)*	*(-6.31)*
Investments			-0.440***	-0.273***	-0.449***
			(-10.48)	*(-12.98)*	*(-3.89)*
Log Size			-0.024***	-0.023***	-0.021***
			(-16.97)	*(-8.01)*	*(-6.20)*
Intercept	0.240***	0.335***	0.399***	0.331***	0.322***
	(20.70)	*(29.22)*	*(31.58)*	*(16.88)*	*(13.10)*
Year dummy	Yes	Yes	Yes	Yes	No
Industry dummy	Yes	Yes	Yes	No	No
Country dummy	Yes	Yes	Yes	No	No
N	5 814	5 814	5 814	5 814	9
Adjusted R^2	0.221	0.297	0.380	0.307	0.351

I run additional regressions on different definitions for cash holdings - the natural log of cash to NA and cash to TA - to test the robustness of the abovementioned findings. The results of these regressions are reported in Appendix 2 and 3. Except for the M/B ratio in the Fama-MacBeth regression of the log of cash to NA, the overall results are similar and lead to the same conclusions regarding H1 and H2 for the determinants of cash holdings.

4.3. The effect of cash holdings on performance

Following Oler and Picconi (2014) I use the coefficients from model 3 in table 6 to calculate an estimated target cash level for each observation[6]. The difference between this estimated target cash holdings and the actual cash holdings is defined as the excess (positive deviation) or insufficient (negative deviation) cash level. Appendix 5 A presents the mean and median of variables for firms broken down into quintiles based on their insufficient or excess cash level. Firms in the lowest quintile have the largest cash shortfall and firms in the highest quintile have the greatest excess cash. As in Oler and Picconi (2014), the majority of variables show either a "U" or inverted "U" shaped pattern between quintiles. The ROA and annual share performance, however, does not indicate that firms in quintile 3, closest to the target cash level, has the highest performance as expected.

Table 7 presents the results of the OLS (model 1 and 3) and fixed effect (model 2 and 4) regressions for the effect of cash holdings on the performance of the sample of European firms. In panel A the dependent variable is next year's ROA, measured as earnings before interest, tax, depreciation, and amortisation scaled to the book value of total assets. It shows that deviating from the target cash level has a significant negative affect on future ROA. In model 1, the coefficient of -3.4% compares well to -3.2% in Oler and Picconi (2014). Economically, this indicates that a one-standard deviation increase in the absolute cash deviation translates to a 4.70% (= 0.145 x -3.4 / 10.5) decrease in the next year's ROA. This may not be devastating to firm performance in the event of a short-term occurrence but demonstrates the negative impact that continuously deviating from target cash levels may have on long-term performance. The FE regression provides a similar result for the effect that deviating from an estimated cash target has on the following year's ROA. It shows the importance of managers employ and accurate cash policy to enhance the performance of a firm.

In panel B the dependent variable is next year's share return, measured as the change in the adjusted closing price of a firm's stock from the end of year t to the end of year t+1. The coefficient for absolute cash deviation shows that deviating from the target cash level has a significant negative affect on the following year's share return. At -10.1% it is substantially larger than -5.2% in Oler and Picconi (2014). It indicates that investors do not correctly anticipate the detrimental affect of firms deviating from an estimated target cash level. Economically it shows that a one-standard deviation increase in the absolute cash deviation translates to a 7.11% (=

[6] In unpublished results I use the coefficients from fixed effects model to calculate the estimated cash target level and absolute cash deviation. The results for the regressions in table 7 remain similar with regards to value, direction, and significance of coefficients.

0.145 x -10.1 / 20.6) decrease in the next year's share return. This is economically a large negative share return for investors following an inefficient cash policy by managers. The FE model provides similar results. If investors were successful in anticipating the negative future performance associated with cash deviation the absolute cash deviation coefficient would have been insignificant.

TABLE 7: REGRESSIONS ESTIMATING THE EFFECT OF CASH HOLDINGS ON PERFORMANCE

The table presents OLS (model 1 and 3) and fixed effect (model 2 and 4) regressions of next year's performance on cash deviation and various control variables associated with performance. In panel A the dependent variable is ROA and in panel B it is Share Return. t-Statistics with Hubert-White robust standard errors are reported in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively. Absolute Cash Deviation is the absolute value of the difference between the actual cash to net asset ratio of firm i in year t and the cash to net asset ratio of firm i in year t as predicted by equation 1. All other variables are defined in Table 1.

	Panel A: ROA		Panel B: Share return	
	OLS	FE	OLS	FE
Independent Variable	(1)	(2)	(3)	(4)
Absolute Cash Deviation	-0.034***	-0.018**	-0.101**	-0.089*
	(-4.53)	*(-2.17)*	*(-2.21)*	*(-1.89)*
R&D to Sales	-0.065***	0.056*	0.209	0.438***
	(-3.01)	*(1.64)*	*(1.57)*	*(3.36)*
M/B ratio			-0.054***	-0.057***
			(-6.16)	*(-6.38)*
Cashflow	0.372***	0.049***	0.559***	0.525***
	(38.96)	*(5.81)*	*(9.21)*	*(8.57)*
Leverage	-0.006	-0.008	-0.109**	-0.139***
	(-0.82)	*(-0.71)*	*(-2.31)*	*(-2.97)*
NWC	0.025***	-0.032***	0.089**	0.099**
	(3.31)	*(-3.41)*	*(1.97)*	*(2.45)*
Investments	0.064***	0.039***	-0.148	-0.111
	(4.19)	*(3.35)*	*(-1.60)*	*(-1.21)*
Log Size	0.003***	0.001	0.003	0.001
	(6.01)	*(1.01)*	*(0.80)*	*(0.26)*
Intercept	0.041***	0.083***	0.552***	0.514***
	(8.51)	*(11.73)*	*(18.74)*	*(18.48)*
Year dummy	Yes	Yes	Yes	Yes
Industry dummy	Yes	No	Yes	No
Country dummy	Yes	No	Yes	No
N	5 168	5 168	5 168	5 168
Adjusted R^2	0.320	0.114	0.149	0.144

4.3.1. Long-term market performance

In this section I investigate an investment strategy based purely on a firm's cash holdings. Panel A of table 8 shows the difference in the compound annual growth rate between an equally weighted investment portfolio of the 129 firms in quintile 5 based on their 2008 cash to NA ratio versus the 129 firms in quintile 1. In addition, I compare an equally weighted portfolio of the 64 firms in decile 10 (firms with the highest cash holdings) to a portfolio of the 64 firms in decile 1 (firms with the lowest cash holdings). A buy-and-hold strategy is assumed, meaning that firms remain in the respective portfolios throughout the period even though their cash holdings may increase or decrease over time. In both instances the portfolio of firms with the highest cash holdings have a higher CAGR. Specifically, firms in quintile 5 provide a mean return of 0.4% per annum higher than quintile 1, and firms in decile 10 provide a mean return of 3.1% per annum higher than decile 1. In panel B, the portfolios are constructed based on the average cash to NA ratio from 2008 to 2010 to lower the impact of one year determining the constituents of the portfolios. The quintile 5 portfolio performs slightly better than the quintile 1 portfolio, 0.3% per annum, but the decile 10 portfolio performs worse than the decile 1 portfolio, 3.9% per annum lower return. The differences are not statistically significant when comparing the means based on t-tests.

In panel C of table 8 I compare the CAGR between equally weighted buy-and-hold portfolios based on their 2008 cash deviation. Quintile 1 are firms with the most insufficient cash and quintile 5 are firms with the highest excess cash in 2008. The results show that the share price of firms in quintile 2 perform better than firms in all other quintiles. This indicates that the share price of firms which are closer to their estimated target cash level, yet still have insufficient cash performs the best. It may indicate that investors are less concerned about insufficient cash than what they are about excess cash. Simutin (2010) compares the market performance of only excess cash firms and find that high excess cash firms perform better than low excess cash firms. Lee and Powell (2011) find that the 1-year and 2-year buy-and-hold return is statistically higher for firms with persistent excess cash but find no statistical difference for the 3-year buy-and-hold return. Oler and Picconi (2014) find that an investment strategy taking a long position in the firms with the least cash deviation and a short position in the firms with the most cash deviation delivers a positive return of 3.6% in the following 12 months. In results not shown, I found that a similar strategy on this sample would result in a positive return of 2.2%, the difference, however, is not statistically significant based on a t-test.

TABLE 8: BUY-AND-HOLD INVESTMENT STRATEGY

Panel A

Cash to NA ratio in 2008	CAGR 2008 to 2016
Quintile 5	0.150
Quintile 1	0.146
Difference	0.004
Decile 10	0.150
Decile 1	0.119
Difference	0.031

Panel B

Average Cash to NA ratio for 2008-2010	CAGR 2010 to 2016
Quintile 5	0.099
Quintile 1	0.096
Difference	0.003
Decile 10	0.078
Decile 1	0.117
Difference	-0.039

Panel C

Dependent Variable:	CAGR 2008 to 2016	
Quintile_Excess_or_Insufficient_Cash 2008		
(I)	(J)	Mean Difference (I-J)
1	2	-0.010
	3	0.017
	4	0.022
	5	0.003
2	1	0.010
	3	0.028
	4	0.032
	5	0.013
3	1	-0.017
	2	-0.028
	4	0.005
	5	-0.014
4	1	-0.022
	2	-0.032
	3	-0.005
	5	-0.019
5	1	-0.003
	2	-0.013
	3	0.014
	4	0.019

4.3.2. Robustness checks

Apart from the robustness checks already mentioned, I perform additional regressions on split samples to check the consistency of my findings. A large proportion of firms are in the manufacturing industry (approximately 53% from SIC 2-digit code 20-39) and a large proportion of firms did not have any R&D expenses (approximately 56% of R&D observations were zero). Furthermore, a large proportion of firms (approximately 48%) are registered in France. I, therefore, repeat the pooled OLS regressions on the following split samples to determine support for H1 and H2: manufacturing firms and non-manufacturing firms; positive R&D observations and zero R&D observations; and French and non-French firms. The results are presented in Appendix A4. All variables of interest remain significant and in the same direction as in the full sample in table 6, except for the zero R&D observation sample where, evidently, no coefficient is obtained for R&D to sales. This indicates that the determinants of cash holdings are robust to business activities and geographic location of sample firms and provides further support for H1 and H2.

Lastly, I repeat the OLS regressions for H3 on the same split samples and report them in Appendix A5. The split sample analyses produce mixed results. In the ROA regressions for manufacturing firms, positive R&D firms, and French firms the results remain the same as in the full sample. This indicates that these firms may have similar characteristics that influences the next year's ROA and that they may unduly influence the results of the full sample. In the Share Return regressions for non-manufacturing firms, and non-French firms the results remain similar as in the full sample. This indicates that these firms have similar underlying characteristics affecting the next year's share performance and that they may unduly influence the results of the full sample. The conclusion from the split samples is that the absolute cash deviation coefficient does not fully address the underlying characteristics affecting firm performance.

5. Conclusion

The past three decades has seen firms across the globe increasing their cash holdings. Determinants for this increase has ranged from growth opportunities, proxied by R&D expenses and the M/B ratio, to the financing policy indicating that managers prefer to accumulate and use retained earnings to fund projects. There are concerns that these actions may be a result of agency conflicts that can be to the detriment of shareholders. I analyse a unique sample of listed firms from four western European countries characterised as bank-based financial systems and having corporate governance structures that may induce agency problems and find support for similar determinants of cash holdings compared to US and UK market-based economies with strict shareholder protection. The precautionary motive for cash holdings is dominant and cash holdings increase with growth opportunities which indicates the importance of having cash reserves readily available to invest in positive NPV projects when they arise. Furthermore, following the pecking order theory, firms prefer to build these cash reserves internally from cashflow as opposed to issuing debt which may be limited or too costly.

After finding support for the determinants of cash holdings I investigate the effect of cash holdings on accounting and market performance. This is of interest to shareholders and potential investors who want to verify that management, the custodians of their investments, are not pursuing their own goals but are indeed acting in the best interest of shareholders. Following Oler and Picconi (2014) I find support for the hypothesis that performance is decreasing with firms deviating from an estimated target cash level. This implies that managers are inefficiently managing the firms' cash levels which leads to a decrease in performance. I show that it is not only accounting performance that decreases with a deviation from a target cash level, but that share performance follows this decrease. If investors were able to anticipate the decrease in return it would be priced into the current share price and the absolute cash deviation coefficient would be insignificant. The results show that investors are unable to anticipate the decrease in future performance. Given these results I, however, do not find statistical evidence for a long-term buy-and-hold investment strategy investing in a portfolio of high cash firms and selling low cash firms. Similarly, I do not find statistical evidence for a long-term buy-and-hold investment strategy investing in a portfolio of low cash deviation firms and selling high cash deviation firms. This may imply that a far more active strategy, annually changing portfolio constituents based on cash holdings may lead to superior performance. More research is required to validate this. Especially, developing an accurate model estimating the optimal target cash level may assist investors in determining the absolute cash deviation and compiling investment portfolios as in Oler and Picconi (2014).

This study contributes to current literature and shows that European firms operating in economies with lower corporate governance and shareholder protection follow the same principles as US firms regarding their cash policy. Furthermore, it contributes by showing that European firms are affected similarly to US firms when they deviate from an estimated target cash level and that investors investing in European firms are not better at anticipating the decrease in performance associated with a cash deviation than investors investing in US firms. There are, however, a few limitations to this study with the most important being data availability and sample selection. I am limited to 9 years of data from 2008 to 2016. A study over a longer period may provide improved results to support or contradict these results. The sample includes surviving firms only which may bias the results. Because of the requirement for a market determined share price I could not solve the potential survival bias. These limitations may be negligent if we consider that similar results were obtained compared to previous empirical studies for H1 and H2. H3 however seems to be more sample dependent. Future research should specifically investigate the moderating effects of other variables on the cash-performance relationship. Structural equation models may be more appropriate to develop an improved investment strategy as mentioned previously.

References

Amess, K., Banerji, S., & Lampousis, A. (2015). Corporate cash holdings: Causes and consequences. *International Review of Financial Analysis*, *42*, 421–433.

Bates, T. W., Kahle, K., & Stulz, R. M. (2009). Why do U.S. firms hold so much more than they used to? *Journal of Finance*, *64*(5), 1985–2021.

Brown, J. R., & Petersen, B. C. (2011). Cash holdings and R&D smoothing. *Journal of Corporate Finance*, *17*(3), 694–709.

Chen, Y.-R., & Chuang, W.-T. (2009). Alignment or entrenchment? Corporate governance and cash holdings in growing firms. *Journal of Business Research*, *62*, 1200–1206.

Chiu, W.-C., Wang, C.-W., & Peña, J. I. (2016). Tail risk spillovers and corporate cash holdings. *Journal of Multinational Financial Management*, *36*, 30–48.

Daher, M. (2010). The determinants of cash holdings in Uk public and private firms. *Accounting and Finance*, *53*(September), 537–560.

de Jong, A., DeJong, D. V., Mertens, G., & Wasley, C. E. (2005). The role of self-regulation in corporate governance: Evidence and implications from The Netherlands. *Journal of Corporate Finance*, *11*(3), 473–503.

de Jong, A., & Veld, C. (2001). An empirical analysis of incremental capital structure decisions under managerial entrenchment. *Journal of Banking & Finance*, *25*(10), 1857–1895.

Dittmar, A., & Mahrt-Smith, J. (2007). Corporate governance and the value of cash holdings. *Journal of Financial Economics*, *83*, 599–634.

Duffhues, P., & Kabir, R. (2008). Is the pay-performance relationship always positive?. Evidence from the Netherlands. *Journal of Multinational Financial Management*, *18*(1), 45–60.

Ferreira, M. A., & Vilela, A. S. (2004). Why do firms hold cash? Evidence from EMU countries. *European Financial Management*, *10*(2), 295–319.

Foley, C. F., Hartzell, J., Titman, S., & Twite, G. J. (2007). Why do firms hold so much cash? A tax-based explanation. *Journal of Financial Economics*, *86*(3), 579–607.

Frank, M. Z., & Goyal, V. K. (2008). Trade-off and pecking order theories of debt. In *Handbook of Empirical Corporate Finance* (pp. 135–202). Elsevier.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2009). *Multivariate data analysis*. *7th Edition*. Pearson Prentice Hall.

Han, S., & Qiu, J. (2007). Corporate precautionary cash holdings. *Journal of Corporate Finance*, *13*, 43–57.

Harford, J., Klasa, S., & Maxwell, W. F. (2014). Refinancing risk and C=cash holdings. *The Journal of Finance*, *69*(3), 975–1012.

Harford, J., Mansi, S. A., & Maxwell, W. F. (2008). Corporate governance and firm cash holdings in the US. *Journal of Financial Economics*, *87*, 535–555.

Hillier, D., Grinblatt, M., & Titman, S. (2012). *Financial Markets and Corporate Strategy* (Second Eur). Berkshire: McGraw-Hill Education.

Jensen, M. (1986). Agency costs of free cash flow, corporate financing, and takeovers. *American Economic Review*, *76*, 323–329.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, *3*, 305–360.

Koh, P.-S., & Reeb, D. M. (2015). Missing R&D. *Journal of Accounting and Economics*, *60*, 73–94.

Kostopoulos, K., Papalexandris, A., Papachroni, M., & Ioannou, G. (2011). Absorptive capacity, innovation, and financial performance. *Journal of Business Research*, *64*(12), 1335–1343.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., & Vishny, R. W. (1998). Law and finance. *The Journal of Political Economy*, *106*(6), 1113–1155.

Lee, E., & Powell, R. (2011). Excess cash holdings and shareholder value. *Accounting and Finance*, *51*(March 2010), 549–574.

Lerner, J., & Hall, B. H. (2010). The financing of R&D and innovation. In *Handbook of the Economics of Innovation* (Vol. 1, pp. 609–639). North-Holland.

Lerner, J., & Wulf, J. (2007). Innovation and incentives: Evidence from corporate R&D. *Review of Economics and Statistics*, *89*(4), 634–644.

Maheshwari, Y., & Vigneswara Rao, K. T. (2017). Determinants of corporate cash holdings. *Global Business Review*, *18*(2), 416–427.

Mikkelson, W. H., & Partch, M. M. (2003). Do persistent large cash reserves hinder performance? *The Journal of Financial and Quantitative Analysis*, *38*(2), 275–294.

Miller, M. H., & Orr, D. (1966). A model of the demand for money by firms. *Quarterly Journal of*

Economics, 413–435.
Modigliani, F., & Miller, M. . (1963). Corporate income taxes and the cost of capital: A correction. *American Economic Review*, *53*, 433–443.
Myers, S. . (1984). The capital structure puzzle. *Journal of Corporate Finance*, *39*, 575–592.
Nason, R. S., & Patel, P. C. (2016). Is cash king? Market performance and cash during a recession. *Journal of Business Research*, *69*, 4242–4248.
Oler, D. K., & Picconi, M. P. (2014). Implications of insufficient and excess cash for future performance. *Contemporary Accounting Research*, *31*(1), 253–283.
Opler, T., Pinkowitz, L., Stulz, R., & Williamson, R. (1999). The determinants and implications of corporate cash holdings. *Journal of Financial Economics*, *52*, 3–46.
Petersen, M. A. (2009). Estimating standard errors in finance panel data sets: Comparing approaches. *Review of Financial Studies*, *22*(1), 435–480.
Qiu, J., & Wan, C. (2015). Technology spillovers and corporate cash holdings. *Journal of Financial Economics*, *115*(3), 558–573.
Schmukler, S., Vesperoni, E., Claessens, S., Demirgüç-Kunt, A., Honohan, P., Lederman, D., Serven, L. (2001). Firms' financing choices in bank-based and market-based economies. *Financial Structure and Economic Growth*, 347–375.
Shen, C. H., & Zhang, H. (2013). CEO risk incentives and firm performance following R&D increases. *Journal of Banking & Finance*, *37*, 1176–1194.
Shin, H.-H., & Kim, Y. H. (2002). Agency costs and efficiency of business capital investment: evidence from quarterly capital expenditures. *Journal of Corporate Finance*, *8*, 139–158.
Simutin, M. (2010). Excess cash and stock returns. *Financial Management*, *39*(3), 1197–1222.
Veugelers, R. (2016). *The European union's growing innovation divide*. *Bruegel Policy Contribution*. Brussels.
Weidemann, J. F. (2017). A state-of-the-art review of corporate cash holding research. *Journal of Business Economics*, 1–33.

Appendix

APPENDIX A 1: DETAILED BREAKDOWN OF 2-DIGIT SIC CODE

	2-digit SIC code	Frequency	Percent
Agricultural Production - Crops	01	4	0.62%
Agricultural Services	07	1	0.15%
Forestry	08	1	0.15%
Metal Mining	10	2	0.31%
Oil and Gas Extraction	13	5	0.77%
Mining and Quarrying of Nonmetallic Minerals, Except Fuels	14	2	0.31%
Construction - General Contractors & Operative Builders	15	8	1.24%
Heamy Construction, Except Building Construction, Contractor	16	10	1.55%
Construction - Special Trade Contractors	17	3	0.46%
Food and Kindred Products	20	35	5.42%
Textile Mill Products	22	2	0.31%
Apparel, Finished Products from Fabrics & Similar Materials	23	14	2.17%
Lumber and Wood Products, Except Furniture	24	6	0.93%
Furniture and Fixtures	25	1	0.15%
Paper and Allied Products	26	9	1.39%
Printing, Publishing and Allied Industries	27	7	1.08%
Chemicals and Allied Products	28	50	7.74%
Petroleum Refining and Related Industries	29	2	0.31%
Rubber and Miscellaneous Plastic Products	30	12	1.86%
Leather and Leather Products	31	2	0.31%
Stone, Clay, Glass, and Concrete Products	32	11	1.70%
Primary Metal Industries	33	9	1.39%
Fabricated Metal Products	34	11	1.70%
Industrial and Commercial Machinery and Computer Equipment	35	52	8.05%
Electronic & Other Electrical Equipment & Components	36	61	9.44%
Transportation Equipment	37	29	4.49%
Measuring, Photographic, Medical, & Optical Goods, & Clocks	38	22	3.41%
Miscellaneous Manufacturing Industries	39	9	1.39%
Railroad Transportation	40	2	0.31%
Local & Suburban Transit & Interurban Highway Transportation	41	1	0.15%
Motor Freight Transportation	42	3	0.46%
United States Postal Service	43	1	0.15%
Water Transportation	44	7	1.08%
Transportation by Air	45	5	0.77%
Transportation Services	47	11	1.70%
Communications	48	23	3.56%
Wholesale Trade - Durable Goods	50	21	3.25%
Wholesale Trade - Nondurable Goods	51	5	0.77%
Building Materials, Hardware, Garden Supplies & Mobile Homes	52	1	0.15%
General Merchandise Stores	53	3	0.46%

Food Stores	54	6	0.93%
Automotive Dealers and Gasoline Service Stations	55	2	0.31%
Apparel and Accessory Stores	56	1	0.15%
Home Furniture, Furnishings and Equipment Stores	57	5	0.77%
Eating and Drinking Places	58	4	0.62%
Miscellaneous Retail	59	7	1.08%
Hotels, Rooming Houses, Camps, and Other Lodging Places	70	7	1.08%
Business Services	73	105	16.25%
Automotive Repair, Services and Parking	75	2	0.31%
Motion Pictures	78	5	0.77%
Amusement and Recreation Services	79	14	2.17%
Health Services	80	7	1.08%
Educational Services	82	1	0.15%
Engineering, Accounting, Research, and Management Services	87	15	2.32%
Services, Not Elsewhere Classified	89	2	0.31%
		646	**100.00%**

APPENDIX A 2: ROBUSTNESS CHECK FOR H1 AND H2 USING ALTERNATIVE DEFINITIONS FOR CASH HOLDINGS

The table presents OLS, fixed effect (FE) and Fama-MacBeth (FMB) regressions of Log(Cash to NA) on various independent variables. t-Statistics with Hubert-White robust standard errors are reported in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively. All variables are defined in Table 1.

	OLS			FE	FMB
Independent Variable	(1)	(2)	(3)	(4)	(5)
R&D to Sales	2.761***		2.413***	1.128***	2.998***
	(8.71)		*(8.17)*	*(2.78)*	*(3.80)*
M/B	0.295***		0.118***	0.151***	0.081
	(15.95)		*(6.25)*	*(6.88)*	*(1.48)*
Cashflow		2.106***	1.909***	1.298***	1.714***
		(16.62)	*(14.06)*	*(15.26)*	*(4.38)*
Leverage		-2.685***	-2.454***	-0.714***	-2.687***
		(-27.16)	*(-23.62)*	*(-5.53)*	*(-9.47)*
NWC			-1.010***	-1.377***	-1.048***
			(-10.17)	*(-13.21)*	*(-4.37)*
Investments			-1.178***	-1.231***	-1.299**
			(-5.75)	*(-11.02)*	*(-2.25)*
Log Size			-0.049***	-0.067***	-0.038**
			(-7.123)	*(-4.52)*	*(-2.20)*
Intercept	-1.991***	-1.511***	-1.425***	-1.883***	-1.468***
	(-36.44)	*(-28.04)*	*(-23.10)*	*(-19.13)*	*(-11.62)*
Year dummy	Yes	Yes	Yes	Yes	No
Industry dummy	Yes	Yes	Yes	No	No
Country dummy	Yes	Yes	Yes	No	No
N	5 814	5 814	5 814	5 814	9
Adjusted R^2	0.260	0.340	0.370	0.199	0.270

APPENDIX A 3: ROBUSTNESS CHECK FOR H1 AND H2 USING ALTERNATIVE DEFINITIONS FOR CASH HOLDINGS

The table presents OLS, fixed effect (FE) and Fama-MacBeth (FMB) regressions of Cash to TA on various independent variables. t-Statistics with Hubert-White robust standard errors are reported in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively. All variables are defined in Table 1.

	OLS			FE	FMB
Independent Variable	(1)	(2)	(3)	(4)	(5)
R&D to Sales	0.316***		0.293***	0.131***	0.311***
	(9.54)		*(9.92)*	*(3.43)*	*(4.10)*
M/B	0.043***		0.022***	0.018***	0.017***
	(22.11)		*(11.43)*	*(8.77)*	*(3.26)*
Cashflow		0.303***	0.274***	0.167***	0.240***
		(23.14)	*(20.19)*	*(21.23)*	*(6.37)*
Leverage		-0.301***	-0.248***	-0.069***	-0.250***
		(-29.45)	*(-23.91)*	*(-5.74)*	*(-9.19)*
NWC			-0.138***	-0.179***	-0.143***
			(-13.89)	*(-18.32)*	*(-6.22)*
Investments			-0.194***	-0.149***	-0.202***
			(-9.44)	*(-14.45)*	*(-3.57)*
Log Size			-0.011***	-0.012***	-0.010***
			(-15.95)	*(-7.92)*	*(-5.81)*
Intercept	0.164***	0.218***	0.246***	0.203***	0.203***
	(28.74)	*(39.09)*	*(39.88)*	*(20.95)*	*(16.72)*
Year dummy	Yes	Yes	Yes	Yes	No
Industry dummy	Yes	Yes	Yes	No	No
Country dummy	Yes	Yes	Yes	No	No
N	5 814	5 814	5 814	5 814	9
Adjusted R^2	0.248	0.340	0.411	0.301	0.367

APPENDIX A 4: ROBUSTNESS CHECKS FOR H1 AND H2 USING SPLIT SAMPLES

OLS regressions of Cash to NA on various independent variables. t-Statistics are reported in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively. All variables are defined in Table 1.

	Manufacturing firms	Non-manufacturing firms	Positive R&D observation	Zero R&D observations	French firms	Non-French firms
Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
R&D to Sales	0.823***	0.413***	0.791***		0.749***	0.507***
	(11.46)	(4.66)	*(9.70)*		*(8.46)*	*(6.09)*
M/B	0.029***	0.063***	0.031***	0.068***	0.079***	0.030***
	(6.27)	(10.69)	*(5.42)*	*(12.66)*	*(12.01)*	*(5.91)*
Cashflow	0.277***	0.825***	0.594***	0.619***	0.684***	0.562***
	(7.37)	(20.39)	*(14.23)*	*(16.72)*	*(16.46)*	*(14.87)*
Leverage	-0.442***	-0.488***	-0.402***	-0.420***	-0.295***	-0.496***
	(-17.22)	(-15.45)	*(-11.41)*	*(-15.47)*	*(-9.47)*	*(-16.02)*
NWC	-0.290***	-0.320***	-0.481***	-0.218***	-0.318***	-0.260***
	(-11.30)	(-11.85)	*(-13.44)*	*(-8.75)*	*(-10.68)*	*(-9.02)*
Investments	-0.372***	-0.531***	-0.480***	-0.416***	-0.526***	-0.399***
	(-6.75)	(-8.73)	*(-7.41)*	*(-7.63)*	*(-8.04)*	*(-7.21)*
Log Size	-0.022***	-0.017***	-0.031***	-0.016***	-0.027***	-0.022***
	(-13.93)	(-8.67)	*(-14.08)*	*(-7.68)*	*(-13.62)*	*(-11.01)*
Intercept	0.407***	0.324***	0.422***	0.347***	0.335***	0.458***
	(25.23)	*(18.36)*	*(18.02)*	*(20.97)*	*(19.59)*	*(24.68)*
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	No	No	Yes	Yes	Yes	Yes
Country dummy	Yes	Yes	Yes	Yes	No	No
N	3 096	2 718	2 561	3 253	2 772	3 042
Adjusted R^2	0.264	0.451	0.405	0.388	0.376	0.409

APPENDIX A 5: COMPARISON OF INSUFFICIENT CASH AND EXCESS CASH FIRMS

The table presents the descriptive statistics (mean and median) of firms broken down into excess cash quintiles. The lowest quintile are insufficient cash firms (actual cash to NA ratio is less than the predicted cash to NA ratio) and the highest quintile are excess cash firms (actual cash to NA ratio is more than the predicted cash to NA ratio). All variables are defined in table 1.

	Insufficient cash								Excess cash	
Quintile	1		2		3		4		5	
Variable	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Excess / Insufficient Cash	-0.206	-0.184	-0.090	-0.088	-0.024	-0.025	0.044	0.042	0.276	0.181
Cash to NA	0.094	0.068	0.104	0.080	0.132	0.110	0.157	0.123	0.488	0.387
R&D to Sales	0.040	0.000	0.023	0.000	0.016	0.000	0.014	0.000	0.028	0.000
M/B	1.150	0.718	0.732	0.538	0.668	0.514	0.624	0.474	0.915	0.646
Cashflow	0.114	0.099	0.085	0.081	0.086	0.086	0.074	0.073	0.098	0.078
Leverage	0.131	0.111	0.187	0.175	0.206	0.196	0.250	0.251	0.192	0.158
NWC	0.015	0.021	0.046	0.051	0.047	0.055	0.046	0.045	0.036	0.027
Investments	0.051	0.040	0.050	0.043	0.056	0.045	0.057	0.044	0.056	0.041
Log Size	5.042	4.749	5.865	5.513	6.298	5.977	6.720	6.456	5.798	5.300
ROA_1	0.118	0.115	0.103	0.106	0.104	0.106	0.098	0.099	0.100	0.095
Annual Share return	0.242	0.165	0.184	0.116	0.192	0.119	0.202	0.145	0.209	0.139
CAGR 2008-2016	0.154	0.143	0.164	0.158	0.137	0.163	0.132	0.135	0.151	0.131

APPENDIX A 6: ROBUSTNESS CHECKS FOR H3 USING SPLIT SAMPLES

OLS regressions of next year's ROA and Annual Share Return on the Absolute Cash Deviation and various control variables. t-Statistics are reported in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively. All variables are defined in table 1

	ROA		Annual Share Return		ROA		Annual Share Return	
	Manufacturing	Non-Manufacturing	Manufacturing	Non-Manufacturing	Positive R&D	Zero R&D	Positive R&D	Zero R&D
Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Absolute Cash Deviation	-0.048***	-0.006	0.011	-0.179***	-0.075***	0.008	-0.098	-0.099
	(-4.53)	*(-0.54)*	*(0.17)*	*(-2.84)*	*(-7.11)*	*(0.73)*	*(-1.49)*	*(-1.53)*
R&D to Sales	-0.148***	0.037	0.257	0.505***	-0.109***		0.268	
	(-5.18)	*(1.24)*	*(1.48)*	*(2.77)*	*(-3.89)*		*(1.53)*	
M/B ratio			-0.059***	-0.045***			-0.066***	-0.048***
			(-5.12)	*(-3.59)*			*(-5.30)*	*(-3.70)*
Cashflow	0.406***	0.351***	0.743***	0.438***	0.384***	0.341***	0.610***	0.505***
	(28.78)	*(26.64)*	*(8.29)*	*(5.29)*	*(28.59)*	*(25.40)*	*(6.88)*	*(6.02)*
Leverage	-0.034***	0.023**	-0.021	-0.258***	-0.018	0.005	-0.104	-0.120*
	(-3.41)	*(2.08)*	*(-0.34)*	*(-3.93)*	*(-1.51)*	*(0.45)*	*(-1.37)*	*(-1.91)*
NWC	0.018*	0.032***	0.085	0.076	0.008	0.043***	-0.030	0.156***
	(1.73)	*(3.44)*	*(1.36)*	*(1.35)*	*(0.68)*	*(4.54)*	*(-0.39)*	*(2.67)*
Investments	0.053**	0.117***	-0.210	-0.064	0.054**	0.064***	-0.175	-0.116
	(2.43)	*(5.57)*	*(-1.58)*	*(-0.51)*	*(2.44)*	*(3.11)*	*(-1.28)*	*(-0.92)*
Log Size	0.003***	0.003***	0.005	-0.001	0.004***	0.003***	-0.003	0.009*
	(4.75)	*(3.57)*	*(1.15)*	*(-0.22)*	*(4.98)*	*(3.59)*	*(-0.55)*	*(1.77)*
Intercept	0.037***	0.036***	0.472***	0.524***	0.060***	0.032***	0.594***	0.505***
	(5.40)	*(5.69)*	*(11.38)*	*(13.74)*	*(7.29)*	*(4.80)*	*(11.65)*	*(12.43)*
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	No	No	No	No	Yes	Yes	Yes	Yes
Country dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	2 752	2 416	2 752	2 416	2 274	2 894	2 274	2 894
Adjusted R^2	0.314	0.290	0.148	0.143	0.392	0.294	0.181	0.132

Appendix A 6: Continued

OLS regressions of ROA_1 and Annual Share Return on the Absolute Cash Deviation and various control variables. t-Statistics are reported in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively. All variables are defined in table 1

	ROA		Annual Share return	
	French	Non-French	French	Non-French
Independent Variable	(9)	(10)	(11)	(12)
Absolute Cash Deviation	-0.057***	-0.014	-0.027	-0.165***
	(-5.47)	*(-1.34)*	*(-0.40)*	*(-2.60)*
R&D to Sales	-0.062**	-0.060**	-0.046	0.369**
	(-1.96)	*(-2.00)*	*(-0.23)*	*(2.02)*
M/B ratio			-0.071***	-0.059***
			(-4.59)	*(-5.15)*
Cashflow	0.357***	0.366***	0.430***	0.639***
	(24.50)	*(28.56)*	*(4.61)*	*(7.79)*
Leverage	-0.041***	0.019	-0.156**	-0.080
	(-3.80)	*(1.63)*	*(-2.21)*	*(-1.16)*
NWC	0.032***	0.023**	0.201***	0.014
	(2.94)	*(2.18)*	*(2.91)*	*(0.22)*
Investments	0.096***	0.051**	-0.197	-0.119
	(4.06)	*(2.55)*	*(-1.31)*	*(-0.987)*
Log Size	0.004***	0.003***	0.007	-0.002
	(6.06)	*(3.86)*	*(1.46)*	*(-0.502)*
Intercept	0.050***	0.046***	0.546***	0.600***
	(7.63)	*(6.47)*	*(13.25)*	*(14.07)*
Year dummy	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes
Country dummy	No	No	No	No
N	2 464	2 704	2 464	2 704
Adjusted R^2	0.309	0.346	0.157	0.147

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