The Shareholder Value of Excess Cash

Master Thesis by Pim Oude Alink

Financial Engineering & Management, University of Twente

The Shareholder Value of Excess Cash

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Graduation committee

Dr. R.A.M.G. Joosten
University of Twente

ir. H. Kroon
University of Twente

ing. M.B.J. van Heugten MSc
PricewaterhouseCoopers Advisory N.V.

Executive Summary

Is it reasonable to assume that all corporate cash holdings are exactly worth their intrinsic value – despite company-, industry-, and country-specific differences between firms? In recent times, this fundamental question has led to discussions between shareholders and management in various corporations. We show that shareholders are right to question the benefit of large corporate cash holdings, since our models indicate that the shareholder value of cash generally deviates among firms and over time. Also, the marginal value of excess cash is lower in firms with a high amount of excess cash and higher in firms with strongly negative amounts of excess cash.

By modeling the relationship between the market value of equity and the value of cash for publicly listed firms, we come up with an estimate of the marginal value of cash. Four our large data set, containing 49,781 firm year observations over 7,123 publicly listed European firms, we find that the marginal value of cash ranges between 0.76 and 1.14, depending on the model employed.

Adding the dimension of excess cash to the problem, we find that deducting industry mean or median cash positions from a firm's cash holding level are appropriate measures for identifying excess cash in corporations; our cash measure being the company's cash position relative to its total assets. We find that for firms with large negative excess cash holdings, i.e., firms that are far below their industry mean or median, the marginal value of cash is much higher than for firms with moderate levels of excess cash and to an even further extent when compared with high excess cash firms. This evidence points toward the presumption that firms do indeed have an optimum for the amount of cash they hold.

Our findings are robust between different specifications of our model, as well as for both our excess cash measures. Furthermore, our results regarding the marginal value of excess cash are in line with literature. There is no previous literature that uses a similar approach to specifically address the value of excess cash, but nevertheless our outcomes regarding the value of excess cash are supported by studies that have taken different approaches to this issue.

Overall, we conclude that either too much or not enough cash in firms creates sub-optimal settings. As we have seen from literature, firms with lots of cash for instance tend to engage in acquisitions and other investments that do not add sufficient value to the firm, while firms with a cash shortage miss out on otherwise valuable opportunities. Having found evidence for this sub-optimality of either very large or very low cash holdings by means of our data analysis on the marginal value of excess cash, we recommend financial advisors as well as investors to assess the extent to which a company holds excess cash and to take this into account when valuing the firm.

Preface

This thesis is my final deliverable for obtaining a Master of Science degree in Industrial Engineering & Management, master track Financial Engineering & Management, at the University of Twente. I have been engaged in this project during a six-month internship in the Valuations department of PwC in Amsterdam. Not only is this a milestone in my academic career, it also indisputably means that my student days are over once and for all. It has been a magnificent time, upon which I look back in great satisfaction.

I would like to express my gratitude to several persons that helped me to realize this master thesis project. First of all, I thank PwC Advisory for offering me the opportunity and resources to conduct my research. Particular thanks go out to Martijn van Heugten, my thesis supervisor at PwC Valuations, for his enthusiastic and constructive support and advice, as well as his sharp criticisms. Many thanks as well to the entire Valuations team for their commitment, helpfulness, and making the internship an enjoyable experience.

I also specially thank Reinoud Joosten, my first supervisor from the University of Twente, for challenging me with tough questions, providing me with elaborate and in-depth feedback, and for the nice debates we had on some of the more conceptual matters regarding this research. Moreover, I thank Henk Kroon, my second supervisor from the University of Twente, for his flexibility and involvement.

Final thanks go out to Nicole, family and friends for their support and their interest in my graduation project, and for providing me with welcome distractions at times, to take my mind off things.

Pim Oude Alink

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1. Research Design

The subject and structure of this thesis are to be elucidated in this first section. First, Sections 1.1 and 1.2 introduce the central issue of this study and explain its relevance, context, and contents. Second, we state the research objective and questions in Section 1.3. Third, we furnish the reader with a clarification of the structure of the remainder of the thesis in Section 1.4.

1.1 Introduction

Problem context - By definition, the 'cash and cash equivalents' item is the single most liquid asset category on the balance sheet of any enterprise. Companies (and individuals alike) need to hold on to an amount of cash to maintain their day-to-day operations. For many reasons, cash outflows may either temporarily or permanently exceed cash inflows and vice versa; undue outflows may lead to a shortage of liquidity, while disproportionate inflows could lead to an excessive cash position. For reasons explained momentarily, a company may want to take corrective action in order to restore the desired cash position under both of these circumstances.

A cash shortage can be a very urgent and tangible problem, for it will lead to direct obstacles in meeting short-term obligations, forcing the company to attract (often costly) external funding. While it may be less perceptible how a surplus of cash is a problem at all, there are several valid reasons why a company should not hold on to overabundant cash. At the very best, the cash will just sit in the firm's bank accounts, which can be considered unattractive (assuming that the interest income obtained is lower than the returns that could potentially be realized otherwise), while investment in negative-NPV projects is an even worse alternative rather commonly associated with excessive cash holding (see for example Harford *et al.* (2008) and Blanchard *et al.* (1994)). On the other hand, having a very large amount of cash available can yield some positive effects, such as the ability to react swiftly to investment opportunities and the means to sustain financial distress by using the cash as a buffer.

Recent developments - At the outset of this study, many newspaper articles, websites, and analyst reports were devoting special attention to the phenomenon of excess cash holdings within corporations. During the ongoing financial crisis, many companies engaged in stockpiling massive amounts of cash, resulting in historically large cash reserves.[1] In itself, the tendency of holding on to cash should not be condemned, for it may well be a crucial safeguard for enduring additional market turbulence in the near future.

[1] Media on this trend: Bloomberg (2013) – "*European companies stockpile $475 billion as outlook dims";*
Het Financieele Dagblad (2013) – "*Europese bedrijven zien kaspositie sterk groeien";*
The Economist (2013) – "*Corporate cash piles"*.

However, this current fashion has also led to conflicts of interest in a shareholder–corporate management setting, with the dispute over Apple's 137 billion dollar cash stockpile as a spectacular example.[2] Apparently, many companies are somehow reluctant to either invest their excess cash holdings or distribute them by means of dividends and/or share repurchases. In these disputes, corporate management usually regards it necessary to hold on to the cash, while shareholders generally claim this to be a destruction of value at their expense. It appears that the financial crisis is either somehow stimulating corporations to hold on to their cash or preventing them from investment or cash distribution.

1.2 Relevance

Knowledge gap - Apart from the conflict of interest between shareholders and corporate executives, cash holdings are also important from a valuations perspective. When it comes to valuing an entity's equity, the amount of cash it holds always is a relevant matter. Usually, excess cash is taken out of the valuation by offsetting it against the company's debt. In order to determine the amount of excess cash, many practitioners quantify the amount of cash that is needed for operational purposes and deduct that from the value for cash and equivalents. The difficulty here is to find a solid figure for the operational cash, so not surprisingly it is common practice to estimate this (as a percentage of total revenue) or to consider cash to be negative debt and cancel the cash position out of the equation altogether. By following this approach, another more implicit assumption is being made as well, i.e., that every unit of both operational and excess cash can be appraised at nominal value. However, literature points out that the market value of corporate cash reserves depends on a set of firm-specific characteristics (see for instance Faulkender & Wang (2006)), and as such changes over time (see among others Bates *et al.* (2011)).

Scientific progress – From the 1930s to the 1960s, some fundamental finance papers and books have been written, some of which contain notions on liquidity or cash (for example Keynes (1936), Donaldson (1961), Modigliani & Miller (1958)). Miller & Orr (1966) herald the beginning of a new period, during which corporate cash holdings and adjoining fields (such as agency theory) have gained slightly more attention. Eventually, the academic discussion on cash positions in companies really intensified during the 1990s. This was triggered by some events, like the clash between investor Kerkorian and Chrysler on the huge cash holdings of that company at that time.

Opler *et al.* (1999) studied the determinants and implications of cash holdings in corporations, which marks the start of this era of renewed and intensified interest in the cash holding phenomenon. One of the other early publications that have received considerable attention was Harford (1999), who claims that high cash reserves lead to poor investment, with negative net present values. These key papers suitably

[2] Some news reportings: Bradshaw, T. and McCrum, D. (Financial Times, March 2nd 2013) – "*Apple's cash conondrum*";
Businessweek (2013) – "*Too much cash isn't good for Apple*";
The Wall Street Journal (2013) – "*Einhorn urges Apple to do more with cash*".

illustrate two fields in which many other articles have been published over the past decades: on the one hand there are studies on the factors that determine the level of cash holdings and the rationale behind these mechanisms, while on the other some papers have been published on the value effects of (excess) cash. Despite the substantial academic interest in this matter, there is low consensus on a few key questions, such as which factors affect cash value and –more fundamentally– whether or not an optimal level of cash exists.

Our contribution - Concluding, the current practitioner's approach to valuing cash can, at the very least, be considered challengeable, but the absence of a more formal method that is founded and accepted by the academic world makes it more or less unavoidable. We address the difficulty of determining where to draw the line between operational cash and excess cash, as well as the lack of clarity in how to value excess cash properly. This thesis is unique in its attempt to find out whether there is a more adequate approach to cash valuation from a practitioner's point of view. Moreover, special attention is paid to the influence of the financial crisis on the excess cash phenomenon, which is another distinctive feature of this thesis, since no work has yet been published on excess cash under these developments.

1.3 Problem statement

Literature on cash holdings and excess cash devotes considerable attention to the motives for holding cash, the determinants of cash holdings, and developments in cash holdings over time. We focus on the much less extensively documented aspect of cash holdings, namely the valuation features of excess cash. The ongoing public debate on cash positions and the lack of a paradigm on the valuation of cash strengthen the relevance of our effort. The 'excess cash valuation'-topic can roughly be split into two separate problems: the assessment of the cash holding level at which cash becomes excessive and the valuation of this excess cash.

Hence, the *research goal* is formulated accordingly:

To determine how excess cash holdings should be measured and valued.

In order to achieve this objective, the *main research question* is formulated as:

What is an appropriate valuation method to determine the amount
and shareholder value of excess cash?

This general statement can be broken down into several *sub-questions*, which altogether form a solid base from which the main question is to be answered:

1) How should the amount of excess cash in a firm be measured?
    a) What determines the cash holding level in firms?
    b) What drives the boundary between cash and excess cash?
    c) How much cash and excess cash do firms hold?
2) What is the value of excess cash?
    a) Why do firms hold cash in general and excess cash in particular?
    b) What defines the value of a firm's cash position?
    c) Does the value of excess cash change in turbulent times?
3) How should practitioners perform (excess) cash valuation?

1.4 Thesis outline

The remaining parts of this thesis are arranged as follows. Section 2 provides a literature review on cash holding and its dynamics. Section 3 describes principles behind the differentiation between cash and excess cash and the value of cash. Section 4 presents the hypotheses and scope for the data research; its methods and data are described in Section 5. In Section 6, we conduct an analysis on how to measure the amount of excess cash, and shows its implications by analyzing cash holdings among firms. In Section 7, the value of excess cash is analyzed and extended to the influence of the financial crisis on this phenomenon. Section 8 presents the conclusions that can be drawn from these results and discusses their validity. Figure 1 below illustrates the structure of this thesis in terms of the research questions.

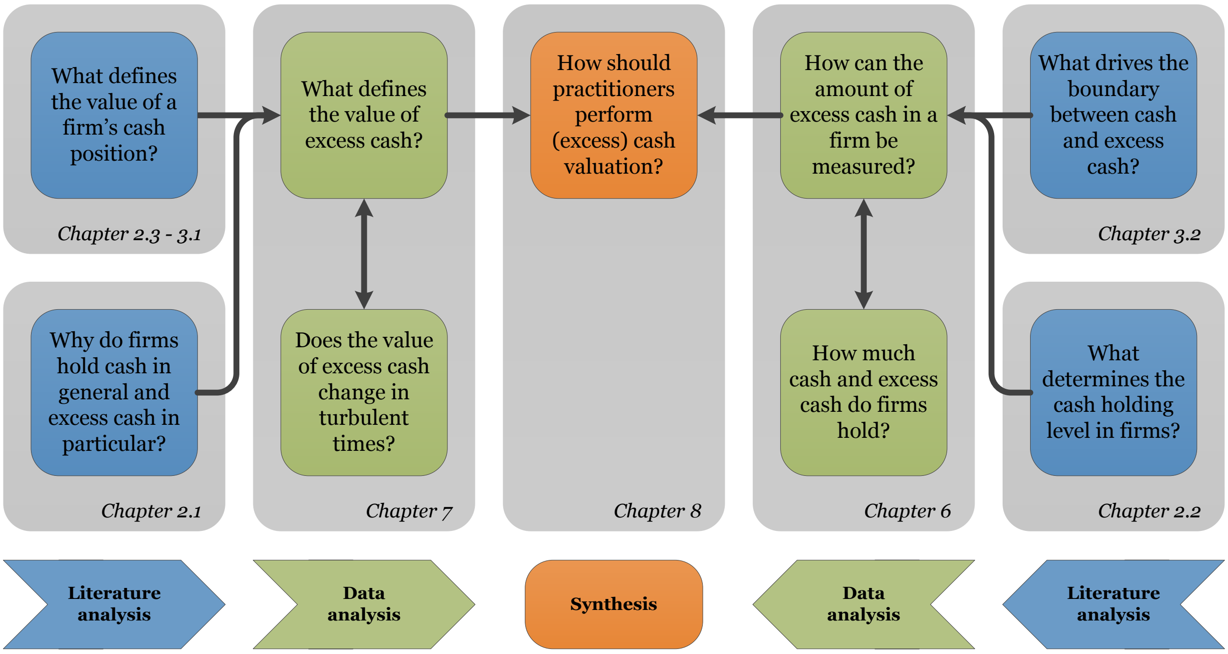

Figure 1 – Research questions and thesis structure

2. The Corporate Cash Holding Phenomenon

The most relevant theoretical backgrounds regarding cash holding are set out in this second section, in order to gain an understanding of why companies hold cash and what the alternatives are. Section 2.1 elaborates on the meaning and purpose of cash and equivalents, and by doing so it explains why and to what extent firms hold cash. Section 2.2 focuses on the determinants of the level of cash holdings among firms, whereas Section 2.3 provides an overview of literature on the value of cash.

2.1 The purpose of holding cash

2.1.1 Introducing cash and cash equivalents

Definition - In accounting, 'cash' consists of checking account balances, non-deposited checks, and actual money, whereas 'cash equivalents' are highly liquid assets with an original maturity of under 3 months, such as short-term government bonds, banker's acceptances, and commercial paper. Being so close to maturity, cash equivalents incorporate a very low interest rate risk. Because they usually are traded in highly active markets, they are easily convertible to a known amount of cash, even before their maturity. Because of the commonalities in their liquidity and risk profile, 'cash and cash equivalents' (CCE) are a combined balance sheet item, representing the most liquid share of current assets. Even though part of the marketable securities of a firm is included in CCE, there usually is another part of marketable securities with maturity between 3 and 12 months, which is posted separately on the balance sheet as 'marketable securities'.

Role and relevance - Under perfect market conditions there would be no taxes, market frictions, and asymmetry in market access. Furthermore, a firm's financial policy would not reveal any information about the company. Under those conditions, the only impact that the CCE position has on the value of the firm is the value of the position itself. Hence, under these circumstances the 'investment' in cash has a zero NPV and is therefore not very relevant to the firm or its stakeholders (Modigliani & Miller, 1958).

However, relaxing the perfect market assumption yields many implications for the effect that cash has on a corporation's value. For instance, raising capital is costly (which could be avoided if sufficient cash and equivalents are available), while on the other hand keeping cash excessively available will result in opportunity costs, for there may be alternatives that would create more value.

2.1.2 Rationale for holding cash

Given the implications that the CCE position has, a firm can choose between three alternative actions when considering its cash and equivalents: to invest, return it to the firm's investors, or to just hold on to it. As introduced in the first section of this thesis, there are some minimal cash requirements that need to be met in order to operate a business. Because of the opportunity cost involved, it may not seem to be optimal in any way to hold on to more cash than this very minimum. Nevertheless, there appear to be several reasons to do so in practice.

One of the first works on the reasons for maintaining liquidity has been published by the well-known economist Keynes. He proposes three main reasons for liquidity preference by an individual: transactions, precautionary, and speculative motives (Keynes, 1936). Over time, research has confirmed the existence of these motives –both for individuals and companies– and has also produced insight into additional sources of motivation for corporations to hold cash (see, among others, Baskin (1987), Cossin & Hricko (2004), and Baum *et al.* (2006)). This section introduces the various reasons for firms to hold on to parts of their cash and equivalents and categorizes them in a coherent structure.

We start off by categorizing all motives into three basic classes: operational incentives, safeguarding incentives, and strategic incentives. The operational incentives category comprises of all parameters emerging from the company characteristics and the nature of business the company is in, that directly influence the supply and demand regarding liquidity, as well as tax-related factors. Safeguarding incentives include all aspects that are liable to volatility, either from the company itself, the financing of the company, or the market in which the company has presence. Strategic parameters involve the ways in which management's or investors' concerns affect the cash holding level. Table 1 ties the cash holding motives that will be introduced in this section to the three categories.

Operational	**Safeguarding**	**Strategic**
Transactions	Precautionary	Agency
Tax	Signaling	Speculative

Table 1 – Aligning the cash holding motives with our three parameter categories

Transactions motive - When a firm is presented with operational expenditures, it will be considerably more costly to attract external funding or to liquidate securities than to use cash available. The direct costs incurred in attracting capital to fund operations are referred to as transaction costs. For obvious reasons, firms will tend to minimize these transactions costs by holding cash at a level that is suitable regarding the nature of their activities. This logical trade-off is the transactions motive for holding cash. In line with this motive, there are economies of scale in cash holding, meaning that a larger firm on average needs relatively less cash for transactions purposes (Miller & Orr, 1966; Servaes & Tufano, 2006).

Precautionary motive - Apart from the direct costs, there also are some indirect costs in attracting capital. It will for instance be more expensive to receive funds when the economy is going through a recession. Also, some companies experience quite some volatility in their own operations (for instance cyclical businesses), which raises their demand for liquidity. Investors do not have full information on the prospects of the business and therefore may tend to undervalue the company, which results in overpriced external financing. Combined with this information asymmetry between firm management and investors, the volatility in the firm's internal and external environments creates a precautionary motive for firms to hold cash (Baum *et al.*, 2006; Servaes & Tufano, 2006).

Generally, firms keep precautionary cash holdings both for operational and investment purposes. Just like companies tend to avoid being short on liquidity for operational expenditures, they do also not want to miss out on good opportunities because they (temporarily) do not have sufficient access to funding, or because the cost is too high. In recent research Lins *et al.* (2010) present their counter-intuitive finding that cash is only held as a precaution for operational expenditures, not for investment opportunities. They state that firms prefer to use lines of credit for investing purposes, as a consequence of which there would be a capital investment motive for safeguarding liquidity, but not specifically for holding cash. Despite this, generally there seems to be a significant advantage in having funds readily available when an instant investment opportunity arises.

Speculative motive - Generally, cash is most valuable when it is hard to obtain. A typical firm's capital market access does not necessarily match its needs. Therefore, some companies keep cash to have it available when it matters, just in case. This can be classified as a speculative motive for holding cash. Characteristically, in emerging economies it is known that some companies are holding huge cash balances in order to be in the position to buy assets from troubled companies at a bargain (Damodaran, 2005). Also, depending on the degree of oligopolistic competition and concentration in the market, cash can be used to retaliate against competitors' initiatives to take over the market (Baskin, 1987).

Agency motive - An agency relationship comprises of an agent that performs certain tasks on behalf of a principal, who has granted some form of decision authority to the agent. Typically, when both the principal and agent are rational utility-optimizing decision makers, the agent will not by definition fully contribute to the principal's best interest. Issues arising from this misalignment are known as 'agency problems', which incur 'agency costs'. Even when the distinction between principal and agent is unclear (for instance because there is a more sophisticated interdependency between them), there still can be many agency problems.

Due to the separation of management and ownership, there is a clear incentive for managers (agent) to hold cash for their own interest at the expense of shareholders (principle), hence there is an agency motive for holding cash. Managers may draw some personal utility from making their firm grow instead of distributing the cash to their stockholders. Often this empire-building behavior of managers is unwittingly stimulated, for instance when their compensation is affected by criteria such as total sales or market share that are positively correlated with firm size (Jensen & Meckling, 1976).

More generally, most managers will tend to use the cash to ensure the firm's long-run survival with themselves in the leading positions. It has been proven by multiple studies that cash-rich firms conduct more acquisitions, for which they generally overpay (e.g., Harford (1999)). More than that, Blanchard *et* *al.* (1994) find that firms that do not invest their cash are themselves targeted for acquisition within a few years, so the only equilibrium strategy for non-dividend paying management is to invest cash (usually on diversification of activities), irrespective of what the return on investment may be. By offering the right incentives, the principal (shareholder) can limit actions by the agent (management) that diverge from his utility optimum. In a shareholder-management setting, leverage could be used to force managers to pay out free cash flow; high debt, with its obligatory payments and interest, is a stronger commitment to prevent wasting cash than raising the dividend or repurchasing shares (Jensen, 1986).

Signaling motive - Managers generally know much more about a corporation's prospects than investors. Based on this information asymmetry between firm insiders and outsiders, there is an incentive for managers to maintain a company's reputation of stability. Dividend payments are one of the most obvious means to do so. Hence, firms tend to smoothen their interest payments and thus choose to hold their cash in prosperous times to be able to pay dividends in harder times (Al-Najjar & Belghitar, 2011). Dividends send out a much stronger signal to shareholders than share repurchases, because they are accompanied by the commitment to pay out more in the future, whereas repurchases could just as well be a one-off event (Harford *et al.*, 2008). If a firm chooses to adopt a stable pattern of dividend payments and amounts, then this will stimulate building a cash buffer.

Tax motive - Multinational firms that face tax expenses in repatriating their earnings tend to hold high cash reserves abroad. Somehow, this does not seem to result in lower domestic cash holdings. When comparing foreign cash holdings between countries, companies hold larger cash reserves in countries with lower taxes and therefore higher repatriation costs (Foley *et al.*, 2007). Hence, there is a tax incentive for holding cash. Also, dividend taxes could withhold companies from paying out cash by means of dividends (Faulkender & Wang, 2006). On the other hand, having debt financing may also yield tax advantages that cannot be obtained by cash financing, which can function as a restraint on the tax incentive for holding cash (Servaes & Tufano, 2006).

2.1.3 Capital structure policies and cash

The previous section provides an overview of the most important motives for firms to hold cash. There are three views on corporate debt and liquidity that relate to these different perspectives, by showing how firms do or do not manage their cash positions (Myers, 1984). These theories only provide a useful framework; when they are presented as a norm or developed into a unifying model, they can easily be rejected on rational grounds (Frank & Goyal, 2005).

Under the *Trade-off Theory*, companies balance the cost and benefits of their cash holdings as part of a bigger capital structuring policy. The trade-off theory came into existence after Modigliani & Miller (1963) added corporate income tax to their original proposition (as published in Modigliani & Miller (1958), stating that under perfect market conditions capital structure is irrelevant), creating a tax shield for debt.

This would imply 100% debt financing, in order to minimize the tax burden. To offset this unrealistic outcome, Kraus & Litzenberger (1973) added the downside of debt financing, the deadweight cost in case of bankruptcy, to the equation. Hence, a trade-off concerning the leverage of the firm was born. As such, cash, debt financing, and equity are alternatives that can be selected based on their respective properties, in order to achieve an optimal leverage profile. This view is in line with most traditional corporate finance theory. Also, most of the motives that have been discussed in the previous section fit into the trade-off theory in some way (Opler *et al.*, 1999).

Firms that behave according to the trade-off theory often exhibit target adjustment behavior, which manifests itself by a propensity to gradually remove deviations from an optimal cash target over time. The most applied form of this theory is the static trade-off, according to which firms make a single-period assessment of the tax benefits of debt and the deadweight cost of bankruptcy. The dynamic trade-off version suggests that firms make a multiple-period calculation that includes the costs of target adjustment (Frank & Goyal, 2005).

According to the *Pecking Order Theory*, also known as the *Financing Hierarchy View*, firms simply prefer internal financing over external financing and debt over equity, due to the costs arising from information asymmetries. A firm's cash position structure is just a side effect from other decisions that the firm makes. From this perspective, only net debt really matters for firms, so attracting debt or spending cash (which could be considered negative debt) are basically the same thing. Hence, there is no optimal amount of cash. This view was introduced by Donaldson (1961); Myers & Majluf (1984) have developed it into a model that is consistent with shareholder wealth maximization, albeit under specific conditions and assumptions.

The agency motive for holding cash, which has been introduced in the previous section, is derived from the *Agency Theory of Free Cash Flow* by Jensen (1986). This is sometimes referred to as a third theory of capital structure that is relevant in the cash holding research setting. In this view, firms use internal funds as a way to evade the control exercised by capital markets. This theory is distinctively different from the other two, especially when considering the other two theories as shareholder value maximizing (Al-Najjar, 2013).

From this perspective, there are three theories that partially strengthen and contradict each other: the first states that firms maximize shareholder wealth by balancing their capital structure (trade-off theory), the second argues that firms tend to do this by minimizing costs arising from information asymmetries (pecking-order theory), and the third supposes that managers do not maximize shareholder utility but focus on their own interests primarily (agency theory). Agency theory of free cash flow often is regarded as the reason that companies deviate from consistently following either the trade-off or pecking order behavior.

Similar to the field of cash holding motives, there has been much discussion about these alternative views on corporate capital structure. According to Shyam-Sunder & Myers (1999), the pecking order theory has more explanatory power than the trade-off theory. Frank & Goyal (2003) argue that the pecking order model may not apply in reality but nonetheless the information contained in the financing deficit is still relevant. Acharya *et al.* (2007) claim that cash transfers resources to the future in an unconditional way, while lines of credit do impose conditions on the firm; this disputes the direction of the pecking order theory, because firms would benefit from using lines of credit whenever available, rather than using cash first (so the order would become debt-cash-equity instead of cash-debt-equity). Drobetz *et al.* (2010) show that the agency theory of free cash flow dominates the pecking order theory in their data set; they even call into question whether precautionary motives for holding cash are valid at all. Despite this debate, all three theories are useful for this research; each validly illustrates a part of the financing mechanism, albeit under different assumptions and conditions.

2.1.4 Empirical evidence on cash holding motives and capital structure theories

Table 2 provides an overview of a large sample of publications that support one or more of the theories and motives. Only publications that explicitly mention their support for specific theories and motives are included. There is an even larger set of publications that do not discuss motives or theories, but do nonetheless include evidence that could be connected to one or more of them. This sample is obtained from a larger set that has been obtained by a literature search; an overview off all relevant papers on motives, theories and drivers is provided in Appendix A. From the sample of explicit empirical evidence on motives and theories, as presented in Table 2, we observe the following:

- Precautionary, agency, and transaction motives are (in that order) the three most commonly proven cash holding motives in our literature set;
- The trade-off theory alone is supported in just as many instances as the pecking order and agency theory of free cash flow together;
- In some of the cases, multiple motives and/or theories are found to be coexistent;
- Several papers present evidence against certain theories and motives;
- There is no obvious relationship between the scope, geography, or time interval of the data set on one hand, and on the other the support authors find for motives and/or theories;
- There is no particular motive or theory that has become dominant to the others over time.

Authors	Year	Dataset	Cash holding motive supported	Capital structure theory confirmed
Al-Najjar, B.	2013	Firms from BRIC-countries, US, UK, 2002-2008 *		Trade-off, pecking order, agency theory
Brisker, E.R., et al.	2013	New S&P 500 companies, 1971-2006	Precautionary, agency	
Melo, M.A.S. and Bilich, F.	2013	Modeling, no data set		Trade-off theory
Acharya, V.V., et al.	2012	Publicly traded US firms, 1996-2010 *	Precautionary, agency	Trade-off theory
Álvarez, R., et al.	2012	Chilean firms, 1996-2009 *	Precautionary	
Bigelli, M. and Sánchez-Vidal, J.	2012	Large Italian unlisted firms, 1996-2005 **		Trade-off, pecking order
Louis, H., et al.	2012	Sample of firms, 1974-2006 **		Agency theory
Sun, Q., et al.	2012	Publicly traded US firms, 1980-2005 **	Precautionary, agency	
Al-Najjar, B. and Belghitar, Y.	2011	UK firms, 1991-2008 *	Signaling	
Lee, E. and Powell, R.	2011	Australian firms, 1990-2007 *		Trade-off theory
McLean, R.D.	2011	US firms, 1971-2008 **	Precautionary	
Tong, Z.	2011	Sample of firms, 1998-2005 *		Agency theory
Venkiteshwaran, V.	2011	Publicly traded US manufacturing firms, 1987-2007		Trade-off theory
Denis, D.J. and Sibilkov, V.	2010	Publicly traded US firms, 1985-2006 **	Precautionary, capital investment	
Dittmar, A. and Duchin, R.	2010	Sample of firms, 1965-2006 **		Trade-off theory
Drobetz, W., et al.	2010	Firms from 45 countries 1995-2005		Agency theory
Lins, K.V., et al.	2010	Survey of CFOs in 29 countries	Precautionary	
Martinez-Sola, C., et al.	2010	US industrial firms, 2001-2007		Trade-off theory
Palazzo, D.	2010	Modeling, no data set	Precautionary	
Bates, T.W., et al.	2009	US firms, 1980-2006 **	Transactions, precautionary	
D'Mello, R., et al.	2008	US listed firms' spin offs, 1985-2000		Trade-off, pecking order theory
Gamba, A. and Triantis, A.	2008	Modeling, no data set	Transactions, capital investment	
Harford, J., et al.	2008	US firms, 1990-2004 **		Agency theory
Baum, C.F., et al.	2007	German food, textile, apparel and chemical firms, 1988-2000	Transactions, precautionary	
Dittmar, A. and Mahrt-Smith, J.	2007	Publicly traded firms US, 1990-2003	Agency	
Foley, F.C., et al.	2007	Large US firms, 1982-2004	Tax	
Guney, Y., et al.	2007	Firms from Japan, France, Germany, UK, US, 1996-2000 *	Precautionary, agency	
Han, S. and Qiu, J.	2007	Publicly traded firms, 1997-2002	Precautionary	
Faulkender, M. and Wang, R.	2006	US firms, 1971-2001 **	Agency, tax	Trade-off theory
Pinkowitz, L., et al.	2006	Listed firms, 1988-1998	Agency	Agency theory
Almeida, H., et al.	2004	Manufacturing firms, 1971-2000	Transactions	
Bruinshoofd, W.A. and Kool, C.J.M.	2004	Large Dutch firms, 1977-1997 *	Precautionary	
Cossin, D. and Hricko, T.	2004	Modeling, no data set	Precautionary, capital investment	
Ferreira, M.A. and Vilela, A.S.	2004	EMU-country firms, 1987-2000 *	Precautionary	Trade-off, pecking order theory
Ozkan, A. and Ozkan, N.	2004	Publicly traded UK firms, 1984-1999 *	Capital investment	Pecking order theory
Schweltzler, B. and Reimund, C.	2004	German firms that were publicly traded in 2002, all years available *		Agency theory
Frank, M.Z. and Goyal, V.K.	2003	Publicly traded US firms 1971-1998		Pecking order theory
Guney, Y., et al.	2003	Firms from Japan, France, Germany, UK, 1983-2000 *	Precautionary, agency	
Mikkelson, W.H. and Partch, M.M.	2003	Sample of high-cash firms, 1986-1991		Trade-off theory
Pinkowitz, L., et al.	2003	Firms in 35 countries, 1988-1999 *		Trade-off, agency theory
Dittmar, A., et al.	2002	Firms from 45 countries, 1998	Transactions	Agency theory
Harford, J.	1999	Firms involved in mergers and acquisitions, 1950-1994		Agency theory
Opler, T., et al.	1999	Publicly traded US firms, 1971-1994 **	Precautionary	Trade-off theory
Shyam-Sunder, L. and Myers, S.C.	1999	Sample of firms 1971-1989 *		Trade-off, pecking order theory
Kim, C.S., et al.	1998	US industrial firms, 1975-1994		Trade-off theory
Blanchard, O.J., et al.	1994	11 US firms that won lawsuits	Agency	
Baskin, J.	1987	Fortune 500 firms, 1960-1984	Transactions, speculative, agency	
Jensen, M.C.	1986	Meta-analysis, no data set		Agency theory
Myers, S.C. and Majluf, N.S.	1984	Modeling, no data set		Pecking order theory
Milbourne, R.	1983	Modeling, no data set		Trade-off theory
Miller, M.H. and Orr, D.	1966	Modeling, no data set		Trade-off theory
Tobin, J.	1956	Modeling, no data set	Transactions	

* excluding financial sector ** excluding financial and utility sectors

Table 2 – Overview of literature explicitly confirming the different motives and theories

2.1.5 Unifying cash holding motives and capital structure theories

As we have seen, the motives for holding cash are frequently mentioned in the context of capital structure theories and vice versa. Apparently, they are somehow related. For example, agency theory of free cash flow also gives an explanation for why managers may overemphasize the importance of precautionary cash holdings, resulting in a larger cash position than needed to maximize shareholder wealth.

Seemingly, the motives are not completely disjunctive or otherwise independent. Hence, rather than just studying this structure of theories and motives, being sub-optimal in terms of mutual exclusiveness, it will be insightful to look into the variables that determine the level of cash held by firms. As Figure 2 shows, it is precisely these variables that tie it all together. Some variables are involved in multiple motives and/or theories and vice versa. The next section provides further insights into these determinants.

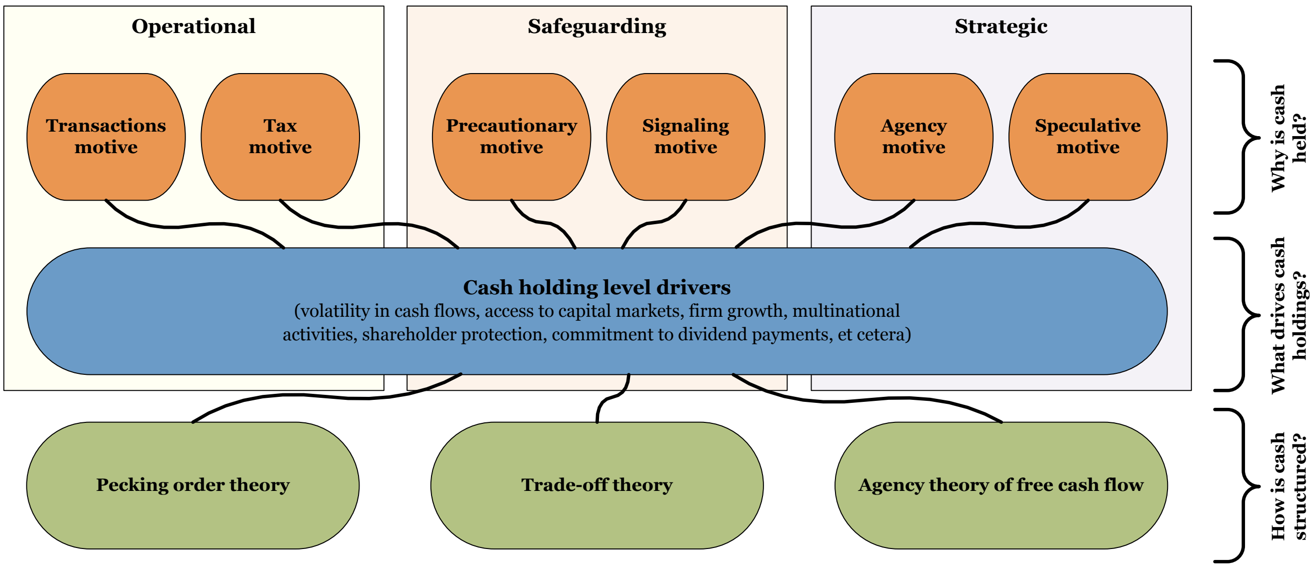

Figure 2 – Interconnecting cash holding motives, theories of capital structure and cash determinants

2.2 The determinants of cash holding levels

2.2.1 Research on cash level drivers

In the previous section, we have seen how motives and theories relate to the determinants of cash holdings. Some insights into the effects of these drivers (whether they inflate or deflate cash positions) can be gained by theorizing on each of the variables' interdependence with the company's cash position under an 'all other things being equal'-assumption. Companies in a less stable environment tend to hold more cash than other firms and firms with easy access to capital markets have less need for holding cash. From such a conceptual perspective, there are many logical interactions between cash holding levels and parameters in a corporation and its environment.

This hypothetical cash driver analysis would become extremely more complex when relaxing the assumption that all other things remain equal. Obviously, all other things do definitely not remain equal in practice and this leads to patterns in cash holdings that are sophisticated and sometimes even confusing. That is exactly why the area of cash holdings in firms has gained considerable attention in literature. Each publication on cash holding has its unique characteristics, regularly leading to insights that are not fully consistent with other literature, which is appropriately illustrated by the subsequent sections (see for instance Tables 3 and 4). Inconsistencies in findings between studies arise from many different properties of the data set, research method, and underlying causal model.

Data set - Important characteristics are the source of the data, the years included in the set, the geographic scope of the set, non-representative sectors that are excluded (most common are the financial sector due to capital requirements and the utility sector due to regulatory inspections; sometimes also (semi-) government owned corporations). Moreover, the data set is affected by the firms that are excluded based on firm characteristics (e.g. firms with negative total assets and other outliers in the data set) or cash holding characteristics (for instance firms that do not exceed certain excess cash thresholds).

Research methods - Some noticeable properties that should be taken into account are the regression technique and specification, underlying hypotheses and assumptions, how the data are corrected or adjusted (which outliers are excluded, but also whether there are dummy variables that cope with industry and country effects), whether cash holdings are studied in time series or across sections, and how the data are clustered in groups (for example, based on persistency in excess cash holdings or certain governance indicators such as shareholder rights).

Causal model – Each piece of empirical research assumes an underlying causal model of interactions between variables in the cash holding field. Perhaps due to the high complexity involved, many authors choose their model rather implicitly. However, like Al-Najjar & Belghitar (2011) show, these assumptions are often flawed. In their paper, they present evidence that dividends and cash holdings are driven by basically the same factors, only the interdependence between the two is insignificant. This may explain why some authors state a positive correlation between cash and dividends, while others claim this to be negative.

2.2.2 Empirical evidence on cash level drivers

Some common themes in empirical research on cash determinants are the interaction between cash holding and firm characteristics (e.g., firm size or quality of governance) and between cash and market characteristics (e.g., competitiveness or volatility in market), but there are many other areas of interest. Table 3 provides an overview into each of the findings that has been reported more than once in our literature sample. Again, a full overview of the relevant literature on motives, theories and drivers is included in Appendix A.

In this set of commonly reported correlations, as displayed in Table 3, we observe the following:

- In 7 out of 20 cases, there is evidence on both a positive and negative correlation. This is mainly due to the conditions described in Section 2.2.1.

- Most factors are predominantly firm-specific: firm size, firm growth (options), working capital, capex, dividend payout, market to book ratio, cash flow, leverage, bank debt, information asymmetry;
- We consider just one determinant, industry volatility, to be fully industry-specific;
- Two drivers are completely country-specific: shareholder/investor protection and quality of institutions/law enforcement;
- A large number of drivers depend on a combination of the firm itself and the industry in which the company operates: (R&D expenditure, investment & investment opportunities, substitute liquid assets, business risk, and cash flow volatility). Two drivers are affected by firm, industry, and country: financial constraints/lack of access to capital and cost of external capital.
- We should at all times take into account the complexity of the interactions between these variables. There may be independent, intervening, exogenous, and/or latent variables that have not been examined properly. Also, some of the drivers that are considered to be dependent variables in the causal model may in fact have some other, more sophisticated relationship with cash levels (recall the example of dividends in Section 2.2.1).

Parameter studied	**Positive correlation with holdings**	**Negative correlation with holdings**	**Parameter studied**	**Positive correlation with holdings**	**Negative correlation with holdings**
Firm size	Al-Najjar (2013) [some countries] Al-Najjar and Belghitar (2011)	Al-Najjar (2013) [other countries] Álvarez et al. (2012) Bates et al. (2009) Bigelli and Sánchez-Vidal (2012) Lee and Powell (2011) Bruinshoofd and Kool (2004) Opler et al. (1999)	Financial constraints	Almeida et al. (2004) Bigelli and Sánchez-Vidal (2012) Brisker et al. (2013) Denis and Sibilkov (2010) D'Mello et al. (2008) Ferreira and Vilela (2004) Opler et al. (1999)	
Leverage	Guney et al. (2007)	Al-Najjar (2013) Al-Najjar and Belghitar (2011) Álvarez et al. (2012) Bates et al. (2009) Ferreira and Vilela (2004) Lee and Powell (2011) Ozkan and Ozkan (2004)	Cash flow volatility	Bigelli and Sánchez-Vidal (2012) Dittmar and Duchin (2010) Han and Qiu (2007) Kim et al. (1998) Lee and Powell (2011)	
Substitute liquid assets		Al-Najjar (2013) Álvarez et al. (2012) D'Mello et al. (2008) Ferreira and Vilela (2004) Ozkan and Ozkan (2004)	Investment & investment opportunities	Ferreira and Vilela (2004) Ozkan and Ozkan (2004) Kim et al. (1998) Mikkelson and Partch (2003)	Bates et al. (2009)
Working capital		Al-Najjar and Belghitar (2011) Bates et al. (2009) D'Mello et al. (2008) Lee and Powell (2011)	Bank debt		Álvarez et al. (2012) Bruinshoofd and Kool (2004) Ferreira and Vilela (2004) Ozkan and Ozkan (2004)
Firm growth & growth options	Al-Najjar and Belghitar (2011) Mikkelson and Partch (2003) Lee and Powell (2011) Opler et al. (1999)		Shareholder protection		Dittmar et al. (2002) Dittmar et al. (2003) Guney et al. (2003)
Dividend payout	Bigelli and Sánchez-Vidal (2012)	Al-Najjar (2013) Al-Najjar and Belghitar (2011) Bates et al. (2009)	Business risk	Al-Najjar and Belghitar (2011) Morellec and Nikolov (2009) Opler et al. (1999)	Cossin and Hricko (2004)
Industry volatility	Álvarez et al. (2012) Bates et al. (2009) Baum et al. (2007)		Quality of institutions	Ferreira and Vilela (2004) Guney et al. (2003)	
Capital expenditure	Lee and Powell (2011) Sheu and Lee (2012)	Bates et al. (2009) Dittmar and Duchin (2010)	Market to book ratio	Bates et al. (2009) Mikkelson and Partch (2003)	
R&D expenditure	D'Mello et al. (2008) Sheu and Lee (2012)	Bates et al. (2009)	Cost of external capital	D'Mello et al. (2008) Kim et al. (1998)	
Cash flow	Ozkan and Ozkan (2004) Lee and Powell (2011)	Bates et al. (2009) Riddick and Whited (2009)	Information asymmetry	Lee and Powell (2011) Cossin and Hricko (2004)	

Table 3 – Cash level determinants in literature

2.3 The determinants of the value of cash

2.3.1 The effects of cash on value

The previous section has shed some light on how cash holdings are affected by the different functions that cash has for a company. Arguably, the factors and corresponding dynamics that drive the cash position should somehow be related to the value of the position as well. For example, when the cash position is decreased under pressure of shareholders while volatility in the market drives up the demand for holding cash, then an increase in cash would add value. Or gaining increased access to capital probably decreases the value of a high cash position, for its substitute form of financing has become more flexible and thus more attractive.

When considering the ways in which a cash position actually adds value to or deducts value from a company, some new aspects come into play. A group of authors has researched the correlations between cash positions, firm performance, and firm value. In this section some of these interactions are identified and discussed.

Size of the cash position - In line with trade-off theory of capital structure and agency theory of free cash flow, one would expect cash to be worth less when the size of the position grows above a certain optimal value. Lee & Powell (2011) argue that the marginal value of cash decreases with the size of the cash position. Faulkender & Wang (2006) confirm this view. Acharya *et al.* (2012) show that riskier firms hold more cash, so more cash does not proxy for more stability. This may be part of the reason why larger cash holdings do not add more value.

Persistence in cash holdings - Some authors emphasize the importance of differences in the length of the time intervals under which firms hold their cash, since this has implications for the value of cash. Mikkelson & Partch (2003) specifically address the phenomenon of persistent large cash holdings, because studying transitory large cash holdings will only generate insight into policy choices that have been made at one point in time. They find that US firms that hold large cash reserves for longer times outperform other firms that are equal in size and industry, as well as similar firms that hold large cash amounts for short amounts of time. When controlling for the firm characteristics that come with their large cash holdings however, there is no significant outperformance. High cash firms grow faster, invest more, and have higher market-to-book ratios on their assets, which may be the reason that they hold more cash. Supported by their data, the authors argue that agency problems are not very relevant for persistent large cash firms.

Schweltzler & Reimund (2004) adapt and refine this methodology and apply it to German firms. They find an operating underperformance in persistent high cash firms, which is in accordance with the agency perspective as proposed by Jensen (1986). They do not clarify whether these conclusions are driven by their methods or by their dataset which is limited to German companies. Using another valuation algorithm, the authors also illustrate that a higher cash-to-sales ratio leads to higher enterprise value. This contradicts the trade-off hypothesis.

In their analysis, Lee & Powell (2011) obtain findings that fit the trade-off model for their sample of Australian firms. They distinguish between persistent and transitory excess cash reserves and find that firms that hold cash persistently are outperformed by those who hold excess cash for short periods of time. They conclude that persistent cash firms have higher and less volatile operating cash flows, lower betas, and lower long-run stock returns.

Leverage and capital market access - According to Faulkender & Wang (2006), the marginal value of cash decreases significantly as a firm's leverage increases. For firms that have constrained access to capital markets the value of cash is higher than for their less constrained peers, especially in the presence of good investment opportunities and low internal funds. Kim *et al.* (1998) show that cash is more valuable when external financing is more expensive. Denis & Sibilkov (2010) confirm this view by showing that cash is worth more in constrained firms, and they find an explanation for this phenomenon: constrained firms generate more value by their investments.

Correlation to the market - In other research, Simutin (2010) finds a positive relationship between excess cash holding and future stock returns in US firms. In contradiction with precautionary reasoning, the researcher finds that high excess cash firms perform worse in economic downturns. Cash is less risky than other assets, but this effect is overruled by the finding that high cash firms have higher market betas. High cash firms invest much more than their low cash peers, but the author finds no relation between excess cash and profits in the future.

Corporate governance - Pinkowitz *et al.* (2006) show that minority shareholders value cash less in countries that provide subordinate investor protection, while they put more value on dividends in those countries. Dittmar & Mahrt-Smith (2007) were the first to tie multiple measures of governance to cash reserves. They show that governance enhances the use of cash (and thereby its value) to a further extent than it influences the amount of cash that is being held. They state that excess cash in a firm does not have a negative impact on value if the firm is well governed. Poorly governed firms generally waste cash on operations as well as on value reducing investments.

Schauten *et al.* (2013) study large European firms and find that they hold substantial and rather volatile cash positions. They reason that there would be no valuation problem in the absence of agency problems, but that there can be significant negative effects when corporate governance is weak. The authors find that the value of excess cash is negatively correlated to the extent to which firms tend to conduct takeover defenses. Their interpretation is that firms defending themselves against takeovers cannot be corrected by the capital markets when they engage in value-destroying activities. Hence, cash is worth less in those companies. They find no relations between cash value and other measures of governance, and their evidence does only apply to common-law countries. For civil-law countries, they find weaker evidence. An additional finding is that governance positively impacts the effect of excess cash on future operating performance. Oswald & Young (2008) write that shareholders can force management to distribute cash by share repurchases if incentives are well aligned and monitoring is close. This yields a higher value than tendencies towards cash retention.

Supply and demand - Gamba & Triantis (2008) find evidence that the value of cash depends on a mix of financial flexibility and costs, holding cost, and investment requirements. As we have seen in this section, this tendency towards combining multiple variables to illustrate the value of cash is quite common in literature.

2.3.2 Empirical evidence on determinants of the value of cash holdings

Our literature review has yielded a collection of evidence on the drivers of the value of cash holdings. Again, the full overview of articles relevant for our analysis of motives and theories, level drivers, and value drivers is included in Appendix A. Table 4 summarizes all our observations on the parameters that determine the value that cash has for a firm. From these outcomes we note the following:

- Considering our previous analysis, 11 out of 22 variables are both a driver for cash level and the value of cash. Interestingly, some of the variables have an opposite effect on value as compared to levels. For example, shareholder protection drives down the level of cash in a firm but increases the value of the cash. By contrast, information asymmetries drive the level up and the value down;
- Of the drivers that have not been addressed in the previous section, again most are firm-specific: return on physical versus liquid assets, size of the cash position, persistence in excess cash holdings, distance to distress, quality of governance, and earnings quality/accounting conservatism;
- The other 'new' drivers are either affected by the firm and its industry (probability of distress, volatility of investment opportunities) or firm, industry, and country altogether (credit market risk);
- Again we should realize that there is a lot of complexity in the causal models, and also that correlations only indicate the direction (and severity) of the interdependencies. For instance, when considering the relationship between cash value and profitability, it remains unclear whether (1) these factors depend on some different commonality such as return on investment and if (2) cash value causes profitability or the other way around.

Parameter studied	Positive correlation with value	Negative correlation with value
Investment & investment opportunities	Baskin (1987) Bates et al. (2011) Kim et al. (1998) Pinkowitz and Williamson (2004) Denis and Sibilkov (2010) Bigelli and Sánchez-Vidal (2012)	
Shareholder/ investor protection	Drobetz et al. (2010) Frésard and Salva (2010) Haw et al. (2011) Pinkowitz et al. (2006)	
Earnings quality / accounting conservatism	Louis et al. (2012) Sun et al. (2012)	
Return on physical relative to liquid assets		Kim et al. (1998)
Firm growth & growth options	Pinkowitz and Williamson (2004)	
Probability of distress	Pinkowitz and Williamson (2004)	Acharya et al. (2012)
Quality of institutions	Pinkowitz et al. (2003)	
Distance to distress		Pinkowitz and Williamson (2004)
Profitability	Bigelli and Sánchez-Vidal (2012)	
Diversification	Blanchard et al. (1994)	Tong (2011)
Firm size	Bates et al. (2011)	
Dividend payout	Bigelli and Sánchez-Vidal (2012)	
Quality of corporate governance	Baskin (1987) Dittmar and Mahrt-Smith (2007) Drobetz et al. (2010) Harford (1999) Schauten et al. (2013) Sheu and Lee (2012) Oswald and Young (2008)	
Size of cash position	Frésard (2008) Mikkelson and Partch (2003) Palazzo (2010)	Faulkender and Wang (2006) Lee and Powell (2011)
Financial constraints/ lack of access to capital	Bates et al. (2011) Faulkender and Wang (2006)	Pinkowitz and Williamson (2004)
Volatility in investment opportunities	Pinkowitz and Williamson (2004)	
Persistence in excess cash holding	Mikkelson and Partch (2003)	Lee and Powell (2011) Schweltzler and Reimund (2004)
Cash flow volatility	Bates et al. (2011) Kim et al. (1998)	
Information asymmetry		Drobetz et al. (2010)
Cost of external capital	Kim et al. (1998)	
Credit market risk	Bates et al. (2011)	
Credit spreads	Acharya et al. (2012)	
Leverage		Faulkender and Wang (2006)

Table 4 – Cash value determinants in literature

3. Quantifying the Value of Excess Cash

In Section 2 we have developed an understanding of how firms' cash holdings come about and what drives their value. This third section shifts our focus towards the implications that these cash holdings have for the value of the firm. Section 3.1 reviews approaches towards valuing cash holdings, and Section 3.2 thereafter sheds some light on defining a method for separating excess cash from the total cash position. Section 3.3 concludes our literature research.

3.1 The marginal value of cash holdings

3.1.1 Making sense of the value of cash

As we have seen in the Section 2, one of the major difficulties in this field is that to a certain extent it remains unclear how all factors combined actually affect value and under which conditions this would be the case. For instance, it has become clear that cash is worth more in financially constrained companies, but will this also be the case when there are obvious agency problems in the firm? Where exactly is the turning point at which the agency problems associated with that specific cash holding outweigh the advantages derived from it by making up for the firm's financial constraints?

A plausible approach to tackle this issue is one that concentrates on the marginal value that cash adds to the capital structure, rather than looking at the impact of single variables. In the past decade, there have been two main contributions to literature that apply such an approach: Pinkowitz & Williamson (2004) and Faulkender & Wang (2006). Both methods successfully bridge the gap between the complex field of variables interacting with cash and the impact of cash holdings on shareholder value. In this section, we describe both approaches in a qualitative manner, followed. In Appendix B, the models and their extended versions are explained in full. We start off by specifying the model of Fama & French (1998), which does not attempt to value cash, but does form the basis for the later models.

3.1.2 Connecting firm characteristics with value

In an attempt to measure tax effects in the pricing of dividends and debt, Fama & French (1998) specify a regression model that combines proxies for earnings, financing, and investment with firm value. They do not succeed in finding reliable evidence on tax effects, but their model does prove to be a statistically sound method that ties firm characteristics to value.

The data set contains a large set of firms over a large number of years (the 1965-1992 period). This is known in statistics as panel data. It would be sub-optimal to perform one cross-sectional regression on the entire set (even though many researchers do this), because this ignores the fact that observations are not independent at all; the residuals of any year may contain correlations across firms and observations of any firm may be correlated across years. Generally, this will deflate the estimated standard errors significantly.

To at least remedy the firm effect part of this econometrical problem, they use an approach that has been inspired by Fama & MacBeth (1973). This involves separate regressions for each year in the sample and then determining average slopes on each of the variables, as well as standard deviations (Petersen, 2005).

3.1.3 Adding cash to the equation

Pinkowitz & Williamson (2004) have specified a regression, which is a variation on the methodology of Fama & French (1998), to determine the marginal value of a unit of cash. They run a regression on a sample of firm characteristics (independent variables) against the market value of equity (dependent variable), one of the independent variables being cash. Hence, the main difference with the Fama & French model is a split of the total assets-parameter into cash and net assets (total assets – cash).

They do this for a large sample of firms over a 45-year time period. Again, following the methodology as proposed by Fama & MacBeth (1973), each year is analyzed separately, leading to a time series of regression results, based on which they draw their conclusions. In each year's model, changes in the independent variables are taken into account; both past (last 2 years) and future (next 2 years).

From this model, they estimate the shareholder value of $1 of cash in a corporation to be approximately $0.97, where 0.97 is the regression coefficient on $C_{i,t}$. The authors assume that there is no optimum in cash holdings, so each dollar can be valued at the flat rate of $0.97. There seem to be large cross-sectional differences in this market value when they split their sample based on firm characteristics. In their further analysis, they attribute these differences to the investment opportunity set rather that the financing set of the firm. Good investment opportunities and an unlikely confrontation with financial distress drive up the value of cash, and vice versa. Contrary to intuition, they find that cash appears to be more valuable in financially unconstrained firms.

3.1.4 A different approach to valuing cash

Faulkender & Wang (2006) take a slightly different route in order to come up with a solid figure for the marginal value of a dollar in cash. Where Pinkowitz & Williamson (2004) use the market value of equity as their dependent variable and focus primarily on the investment opportunity set, Faulkender & Wang (2006) study excess equity returns with a special interest in the financing opportunity set. To come up with figures for the stock returns (dependent variable) and their set of company characteristics (independent variables), they assign each firm to a benchmark portfolio and then measure the deviation from the benchmark on every variable. This deviation is labeled as the unexpected change.

In contrast with the Fama-MacBeth methodology, they do this for the full sample of firms in one go, and later on use White heteroskedastic-consistent standard errors to adjust for time and firm effects. They group the data in 25 portfolios based on firm size and book to market value of equity in order to at least partially adjust for the time-effect.

Based on this standard model, the authors estimate $0.75 to be the value that a shareholder places on $1 in the average firm year from their sample. When adding two interaction terms to the model (See Appendix B), they find a value of $0.94, which the authors regard to be more representative. Additionally, they find that the marginal value of cash decreases with an increase in cash and leverage, and that the marginal value of cash is significantly higher in firms with constrained access to capital markets (confirming intuition), especially when they face valuable investment opportunities. Another interesting finding is that the marginal value of cash is due to corporate income taxes much lower when distributing cash by dividends rather than by share repurchases.

3.2 Drawing the boundary between cash and excess cash

Considering how cash is valued in practice, it would be commonsensical to make a clear distinction between 'normal' and excess cash, and then value the excess cash at its true value rather than to just treat it as negative debt. A distinction commonly made is that between operational and excess cash. However, there seems to be no definition for either operational or excess cash that is both realistic and solid. This section defines and discusses three categories of solutions that are applied in literature.

Cross sectional regression - In Section 2, we have dealt with a large sample of papers that use a regression model to assess which factors relate to cash holding levels. Using a regression model, one could determine the level of cash holdings that is to be expected based on firm characteristics. The additional amount of cash held by the company then simply is excess cash. Among others, Opler *et al.* (1999) use this approach by taking the residual from cross-sectional regressions of cash-to-assets ratios on variables that determine cash holding levels. Lee & Powell (2011) use the same kind of cross-sectional regression method, but use a different measure for excess cash, i.e. all cash that exceeds 1.5 times the volatility in cash holdings (within the firm) above the baseline cash holdings estimated by the regression.

Modeling - Another group of researchers have explored a totally different approach to gain insight into the excess cash puzzle. Assuming the Trade-Off Theory of capital structure to be representative, they create a mathematical model that describes the effects associated with cash holding. Three types of models are prevalent in literature: inventory theory, linear programming and dynamic programming models. All models are used to determine an optimal level of cash holding for a firm given its parameters. Again the cash held in surplus of this optimal amount is regarded to be excess cash.

Kim *et al.* (1998) build a model that makes a trade-off between the holding cost of liquid assets and the advantages of not having to attract external financing later on. Melo & Bilich (2013) develop a model that maximizes the utility of total wealth for a company. Both models can be used to derive a measure of excess cash.

Sector analysis - Schweltzler & Reimund (2004) prove the industry median cash holding level to be an appropriate proxy for individual firms' optimal cash holding levels. Damodaran (2005) suggests to distinguish between operating and excess cash by taking the industry average as the level of operational cash. These ideas build on the presumption that a sector as a whole has a specific cash level requirement, depending on the nature of the business conducted within the sector as well as a typical firm's characteristics for that sector. On an aggregate level, firms on average should meet that standard.

One of the advantages of a sector focus is that it accounts for some of the sector-specific parameters (such as market volatility), and the commonalities in the values of firm-specific variables within the sector (such as R&D expenditure in a technology-intensive sector). This contributes to a more consistent pattern in cash holdings while it does not make the analysis more complex (which would be the case if all those parameters were to be included in the regression specification). Also, those determinants that have not been addressed in our literature sample may be included by adopting this sector perspective. For instance, sector-specific differences in alternatives for liquidity, such as flexibility of payment to suppliers, can explain part of the difference in demand for cash between firms.

3.3 Recap of literature findings

In Section 2, we have examined the role of cash in corporations, both from the viewpoint of motives and capital structure theories. We have developed a thorough understanding of all dynamics that are involved, which is summarized in our integral framework connecting the theory on cash holdings. It turns out that the factors that influence cash positions are the pivot between cash holding motives and theories of capital structure.

Hence, we shifted our view towards how levels of cash holdings (Section 2.2) and the value of cash (Section 2.3) are interdependent with these firm-, industry- and/or country-specific characteristics. We have established an elaborate list of relationships supported by literature, which is useful for understanding the dynamics involved in the cash holding puzzle. Nevertheless, we observe that these factors combined do not provide us with a solid structure that represents the value of cash, mainly because parameters are neither mutually exclusive nor collectively exhaustive.

Consequently, in order to be able to value cash, we need an approach that uses an appropriate set of determinants and through them connects cash to value. This set should be small enough to be interpretable, yet large enough to be reliable. Fama & French (1998) created a solid model that ties taxes and financing decisions to firm value, and this inspired (Pinkowitz & Williamson, 2004) and Faulkender & Wang (2006) to apply a similar approach that incorporates cash as an additional variable.

As we have seen, choosing a definition for excess cash is often done rather arbitrarily, which is fine as long as the resulting figure for excess cash is then handled in a corresponding manner. Our research is new in its attempt to incorporate the excess cash phenomenon into the cash value problem, by researching the marginal value of cash under different excess cash measures. This yields new insights into the dynamics regarding the value of cash, enabling us to draw inferences for a practitioner's approach for cash valuation, which is the main question of this thesis. Our comprehension of existing literature will also be of value for the interpretation of our results.

4. Hypotheses and Scope

In the previous literature analysis sections, we addressed some of our research sub-questions and gained a thorough understanding of all factors involved in the excess cash holding and valuation field. By revisiting our research questions and formulating our hypotheses (Section 4.1) and scope (Section 4.2), we now shift towards the data analysis part of our research.

4.1 Hypotheses

4.1.1 Research questions

Our first research sub-question is: "how should the amount of excess cash in a firm be measured?". Having researched the determinants of the cash holding level (question 1a) and the boundary between cash and excess cash (question 1b), we have to conduct some analysis to come up with a complete answer to the first question. As such, we look into how much cash firms hold (question 1c) and come up with an optimal manner to measure excess cash, which answers our first sub-question. This first part of the analysis is of an explorative nature. Section 6 explains the analysis results on the development of cash holdings over time and across different industries and countries. Different measures of cash and excess cash are used in this phase, and conclusions are drawn on which measures are most appropriate for the remainder of the analysis.

The second research sub-question is formulated as: "what is the value of excess cash?". Again, we have done the literature analysis to support our analysis; we have seen why firms hold cash and excess cash (question 2a) and which factors determine the value of excess cash (question 2b). Now we are able to perform analysis to come up with an answer to our second sub-question, the value of excess cash. Also, we will look into the effects that the crisis has in the field of cash holdings (question 2c). In Section 7, the marginal value of excess cash is determined by regression analyses.

For both parts of the analysis, we formulate hypotheses on different aspects involved. Using these hypotheses as stepping stones, we are able to comprehensively answer the research questions.

4.1.2 Explorative analysis on cash holding levels

The main goal of our research is to improve the practitioners' approach to measure and value cash. In order to be able to interpret our findings later on, some explorative analysis is to be conducted first: both on the developments of cash over time and across sections such as industries and countries. Not only do we investigate actual cash holdings over time and across sections; we also add the excess cash dimension to the analysis. Under different definitions for excess cash, we see how excess cash has developed over time. Furthermore, every piece of research uses some data source, covers a specific time period, and has its own classifications and definitions. Because the data set used in this analysis will be unique, we would like to familiarize ourselves with the data set and moreover confirm whether the data at least follow a similar pattern as compared to other research. To these ends, we formulate the following hypotheses for the time series study:

Hypothesis 1 *Overall, cash positions have grown from 2000 onward;*

Hypothesis 2 *The start of the economic recession has a significant effect on the levels of cash held by corporations.*

The first hypothesis is based on numerous reports by media and literature that in general firms have steadily increased their cash holdings over the years. Our second hypothesis is in line with safeguarding (precautionary and signaling) motives: on one hand access to capital has decreased after the outset of the financial crisis and we assume that this caused firms to hold more cash to be able to steadily continue their business; on the other, the crisis may have caused negative shocks in cash positions as well, for liquidity alternatives have become less available, which may have caused firms to spend their cash buffer.

After analyzing the course of the (excess) cash positions over time, our focus shifts towards looking at systematic differences in cash holdings between different sub-sets of our data:

Hypothesis 3 *Large and consistent country-specific differences can be found in cash holding levels;*

Hypothesis 4 *Industries have considerably different cash holding levels.*

Based on our literature review, obvious sub-sets to analyze are industries and countries, because we have seen that many of the cash level and value drivers are industry- or country-specific, or at least partially so. Our expectation is that capital- and R&D-intense industries contain higher cash levels. Also, we expect countries to show different excess cash levels; those with low shareholder protection (such as The Netherlands) will probably have larger cash holdings than others.

4.1.3 Regression analysis on cash value

After analyzing different measures for excess cash, we want to gain insights into the value of excess cash holdings. Therefore, we analyze how the extent to which firms hold excess cash relates to value. This ultimately enables us to do recommendations on how to value excess cash from a practitioner's point of view.

Supported by literature on agency theory of free cash flow, it is commonly contended that excess cash is worth less than face value. We want to see whether this claim is supported by our data set. Hence, we frame the following hypothesis:

Hypothesis 5 *The marginal value of excess cash is generally lower than one.*

Extending this line of thinking, we would expect that the marginal value of cash declines as the cash position grows. Therefore, we formulate our corresponding hypothesis accordingly:

Hypothesis 6 *The marginal value of cash is highest in firms that have negative excess cash holdings, moderate in firms that are around the zero excess cash level, and lowest in firms that hold high excess cash.*

As one of our research sub-questions addresses the impact that the crisis has on cash holdings, we want to look into that topic as well from a cash value point of view. Based on the intensified reporting on shareholder-management conflicts on cash positions and the decline in investment opportunities during the crisis, we express the following hypothesis:

Hypothesis 7 *The marginal value of cash was lower after the start of the crisis than before.*

4.2 Scope

We obtain all data through Standard & Poor's Capital IQ service. Our sample comprises of all publicly traded companies from all large developed economies in Europe: Austria, Belgium, Denmark, France, Finland, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and United Kingdom. We define a public company as any legal entity whose equity is trading on a public stock exchange. We collect all available data over the 1998-2012 timespan. To avoid survivorship bias, we include all firms that were listed (and therefore had a non-zero market capitalization) at any point in this time interval; both those that are still in business as listed companies and those that were listed in just some of the years.

We do not study the utility sector (Standard Industrial Classification (SIC)-codes between 4000 and 4999), since regulation changes the function that cash has for those firms. The financial sector (SIC-codes 6000-6999) is also omitted, because cash plays a unique role in financial institutions, and they are subject to regulations (e.g. capital ratios under Basel III), causing them to have unrepresentative cash holdings for our research's purposes.

Data points are collected as of each fiscal year end (for balance sheet items and such) or as the sum over the fiscal year (for cash flows, revenue, et cetera). Depending on availability, all data are collected either in millions of EUR or in local currency and then converted to EUR at historical exchange rates.

Using these operations yields a 'basic' set of data, which is not yet corrected for unrealistic values, outliers, and the like. For both parts of our analysis, we use different methods and therefore both have different data collection and treatment needs. For that reason, we split the description of our methods and further data set editing in the subsequent sections.

5. Methods and Data

In the previous section, we have defined the focus for our data analysis. This section explains the methodology used and the data operations required. The analysis, as presented in the subsequent Sections 6 and 7, is twofold; so is this fifth Section. We collect and prepare a large data set to conduct both different analyses. Sections 5.1 and 5.2 describe the methodology and data set for our explorative analysis on excess cash levels. Subsequently, Sections 5.3 and 5.4 address these same issues, albeit for the more sophisticated cash value regressions part of our analysis.

5.1 Methods – explorative analysis on excess cash levels

In order to cover different aspects of cash position developments, we define six measures - two for cash and four for excess cash. Our cash measures are cash and cash equivalents (A) and cash divided by total assets (B), to adjust for differences in firm size and overall growth in assets over time. Our excess cash metrics are based on the common 2% of revenues rule of thumb (1), the industry average and median (2a and 2b respectively) of our second cash measure, and a novel approach that estimates excess cash from the volatility in earnings (3). The first three excess cash measures have been described by literature (see Section 3); the latter is an experimental new approach, to incorporate the volatility of cash flows into the definition. Based on the volatility in a firm's earnings over the full sample period, it defines the level of cash that should suffice to fully cope with this volatility.

For each firm, we define the variables as follows:

- *Cash measure A* is 'plain vanilla' cash and cash equivalents [CCE];
- *Cash measure B* equals CCE divided by total assets [$\mathrm{CCE/TA}$];
- *Excess cash measure 1* is calculated as CCE minus 2% of Total Revenue [$\mathrm{CCE} - 0.02 * \mathrm{TR}$];
- *Excess cash measure 2a* is cash measure B minus the industry mean CCE/TA ratio [$\mathrm{CCE/TA} - \overline{\mathrm{X}}_{\mathrm{I}}(\mathrm{CCE/TA})$];
- *Excess cash measure 2b* equals cash measure B minus the industry median CCE/TA ratio [$\mathrm{CCE/TA} - \widetilde{\mathrm{X}}_{\mathrm{I}}(\mathrm{CCE/TA})$];
- *Excess cash measure 3* is calculated using a slightly more elaborate procedure. By determining the volatility (σ) in each company's annual EBITDA/TA ratios over all available years (for every firm in our sample that provides over 4 observations for the EBITDA/TA ratio) and then taking the industry mean of these standard deviations, we obtain an industry sigma (σ_I), which is a good proxy for cash flow volatility (Dittmar & Duchin, 2010). The amount of excess cash is then determined by taking the amount of cash held in excess (or short) of this industry sigma [$CCE/TA - \sigma_I$].

To get a thorough understanding of the excess cash phenomenon in our data, we will study these six measures over time, between industries and between countries. We use the first two digits of the SIC-code to define the industries. As displayed in Table 5, our data comprises 57 industries. The countries have been specified in Section 4.2.

2-digit SIC code industries (excluding utilities and financials)

01 Agricultural Production - Crops	27 Printing & Publishing	56 Apparel & Accessory Stores
02 Agricultural Production - Livestock	28 Chemical & Allied Products	57 Furniture & Home Furnishing Stores
07 Agricultural Services	29 Petroleum & Coal Products	58 Eating & Drinking Places
08 Forestry	30 Rubber & Miscellaneous Plastics	59 Miscellaneous Retail
09 Fishing, Hunting, & Trapping	31 Leather & Leather Products	70 Hotels & Other Lodging Places
10 Metal Mining	32 Stone, Clay, & Glass Products	72 Personal Services
12 Coal Mining	33 Primary Metal Industries	73 Business Services
13 Oil & Gas Extraction	34 Fabricated Metal Products	75 Auto Repair, Services, & Parking
14 Nonmetallic Minerals, Except Fuels	35 Industrial Machinery & Equipment	76 Miscellaneous Repair Services
15 General Building Contractors	36 Electronic & Other Electric Equipment	78 Motion Pictures
16 Heavy Construction, Except Building	37 Transportation Equipment	79 Amusement & Recreation Services
17 Special Trade Contractors	38 Instruments & Related Products	80 Health Services
20 Food & Kindred Products	39 Miscellaneous Manufacturing Industries	81 Legal Services
21 Tobacco Products	50 Wholesale Trade - Durable Goods	82 Educational Services
22 Textile Mill Products	51 Wholesale Trade - Nondurable Goods	83 Social Services
23 Apparel & Other Textile Products	52 Building Materials & Gardening Supplies	84 Museums, Botanical, Zoological Gardens
24 Lumber & Wood Products	53 General Merchandise Stores	87 Engineering & Management Services
25 Furniture & Fixtures	54 Food Stores	89 Services, Not Elsewhere Classified
26 Paper & Allied Products	55 Automotive Dealers & Service Stations	99 Non-Classifiable Establishments

Table 5 – Industry classification used on the data set

5.2 Data – explorative analysis on excess cash levels

5.2.1 Data collection

For the first part of the analysis, we choose to employ as few exclusions and corrections as possible, because our main goal here is to get an overview and obtain some general insights. Hence, in this stage only negative values and obvious outliers are excluded from our data set, and we choose to observe -but not correct for- more sophisticated patterns in our data such as non-normality, and heteroskedasticity. An overview of the variables in our data download is presented in Table 6. From our initial sample, we exclude firm years with negative data points in CCE, TA, or TR. We then calculate the metrics that we are going to explore in this part of the analysis.

Item	Abbreviation	Category
Country of incorporation	-	Company information
Standard Industrial Classification code	SIC	Company information
Cash and Cash Equivalents	CCE	Balance sheet
Total Assets	TA	Balance sheet
Total Revenues	TR	Income statement
Earnings Before Interest, Tax, Depreciation & Amortization	EBITDA	Income statement

Table 6 – Data items used in explorative analysis

5.2.2 Data treatment and final sample descriptives

Outliers do exist in our data set, especially considering the operations that we perform on each of the metrics. For instance, a very small figure for total assets divided by a larger figure for cash holdings will drive up the average CCE/TA ratio tremendously. Therefore, we need to trim our set for outliers on each of the metrics. For each metric in each year, we eliminate the observations that are more than 3 times the standard deviation of all observations away from the mean. Under a Normal distribution, this would mean that 0.1% of values in both tails of the distribution would be excluded.

As can be seen from the descriptive statistics at the end of this section, some of our data appears to have high kurtosis, so not surprisingly more than 0.1% is excluded during this operation. In other words, the probability mass is not evenly distributed and the mass in the tail of our data distribution seems to be underestimated by the Normal Distribution.

We do not require the data set for any firm to be complete in this stage; companies are not excluded as long as one or more metrics are available. Hence, all that can be calculated from the data is actually used. Our final sample consists of an average of 66,939 firm year observations over 7,123 companies. In Table 7, the descriptive statistics of the data collected and measures calculated for the explorative analysis is presented.

Variable / metric	Obs	Zero/Excl	Mean	StDev	Skewness	Kurtosis	Min	Q1	Median	Q3	Max
CCE	67,891	38,954	53.5	176.3	6.7	58.5	0.0	1.1	5.5	25.9	3,000.5
TA	70,212	36,633	1,418.4	8,046.2	14.8	305.0	0.0	19.6	83.0	373.1	309,644.0
TR	67,517	39,328	1,253.3	7,326.8	19.4	578.3	0.0	17.2	82.9	385.4	361,914.1
EBITDA	63,484	43,361	170.1	1,110.7	18.0	435.3	-6,369.3	0.3	7.1	43.8	43,062.1
CCE/TA	66,670	40,175	0.12	0.13	1.87	3.46	0.00	0.03	0.07	0.15	0.75
Industry mean CCE/TA	855	0	0.10	0.05	0.77	0.98	0.00	0.07	0.09	0.13	0.29
Industry median CCE/TA	855	0	0.07	0.04	1.72	4.51	0.00	0.04	0.06	0.08	0.29
CCE - 2% TR	65,180	41,665	40.39	149.04	6.71	61.09	-1,861.29	0.19	3.10	18.21	2,416.68
CCE/TA - ind.mean CCE/TA	66,834	40,011	-0.02	0.13	1.44	2.63	-0.35	-0.10	-0.04	0.02	0.56
CCE/TA - ind.median CCE/TA	66,704	40,141	0.04	0.13	1.77	3.39	-0.29	-0.04	0.00	0.07	0.63
CCE/TA - ind.sigma EBITDA	67,963	38,882	-0.14	0.47	-4.17	21.25	-3.02	-0.18	-0.07	0.01	0.94

Table 7 – Descriptive statistics for the explorative analysis data set

5.3 Methods – regression analysis on excess cash value

5.3.1 Determining the marginal value of excess cash

In Section 3.2, we introduced two models for analyzing the marginal value of excess cash. The approach that we choose resembles that of Pinkowitz & Williamson (2004) and adds the dimension of excess cash holdings. We choose to base our procedure on their methodology, because of its relative straightforwardness and its robustness. Also, the Faulkender & Wang (2006) method relies on a partition in benchmark groups following a specific method for U.S. firms, which would cause complications for our European data set. Consequently, we prefer the Pinkowitz & Williamson approach both from a theoretical and practical point of view.

5.3.2 The Fama-MacBeth approach

When studying panel data, there generally are two things that should be taken into account: within each year in the data set (the 'X-axis') there could be correlations between the values of different companies in the data set, while within each firm in the data set (the 'Y-axis') there may be autocorrelation in the values of variables on successive years. Using Ordinary Least Squares (OLS) regressions on such a panel data set leads to reasonable results in terms of the intercept and slopes that it estimates, but the standard deviation will be underestimated due to the (auto-) correlations ignored (Petersen, 2005).

Fama & French (1998) use a method inspired by the Fama-MacBeth regressions (as introduced in (Fama & MacBeth, 1973)) to tackle the first part of this problem. This involves running a cross-sectional regression on each year (t) in the data set time span (T) and then calculating full set results from the time series of yearly regression results. We refer to this approach as the Fama-MacBeth (FM) methodology. As Cochrane (2001) and Petersen (2005) explain, full set estimates on the intercept ($\hat{\alpha}_{FM}$) are calculated as an average of the yearly estimates ($\hat{\alpha}_t$):

$$\hat{\alpha}_{FM} = \sum_{t=1}^{T} \frac{\hat{\alpha}_t}{T}. \tag{1}$$

Likewise, each regression coefficient estimate ($\hat{\beta}_{n,FM}$) is determined as an average of the yearly estimates ($\hat{\beta}_t$), where the subscript n indicates the number of the coefficient (as specified by the regression formula) and i denotes the firm:

$$\hat{\beta}_{n,FM} = \sum_{t=1}^{T} \frac{\hat{\beta}_{n,t}}{T} = \frac{1}{T}\sum_{t=1}^{T}\left(\frac{\sum_{i=1}^{I} X_{i,t}Y_{i,t}}{\sum_{i=1}^{I} X_{i,t}^{2}}\right) = \beta_n + \frac{1}{T}\sum_{t=1}^{T}\left(\frac{\sum_{i=t}^{I} X_{i,t}\varepsilon_{i,t}}{\sum_{i=t}^{I} X_{i,t}^{2}}\right). \tag{2}$$

Then, the standard deviations of the cross-sectional regression estimates are used to estimate the variance on the intercept ($S^2(\hat{\alpha}_{FM})$) for the full set:

$$S^2(\hat{\alpha}_{FM}) = \frac{1}{T^2}\sum_{t=1}^{T}(\hat{\alpha}_t - \hat{\alpha}_{FM})^2 \tag{3}$$

and the variance of the coefficient estimates ($S^2(\hat{\beta}_{FM})$) is determined similarly:

$$S^2(\hat{\beta}_{n,FM}) = \frac{1}{T^2}\sum_{t=1}^{T}(\hat{\beta}_{n,t} - \hat{\beta}_{n,FM})^2. \tag{4}$$

The R^2 statistic from the regression is also calculated as an average of each of the years' R^2. This procedure leads to standard errors that are corrected for cross-sectional correlation. Hence, these are better estimates than those based on an OLS regression. Nevertheless, no adjustments have been made for the time-series autocorrelation. As Fama & French (1998) point out however, adjusting for autocorrelation will do more harm than good due to the limited number of time periods in which we do observations.

5.3.3 Rationale behind the regression formulas

Now that we have illustrated the FM-method that we will use on the data set, the most important next step is to define each of the yearly cross-sectional regressions. We formulate two versions of the regression formula: one is a variant on the basic Pinkowitz & Williamson model, while the other resembles their enhanced specification that includes growth parameters on the cash variable. Again, for the original model specifications and comparisons we refer to Appendix B.

Since we want to analyze how shareholders value cash, we take the market value of equity (M) as dependent variable in our models. All variables, both explanatory and explained, are deflated by total assets (TA), to remove heteroskedasticity and the dominating effect of large firms in the sample (some of the large firms have huge cash balances in absolute terms, but not in relative terms). We regress the market value of equity on a collection of parameters that capture the past, current, and future states of profits, investment, R&D, dividend policy, leverage, and cash.

To encompass the profit elements, we include earnings (E) as a variable. The changes in net assets (NA) represent the investment component and R&D expenses (RD) cover the R&D part. Both of these variables also pick up information on (future) profitability that is missed by the earnings variable. As proxies for dividend and leverage policies, we select dividends (D) and interest expenses (I) respectively; the latter being a direct measure of book leverage (given that it's deflated by total assets). For our research's purposes, we include cash (C) as an explanatory variable too (hence investment is represented by net assets rather than total assets in our model).

By themselves, these variables do not yet fully capture the value that shareholders place on the firm's equity. The market value also reflects expectations on how the firm will perform in the foreseeable future.

Therefore, the growth over the past and next 2 years is also included for each of the parameters in the model as a proxy for this phenomenon. Because some of the current variable values (such as R&D) could drive future value of the firm's equity, the 2-year growth in our dependent variable -the market value of equity- is taken into account as well. All growth parameters, both future and past, are studied over a 2 year time period. As Fama (1990) advocates, this is the most appropriate time horizon when looking at how far the market in reality looks ahead (and back).

5.3.4 Specification of regression formulas

As announced, we use an adopted version of the Pinkowitz & Williamson (2004) regressions. First, we test their models on our data set, to see whether there are any differences in outcomes that can purely be attributed to the different nature of our data sets. Their basic model is specified in Appendix B, as is their extended model. Using the Fama-MacBeth methodology on the Pinkowitz & Williamson regressions will give us the marginal value of cash within our full sample. Table 8 provides an overview of all variables involved in the formulas in this section.

Symbol	Meaning	Symbol	Meaning
α	Regression intercept	$V_{i,t}$	Represents any value or growth parameter
$\beta_{i,t}$	Regression coefficients	M	Market value of equity
$\varepsilon_{i,t}$	Regression residual	E	Earnings
i	Firm identifier	NA	Net assets
t	Fiscal year end of observation	RD	R&D expenses
δ	Dummy variable	I	Interest expense
γ	Dummy coefficient	D	Dividends
$X_{i,t}$	Value of independent variable X at t	C	Cash
$dX_{i,t}$	Change in X over $t-2$ to t	A	Total assets
$dX_{i,t+2}$	Change in X over t to $t+2$		

Table 8 – Overview of model parameters

To obtain insights into the marginal value of cash for firms with different amounts of excess cash, we need a new variable to enter our model. This variable represents to which extent the firms hold excess cash. We use multiple dummy variables to code this dimension; dummies being binary variables that are each assigned a value of 1 for a specific sub-set of the data and 0 on the others.

We analyze models with interaction effects, meaning that the dummies allow different intercepts ($a_j\delta_j$) as well as coefficients on the cash variable ($\delta_j * C_{i,t}$) for each excess cash subsection of the data. It also means that the model requires all the other coefficients to be the same across the entire sample. Although this may be a rather restrictive specification from that perspective, it will lead to a more efficient model from an overall point of view (Fox, 1997). In equation form, the dummies are included as follows:

$$M_{i,t} = \sum_{j=1}^{J} \alpha_j \delta_j + \sum_{j=1}^{J} \gamma_j (\delta_j * C_{i,t}) + \sum_{n=1}^{N} \beta_n V_{n,i,t} + \varepsilon_{i,t} \qquad (5)$$

where j is an index for the dummy group, γ represents the regression coefficient for the interactive cash dummy, n is an index for all the other variables (both value and growth parameters) that are represented by V. Recall that regression coefficients β is the same over the whole data set, while coefficient γ is allowed to be different for each excess cash subset.

To avoid perfect multicollinearity, the number of dummy variables we employ (J) is equal to the number of dimensions in our excess cash scale minus 1; if we make three classes of firms based on their excess cash holdings, then we use two dummy parameters (hence $J = 2$). For excess cash group 1 this results in $\delta_1 = 1$ and $\delta_2 = 0$, for excess cash group 2 both dummy parameters are zero (for this is our point of reference), and for excess cash group 3 For excess cash group 1 this results in $\delta_1 = 0$ and $\delta_2 = 1$. The exact classification of the groups will be elaborated in Section 7.

Applying these dummy enhancements to our basic model, we get the following regression formula:

$$\begin{aligned} M_{i,t} = \alpha + \sum_{j=1}^{J} \alpha_j \delta_j + \sum_{j=1}^{J} \gamma_j \left(\delta_j * C_{i,t}\right) + \beta_1 E_{i,t} + \beta_2 dE_{i,t-2} + \beta_3 dE_{i,t+2} + \beta_4 dNA_{i,t-2} \\ + \beta_5 dNA_{i,t+2} + \beta_6 RD_{i,t} + \beta_7 dRD_{i,t-2} + \beta_8 dRD_{i,t+2} + \beta_9 I_{i,t} + \beta_{10} dI_{i,t-2} \\ + \beta_{11} dI_{i,t+2} + \beta_{12} D_{i,t} + \beta_{13} dD_{i,t-2} + \beta_{14} dD_{i,t+2} + \beta_{15} dM_{i,t+2} + \beta_{16} C_{i,t} \\ + \varepsilon_{i,t} \end{aligned} \tag{6}$$

which is essentially the basic Pinkowitz & Williamson regression specification plus the excess cash dimension as modeled by the dummy parameters. For our extended model, which is very similar to the basic model, except for the fact that this specification incorporates cash growth parameters ($dC_{i,t-2}$ and $dC_{i,t+2}$), this becomes:

$$\begin{aligned} M_{i,t} = \alpha + \sum_{j=1}^{J} \alpha_j \delta_j + \sum_{j=1}^{J} \gamma_j \left(\delta_j * C_{i,t}\right) + \beta_1 E_{i,t} + \beta_2 dE_{i,t-2} + \beta_3 dE_{i,t+2} + \beta_4 dNA_{i,t-2} \\ + \beta_5 dNA_{i,t+2} + \beta_6 RD_{i,t} + \beta_7 dRD_{i,t-2} + \beta_8 dRD_{i,t+2} + \beta_9 I_{i,t} + \beta_{10} dI_{i,t-2} \\ + \beta_{11} dI_{i,t+2} + \beta_{12} D_{i,t} + \beta_{13} dD_{i,t-2} + \beta_{14} dD_{i,t+2} + \beta_{15} dM_{i,t+2} + \beta_{16} C_{i,t} \\ + \beta_{17} dC_{i,t-2} + \beta_{18} dC_{i,t+2} + \varepsilon_{i,t}. \end{aligned} \tag{7}$$

We calculate the growth ratios $dX_{i,t-2}$ (over $t-2$ to t) as $X_{i,t-2} - X_{i,t}$ and $dX_{i,t+2}$ (over t to $t+2$) as $X_{i,t+2} - X_{i,t}$. This method applies to each of the growth variables in our model. By making a separate classification into dummy categories for each year, we allow firms to switch between categories over time, which accurately reflects reality. This is one of the advantages of the dummy approach we use. Our excess cash metric already reflects sector-specific differences. Hence we do not cluster our data in other groups than those based on our excess cash measure. Also, we do not choose to include year dummies or dummies that indicate whether the observations are pre- or post-crisis, because we will regress every year separately anyhow, due to the Fama-MacBeth methodology. Hence, adding those dummies would not add any value to the model.

An alternative approach would be to divide the companies into the separate groups as defined by our dummies and then run separate regressions on each of these groups. This would allow different slopes on all variables (not just the cash variable like in our model), but on the other hand this would cause us to discard information contained in the full data set. Therefore, we prefer the dummy approach.

5.4 Data – regression analysis on excess cash value

5.4.1 Data collection

In the second part of our analysis, we have to do more in terms of data treatment than in the explorative analysis. This is due to the fact that we are going to perform regression analyses, and thus our data has to meet the underlying requirements. First, we download all available data on each of the parameters as pointed out in Table 9. Some of the parameters needed for our regression analysis need to be calculated from other variables in the data set; the calculation method is included in the table as well. Missing values for RD and D are set equal to zero. Like before, we exclude negative values on parameters that should not at any point be negative: M, NA, TA, CCE, RD, I, D.

Item	Abbreviation	Category/calculation
Market value of equity at fiscal year end	M	M = SO * SP
Shares outstanding at fiscal year end	SO	Equity market data
Share price at fiscal year end	SP	Equity market data
Earnings over fiscal year	E	E = NI – EI – ITE – NIE
Net income	NI	Income statement
Extraordinary items	EI	Income statement
Income tax expense	ITE	Income statement
Net interest expense	NIE	Income statement
Net assets at fiscal year end	NA	NA = TA - CCE
Total assets at fiscal year end	TA	Balance sheet
Cash and cash equivalents at fiscal year end	CCE	Balance sheet
R&D expenditure over fiscal year	RD	Income statement
Interest expense over fiscal year	I	Income statement
Common dividends paid over fiscal year	D	Cash flow statement

Table 9 – Data items used in regression analysis

5.4.2 Data treatment and plain data descriptives

We deflate all variables with the book value of assets (TA) of the corresponding firm in the year in question, because this controls for differences in firm size over the years, the dominance of large firms, and -at least partly- heteroskedasticity. Note that the notation in our regression model is therefore simplified: for example $dE_{i,t-2}$ actually represents $(\mathrm{E}_{i,t-2} - \mathrm{E}_{i,t})/\mathrm{A}_{i,t}$ and $dE_{i,t+2}$ actually stands for $(E_{i,t+2} - E_{i,t})/A_{i,t}$. On each of the variables, we trim 2% of values at each end of the distribution to deal with outliers. This leads to a plain data set consisting of an average of 51,232 firm year observations over 7,123 companies.

5.4.3 Data corrections and transformed data descriptives

As Osborne & Waters (2002) emphasize, linear regression models impose some requirements on the distribution of our data. Dividing all parameters by total assets already solves some data issues. However, should one or more of the assumptions not be met, then our model will be inefficient at best and inaccurate or misleading at worst. For that reason, we have to take into account each of the assumptions and -if necessary- make adjustments to the data.

Assumption 1 – linearity: when fitting a linear model, the relationship between the dependent and independent variables should be linear. Violations of this condition may have very serious effects for the validity of the outcomes of the regression, so non-linear relationships should be corrected by data transformations. Therefore, we need to check for a linear relationship between our dependent and independent variables.

Assumption 2 – independence: when fitting a linear model on a time series, there may be issues when variables have serial correlation. It is not likely that consecutive observations of a specific company's parameters are not related by any means. However, because we do cross sectional regressions following the Fama-MacBeth procedure, we choose not to do further testing or corrections on this matter.

Assumption 3 – homoskedasticity: homoskedasticity implies that the variance of regression errors is constant over all levels of the independent variable. When this condition is not met -i.e. heteroskedasticity exists in the data- this will potentially cause incorrect confidence intervals or putting too much weight on the subset of the data in which the variance is greatest. Therefore, we check for this phenomenon in the regression output.

Assumption 4 – Normality: linear regression models assume that the data follows a Normal distribution. Skewness (asymmetry in the distribution) and kurtosis ('fatness' of the distribution tails/ presence of outliers) may indicate a problem with this assumption. Normality violations occur either when linearity issues exist, or when one or multiple of the dependent and independent variables are themselves non-normal. Transformations of data and trimming outliers could solve this problem.

Adjustments - Non-normality is easily identified from a normal probability plot of the regression residuals, but we will check for it upfront by looking at the distribution of each parameter in our models. First we observe that our dependent variable, the market value of equity, seems very non-Normal. We find that a transformation by the natural logarithm makes the data follow a Normal distribution pattern, when looking at histograms as well as Q-Q plots (see Appendix G). Note that this procedure implies that the regression outputs should be interpreted accordingly: as the result of a model in which the dependent as well as some of the independent variables have been transformed by natural logarithm.

With regard to heteroskedasticity, we already deflated all variables by total assets, so part of this problem seems to be solved by now. Heteroskedasticity may also be a byproduct of other violations of assumptions, and we expect that Normality corrections on our data cope with the remainder of this issue. For those reasons, we do not conduct any further alterations in this stage and examine the estimated residuals to see whether any heteroskedasticity problems arise after all.

These adjustments lead to a new data set, which after exclusions of outliers consists of 49,781 firm year observations over 7,123 companies. This transformed data set's descriptives are summarized in Table 10 below; for the full version we refer to Appendix F.

Variable	Obs	Mean	StDev	Q1	Median	Q3
ln(Market capitalization)	53,623	-0.10	1.21	-0.93	-0.26	0.59
Earnings	67,365	-0.04	0.19	-0.03	0.02	0.05
Earnings growth t-2	45,411	-0.01	0.19	-0.03	0.00	0.03
Earnings growth t+2	46,363	0.01	0.19	-0.04	0.01	0.05
Net assets growth t-2	43,660	-0.05	0.39	-0.27	-0.08	0.09
Net assets growth t+2	44,829	0.22	0.69	-0.10	0.07	0.30
R&D expenditure	67,386	0.01	0.03	0.00	0.00	0.00
R&D expenditure growth t-2	51,804	0.00	0.01	0.00	0.00	0.00
R&D expenditure growth t+2	51,804	0.00	0.01	0.00	0.00	0.00
Interest expense	60,501	0.01	0.01	0.00	0.01	0.02
Interest expense growth t-2	39,252	0.00	0.01	-0.01	0.00	0.00
Interest expense growth t+2	39,980	0.00	0.01	0.00	0.00	0.01
Dividends paid	67,386	0.01	0.02	0.00	0.00	0.01
Dividends paid growth t-2	51,804	0.00	0.01	0.00	0.00	0.00
Dividends paid growth t+2	51,804	0.00	0.01	0.00	0.00	0.00
Market capitalization growth t+2	35,895	0.19	2.58	-0.28	0.01	0.35
Cash and equivalents	65,927	0.12	0.14	0.03	0.07	0.16
Cash and equivalents growth t-2	43,713	0.00	0.13	-0.04	0.00	0.02
Cash and equivalents growth t+2	44,894	0.04	0.23	-0.03	0.00	0.05

Note: all variables have been divided by total assets of the corresponding firm at each year; ln(X) denotes a log-transformed variable; outliers have been excluded.

Table 10 – Descriptive statistics for the data set

From this full and final sample, we draw subsamples for our annual regressions. The regression specifications require that the growth factors are present, so we can only use a firm year observation if all of the following requirements are met:

- All parameters except NA have a value on that year t;
- The (transformed) values of E, NA, RD, I, D, and C are present on both year $t-2$ and year $t+2$;
- There is an observation for M in year $t+2$.

6. Explorative Analysis on Excess Cash Levels

This sixth section presents the first part of our analysis, which involves both an explorative analysis into cash holding levels over the past years, and an examination of different excess cash definitions and their implications. To test our hypotheses, we want to see how the distributions of cash and excess cash have developed over time, with special attention for the effects of the financial crisis (Section 6.1), and across sections (Section 6.2), and thereupon employ a battery of statistical procedures to test our observations. Section 6.3 summarizes the insights obtained from this analysis and their implications for the second part of our data analysis.

6.1 Time series analysis

6.1.1 The expansion of cash holdings

As anticipated, the cash positions of European companies have indeed grown tremendously over the last decade and a half. Over the full 1998-2012 time period, average CCE has more than doubled, with a change from 41.28mln€ to 95.50mln€, which amounts to a growth of 131%, while the median has increased with 75% from 4.60mln€ to 8.05mln€. This yields a compound annual growth rate (CAGR) of 6.2% for the mean and 4.1% for the median.[3] We already know that this does not fully reflect the dynamics of the market; on one hand some of the larger firms in our sample drive up the average rather radically, while on the other it may be the case that firms themselves have increased in size over the years as well. Therefore, we also study the cash/total assets (CCE/TA) ratio – total assets being an adequate proxy for firm size. Figure 3 gives a graphical representation of the growth in both cash metrics. Appendix C shows descriptives on both variables for each year.

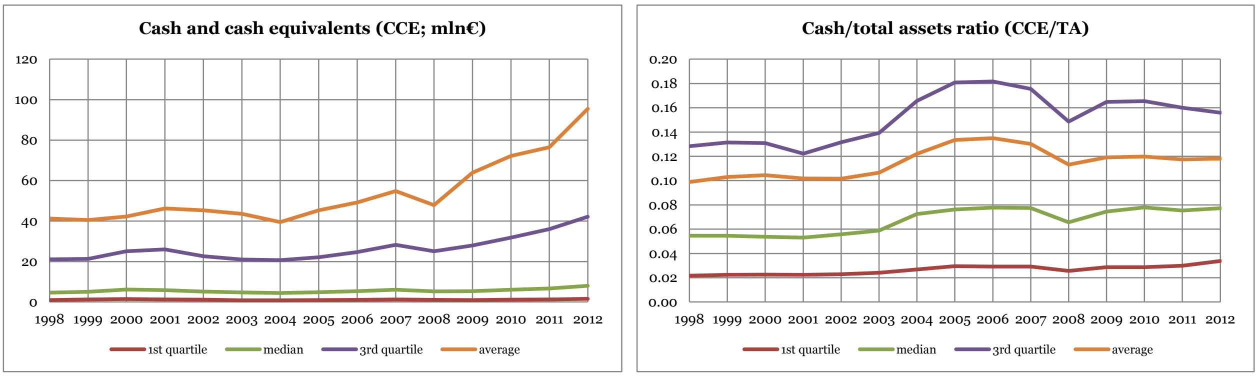

Figure 3 – Time series graphs of cash holdings (all values at fiscal year-end)

The measure of CCE/TA is more informative, as it represents the cash position of the companies relative to their size rather than just the absolute numbers. Looking at CCE/TA we find that the average

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3 CAGR represents the average year-over-year growth rate, as calculated by $CAGR = \frac{ending\ value}{starting\ value}^{\left(\frac{1}{time\ period}\right)} - 1$.

amount of cash has grown from 9.89% to 11.80% of total assets, which corresponds with a CAGR of 1.3%. For the median, the increase was stronger: from 5.45% to 7.73% over 15 years yields a CAGR of 2.5%. For the full time period, the median is basically parallel to -but always substantially higher than- the mean, indicating that the data may still be skewed (and/or have a high kurtosis), albeit far less profoundly than in the CCE graph. Table 11 highlights this and indicates the 'benchmark' of the Normal distribution. Based on a Kolmogorov-Smirnov test on the CCE/TA ratio, we have to reject the null hypothesis that the data distribution is equal to the Normal distribution. We also apply a Jarque-Bera test to further assess the goodness-of-fit to the Normal distribution. Its test statistic is defined as:

$$JB = \frac{n}{6}\left(S^2 + \frac{1}{4}(K-3)^2\right), \tag{8}$$

with n representing the number of observations, S for skewness, and K for kurtosis. The JB statistic has a chi-squared distribution with two degrees of freedom, given that the data comes from a Normal distribution. At the 5% level, this yields a critical value of 5.99. Entering the CCE/TA skewness and kurtosis (from Table 11) as well as the number of observations (65,927) into the equation yields a JB-value of 39,005. This means that $\mathrm{JB} > \chi^2_{\mathrm{critical}}$; hence we reject the null hypothesis that the data follows a Normally distributed pattern.

Moment	CCE distribution	CCE/TA distribution	Normal distribution
Skewness	6.7	1.87	~ 0
Kurtosis	58.8	3.46	~ 3

Table 11 – Comparison of skewness and kurtosis for cash metrics

Despite these indicators of non-normality, we are still much more satisfied with CCE/TA as a measure for cash positions for several reasons: the mean and median both lie between the first and third quartiles, the variances are more stable over time (again, see Appendix C), and even though skewness and kurtosis are higher than 0 and 3 respectively, they are much better than in the CCE data.

We confidently confirm Hypothesis 1: cash holdings have increased from 2000 onward. Our findings also are in line with news press and the scientific community over the past years, both of which seem to agree on the tendency of growing cash holdings.

6.1.2 Financial crisis effects

We test whether pre- and in-crisis cash holdings are significantly different (Hypothesis 2) by applying a paired sample t-test to the data, because we want to compare two dependent samples of data. We test all available paired observations of CCE/TA between fiscal year-ends 2007 and 2008 and repeat this for 2008 and 2009.

t-test on CCE/TA Ratios	pre-crisis (FY2007)	in-crisis (FY2008)	pre-crisis (FY2006)	in-crisis (FY2009)
Mean	0.127	0.111	0.133	0.118
Variance	0.019	0.015	0.022	0.016
Observations	4698	4698	4317	4317
Pearson Correlation	0.705		0.491	
df	4697		4316	
t Stat	10.648		6.923	
P(T<=t) one-tail	0.000		0.000	
t Critical one-tail	1.645		1.645	
P(T<=t) two-tail	0.000		0.000	
t Critical two-tail	1.960		1.961	

Table 12 – Paired two sample t-tests between ‘07-‘08 and ‘06-’09 for the CCE/TA ratios

As Table 12 shows, the two-tailed p-values are much smaller than 0.05, so we can reject the null hypothesis that the means are equal. Accordingly, we confirm Hypothesis 2: the onset of the economic recession has had a significant effect on the levels of cash held by corporations. More specifically, cash holdings per total assets have decreased significantly after the start of the crisis. This subscribes to the viewpoint of precautionary cash holdings: the crisis has caused companies to eat into their cash buffers.

6.1.3 Excess cash metrics over time

In Section 5, we introduced several measures for excess cash. In Figure 4 the time series on each metric are denoted. The full descriptives on each metric are in Appendix C. The first excess cash metric, CCE minus 2% of total revenue, basically follows the same pattern as CCE, which is again not very insightful due to the impact of firm size. Also, it has a very high spread with a strongly positive skewness. Overall, this measure is not very efficient and it would be very hard to interpret regression results based on this measure.

Excess cash metric 2a is much more stable: for instance its mean and median are relatively close to each other and both lie between the 1st and 3rd quartiles. The metric also seems to be less heteroskedastic, as its standard deviation is more stable over time. Nevertheless, there seems to be some skewedness towards the left. Excess cash metric 2b shows a similar pattern, but with higher values.

Excess cash metric 3 appears to underestimate excess cash, as reflected by its predominantly negative values. This finding is in line with the fact that firms do not solely rely on CCE to cope with volatility in earnings. Also, the variance in this fourth excess cash metric changes drastically over time.

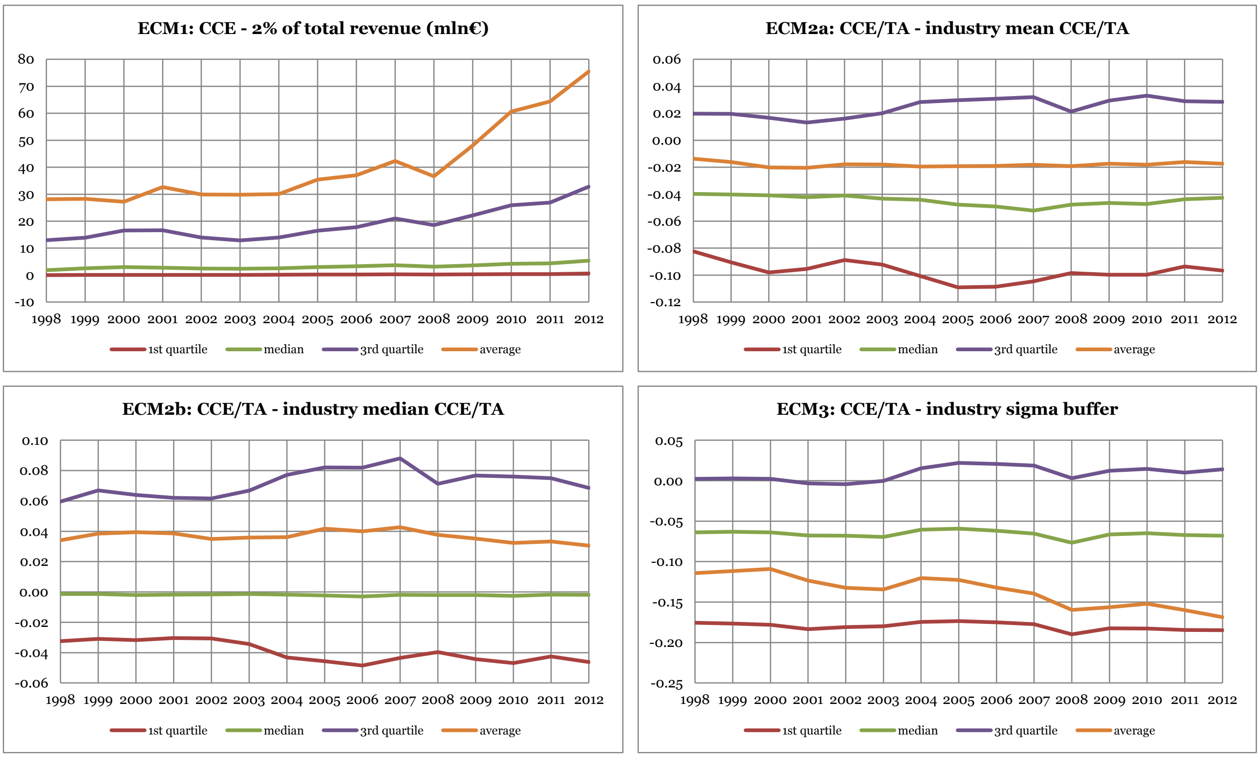


Figure 4 – Development of the cash metrics over time (all values at fiscal year-end)

Given these insights, we conclude that the CCE/TA ratio seems to be the most suitable measure for analyzing cash levels, whereas the excess cash measures based on industry means and medians (ECM2a and ECM2b) are the most appropriate ones to be used in our analysis of excess cash. Henceforth, we employ these measures in our analysis.

6.2 Cross-sectional analysis

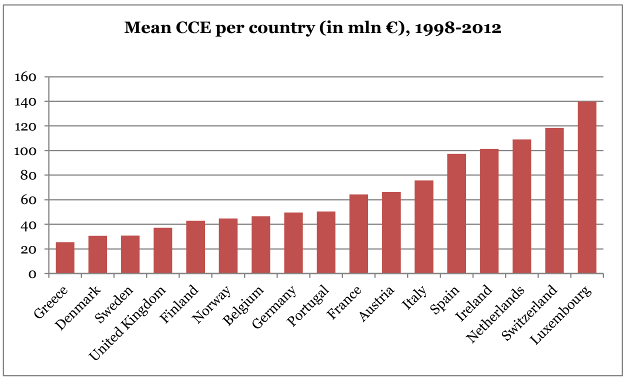
6.2.1 Country-specific characteristics

As our literature research indicates, there would be substantial differences in cash holdings between countries, for example based on their law origins, economic models, and banking system. Therefore, we suppose that there are country-specific differences in cash holdings. Looking at Table 13 and Appendix D, we see that there are large differences in mean, standard deviations and median cash holdings, irrespective of the metric we use. There is however a difference in which firms are the largest and smallest when controlling for total assets (metrics B, 2a, 2b, and 3) or not (metrics A and 1). Considering the means and medians of measure A and B together, we find that Luxembourg, Switzerland, Ireland, and Austria are always in the upper half and Greece, Portugal, Denmark and Belgium are in the lower, regardless of the metric used.

	# firms	# obs.	A		B		1		2a		2b		3	
			Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Austria	96	1,014	66.3	12.7	0.12	0.08	51.2	9.1	0.00	-0.02	0.05	0.01	-0.08	-0.03
Belgium	151	1,603	46.5	7.0	0.09	0.05	28.0	2.8	-0.04	-0.05	0.02	-0.01	-0.08	-0.06
Denmark	173	1,773	30.7	3.9	0.09	0.05	22.9	1.8	-0.03	-0.06	0.02	-0.01	-0.10	-0.08
France	999	9,929	64.4	4.2	0.10	0.06	49.8	2.2	-0.04	-0.05	0.02	-0.01	-0.11	-0.07
Finland	137	1,696	42.8	9.2	0.10	0.06	25.0	4.0	-0.03	-0.04	0.02	0.00	-0.08	-0.06
Germany	919	9,227	49.6	6.4	0.13	0.08	34.7	3.3	-0.01	-0.04	0.05	0.00	-0.06	-0.06
Greece	276	2,348	25.5	3.6	0.07	0.03	20.2	1.7	-0.04	-0.05	0.00	-0.02	-0.13	-0.05
Ireland	136	1,116	101.3	13.1	0.15	0.10	95.5	16.0	0.00	-0.03	0.07	0.02	-0.31	-0.10
Italy	270	3,008	75.7	12.9	0.09	0.05	59.1	8.0	-0.04	-0.05	0.01	-0.01	-0.09	-0.07
Luxembourg	57	458	139.8	36.5	0.12	0.09	130.9	26.2	-0.02	-0.03	0.04	0.02	-0.26	-0.04
Netherlands	220	2,215	109.1	16.8	0.10	0.06	78.5	6.7	-0.02	-0.04	0.03	-0.01	-0.08	-0.07
Norway	287	2,368	44.7	8.4	0.14	0.08	36.5	5.9	0.00	-0.03	0.05	0.01	-0.10	-0.07
Portugal	68	746	50.4	4.4	0.04	0.02	34.3	0.6	-0.07	-0.06	-0.02	-0.03	-0.24	-0.06
Spain	160	1,597	97.3	9.8	0.05	0.03	67.6	3.1	-0.05	-0.06	-0.01	-0.02	-0.13	-0.06
Sweden	561	5,436	30.9	2.7	0.14	0.08	22.0	1.5	-0.01	-0.04	0.05	0.00	-0.14	-0.07
Switzerland	290	2,775	118.4	23.4	0.13	0.09	93.1	17.2	0.00	-0.02	0.05	0.02	-0.13	-0.05
United Kingdom	2,323	19,567	37.3	3.7	0.13	0.08	28.1	2.4	-0.01	-0.04	0.05	0.00	-0.20	-0.07

Table 13 – Descriptives of the (excess) cash measures on all countries in the data set

In absolute terms, the average observation of cash in listed corporations over the full time period amounts to more than 100 mln€ in Luxembourg, Switzerland, Netherlands, and Ireland; thus making them the cash-richest sub-sections of our data set. The left hand side of Figure 5 shows all averages and the resulting ranking. A different order emerges when controlling for firm size, as can be seen in the right hand side of Figure 5. Apparently, the average size of listed firms as compared to their cash holdings differs rather drastically between countries.



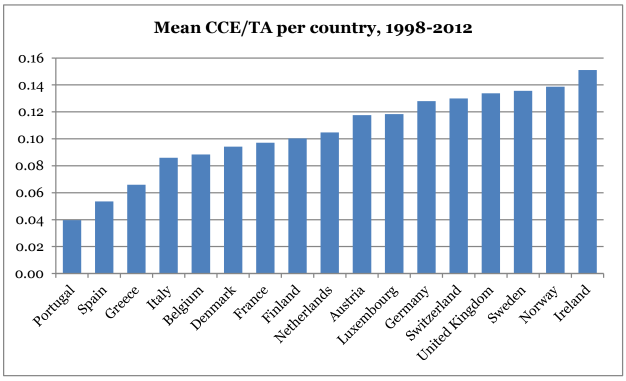


Figure 5 – Illustration of the cash holding levels in listed companies over European countries

In about half of the countries, the average observation of the CCE/TA ratio is above 0.10 – meaning that in the average firm-year between 1998 and 2012 the listed companies in those countries held over 10% of their assets in cash. Remarkably, the bottom of the list comprises of all Mediterranean countries in our sample; the average firm year observation off CCE/TA in Portugal and Spain approximately being at an extraordinarily low of 4% and 5% respectively. From that perspective, it is notable that Ireland, with its financial prudence nowadays not rarely bracketed together with the Mediterranean economies (abbreviated as the GIIPS-countries), has the highest average CCE/TA ratio with cash levels over 15% of assets. By now, we positively confirm Hypothesis 3: there are indeed large differences in cash holdings between countries.

When comparing excess cash measures (calculated as means (ECM2a) and medians (ECM2b) of all firms in each country for all years combined), we find a roughly similar ranking as for the CCE/TA measure, as Figure 6 illustrates. This indicates that, according to or metrics and on an aggregate level, a higher share of cash per total assets demarcates more excess cash. Our excess cash measures are unambiguous with regard to the order of firms; ECM2b (CCE/TA minus industry median) however systematically yields a higher estimate of the amount of excess cash than ECM2a (CCE/TA minus industry mean). Recall that this is a logical result of the skewedness in the distribution of CCE/TA, yielding a higher industry mean than median.

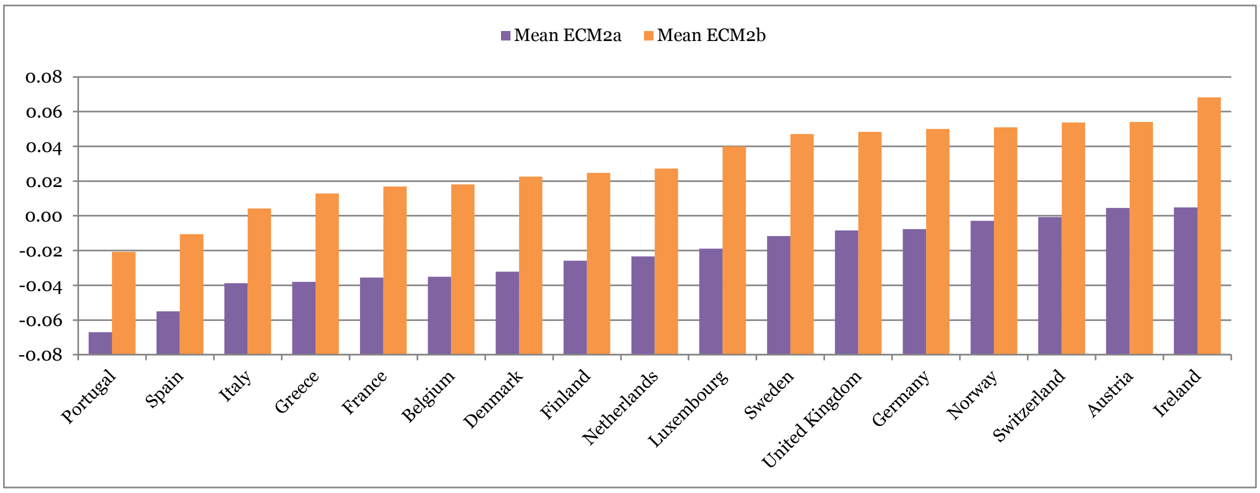


Figure 6 – Excess cash levels in European listed firms, clustered by country

Interestingly, we find that deducting the (negative and positive) country-level excess cash aggregates from the country-level CCE/TA ratios leads to very similar levels over all countries. Conceptually, deducting excess cash from the cash position leads to the level of operational cash. One would expect the level of operational cash required to conduct business to be more dependent on factors such as the industry, not the country. We indeed find the level of operational cash to be rather equivalent between countries; based on ECM2a the level is in the 10-15% spectrum and for ECM2b firms hold operational cash of 6-9% of total assets.

6.2.2 Industry-specific characteristics

Looking at the industry-specific differences in cash holdings in Table 14 and Appendix E, we find that the construction industry has highest cash levels on four metrics and services is rather low, except when the holdings are divided by total assets (which may be due to the overall low amount of assets in the services industry). Overall, there seem to be some sizable differences on our metrics for each industry.

	# firms	# obs.	A Mean	A Median	B Mean	B Median	1 Mean	1 Median	2a Mean	2a Median	2b Mean	2b Median	3 Mean	3 Median
Agriculture, Forestry & Fishing	56	501	35.6	3.6	0.10	0.05	34.3	3.0	-0.01	-0.03	0.03	0.00	-0.02	-0.02
Mining	510	3,648	57.7	3.9	0.16	0.10	68.9	6.1	-0.03	-0.08	0.04	-0.01	-1.15	-0.32
Construction	218	2,248	133.9	27.6	0.10	0.07	102.7	17.5	0.00	-0.03	0.02	0.00	0.05	0.03
Manufacturing	3,265	32,382	64.0	6.7	0.10	0.06	47.2	3.5	-0.02	-0.04	0.03	0.00	-0.05	-0.06
Wholesale Trade	397	3,787	28.8	4.4	0.09	0.05	11.5	1.0	-0.01	-0.03	0.03	0.00	0.00	-0.03
Retail Trade	422	4,144	69.0	8.4	0.09	0.05	42.4	2.2	-0.01	-0.03	0.03	0.00	0.00	-0.03
Services	2,165	19,627	28.0	3.6	0.14	0.09	22.7	2.6	-0.02	-0.07	0.04	0.00	-0.15	-0.12
Non-Classifiable	90	537	70.4	7.3	0.12	0.06	77.0	8.1	-0.06	-0.11	0.05	-0.01	-	-

Note: due to a very high industry sigma, all observations on the third excess cash measure in the 'non-classifyable' group have been removed as outliers

Table 14 – Descriptives of the (excess) cash measures on all main industries in the data set

In absolute terms, the construction industry has extraordinarily high cash levels; an average of over 130 mln€. All CCE values are depicted in the left graph in Figure 7, while CCE/TA is compared in the right chart. Both graphs' data points are calculated by taking the average of all firms in each sector over all years. When adjusting for firm size, the order of firms is completely different than it is for plain CCE. All industries have averages of between about 8% (wholesale trade) and 16% (mining). Based on these insights, we confirm Hypothesis 4: industries have considerably different cash holdings.

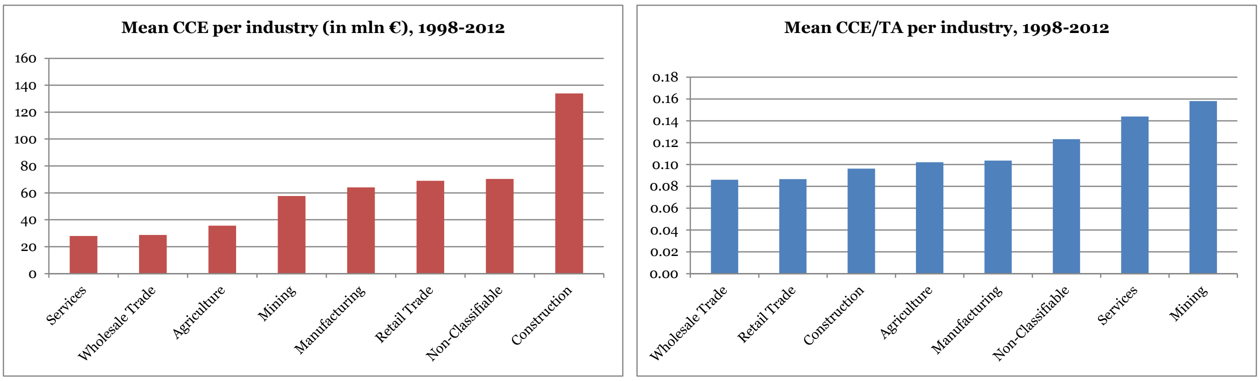


Figure 7 –Industry-level aggregates of the cash holding levels in European listed companies

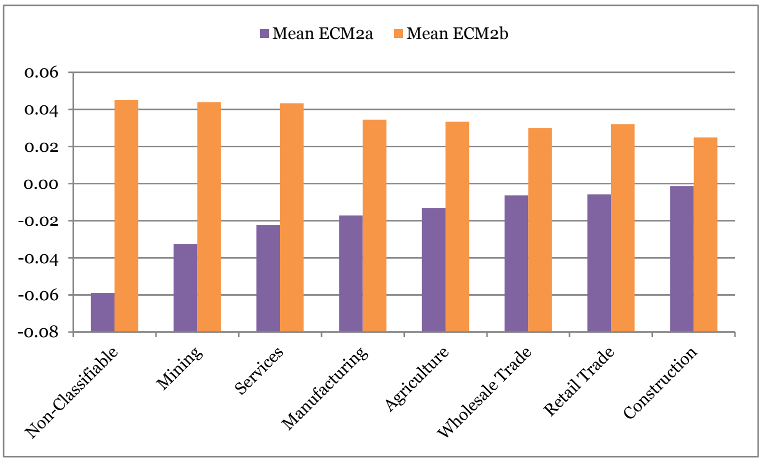


Figure 8 – Excess cash levels in European listed firms, clustered by industry

As Figure 8 exemplifies, we find that ECM2b gauges a higher degree of excess cash than ECM2a in all categories, exactly like we did in the country analysis. What we did not observe in previous analysis is the almost inverse order of the industries' excess cash levels when sorting on ECM2a and ECM2b consecutively. This is caused by a different distribution of the CCE/TA data among industries. In a nutshell, we find different values on the metrics coming from similar data distributions in the subsets based on countries, whereas we find different values coming from differently distributed data in the industry subsets. From this viewpoint, the industry differences in (excess) cash holdings are more fundamental than the country differences. We again refer to Appendices C and D for the full descriptives of the metrics on all industries and countries.

7. Regression Analysis on Excess Cash Value

In the previous section, we have explored cash holdings and a variety of methods to distinguish between cash and excess cash. In this section, we apply these findings in order to determine the value of excess cash. We start off by verifying our model in Section 7.1, and then analyze the value of excess cash (7.2), and the impact of the financial crisis (7.3).

7.1 Model verification

7.1.1 Pinkowitz & Williamson models on untransformed data

We first look into the full Pinkowitz & Williamson model, which does not account for violations of linear regression assumptions (if any). To confirm the first part of our model and to see how our data set reacts to their specification, we first conduct a regression following their exact methodology – without the data transformations. Appendix G provides the Fama-MacBeth regression results for the basic and extended models on the plain data (left hand side of the appendix). To highlight the outcomes in terms of the value of cash, the left hand side of Table 15 shows the slopes on the cash variables.

Our results indicate that the value of a marginal unit of cash in our entire data set is 0.76 according to the basic model and 1.14 according to the extended model. Pinkowitz & Williamson report 0.97 and 0.94 respectively. Hence, our findings are slightly different, which we interpret as a result of the differences in the data sets: we study a different time period as well as a different geographical region. As such, we are comfortable with our implementation of the model.

7.1.2 Pinkowitz & Williamson models on log-transformed data

As explained in Section 5, we transform our data in order to meet the underlying assumptions of linear regression. Hence, from this point forward we shift our attention towards the transformed data set. The right hand side of Appendix G provides the Fama-MacBeth regression results for the basic and extended models; the right hand side of Table 15 shows the slopes on the cash variables.

	Untransformed data		***Log-transformed data***	
	Basic model	**Extended model**	**Basic model**	**Extended model**
C_t	**0.76**	**1.14**	**0.87**	**1.05**
dC_{t-2}	-	0.33	-	0.10
dC_{t+2}	-	0.23	-	0.34

Table 15 – Regression coefficients on the cash parameters for our two models and data specifications

Again, we get different outcomes for both models, but now the values lie less far apart. Our values of 0.81 and 1.05 on the transformed data indicate that the marginal value of cash is somewhere around 1, again with a larger downside than upside deviation. In all our models up to this point, the adjusted R^2 was about 0.37, which is lower than the goodness-of-fit parameters in Pinkowitz & Williamson's models; they find R^2 values around 0.48. Because the R^2 values are almost the same for the basic and extended model, we proceed with both models in the remainder of our analysis. This also implies that we only partially confirm Hypothesis 5: the marginal value of cash is generally lower than one. We have seen that this is not true for all model specifications.

The second page of Appendix G provides an overview of the underlying yearly regression results that are used for the Fama-MacBeth approach in the Pinkowitz & Williamson models. Section 7.3 elaborates on the time series of regression results and the impact of the financial crisis.

7.2 The value of excess cash

7.2.1 Dummy variable classification

As briefly pointed out in Section 3, Pinkowitz & Williamson (2004) choose to not define whether there is an optimal level of cash holdings. Based on this reasoning, they state that the marginal value of cash from their regression accurately reflects the market value of the entire cash position, albeit in the narrow sense. More specifically, they suppose that one of three assumptions must be true, however they are agnostic as to which of them it actually is:

1. There is no such thing as an optimal cash holding level for firms;
2. There is an optimal cash holding level for firms, but, on average, firms are at their target;
3. There is an optimal level and firms are not at their target, but the change-in-cash-coefficients in the extended model fully control for this.

Controlling for changes in cash, they find a slightly better predictive value in their extended model, which provides some support in favor of the latter statement. Although we partially agree with their third premise, we take a different view on the issue of the optimality of cash holdings. In line with the trade-off theory and our reasoning on excess cash holdings, we assume that for every company there is an optimal level of cash. In fact, this optimal level is demarcated by the very boundary that we have defined between cash and excess cash for each firm. We expect that shareholders put a higher value on the marginal unit of cash in firms that are below rather than above their optimal cash holding level.

Supposing that there are optimal levels of cash, the question is whether the extended regression model alone is successful in controlling for the fact that firms may not be at their optimal cash holding level at all times. Therefore, we choose to include dummy variables in our model that control for the extent to which companies hold excess cash. These dummies enable us to see how the value of cash changes over the spectrum of excess cash holding levels, i.e. how the distance between firms' cash positions and the optimum affects the value that shareholders place on the marginal unit of cash in the company.

We divide all the firm-year observations into three groups, based on their value on excess cash measure 2a and 2b in that specific year. The first group comprises of the firms that are among the bottom 20% of the cash metric values, the third contains all firms in the top 20% and the second includes all remaining firm year observations. Since we have three groups, we need just two dummies conduct this analysis, in order to avoid multicollinearity problems. The dummies are specified in Table 16; note that the neutral excess cash group is the reference group; it has therefore not been assigned a dummy.

Category	Dummy 1	Dummy 3
Strongly negative excess cash: bottom 20% of Excess Cash Measure (2a or 2b)	1	0
Moderate excess cash: middle 60% of Excess Cash Measure (2a or 2b)	0	0
Strongly positive excess cash: top 20% of Excess Cash Measure (2a or 2b)	0	1

Table 16 – Excess cash groups and dummy classification

7.2.2 Results on the dummy variables

We now conduct the Pinkowitz & Williamson regression models complemented with our dummy variables. Appendix J provides the Fama-MacBeth regression results for the basic and extended models with dummy variables – both on the normal data set and one with the natural logarithm of the market value of equity as the dependent variable. Table 17 summarizes the coefficients on the cash parameters for the basic and extended models under ECM2a. Table 18 reports the same findings, but now for dummies based on ECM2b.

Category	Basic model	Extended model
1: Bottom 20% of Excess Cash Measure 2a	1.46	1.59
2: Middle 60% of Excess Cash Measure 2a	1.79	1.89
3: Top 20% of Excess Cash Measure 2a	1.19	1.34

Table 17 – The marginal value of cash ($\beta_{16}C_t + \sum \gamma_j \delta_j$) under Excess Cash Measure 2a

Category	Basic model	Extended model
1: Bottom 20% of Excess Cash Measure 2b	3.11	3.20
2: Middle 60% of Excess Cash Measure 2b	1.66	1.77
3: Top 20% of Excess Cash Measure 2b	0.91	1.07

Table 18 – The marginal value of cash ($\beta_{16}C_t + \sum \gamma_j \delta_j$) under Excess Cash Measure 2b

Our first observation is that using ECM2b for the dummy parameters results in a steeper pattern of marginal value of cash for the different groups; for group 1 the value is much higher (as compared to ECM2A dummies) but for group 3 the value is faintly lower. Overall, the pattern that we expected (as formulated in Hypothesis 6) is confirmed; this is illustrated by Figure 9. Our second observation is that the basic and extended models yield similar results; their values are just slightly different and the patterns are the same. What we do not fully understand is how our dummy regression models come up with systematically higher marginal values than the regression models without the dummies in the previous sections. We suspect that this is caused by the fact that we do not allow any coefficients other than the cash coefficient to be different for each group.

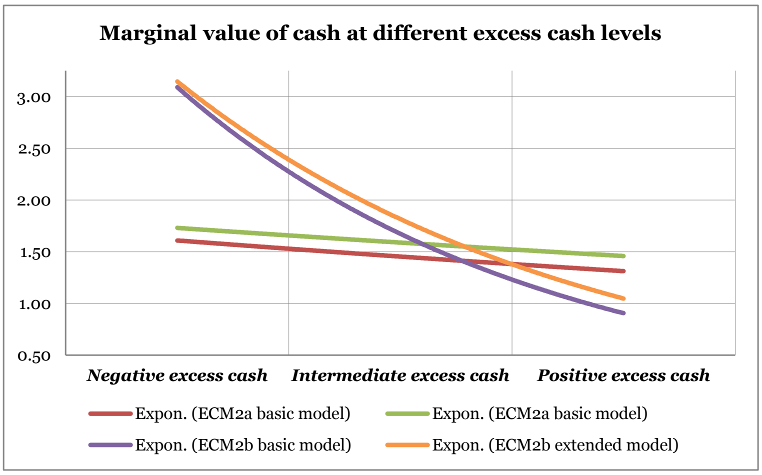


Figure 9 – Exponential trend lines showing patterns in regression coefficients over the dummy groups

In Appendix I, we show our regression outcomes when we only allow slope dummies in our model. In line with our expectation, this causes the model to put far more emphasis on the regression coefficient on the cash variables; when the intercepts are not allowed to be different for each dummy group, all differences in the market value of equity for the groups must be fully attributed to the cash parameter, which causes them to attain more extreme values. In terms of adjusted R^2s, we see that the model with slope and intercept dummies systematically has a slightly higher (0.1-0.2% on each version of the model) goodness-of-fit than the model with just the slope dummies.

7.3 Impact of the financial crisis

In order to obtain the Fama-MacBeth coefficients like we did in the previous sections, we have run annual cross-sectional regressions for the various models and dummy specifications. So as to assess the impact that the financial crisis has had on the value of cash in general and the value of excess cash in particular, we will look at the results of the underlying annual regressions. Starting with the development of the value of cash over time, Figure 10 shows the annual regression coefficients (left hand side) and a polynomial trend line (right hand side) showing a generalized trend in the same regression outcomes.

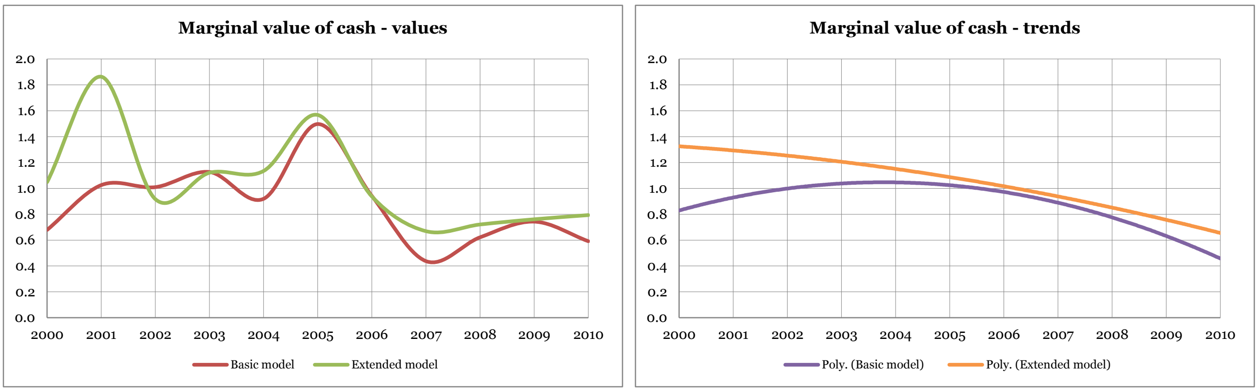


Figure 10 – Regression outcomes (left) and trends (right) over time (all values at fiscal year-end)

Generally, the marginal value of cash has decreased over the time period of our data set – this is visibly illustrated by the concave patterns in the trend lines of Figure 10. For the actual coefficients, we notice that both the basic and extended model show a global minimum at fiscal year-end 2007. While both models peak at the 2005 year-end, the extended model has an additional peak at year-end 2001. All coefficient values have decreased after the onset of the financial crisis. These findings are in line with our expectation that the value of cash has decreased after start of the crisis (Hypothesis 7).

Making the same time series for the dummy regressions' annual outputs, we do some interesting additional findings. Figure 11 shows the annual coefficients under ECM2a and ECM2b; the markers indicating the actual data points and the lines displaying the trends. For comprehensibility's sake, we only show the results of the extended model here (of which the outcomes are comparable with the basic model results, though at a marginally higher R^2 for the model's goodness-of-fit).

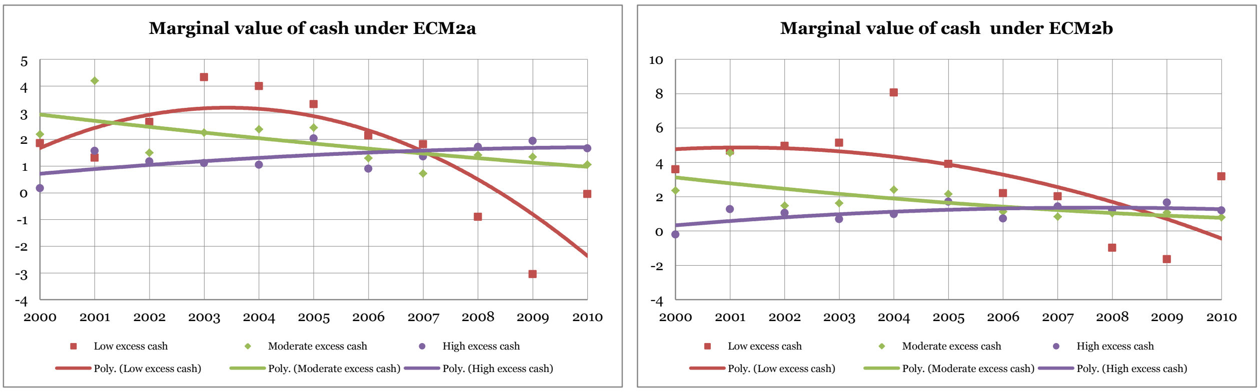


Figure 11 – Excess cash value trends over time (all values at fiscal year-end)

Under both excess cash measures, it appears that the marginal value of excess cash has generally decreased over time. For moderate excess cash firms, the marginal value of cash has been gradually decreasing over the data set time frame. Remarkably, the outputs indicate that the marginal value of cash has slightly yet steadily increased over time for high excess cash firms, while for low excess cash firms, the marginal value of cash peaks before the onset of the crisis and shoots below the other lines afterwards.

The latter phenomenon is rather counter-intuitive: one would expect that low excess cash firms needed cash more than ever after the start of the crisis, but the marginal unit of cash's contribution to the market value of equity is very low for those years. We interpret this as a change of dynamics in firms that are low on cash and enter a recession; adding cash to those organizations seemingly does not raise their market value of equity. An alternative rationale would be that this is where the fundamental Fama & French model may be showing its shortcomings. It seems that the market value of equity simply is not fully captured by their parameters for our data set, containing two major crises in a time span that comprises of over a relatively limited number of years. This statement is also supported by the lower R^2-values that we find for any of our model specifications.

8. Conclusion

Having studied the results of our analysis, we are now fully able to address our main research question: "What is an appropriate valuation method to determine the amount and shareholder value of excess cash?". We approach this by revisiting the highlights of our research and formulating the corresponding conclusions in Section 8.1. In Section 8.2, we discuss the validity of our research and in Section 8.3 we identify further research opportunities.

8.1 Synthesis

8.1.1 Interpreting cash holding levels and value

Firms have many different purposes for holding cash. We have seen different motives for companies to hold on to cash (like the precautionary, transactions, and agency motives), while on the other hand there are theories of capital structure that explain how firms do or do not manage their cash positions (Trade-off, Pecking order, and Agency Theory of Free Cash Flow). There is no method in literature that succeeds in connecting these dynamics and quantifying how they lead to firms holding on to a specific level of cash and equivalents.

However, the is a large variety of empirical evidence on explicit company-, industry- or country-specific characteristics and how these relate to the cash holding level of corporations. Some of the effects that these drivers have on the level of cash in companies are agreed on by many authors (e.g. financial constraints and cash flow volatility cause firms to hold more cash), while others are disputed (e.g. some authors find the level of Capex and the level of cash flow to drive up cash holdings; others find the opposite effect).

For the value of cash, we find a similar phenomenon: a large sample of factors drive the value of a firms cash position up or down, and again some effects of these drivers' consequences are beyond dispute (e.g. the quality of corporate governance and the availability of investment opportunities drive up the value of cash), while others are not agreed on by all authors (e.g. the size of the cash position and the persistence of the cash holding level are both found to inflate and deflate the value of the cash position).

A commonality in most of these empirical studies is that they tend to focus on identifying the effects of a small sample of parameters on the level and/or value of corporate cash holdings, rather than taking a company's cash holding level and characteristics and then trying to calculate the value of cash in that particular firm.

8.1.2 Identifying and valuing excess cash

We then shifted our focus towards a different dimension of the corporate cash holding phenomenon: drawing the line between 'operational' and 'excess' cash. Literature does prescribe some alternative ways of addressing this matter, but in particular there is no agreement on a best practice. Hence, we had to address two main issues in this part of our research: (1) finding a way to measure excess cash and (2) quantifying the value of (excess) cash.

For the first issue, we have chosen a rather practical approach. Testing different measures of cash and excess cash on our data set has yielded two excess cash metrics of choice: the company's CCE/TA-ratio minus the industry mean CCE/TA (ECM2a) as well as this same CCE/TA ratio minus the industry median CCE/TA (ECM2b). Testing these metrics on country and industry subsets of the data yields interpretable results. For instance, cash has grown tremendously over the past 15 years, CCE/TA as well (but to a lesser extent), and excess cash has remained fairly stable. Looking at specific industries and countries, we find substantial differences in cash and excess cash, which is confirming or hypotheses as well.

For the second issue, we found a more sophisticated method. Determining the marginal value of cash, i.e., the impact that adding one unit of cash to the cash position has on the market value of the company's equity, allows us to study the added value of one Euro of cash for shareholders. We have found multiple techniques to obtain the marginal value of cash. We have adopted the Pinkowitz & Williamson (2004) model (which is based on a more fundamental model by Fama & French (1998)) to analyze the value of cash for firms with low, moderate, and high excess cash levels, as based on our previously defined metrics.

8.1.3 Determining the marginal value of (excess) cash

Applying these methodologies on a large set of data (comprising of 49,781 firm year observations over 7,123 publicly listed European firms), we find that the marginal value of cash in general is somewhere around one, depending on which model we apply. We confirm our hypothesis that excess cash is worth more for firms with low excess cash, followed by moderate excess cash, followed by high excess cash. Combining this pattern with the finding that the marginal value of cash is generally around one, we deduce that the value of cash should usually be lower than one for firms with excess cash, and higher than one for firms with a cash shortage.

The value of cash in general as well as in moderate excess cash corporations has decreased slightly over time, while for low excess cash firms the value has dropped even more after the onset of the financial crisis. The amounts of cash have also generally increased after the start of the crisis, which confirms the image that firms have used up part of their cash buffers and furthermore that the value of cash decreases when funding and investment opportunities are scarce.

8.1.4 Implications for financial practitioners

Putting it all together, we conclude that the value of cash should not always be appraised at face value; this would wrongfully over-simplify the situation at hand. In line with many publications and as we have confirmed ourselves as well, cash is not simply negative debt and, depending on the amount of cash that a company holds in excess or short of its optimum, its value deviates substantially.

We assume that there is an optimal amount of cash (at the point of zero excess cash); hence the value of the cash position is not just the marginal value multiplied by the amount of cash. The marginal value only tells us how one Euro added to or deducted from the cash position affects the market value of the company's equity.

One major difficulty is to determine the amount of excess cash that a company holds, because this requires a full assessment of all factors involved, which would be extremely hard from a practical point of view. Therefore, we introduced four excess cash measures that can be calculated with much more simplicity, and as stated before in this conclusion, find two that perform quite well (industry mean CCE/TA and industry median CCE/TA); not only when looking at time series of -and cross-sectional differences between- the metrics, but also when using them in our regressions.

Accordingly, we advocate that for any company the amount of excess cash is best assessed by deducting industry mean and median CCE/TA ratios from its CCE/TA position. We have proven this to be a method that suffices in terms of reducing the full complexity involved, and at the same time yields estimates that still are suitable for analysis. The shareholder value of cash could be deduced by studying the marginal value of cash by using our regression model. In practice, one could periodically determine (either an industry-specific or general) discount factor for high as well as low excess cash firms, and use that as a reference when looking into any particular company's cash position.

8.2 Discussion and validity

We have applied a variety of model specifications to conduct our analysis. This contributes to our confidence in having correctly confirmed six out of seven hypotheses. Whereas the outcomes in terms of exact values we find are in some cases dependent on the model used, we do not breach any of our conclusions by changing the model, except for the general value of cash. As discussed, the latter is found to be around one, with larger deviations downward than upward; however, we obtain below-one values when deploying our basic model and values larger than one when using the extended model. One other oddity that we find is that whereas our dummy regressions confirm the hypothesized pattern, the value of the corresponding coefficients appears to be systematically too high. We are not entirely sure about what causes these patterns, but we expect that at least part of it comes from the fact that the assumptions for linear regression (such as Normality) are not fully backed by our data set.

Altogether, our assumptions and models -each of which simplify reality to enable us to draw conclusions- seem to lead to outcomes that are in line with the theoretical framework as presented in the second and third sections. We do however see some limitations of the fundamental Fama & French model and using the Fama-MacBeth methodology of annual regressions. The first seems to be having difficulties to cope with the shocks in the market over the past years, while the latter is basically ignoring part of the auto-correlation in the data. However, due to its relative intuitiveness and the limited number of years in our data set, we chose not to change our strategy on this matter.

In terms of external validity, we would advise to proceed with caution when trying to use our models and methodology on other data sets. Even though most of our findings are roughly in line with those of Pinkowitz & Williamson on data from a different time and with another geographical focus, there are some noticeable differences in the exact results, such as the regression coefficients. Unfortunately, they did not publish their regression results split by year, making it hard for us to identify the exact discrepancies.

8.3 Further research

We identify three main directions for further research:

1. Applying our models to different data sets in terms of geography and time, to assess their external validity. This could lead to new insights in shortcomings of the models and potentially how to improve them;
2. Using different model and dummy specifications to see whether better results can be obtained (higher goodness of fit, higher significance, more intuitively correct estimates of the value of excess cash, et cetera);
3. Finding alternative approaches to determine the value of excess cash. Ideally, we would like to have a factor that can be multiplied by the amount of cash to obtain an accurate value for the entire cash position. This necessitates not only that new methods and models be defined; there is also some more fundamental or conceptually difficult issues to be coped with. As we have seen in our assessment of the Pinkowitz & Williamson model, one cannot determine the exact value of an entire cash position without having a discussion on whether or not there is an optimal level of cash holdings, whether or not firms on average are at their optima, and whether or not the models are even able to effectively cope with these dynamics.

Hence, there are several potential directions for further research. Ultimately, each piece of research will help us to broaden and deepen our understanding of the dynamics involved in the field of corporate cash holdings, even if there might not be one definite and concrete explanation to cover all of it.

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Appendices

Appendix A – Full literature overview

Authors	Year	Title	Data set	Cash motive supported	Capital theory supported	Positive cash level correlation	Negative cash level correlation	Positive cash value correlation	Negative cash value correlation
Al-Najjar	2013	The financial determinants of corporate cash holdings: Evidence from some emerging markets	BRIC-country, US and UK firms, 2002-2008 *		Trade-off, pecking order, agency theory of free cash flow	Profitability, firm size (depending on country)	Leverage, didend payout ratio, asset liquidity, firm size (depending on country)		
Brisker et al.	2013	Changes in cash holdings around the S&P 500 additions	New S&P 500 companies, 1971-2006	Precautionary, agency			Being added to the S&P 500 index (better capital access, deterioration in agency conflicts, and to a smaller extent weaker investment opportunities)		
Melo & Bilich	2013	Expectancy balance model for cash flow	Modeling, no data set		Trade-off theory				
Schauten et al.	2013	Corporate Governance and the Value of Excess Cash Holdings of Large European Firms	Publicly traded European companies, 1990-2008						Takeover defenses (for firms from common-law countries)
Acharya et al.	2012	Cash holdings and credit risk	Publicly traded US firms, 1996-2010 *	Precautionary, agency	Trade-off theory			Credit spreads, long-term default probability	Short-term default probability
Álvarez et al.	2012	Liquidity crises and corporate cash holdings in Chile	Chilean firms, 1996-2009 *	Precautionary		Industry volatility	Liquidity problems, size, leverage, bank debt, other liquid assets		
Bigelli & Sánchez-Vidal	2012	Cash holdings in private firms	Large Italian unlisted firms, 1996-2005 **		Trade-off, pecking order theory	Risk in cash flows, financial constraints, length of cash conversion cycle, dividend payment	Size, tax rates, financing deficits	Profitability, dividends, medium-term investment	
Campello et al.	2012	Access to liquidity and corporate investment in Europe during the	Survey of 600 European and US CFOs in 2009						
Louis et al.	2012	Value of cash holdings and accounting conservatism	Sample of firms, 1974-2006 **		Agency theory of free cash flow			Accounting conservatism	
Sheu & Lee	2012	Excess cash holdings and investment: The moderating roles of financial constraints and managerial entrenchment	Publicly traded Taiwanese firms, 2000-2006 *			R&D, capex (especially for constrained firms and firms with entrenched management)		Quality of management	
Sun et al.	2012	Earnings quality and corporate cash holdings	Publicly traded US firms, 1980-2005 **	Precautionary, agency			Earnings quality	Earnings quality	
Al-Najjar & Belghitar	2011	Corporate cash holdings and dividend payments: Evidence from simultaneous analysis	UK firms, 1991-2008 *	Signaling		Growth, firm size, risk	Dividends, leverage, profitability (low significance), working capital ratio		
Ammann et al.	2011	Cash holdings and corporate governance around the world	Firms from 22 developed economies, 2003-2007						
Ammann et al.	2011	Corporate governance and firm value: International evidence	Non-US firms, excluding some (emerging) countries, 2003-2007						
Bates et al.	2011	Why has the value of cash increased over time?	US firms, 1980-2006 **	Transactions, precautionary		Industry sigma, market to book ratio	Real size, cash flow/assets, net working capital/assets, capex, leverage, R&D/sales, dividend, acquisition activity		
Haw et al.	2011	The contribution of stock repurchases to the value of the firm and cash holdings around the world	Publicly traded firms from 33 countries, 1998-2004 *					Investor protection	
Lee & Powell	2011	Excess cash holdings and shareholder value	Australian firms, 1990-2007 *		Trade-off theory	Growth options, level of information asymmetry, cash flow variability, Capex, net investing and financing cash flows	Leverage, net working capital, firm size		Size of the cash balance, length of the time interval that excess cash is held
McLean	2011	Share issuance and cash savings	US firms, 1971-2008 **	Precautionary		Share issuance			
Tong	2011	Firm diversification and the value of corporate cash holdings	Sample of firms, 1998-2005 *		Agency theory of free cash flow				Firm diversification (weak governance strengthens the effect of diversification on cash value)
Venkiteshwaran	2011	Partial adjustment toward optimal cash holding levels	Publicly traded US manufacturing firms, 1987-2007		Trade-off theory				
Denis & Sibilkov	2010	Financial constraints, investment, and the value of cash holdings	Publicly traded US firms, 1985-2006 **	Precautionary, capital investment		Financial constraints		Level of investment from constrained firms	
Dittmar & Duchin	2010	The Dynamics of Cash	Sample of firms, 1965-2006 **		Trade-off theory	Cash flow volatility	Capex		
Drobetz et al.	2010	Information asymmetry and the value of cash	Firms from 45 countries 1995-2005		Agency theory of free cash flow (dominates pecking order; precautionary is contradicted)			Investor protection and governance (given high information asymmetry)	Information asymmetry
Frésard & Salva	2010	The value of excess cash and corporate governance: Evidence from US cross-listings	US firms 1989-2005 **					Shareholder protection (for firms in countries with low shareholder protection, a cross-listing in the US enhances the value of its cash)	
Lins et al.	2010	What drives corporate liquidity? An international survey of cash holdings and lines of credit	Survey of CFOs in 29 countries	Precautionary					

Authors	Year	Title	Data set	Cash motive supported	Capital theory supported	Positive cash level correlation	Negative cash level correlation	Positive cash value correlation	Negative cash value correlation
Martinez-Sola et al.	2010	Corporate cash holdings and firm value	US industrial firms, 2001-2007		Trade-off theory				
Palazzo	2010	Firm's cash holdings and the cross-section of equity returns	Modeling, no data set	Precautionary				Size of the cash position	
Bates et al.	2009	Why do U.S. firms hold so much more cash than they used to?	US firms, 1980-2009 **					Size & financial constraints (in general), investment opportunity set & cash flow volatility (during 1990s), credit market risk (during 2000s)	
Chen & Chuang	2009	Alignment or entrenchment? Corporate governance and cash holdings in growing firms	NASDAQ high-tech firms, 1997-2003						
Morellec & Nikolov	2009	Cash holdings and competition	Sample of firms, 1980-2005 **			Business risk, competition in the industry (in the prescence of financing constraints)			
Ramírez & Tadesse	2009	Corporate cash holdings, uncertainty avoidance, and the multinationality of firms	Firms from 49 countries, 1990-2004 **			Uncertainty avoidance in the cultures that a company is exposed to, multinationality of the firm			
Riddick & Whited	2009	The corporate propensity to save	US firms, 1972-2006 *				Amount of cash flow		
Cooper et al.	2008	Asset growth and the cross-section of stock returns	US publicly traded firms, 1968-2003						Abnormal stock returns
D'Mello et al.	2008	Determinants of corporate cash	US listed firms' spin offs, 1985-		Trade-off, pecking order theory	Sales growth, R&D expediture	Net working capital ratio, presence		
Frésard	2008	Financial strength and product market behaviors, the real effects of corporate cash holdings	US firms, 1971-2005					Size of the position compared to competitors (larger relative-to-rivals reserves lead to future market share gains, especially when rivals face constraints)	
Gamba & Triantis	2008	The value of financial flexibility	Modeling, no data set	Transactions, capital investment					
Harford et al.	2008	Corporate governance and firm cash holdings in the US	US firms, 1990-2004 **		Agency theory of free cash flow	Governance (which leads to low capex, low frequency of acquisitions, high R&D investment)			
Oswald & Young	2008	Share reacquisitions, surplus cash, and agency problems	UK firms listed on LSE, 1995-2003 *					Incentive alignment, monitoring by external shareholders	
Baum et al.	2007	The Effects of Industry-Level Uncertainty on Cash Holdings: The Case of Germany	German food, textile, apparel and chemical firms, 1988-2000	Transactions, precautionary		Volatility of input prices, industry level uncertainty			
Dittmar & Mahrt-Smith	2007	Corporate governance and the value of cash holdings	Publicly traded firms US, 1990-2003	Agency				Quality of corporate governance	
Foley et al.	2007	Why do firms hold so much cash? A tax-based explanation	Large US firms, 1982-2004	Tax		Repatriating tax burdens			
Guney et al.	2007	International evidence on the non-linear impact of leverage on	Firms from Japan, France, Germany, UK, US, 1996-2000 *	Precautionary, agency		Leverage			
Han & Qiu	2007	Corporate precautionary cash holdings	Publicly traded firms, 1997-2002	Precautionary		Cash flow volatility (for financially constrained firms)			
Baum et al.	2006	The impact of macroeconomic uncertainty on non-financial firms' demand for liquidity	US firms, 1970-2000 *				Macroeconomic uncertainty (proxied by variance in GDP, industrial production, inflation and		
Faulkender & Wang	2006	Corporate financial policy and the value of cash	US firms, 1971-2001 **	Agency, tax	Trade-off theory			Constraints in capital market access	Size of the cash position, leverage
Pinkowitz et al.	2006	Does the contribution of corporate cash holdings and dividends to firm value depend on governance? A cross-country analysis	Sample of firms in 35 countries, 1988-1999 *		Trade-off, agency theory of free cash flow			Quality of institutions	
Yan	2006	The determinants and implications of mutual fund cash holdings: Theory and evidence	Diversified domestic equity funds, 1992-2001						
Almeida et al.	2004	The cash flow sensitivity of cash	Manufacturing firms, 1971-2000	Transactions		Financial constrainedness,			
Bruinshoofd & Kool	2004	Dutch corporate liquidity management: New evidence on aggregation	Large Dutch firms, 1977-1997 *	Precautionary		Short debt, return on assets, earnings uncertainty	Size, total debt, average interest rate		
Cossin & Hricko	2004	The benefits of holding cash: a real options approach	Modeling, no data set	Precautionary, capital investment		Underpricing due to information asymmetries, loss in sub-optimal timing of investment	Risk (from an options perspective cash should be accumulated when risk is lower)		
Ferreira & Vilela	2004	Why do firms hold cash? Evidence from EMU countries	EMU-country firms, 1987-2000 *	Precautionary	Trade-off, pecking order theory (agency is contradicted)	Investment opportunity set, quality of law enforcement	Amount fo liquid assets substitutes, leverage, capital market		

Authors	Year	Title	Data set	Cash motive supported	Capital theory supported	Positive cash level correlation	Negative cash level correlation	Positive cash value correlation	Negative cash value correlation
Ozkan & Ozkan	2004	Corporate cash holdings: An empirical investigation of UK companies	Publicly traded UK firms, 1984-1999 *	Capital investment	Pecking order theory	Very low and high levels of managerial ownership, level of cash flows, investment opportunities	Moderate levels of managerial ownership, liquidity (other than cash), leverage, bank debt financing		
Pinkowitz & Williamson	2004	What is a dollar worth? The market value of cash holdings	Listed firms, 1988-1998	Agency	Agency theory of free cash flow			Investor protection	
Schweltzler & Reimund	2004	Valuation effects of corporate cash holdings, evidence from Germany	German firms that were publicly traded in 2002, all years available *		Agency theory of free cash flow				Persistence in cash holdings
Titman et al.	2004	Capital investments and stock returns	Domestic stocks listed on NYSE, Amex and NASDAQ, 1973-1996						
Dittmar et al.	2003	International corporate governance and corporate cash	Firms from 45 countries, 1998 **				Shareholder protection		
Frank & Goyal	2003	Testing the pecking order theory of capital structure	Publicly traded US firms 1971-1998		Pecking order theory (declining over time)				
Guney et al.	2003	Additional international evidence on corporate cash holdings	Firms from Japan, France, Germany, UK, 1983-2000 *	Precautionary, agency		Creditor protection, law enforcement (both increase the cost of financial distress)	Shareholder rights		
Mikkelson & Partch	2003	Do persistent large cash reserves hinder performance?	Sample of high-cash firms, 1986-1991		Trade-off theory	Firm growth, level of investment, market-to-book value of assets		Persistence in cash holdings, size of the cash position	
Pinkowitz et al.	2003	Do firms in countires with poor protection of investor rights hold more cash?	Sample of firms, 1952-1997 **					Quality and volatility of investment opportunity set, probability of distress, growth options	Stability of investment program, distance to distress, financial constrainedness
Dittmar et al.	2002	Corporate liquidity	Firms from 45 countries, 1998	Transactions	Agency theory of free cash flow		Shareholder protection		
La Porta et al.	2002	Investor protection and corporate valuation	Firms from 27 wealthy countries *						
Graham & Harvey	2001	The theory and practice of corporate finance: Evidence from the field	Survey of Fortune 500 CFOs						
Harford	1999	Corporate cash reserves and acquisitions	Firms that conducted mergers and acquisitions, 1950-1994		Agency theory of free cash flow				Likelyhood of agency problems
Opler et al.	1999	The determinants and	Publicly traded US firms, 1971-	Precautionary	Trade-off theory	Growth opportunities, business risk	Firm size, access to credit markets		
Shyam-Sunder & Myers	1999	Testing static tradeoff against pecking order models of capital structure	Sample of firms 1971-1989 *		Trade-off, pecking order theory				
Kim et al.	1998	The determinants of corporate liquidity: Theory and evidence	US industrial firms, 1975-1994		Trade-off theory	Cost of external financing, variance of future cash flows, return on	Return differential between physical and liquid assets	Cost of external financing, variance of future cash flows, return on	Return differential between physical and liquid assets
Blanchard et al.	1994	What do firms do with cash windfalls?	11 US firms that won lawsuits	Agency				Diversification	
Baskin	1987	Corporate liquidity in games of monopoly power	Fortune 500 firms, 1960-1984	Transactions, speculative, agency				Degree of encroachment, investment opportunities	
Amihud & Mendelson	1986	Liquidity and stock returns	NYSE stocks, 1961-1980						
Jensen	1986	Agency costs of free cash flow, corporate finance, and takeovers	Meta-analysis, no data set		Agency theory of free cash flow				
Vickson	1985	Simple Optimal Policy for Cash Management: The Average Balance Requirement Case	Modeling, no data set						
Myers & Majluf	1984	Corporate financing and investment decisions when firms have information that investors	Modeling, no data set		Pecking order theory				
Milbourne	1983	Optimal Money Holding under Uncertainty	Modeling, no data set		Trade-off theory				
Miller & Orr	1966	A model of the demand for money by firms	Modeling, no data set		Trade-off theory				
Tobin	1956	The interest elasticity of the transactions demand for cash	Modeling, no data set	Transactions					

* excluding financial sect * excluding financial and utility sectors

Appendix B – Full comparison of regression models

	Fama & French (1998) Baseline model	Pinkowitz & Williamson (2004) Baseline model	Pinkowitz & Williamson (2004) Extended model	Faulkender & Wang (2006) Baseline model	Faulkender & Wang (2006) Extended model
Data set	Compustat firms, 1965-1992	Compustat firms, 1952-1997	Same as baseline model	US firms, 1971-2001	Same as baseline model
Data treatment/ corrections	Observations are trimmed at the 1% level using the full sample. Firms are clustered in two (above or below median) size groups and three (bottom 30%; middle 40%; top 30%) book value to market value of equity ratio (BE/ME) groups, which leads to six seperate regression groups.	Excluding financial and utility sectors. Missing values for R&D are set to zero. Observations are trimmed at the 1% level using the full sample. Firm years where the fiscal year end was changed (also in two years before of after the observation) are excluded. Negative values on assets etc. are exluded as well.	Same as baseline model	Excluding financial and utility sectors. All data is converted to real values in 2001 dollars using consumer price index. Missing values for R&D are set to zero. All variables are trimmed at the 1% tails to remove outliers. Firm years with negative assets, market value of equity or dividends are deleted. The data is grouped in 25 portfolios formed on size and BE/ME.	Same as baseline model
Final sample size	Approximately 64,800 firm years (average of 2400 firms per annual regression)	88,844 firm years (representing a total of 9,844 firms)	Same as baseline model	82,187 firm years	Same as baseline model
Dependent variable	Total market value of the firm (V_i,t) minus book value of its assets (A_i,t).	Market value of equity (M_i,t) (measured by price * shares outstanding).	Same as baseline model	Stock's excess return over the fiscal year (as compared to benchmark portfolio).	Same as baseline model
Independent variables *(for firm i in fiscal year t)*	***Year end value*** of earnings before interest and extraordinary items (E_i,t), R&D expenditures (RD_i,t), interest (I_i,t), and dividends (D_i,t). ***Change from year t-2 to t*** in earnings (dE_i,t), total assets (dA_i,t), R&D expenses (dRD_i,t), interest expense (dI_i,t), and dividends (dD_i,t). ***Change from year t to t+2*** in the same variables as above (now denoted as dE_i,t+2, dA_i,t+2, dRD_i,t+2, dI_i,t+2, dD_i,t+2) plus in the total market value of the firm (dM_i,t+2).	***Year end value*** of earnings before extraordinary items plus interest (E_i,t), R&D expenses (RD_i,t), interest (I_i,t), dividends (D_i,t) and cash & marketable securities (C_i,t). ***Change from year t-2 to t*** in earnings (dE_i,t), net assets (dNA_i,t), R&D expenses (dRD_i,t), interest expense (dI_i,t), and dividends (dD_i,t). ***Change from year t to t+2*** in the same variables as above (now denoted as dE_i,t+2, dNA_i,t+2, dRD_i,t+2, dI_i,t+2, dD_i,t+2) plus in the market value of equity (dM_i,t+2).	All variables of the baseline model plus ***change from year t-2 to t and from t to t+2*** in cash and marketable securities (dC_i,t and dC_i,t+2).	***Year end value*** of previous year's cash holdings (C_i,t-1), market leverage (L_i,t), and net financing (NF_i,t). ***Unexpected change*** (as compared to benchmark portfolio) in cash holdings (dC_i,t) and sources of value other than cash over the fiscal year that may be correlated with cash holdings: earnings before interest and extraordinary items (dE_i,t), total assets net of cash (dNA_i,t), R&D expenditures (dRD_i,t), interest expense (dI_i,t), and total dividends (dD_i,t).	All variables of the baseline model plus two ***interaction terms***: 1-year lagged cash holdings (C_i,t-1) * change in cash holdings (dC_i,t) [to estimate the effect of changes in the value of cash for different cash holdings] and leverage (L_i,t) * change in cash holdings (dC_i,t) [to capture the effect of leverage on the marginal value of cash].
Parameter treatment	All variables are deflated by book value of assets at the dependent variable's year end.	All variables are deflated by book value of assets at the dependent variable's year end.	Same as baseline model	All variables except leverage are deflated by the 1-year lagged market value of equity.	Same as baseline model
Regression type	Fama - MacBeth method, which involves running cross-sectional regressions on each year and using the time series of coefficients to generate inferences.	Fama - MacBeth method, which involves running cross-sectional regressions on each year and using the time series of coefficients to generate inferences.	Same as baseline model	OLS regression with White heteroskadistic-consistent standard errors corrected for correlations between year-on-year observations within firms.	Same as baseline model
Marginal value of cash	Not quantified (as cash is not part of the model)	Regression coefficient on C_i,t = **$0.97**	Regression coefficient on C_i,t = **$0.94**	Regression coefficient on dC_i,t = **$0.75**	Regression coefficients on dC_i,t + (C_i,t-1 * dC_i,t) * mean cash ratio + (L_i,t * dC_i,t) * mean leverage ratio = **$0.94**
Significance	-	P-values not reported Adjusted R^2 = 0.47	P-values not reported Adjusted R^2 = 0.48	All variables' p-values are at 1% level Adjusted R^2 = 0.19	All variables' p-values are at 1% level Adjusted R^2 = 0.20

Symbol	Meaning	Model
α	Regression intercept	Both
β	Regression coefficients	Both
ε	Regression error term	Both
i	Firm identifier	Both
t	Fiscal year end of observation	Both
$Y_{i,t}$	Value of dependent variable Y at t	Both
$X_{i,t}$	Value of independent variable X at t	Both
$dX_{i,t}$	Change in X over $t-2$ to t	Pinkowitz & Williamson
$dX_{i,t+2}$	Change in X over t to $t+2$	Pinkowitz & Williamson
$\Delta X_{i,t-1}$	Unexpected change in X over $t-1$ to t	Faulkender & Wang
$\Delta X_{i,t}$	Unexpected change in X over t to $t+1$	Faulkender & Wang
M	Market value of equity	Pinkowitz & Williamson
$r_{i,t} - R_{i,t}^{B}$	Excess stock return (stock –benchmark return)	Faulkender & Wang
E	Earnings	Both
NA	Net assets	Both
RD	R&D expenses	Both
I	Interest expense	Both
D	Dividends	Both
C	Cash	Both
L	Leverage	Faulkender & Wang
NF	Net financing	Faulkender & Wang

Basic Pinkowitz & Williamson regression specification

$$\begin{aligned} M_{i,t} = {} & \alpha + \beta_1 E_{i,t} + \beta_2 dE_{i,t} + \beta_3 dE_{i,t+2} + \beta_4 dNA_{i,t} + \beta_5 dNA_{i,t+2} + \beta_6 RD_{i,t} + \beta_7 dRD_{i,t} + \beta_8 dRD_{i,t+2} \\ & + \beta_9 I_{i,t} + \beta_{10} dI_{i,t} + \beta_{11} dI_{i,t+2} + \beta_{12} D_{i,t} + \beta_{13} dD_{i,t} + \beta_{14} dD_{i,t+2} + \beta_{15} dM_{i,t+2} + \beta_{16} C_{i,t} + \varepsilon_{i,t} \end{aligned}$$

Enhanced Pinkowitz & Williamson regression specification

$$\begin{aligned} M_{i,t} = {} & \alpha + \beta_1 E_{i,t} + \beta_2 dE_{i,t} + \beta_3 dE_{i,t+2} + \beta_4 dNA_{i,t} + \beta_5 dNA_{i,t+2} + \beta_6 RD_{i,t} + \beta_7 dRD_{i,t} + \beta_8 dRD_{i,t+2} \\ & + \beta_9 I_{i,t} + \beta_{10} dI_{i,t} + \beta_{11} dI_{i,t+2} + \beta_{12} D_{i,t} + \beta_{13} dD_{i,t} + \beta_{14} dD_{i,t+2} + \beta_{15} dM_{i,t+2} \\ & + \beta_{16} C_{i,t} + \beta_{17} dC_{i,t} + \beta_{18} dC_{i,t+2} + \varepsilon_{i,t} \end{aligned}$$

Basic Faulkender & Wang regression specification

$$\begin{aligned} r_{i,t} - R_{i,t}^{B} = {} & \alpha + \beta_1 \Delta C_{i,t} + \beta_2 \Delta E_{i,t} + \beta_3 \Delta NA_{i,t} + \beta_4 \Delta RD_{i,t} + \beta_5 \Delta I_{i,t} + \beta_6 \Delta D_{i,t} + \beta_7 \Delta C_{i,t-1} + \beta_8 L_{i,t} \\ & + \beta_9 NF_{i,t} + \varepsilon_{i,t} \end{aligned}$$

Enhanced Faulkender & Wang regression specification

$$\begin{aligned} r_{i,t} - R_{i,t}^{B} = {} & \alpha + \beta_1 \Delta C_{i,t} + \beta_2 \Delta E_{i,t} + \beta_3 \Delta NA_{i,t} + \beta_4 \Delta RD_{i,t} + \beta_5 \Delta I_{i,t} + \beta_6 \Delta D_{i,t} + \beta_7 \Delta C_{i,t-1} + \beta_8 L_{i,t} \\ & + \beta_9 NF_{i,t} + \beta_{10} C_{i,t-1} * \Delta C_{i,t} + \beta_{11} L_{i,t} * \Delta C_{i,t} + \varepsilon_{i,t} \end{aligned}$$

Appendix C – Cash level metrics over time

Cash measure A	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
observations	3,533	3,906	4,069	4,159	4,237	4,379	4,908	5,179	5,278	5,224	5,037	4,915	4,765	4,454	3,848
sum	145,840	158,290	172,089	192,126	191,940	190,955	193,881	234,893	259,551	286,600	240,938	314,287	343,900	340,676	367,476
average	41.3	40.5	42.3	46.2	45.3	43.6	39.5	45.4	49.2	54.9	47.8	63.9	72.2	76.5	95.5
standard deviation	129.9	123.8	122.3	143.1	148.1	148.0	121.8	143.0	151.7	172.7	142.4	212.7	236.0	241.3	295.6
min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1st quartile	0.9	1.2	1.5	1.3	1.1	0.9	0.9	0.9	1.1	1.2	1.0	1.0	1.2	1.3	1.6
median	4.6	5.1	6.2	5.9	5.2	4.7	4.4	4.8	5.4	6.1	5.2	5.4	6.1	6.7	8.1
3rd quartile	21.1	21.3	25.0	26.0	22.7	20.9	20.7	22.1	24.7	28.2	25.1	27.9	31.8	36.0	42.1
max	1,433.7	1,279.0	1,293.2	1,563.4	1,678.0	1,659.0	1,350.0	1,419.1	1,430.2	1,744.8	1,569.4	2,308.0	2,548.7	2,628.7	3,000.5

Cash measure B	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
observations	3,471	3,829	3,977	4,069	4,149	4,291	4,831	5,088	5,181	5,133	4,951	4,836	4,680	4,395	3,789
sum	343	394	415	414	421	457	590	679	699	668	560	576	561	516	447
average	0.10	0.10	0.10	0.10	0.10	0.11	0.12	0.13	0.13	0.13	0.11	0.12	0.12	0.12	0.12
standard deviation	0.12	0.12	0.13	0.13	0.12	0.12	0.14	0.15	0.15	0.15	0.13	0.13	0.13	0.12	0.12
min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1st quartile	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
median	0.05	0.05	0.05	0.05	0.06	0.06	0.07	0.08	0.08	0.08	0.07	0.07	0.08	0.08	0.08
3rd quartile	0.13	0.13	0.13	0.12	0.13	0.14	0.17	0.18	0.18	0.18	0.15	0.16	0.17	0.16	0.16
max	0.57	0.62	0.68	0.65	0.62	0.63	0.70	0.75	0.75	0.72	0.66	0.65	0.65	0.63	0.64

Excess cash measure 1	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
observations	3,482	3,838	3,975	4,049	4,106	4,241	4,701	4,897	4,994	4,949	4,796	4,681	4,562	4,251	3,658
sum	97,920	108,422	108,238	132,183	122,800	126,557	141,415	173,382	184,689	209,541	175,734	225,083	276,710	273,664	276,273
average	28.1	28.2	27.2	32.6	29.9	29.8	30.1	35.4	37.0	42.3	36.6	48.1	60.7	64.4	75.5
standard deviation	113.8	102.0	92.2	121.3	118.9	125.0	105.5	120.7	123.5	144.0	122.2	163.0	214.5	221.8	242.3
min	-846.8	-360.9	-463.1	-458.1	-979.7	-987.9	-367.8	-401.8	-421.8	-439.9	-474.3	-884.2	-1,071.3	-1,861.3	-1,142.8
1st quartile	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.2	0.3	0.4	0.4	0.6
median	1.8	2.5	3.0	2.8	2.4	2.4	2.5	3.0	3.3	3.7	3.1	3.6	4.2	4.3	5.4
3rd quartile	12.9	13.9	16.6	16.7	13.9	12.9	13.9	16.4	17.7	21.0	18.5	22.1	25.9	26.9	32.8
max	1,347.3	1,074.6	1,016.4	1,408.0	1,603.2	1,473.7	1,119.1	1,202.5	1,197.2	1,545.5	1,246.5	1,766.2	2,231.4	2,259.7	2,416.7

Excess cash measure 2a	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
observations	3,477	3,845	3,997	4,072	4,154	4,297	4,838	5,108	5,201	5,148	4,964	4,843	4,691	4,402	3,797
sum	-47	-62	-80	-83	-74	-77	-95	-98	-99	-93	-95	-84	-85	-71	-66
average	-0.01	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
standard deviation	0.11	0.12	0.13	0.12	0.12	0.12	0.13	0.15	0.15	0.14	0.13	0.13	0.12	0.12	0.12
min	-0.19	-0.22	-0.22	-0.22	-0.28	-0.22	-0.31	-0.34	-0.35	-0.29	-0.24	-0.24	-0.25	-0.24	-0.23
1st quartile	-0.08	-0.09	-0.10	-0.10	-0.09	-0.09	-0.10	-0.11	-0.11	-0.10	-0.10	-0.10	-0.10	-0.09	-0.10
median	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.04	-0.04
3rd quartile	0.02	0.02	0.02	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03
max	0.43	0.47	0.51	0.50	0.47	0.48	0.52	0.56	0.56	0.54	0.51	0.49	0.48	0.47	0.48

Excess cash measure 2b	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
observations	3,466	3,835	3,985	4,067	4,148	4,292	4,831	5,097	5,192	5,140	4,956	4,836	4,681	4,392	3,786
sum	118	147	157	157	145	154	175	212	208	220	186	170	151	146	115
average	0.03	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03
standard deviation	0.11	0.12	0.13	0.12	0.11	0.12	0.13	0.15	0.15	0.14	0.12	0.12	0.12	0.12	0.12
min	-0.15	-0.16	-0.15	-0.19	-0.20	-0.15	-0.19	-0.29	-0.28	-0.21	-0.14	-0.15	-0.17	-0.19	-0.14
1st quartile	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.04	-0.05	-0.05	-0.04	-0.04	-0.04	-0.05	-0.04	-0.05
median	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3rd quartile	0.06	0.07	0.06	0.06	0.06	0.07	0.08	0.08	0.08	0.09	0.07	0.08	0.08	0.07	0.07
max	0.49	0.53	0.59	0.57	0.53	0.54	0.58	0.63	0.63	0.61	0.57	0.55	0.55	0.53	0.54

Excess cash measure 3	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
observations	3,522	3,906	4,074	4,149	4,216	4,358	4,916	5,183	5,287	5,233	5,064	4,926	4,787	4,477	3,865
sum	-403	-436	-444	-512	-558	-586	-592	-635	-698	-730	-809	-771	-727	-717	-652
average	-0.11	-0.11	-0.11	-0.12	-0.13	-0.13	-0.12	-0.12	-0.13	-0.14	-0.16	-0.16	-0.15	-0.16	-0.17
standard deviation	0.38	0.39	0.40	0.42	0.43	0.44	0.44	0.48	0.49	0.50	0.51	0.52	0.51	0.51	0.55
min	-3.02	-3.02	-3.02	-3.02	-3.02	-3.02	-3.02	-3.02	-3.02	-3.02	-3.02	-3.02	-3.02	-3.02	-3.02
1st quartile	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18	-0.17	-0.17	-0.18	-0.18	-0.19	-0.18	-0.18	-0.18	-0.18
median	-0.06	-0.06	-0.06	-0.07	-0.07	-0.07	-0.06	-0.06	-0.06	-0.07	-0.08	-0.07	-0.06	-0.07	-0.07
3rd quartile	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.02	0.00	0.01	0.01	0.01	0.01
max	0.78	0.92	0.92	0.92	0.93	0.94	0.94	0.92	0.93	0.94	0.94	0.94	0.94	0.88	0.88

Cash measure 1: Cash and cash equivalents (CCE; in EUR)
Excess cash measure 1: CCE – 2% of revenue (in EUR)
Excess cash measure 3: CCE/TA – industry median CCE/TA (%)
Cash measure 2: Cash / Total assets (CCE/TA) (%)
Excess cash measure 2: CCE/TA – industry mean CCE/TA (%)
Excess cash measure 4: CCE/TA – industry sigma buffer (%)

Note: firms are subdivided into industries according to their 2-digit SIC codes

Appendix D – Cash level metrics between countries

(Excess) cash metric	Country	Austria	Belgium	Denmark	France	Finland	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Norway	Portugal	Spain	Sweden	Switzerland	United Kingdom
	Number of companies	96	151	173	999	137	919	276	136	270	57	220	287	68	160	561	290	2,323
A) CCE (mln€)	Observations	1,014	1,616	1,812	9,846	1,697	9,302	2,363	1,169	2,992	456	2,201	2,432	750	1,582	5,545	2,776	20,338
	Mean	66.3	46.5	30.7	64.4	42.8	49.6	25.5	101.3	75.7	139.8	109.1	44.7	50.4	97.3	30.9	118.4	37.3
	StDev	186.9	141.9	108.3	215.0	107.1	169.6	78.7	241.3	193.9	277.2	254.5	123.7	123.7	275.4	144.1	267.1	137.2
	Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1st quartile	3.6	1.7	1.1	0.9	2.9	1.5	0.9	1.9	3.1	7.7	2.4	1.7	0.2	1.9	0.5	6.0	0.7
	Median	12.7	7.0	3.9	4.2	9.2	6.4	3.6	13.1	12.9	36.5	16.8	8.4	4.4	9.8	2.7	23.4	3.7
	3rd quartile	42.0	30.2	20.0	21.8	34.0	23.6	14.7	67.7	51.1	113.9	81.8	31.9	39.8	57.3	11.6	94.5	17.5
	Max	1,952.5	1,954.0	1,803.8	2,733.0	1,849.9	2,816.0	985.5	1,844.3	2,137.0	2,314.2	2,465.0	1,400.8	1,886.7	2,947.0	3,000.5	2,605.4	2,714.5
B) CCE/TA ratio	Observations	1,010	1,600	1,754	9,965	1,697	9,201	2,354	1,133	3,026	469	2,232	2,345	750	1,605	5,412	2,780	19,337
	Mean	0.12	0.09	0.09	0.10	0.10	0.13	0.07	0.15	0.09	0.12	0.10	0.14	0.04	0.05	0.14	0.13	0.13
	StDev	0.13	0.11	0.13	0.11	0.10	0.14	0.09	0.15	0.10	0.10	0.12	0.15	0.06	0.07	0.15	0.12	0.15
	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1st quartile	0.03	0.03	0.02	0.03	0.03	0.03	0.01	0.04	0.03	0.04	0.02	0.03	0.00	0.01	0.03	0.05	0.03
	Median	0.08	0.05	0.05	0.06	0.06	0.08	0.03	0.10	0.05	0.09	0.06	0.08	0.02	0.03	0.08	0.09	0.08
	3rd quartile	0.15	0.10	0.11	0.13	0.13	0.18	0.08	0.21	0.11	0.17	0.14	0.19	0.05	0.07	0.19	0.18	0.19
	Max	0.73	0.68	0.75	0.75	0.74	0.74	0.74	0.74	0.74	0.64	0.75	0.75	0.67	0.59	0.74	0.74	0.75
1) CCE - 2%*TR (mln€)	Observations	1,012	1,613	1,761	9,802	1,684	9,109	2,342	961	2,979	429	2,165	2,330	737	1,577	5,346	2,671	18,662
	Mean	51.2	28.0	22.9	49.8	25.0	34.7	20.2	95.5	59.1	130.9	78.5	36.5	34.3	67.6	22.0	93.1	28.1
	StDev	159.5	122.6	95.0	183.4	90.8	137.4	70.4	222.1	163.4	278.4	211.5	109.3	105.6	225.1	115.0	228.5	114.4
	Min	-322.2	-581.8	-65.5	-577.8	-221.6	-439.9	-100.9	-99.0	-653.8	-61.6	-979.7	-348.2	-176.1	-458.1	-136.3	-1,861.3	-987.9
	1st quartile	1.4	0.2	0.0	0.1	0.5	0.1	0.0	2.3	0.8	5.1	-0.1	0.7	-0.7	-0.3	0.1	3.3	0.2
	Median	9.1	2.8	1.8	2.2	4.0	3.3	1.7	16.0	8.0	26.2	6.7	5.9	0.6	3.1	1.5	17.2	2.4
	3rd quartile	29.2	17.8	11.7	14.9	15.1	16.4	10.2	64.7	36.9	100.9	55.1	25.7	24.8	31.4	7.5	75.3	13.3
	Max	1,703.3	1,834.8	1,625.3	2,416.7	1,633.6	2,152.5	799.3	1,693.1	1,789.8	2,292.1	2,009.4	1,456.5	1,514.9	2,326.9	2,293.1	2,248.4	2,259.7
2a) CCE/TA - annual industry mean CCE/TA	Observations	1,014	1,602	1,760	9,965	1,696	9,231	2,350	1,141	3,026	472	2,240	2,359	750	1,605	5,411	2,790	19,422
	Mean	0.00	-0.04	-0.03	-0.04	-0.03	-0.01	-0.04	0.00	-0.04	-0.02	-0.02	0.00	-0.07	-0.05	-0.01	0.00	-0.01
	StDev	0.12	0.11	0.13	0.11	0.10	0.13	0.09	0.15	0.10	0.11	0.12	0.14	0.07	0.08	0.14	0.12	0.15
	Min	-0.24	-0.25	-0.26	-0.35	-0.31	-0.26	-0.34	-0.30	-0.25	-0.28	-0.26	-0.34	-0.26	-0.34	-0.35	-0.33	-0.35
	1st quartile	-0.07	-0.10	-0.10	-0.10	-0.08	-0.09	-0.09	-0.10	-0.10	-0.08	-0.10	-0.09	-0.11	-0.09	-0.11	-0.08	-0.10
	Median	-0.02	-0.05	-0.06	-0.05	-0.04	-0.04	-0.05	-0.03	-0.05	-0.03	-0.04	-0.03	-0.06	-0.06	-0.04	-0.02	-0.04
	3rd quartile	0.04	0.00	0.00	0.00	0.01	0.04	-0.01	0.07	0.00	0.03	0.02	0.05	-0.03	-0.03	0.04	0.05	0.05
	Max	0.54	0.52	0.55	0.55	0.47	0.56	0.56	0.55	0.53	0.48	0.53	0.53	0.32	0.49	0.54	0.54	0.56
2b) CCE/TA - annual industry median CCE/TA	Observations	1,014	1,599	1,754	9,960	1,697	9,207	2,350	1,138	3,026	471	2,230	2,346	750	1,605	5,403	2,780	19,374
	Mean	0.05	0.02	0.02	0.02	0.02	0.05	0.00	0.07	0.01	0.04	0.03	0.05	-0.02	-0.01	0.05	0.05	0.05
	StDev	0.12	0.10	0.12	0.10	0.10	0.13	0.09	0.15	0.10	0.10	0.11	0.14	0.06	0.07	0.14	0.12	0.14
	Min	-0.14	-0.18	-0.14	-0.28	-0.24	-0.15	-0.27	-0.23	-0.19	-0.21	-0.17	-0.27	-0.14	-0.29	-0.28	-0.26	-0.28
	1st quartile	-0.02	-0.04	-0.05	-0.04	-0.03	-0.04	-0.04	-0.03	-0.04	-0.02	-0.04	-0.03	-0.05	-0.04	-0.04	-0.02	-0.04
	Median	0.01	-0.01	-0.01	-0.01	0.00	0.00	-0.02	0.02	-0.01	0.02	-0.01	0.01	-0.03	-0.02	0.00	0.02	0.00
	3rd quartile	0.09	0.03	0.04	0.05	0.05	0.09	0.02	0.12	0.04	0.08	0.06	0.10	0.00	0.00	0.09	0.10	0.10
	Max	0.59	0.56	0.63	0.61	0.53	0.63	0.63	0.62	0.62	0.58	0.55	0.63	0.39	0.55	0.61	0.62	0.63
3) CCE/TA - industry volatility buffer	Observations	1,018	1,589	1,797	10,035	1,704	9,310	2,331	1,153	3,000	449	2,220	2,393	738	1,606	5,498	2,851	20,271
	Mean	-0.08	-0.08	-0.10	-0.11	-0.08	-0.06	-0.13	-0.31	-0.09	-0.26	-0.08	-0.10	-0.24	-0.13	-0.14	-0.13	-0.20
	StDev	0.33	0.20	0.25	0.29	0.25	0.22	0.40	0.83	0.19	0.74	0.23	0.35	0.46	0.25	0.53	0.47	0.66
	Min	-2.98	-1.46	-0.92	-3.02	-3.01	-2.87	-3.01	-3.02	-1.47	-3.02	-3.01	-3.01	-2.99	-1.48	-3.02	-3.02	-3.02
	1st quartile	-0.15	-0.17	-0.20	-0.18	-0.16	-0.16	-0.11	-0.23	-0.18	-0.17	-0.17	-0.20	-0.23	-0.18	-0.18	-0.16	-0.20
	Median	-0.03	-0.06	-0.08	-0.07	-0.06	-0.06	-0.05	-0.10	-0.07	-0.04	-0.07	-0.07	-0.06	-0.06	-0.07	-0.05	-0.07
	3rd quartile	0.03	-0.01	-0.01	-0.01	-0.01	0.02	-0.02	0.03	-0.01	0.03	0.01	0.03	-0.02	-0.02	0.02	0.03	0.03
	Max	0.64	0.62	0.82	0.75	0.81	0.94	0.74	0.88	0.93	0.77	0.88	0.76	0.31	0.61	0.89	0.92	0.94

Note: all values in the table are determined on the full time series aggregate (1998-2012)

Appendix E – Cash level metrics between industries

(Excess) cash metric	Industry classification	Agriculture, Forestry & Fishing	Mining	Construction	Manufacturing	Wholesale Trade	Retail Trade	Services	Non-Classifiable
	2-digit SICs	01-09	10-14	15-17	20-39	50-51	52-59	70-89	91-99
	Number of companies	56	510	218	3265	397	422	2165	90
A) CCE (mln€)	Observations	509	3954	2221	32604	3798	4110	20014	681
	Mean	35.6	57.7	133.9	64.0	28.8	69.0	28.0	70.4
	StDev	96.5	185.1	288.3	198.7	87.3	202.6	109.8	194.0
	Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1st quartile	0.6	0.7	4.8	1.4	0.9	1.7	0.8	0.7
	Median	3.6	3.9	27.6	6.7	4.4	8.4	3.6	7.3
	3rd quartile	19.8	25.1	117.4	32.6	17.1	37.3	14.6	40.0
	Max	1185.8	2531.1	2947.0	3000.5	1158.8	2714.5	2493.6	2816.0
B) CCE/TA ratio	Observations	500	3742	2263	32233	3789	4160	19322	661
	Mean	0.10	0.16	0.10	0.10	0.09	0.09	0.14	0.12
	StDev	0.13	0.16	0.10	0.12	0.10	0.10	0.15	0.15
	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1st quartile	0.01	0.04	0.03	0.02	0.02	0.02	0.03	0.02
	Median	0.05	0.10	0.07	0.06	0.05	0.05	0.09	0.06
	3rd quartile	0.13	0.23	0.13	0.13	0.11	0.11	0.21	0.16
	Max	0.69	0.75	0.62	0.75	0.74	0.74	0.75	0.75
1) CCE - 2%*TR (mln€)	Observations	492	2584	2213	31872	3762	4095	19601	561
	Mean	34	69	103	47	12	42	23	77
	StDev	96	185	237	165	65	174	96	193
	Min	-8	-322	-79	-1861	-440	-578	-150	-431
	1st quartile	0	1	1	0	0	0	0	1
	Median	3	6	17	3	1	2	3	8
	3rd quartile	19	39	86	22	8	18	11	45
	Max	1170	2125	2176	2417	909	2231	2327	1583
2a) CCE/TA - annual industry mean CCE/TA	Observations	498	3814	2261	32266	3778	4155	19394	668
	Mean	-0.01	-0.03	0.00	-0.02	-0.01	-0.01	-0.02	-0.06
	StDev	0.12	0.17	0.09	0.12	0.10	0.10	0.15	0.17
	Min	-0.24	-0.35	-0.18	-0.26	-0.13	-0.15	-0.28	-0.26
	1st quartile	-0.08	-0.14	-0.06	-0.09	-0.07	-0.07	-0.13	-0.16
	Median	-0.03	-0.08	-0.03	-0.04	-0.03	-0.03	-0.07	-0.11
	3rd quartile	0.02	0.04	0.04	0.02	0.02	0.02	0.04	-0.02
	Max	0.51	0.56	0.48	0.55	0.56	0.55	0.56	0.56
2b) CCE/TA - annual industry median CCE/TA	Observations	497	3792	2262	32197	3781	4157	19365	653
	Mean	0.03	0.04	0.02	0.03	0.03	0.03	0.04	0.05
	StDev	0.12	0.17	0.09	0.12	0.10	0.10	0.15	0.14
	Min	-0.15	-0.29	-0.15	-0.17	-0.09	-0.10	-0.20	-0.11
	1st quartile	-0.02	-0.07	-0.04	-0.03	-0.03	-0.03	-0.06	-0.04
	Median	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	-0.01
	3rd quartile	0.05	0.11	0.06	0.06	0.05	0.05	0.10	0.08
	Max	0.60	0.62	0.52	0.63	0.61	0.61	0.63	0.59
3) CCE/TA - industry volatility buffer	Observations	509	4003	2266	33117	3814	4188	20066	0
	Mean	-0.02	-1.15	0.05	-0.05	0.00	0.00	-0.15	-
	StDev	0.25	1.29	0.10	0.17	0.12	0.12	0.37	-
	Min	-0.66	-3.02	-0.07	-0.32	-0.12	-0.14	-1.48	-
	1st quartile	-0.05	-2.77	-0.02	-0.17	-0.07	-0.07	-0.20	-
	Median	-0.02	-0.32	0.03	-0.06	-0.03	-0.03	-0.12	-
	3rd quartile	0.07	-0.20	0.09	0.00	0.02	0.03	0.00	-
	Max	0.93	0.81	0.86	0.94	0.90	0.94	0.94	-

Note: all values in the table are determined on the full time series aggregate (1998-2012). While the data is presented on the highest industry classification level, industry means, medians, and volatility buffers have actually been calculated on a more accurate 2-digit SIC basis, which distinguishes 57 sub-industries in our data set. Due to very high EBITDA volatility, all observations of excess cash measure 3 in the non-classifyable

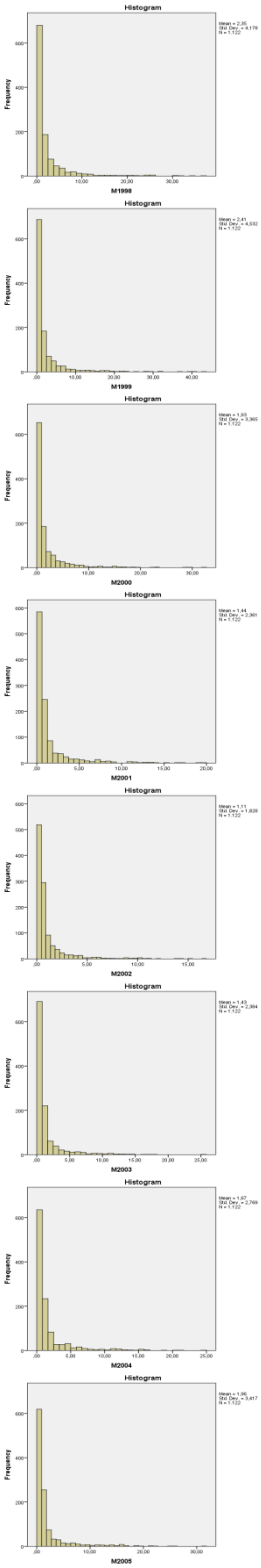
Appendix F – Full descriptives tables of plain and log-transformed data sets

Variable	Obs	Zero/Excl	Mean	StDev	Skewness	Kurtosis	Min	Q1	Median	Q3	Max
ln(Market capitalization)	53,623	53,222	-0.10	1.21	0.54	0.00	-3.17	-0.93	-0.26	0.59	3.69
Earnings	67,365	39,480	-0.04	0.19	-3.29	13.71	-1.62	-0.03	0.02	0.05	0.27
Earnings growth t-2	45,411	61,434	-0.01	0.19	-2.35	25.24	-2.62	-0.03	0.00	0.03	1.10
Earnings growth t+2	46,363	60,482	0.01	0.19	0.00	11.69	-1.76	-0.04	0.01	0.05	1.38
Net assets growth t-2	43,660	63,185	-0.05	0.39	1.78	7.32	-0.87	-0.27	-0.08	0.09	3.07
Net assets growth t+2	44,829	62,016	0.22	0.69	4.39	30.19	-0.72	-0.10	0.07	0.30	8.69
R&D expenditure	67,386	39,459	0.01	0.03	4.70	23.74	0.00	0.00	0.00	0.00	0.25
R&D expenditure growth t-2	51,804	55,041	0.00	0.01	-5.41	48.74	-0.11	0.00	0.00	0.00	0.07
R&D expenditure growth t+2	51,804	55,041	0.00	0.01	2.45	52.75	-0.09	0.00	0.00	0.00	0.11
Interest expense	60,501	46,344	0.01	0.01	1.50	2.88	0.00	0.00	0.01	0.02	0.09
Interest expense growth t-2	39,252	67,593	0.00	0.01	0.70	4.17	-0.05	-0.01	0.00	0.00	0.07
Interest expense growth t+2	39,980	66,865	0.00	0.01	1.93	9.01	-0.04	0.00	0.00	0.01	0.12
Dividends paid	67,386	39,459	0.01	0.02	2.23	5.39	0.00	0.00	0.00	0.01	0.11
Dividends paid growth t-2	51,804	55,041	0.00	0.01	-0.31	8.94	-0.07	0.00	0.00	0.00	0.07
Dividends paid growth t+2	51,804	55,041	0.00	0.01	0.94	8.48	-0.07	0.00	0.00	0.00	0.09
Market capitalization growth t+2	35,895	70,950	0.19	2.58	2.28	26.55	-20.62	-0.28	0.01	0.35	29.20
Cash and equivalents	65,927	40,918	0.12	0.14	2.01	4.17	0.00	0.03	0.07	0.16	0.85
Cash and equivalents growth t-2	43,713	63,132	0.00	0.13	1.59	11.55	-0.58	-0.04	0.00	0.02	1.15
Cash and equivalents growth t+2	44,894	61,951	0.04	0.23	6.21	65.91	-0.52	-0.03	0.00	0.05	3.98

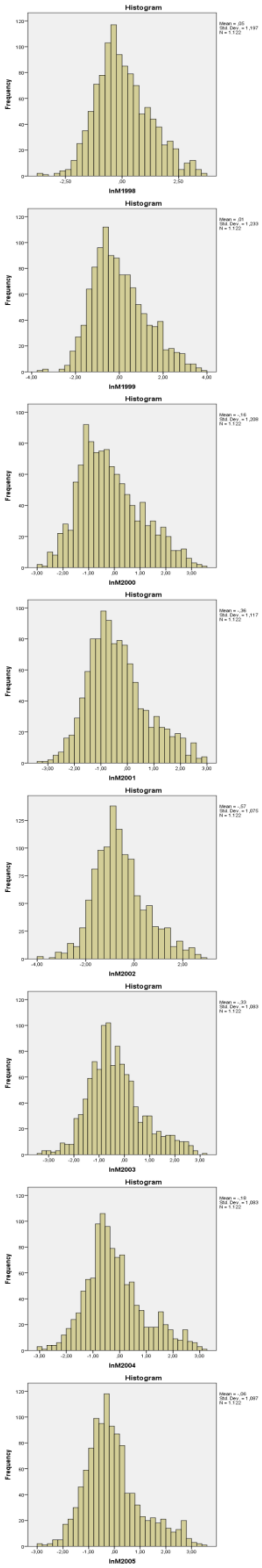
Note: all variables have been divided by total assets of the corresponding firm at each year; ln(X) denotes a log-transformed variable; outliers have been excluded.

Appendix G – Dependent variable transformation

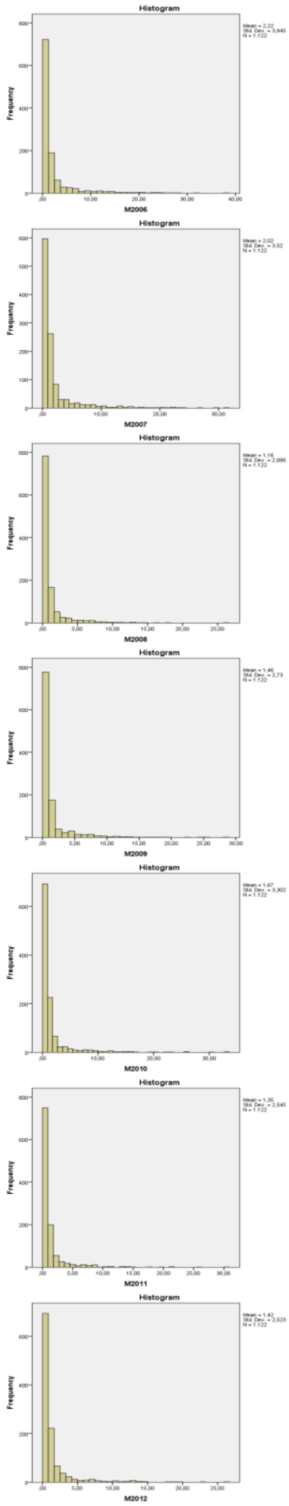
Distribution of M



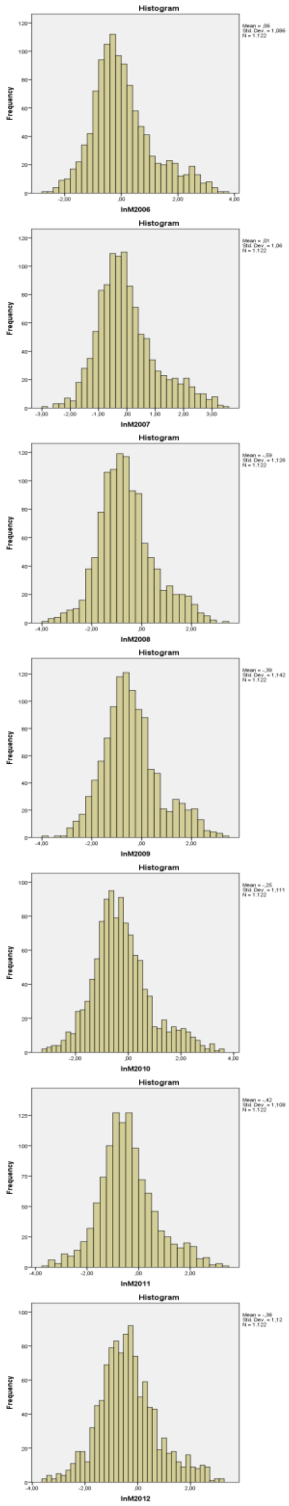
Distribution of ln(M)



Distribution of M

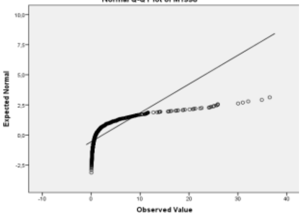


Distribution of ln(M)

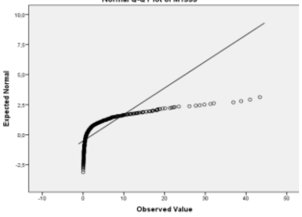


Distribution of M

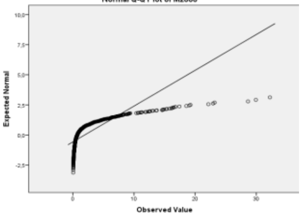
Normal Q-Q Plot of M1998



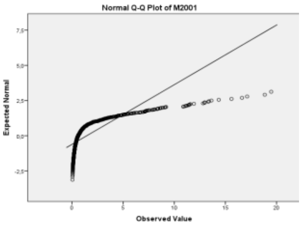
Normal Q-Q Plot of M1999



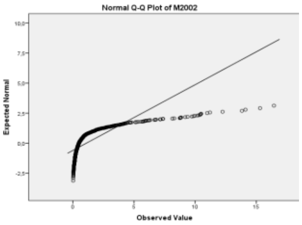
Normal Q-Q Plot of M2000



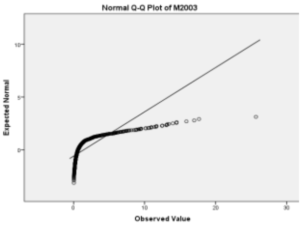
Normal Q-Q Plot of M2001



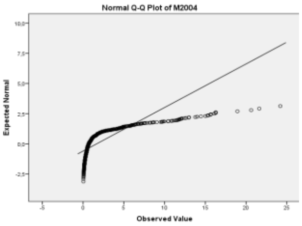
Normal Q-Q Plot of M2002



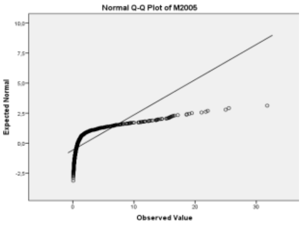
Normal Q-Q Plot of M2003



Normal Q-Q Plot of M2004

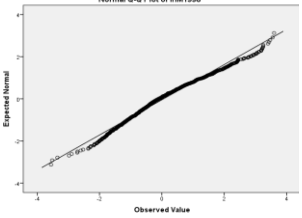


Normal Q-Q Plot of M2005

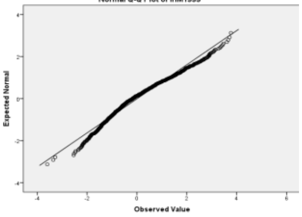


Distribution of ln(M)

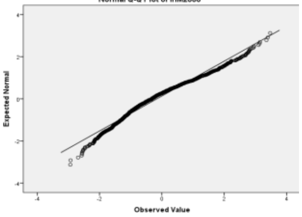
Normal Q-Q Plot of lnM1998



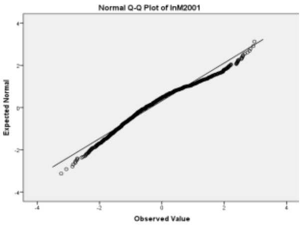
Normal Q-Q Plot of lnM1999



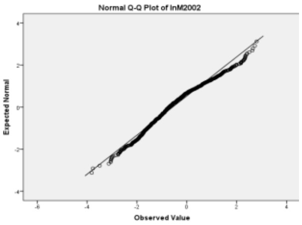
Normal Q-Q Plot of lnM2000



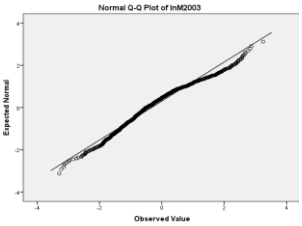
Normal Q-Q Plot of lnM2001



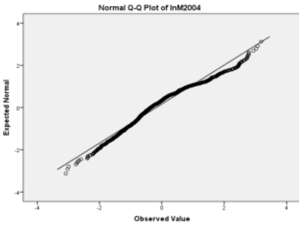
Normal Q-Q Plot of lnM2002



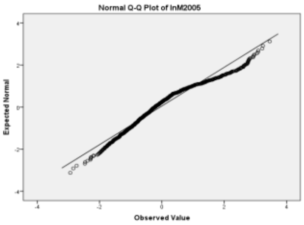
Normal Q-Q Plot of lnM2003



Normal Q-Q Plot of lnM2004

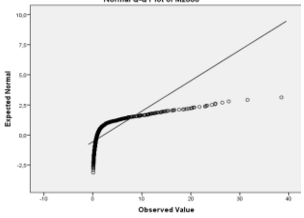


Normal Q-Q Plot of lnM2005

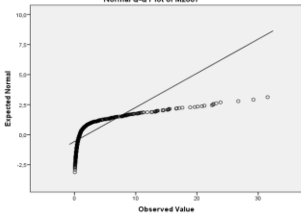


Distribution of M

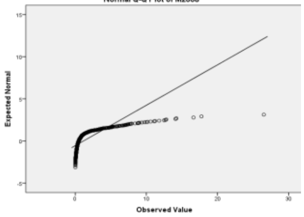
Normal Q-Q Plot of M2006



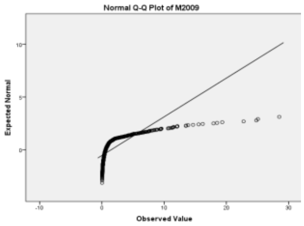
Normal Q-Q Plot of M2007



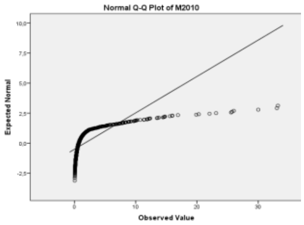
Normal Q-Q Plot of M2008



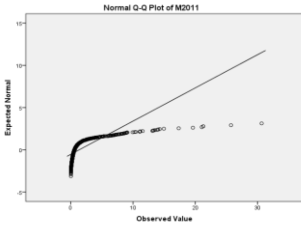
Normal Q-Q Plot of M2009



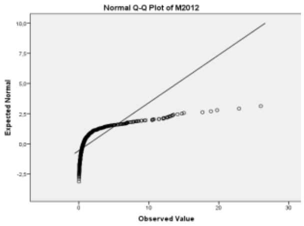
Normal Q-Q Plot of M2010



Normal Q-Q Plot of M2011

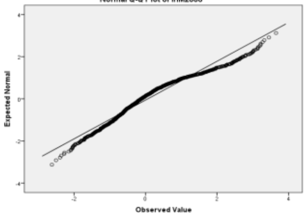


Normal Q-Q Plot of M2012

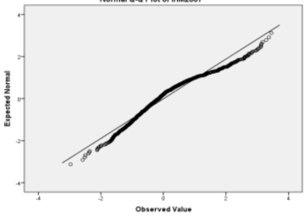


Distribution of ln(M)

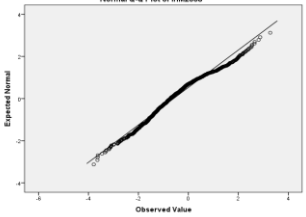
Normal Q-Q Plot of lnM2006



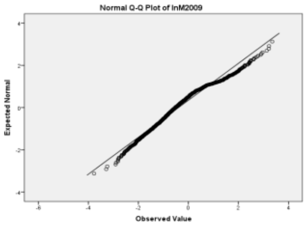
Normal Q-Q Plot of lnM2007



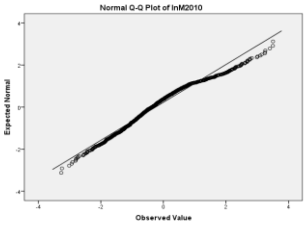
Normal Q-Q Plot of lnM2008



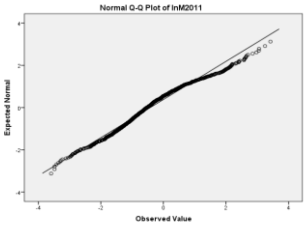
Normal Q-Q Plot of lnM2009



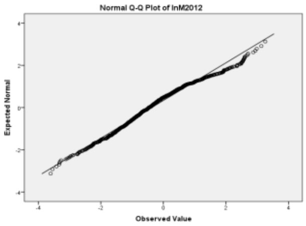
Normal Q-Q Plot of lnM2010



Normal Q-Q Plot of lnM2011



Normal Q-Q Plot of lnM2012



Appendix H – FM regression output –P&W method versus transformed data

Fama-MacBeth results Untransformed (left) and transformed (right)	Basic model	Extended model	Basic model	Extended model
Intercept	0.63 (0.14)	0.62 (0.14)	-0.69 (0.06)	-0.71 (0.06)
E_t	-1.60 (0.81)	-1.68 (0.82)	-0.48 (0.33)	-0.50 (0.34)
dE_t-2	-0.53 (0.59)	-0.55 (0.59)	-0.15 (0.25)	-0.15 (0.25)
dE_t+2	-0.48 (0.56)	-0.51 (0.57)	-0.32 (0.23)	-0.35 (0.23)
dNA_t-2	-0.46 (0.22)	-0.46 (0.22)	-0.42 (0.09)	-0.42 (0.09)
dNA_t+2	0.47 (0.17)	0.49 (0.17)	0.36 (0.07)	0.36 (0.07)
RD_T	13.21 (3.23)	12.77 (3.23)	5.68 (1.32)	5.53 (1.32)
dRD_t-2	3.04 (9.88)	2.46 (9.86)	1.62 (3.91)	1.39 (3.90)
dRD_t+2	11.91 (8.48)	12.07 (8.46)	5.80 (3.37)	5.83 (3.37)
I_t	-6.29 (5.86)	-6.12 (5.86)	-9.72 (2.37)	-9.45 (2.38)
dI_t-2	0.85 (6.69)	0.65 (6.68)	0.15 (2.69)	0.08 (2.69)
dI_t+2	-0.44 (6.07)	-0.53 (6.06)	-2.26 (2.49)	-2.25 (2.49)
D_t	22.18 (3.80)	21.82 (3.81)	13.71 (1.54)	13.65 (1.55)
dD_t-2	-3.74 (5.06)	-3.93 (5.06)	-2.64 (2.05)	-2.68 (2.05)
dD_t+2	20.32 (4.20)	20.10 (4.19)	11.81 (1.71)	11.65 (1.71)
dM_t+2	-0.30 (0.03)	-0.30 (0.03)	-0.07 (0.01)	-0.07 (0.01)
C_t	**0.76** (0.57)	**1.14** (0.67)	**0.87** (0.23)	**1.05** (0.27)
dC_t-2	-	0.33 (0.67)	-	0.10 (0.27)
dC_t+2	-	0.23 (0.55)	-	0.34 (0.23)
N	11	11	11	11
Adjusted R^2	0.368	0.372	0.369	0.371

Annual regressions	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010	
	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended
Intercept	-0.69 ***	-0.72 ***	-0.64 ***	-0.72 ***	-0.96 ***	-0.95 ***	-0.82 ***	-0.81 ***	-0.69 ***	-0.70 ***	-0.50 ***	-0.50 ***	-0.55 ***	-0.57 ***	-0.47 ***	-0.52 ***	-0.90 ***	-0.90 ***	-0.71 ***	-0.71 ***	-0.70 ***	-0.72 ***
	(0.073)	(0.074)	(0.072)	(0.074)	(0.058)	(0.060)	(0.050)	(0.051)	(0.049)	(0.050)	(0.059)	(0.060)	(0.044)	(0.046)	(0.050)	(0.052)	(0.055)	(0.056)	(0.057)	(0.059)	(0.057)	(0.057)
E_t	1.30 **	1.18 **	1.39 ***	1.04 **	0.10	0.16	0.00	0.07	-0.53 **	-0.36	-0.66 **	-0.69 **	-0.08	-0.14	-0.66 **	-0.83 ***	-1.51 ***	-1.36 ***	-2.06 ***	-2.03 ***	-2.58 ***	-2.57 ***
	(0.524)	(0.524)	(0.523)	(0.525)	(0.360)	(0.369)	(0.249)	(0.254)	(0.265)	(0.277)	(0.305)	(0.313)	(0.235)	(0.236)	(0.319)	(0.320)	(0.285)	(0.292)	(0.282)	(0.288)	(0.314)	(0.317)
dE_t-2	0.98 **	0.96 **	1.92 ***	1.81 ***	-0.34	-0.34	-0.43 ***	-0.43 ***	-0.58 ***	-0.54 ***	-0.60 ***	-0.61 ***	-0.33	-0.30	-0.09	-0.06	-0.35	-0.37 *	-0.98 ***	-0.98 ***	-0.90 ***	-0.82 ***
	(0.485)	(0.484)	(0.484)	(0.482)	(0.223)	(0.223)	(0.096)	(0.097)	(0.107)	(0.109)	(0.221)	(0.223)	(0.201)	(0.201)	(0.281)	(0.280)	(0.222)	(0.222)	(0.211)	(0.212)	(0.183)	(0.184)
dE_t+2	-0.24	-0.34	-0.02	-0.23	-0.01	0.05	-0.27	-0.19	-0.68 ***	-0.69 ***	-0.54 **	-0.51 **	0.48 ***	0.40 ***	0.20	0.06	-1.09 ***	-1.00 ***	-0.35	-0.34	-0.95 ***	-1.07 ***
	(0.231)	(0.234)	(0.330)	(0.331)	(0.296)	(0.302)	(0.196)	(0.199)	(0.175)	(0.175)	(0.221)	(0.221)	(0.149)	(0.152)	(0.231)	(0.233)	(0.252)	(0.257)	(0.222)	(0.226)	(0.244)	(0.245)
dNA_t-2	-0.50 ***	-0.49 ***	-0.22 **	-0.23 **	-0.28 ***	-0.28 ***	-0.11 *	-0.11 *	-0.28 ***	-0.27 ***	-0.53 ***	-0.54 ***	-0.44 ***	-0.43 ***	-0.60 ***	-0.59 ***	-0.30 ***	-0.29 ***	-0.44 ***	-0.44 ***	-0.96 ***	-0.94 ***
	(0.108)	(0.109)	(0.105)	(0.105)	(0.081)	(0.081)	(0.067)	(0.067)	(0.079)	(0.080)	(0.097)	(0.097)	(0.069)	(0.069)	(0.076)	(0.076)	(0.083)	(0.083)	(0.088)	(0.088)	(0.103)	(0.103)
dNA_t+2	0.34 ***	0.32 ***	0.54 ***	0.54 ***	0.03	0.03	0.06	0.08 *	0.11 ***	0.11 ***	0.06	0.08	0.38 ***	0.36 ***	0.76 ***	0.75 ***	0.32 ***	0.33 ***	0.63 ***	0.64 ***	0.68 ***	0.67 ***
	(0.077)	(0.077)	(0.104)	(0.103)	(0.083)	(0.083)	(0.045)	(0.046)	(0.040)	(0.040)	(0.049)	(0.050)	(0.044)	(0.045)	(0.070)	(0.070)	(0.081)	(0.081)	(0.076)	(0.077)	(0.085)	(0.085)
RD_t	9.32 ***	9.06 ***	10.78 ***	9.79 ***	5.11 ***	5.13 ***	7.18 ***	7.14 ***	5.48 ***	5.40 ***	4.61 ***	4.45 ***	4.60 ***	4.79 ***	5.42 ***	5.13 ***	2.61 **	2.58 **	3.09 **	3.10 **	4.26 ***	4.28 ***
	(2.231)	(2.228)	(1.801)	(1.799)	(1.163)	(1.164)	(0.919)	(0.921)	(0.948)	(0.949)	(1.315)	(1.319)	(1.035)	(1.038)	(1.180)	(1.178)	(1.257)	(1.258)	(1.261)	(1.263)	(1.381)	(1.377)
dRD_t-2	10.21 **	9.94 **	5.01	4.57	3.09	3.00	4.38	4.43	0.22	-0.29	1.56	1.42	2.74	3.14	1.20	0.69	2.70	2.54	-4.20	-4.17	-9.12	-10.00
	(4.585)	(4.578)	(3.802)	(3.778)	(3.014)	(3.016)	(2.799)	(2.797)	(2.735)	(2.743)	(3.544)	(3.544)	(3.290)	(3.286)	(3.609)	(3.595)	(4.310)	(4.308)	(5.139)	(5.142)	(6.169)	(6.158)
dRD_t+2	-1.57	-2.03	5.34	5.08	5.58 *	5.70 *	-0.96	-0.71	4.91 **	4.75 *	3.58	3.78	2.33	2.46	9.68 ***	9.51 ***	16.64 ***	16.95 ***	12.18 ***	12.17 ***	6.11	6.42
	(2.884)	(2.881)	(3.879)	(3.856)	(2.942)	(2.945)	(2.354)	(2.354)	(2.452)	(2.452)	(2.436)	(2.440)	(2.400)	(2.396)	(3.498)	(3.483)	(4.018)	(4.017)	(4.365)	(4.368)	(5.855)	(5.841)
I_t	-9.96 ***	-9.59 ***	-12.90 ***	-10.88 ***	-10.44 ***	-10.84 ***	-9.75 ***	-10.27 ***	-11.62 ***	-11.43 ***	-12.69 ***	-12.83 ***	-7.49 ***	-7.08 ***	-7.53 ***	-6.70 ***	-9.10 ***	-9.22 ***	-10.22 ***	-10.19 ***	-5.19 **	-4.95 **
	(2.890)	(2.885)	(3.002)	(3.011)	(2.440)	(2.475)	(2.006)	(2.019)	(2.076)	(2.081)	(2.487)	(2.488)	(1.840)	(1.852)	(2.235)	(2.239)	(2.355)	(2.358)	(2.369)	(2.374)	(2.373)	(2.369)
dI_t-2	-3.21	-3.55	-5.75	-5.38	0.69	0.53	1.87	1.68	7.59 ***	7.42 ***	10.52 ***	10.66 ***	6.99 ***	6.96 ***	0.00	-0.23	-4.54	-4.71 *	-6.76 **	-6.78 **	-5.79 **	-5.73 **
	(3.309)	(3.303)	(3.588)	(3.565)	(2.544)	(2.552)	(1.886)	(1.887)	(2.084)	(2.088)	(2.941)	(2.946)	(2.319)	(2.315)	(2.735)	(2.723)	(2.796)	(2.796)	(2.713)	(2.714)	(2.690)	(2.683)
dI_t+2	-0.26	-0.15	-7.67 **	-7.65 **	-5.19 *	-5.23 *	-3.51 *	-3.76 *	-4.76 **	-4.72 **	3.53 *	3.18	-3.71 **	-3.49 **	-4.25 *	-4.14 *	9.32 ***	9.57 ***	1.99	2.00	-10.32 ***	-10.40 ***
	(2.425)	(2.423)	(3.489)	(3.465)	(3.021)	(3.023)	(1.939)	(1.941)	(1.981)	(1.982)	(1.934)	(1.943)	(1.486)	(1.484)	(2.322)	(2.313)	(2.830)	(2.833)	(2.916)	(2.917)	(3.091)	(3.082)
D_t	4.60 **	4.63 **	10.32 ***	10.23 ***	15.61 ***	15.51 ***	13.93 ***	13.82 ***	14.13 ***	13.75 ***	11.99 ***	11.86 ***	9.59 ***	9.80 ***	15.21 ***	15.41 ***	17.01 ***	16.77 ***	18.31 ***	18.30 ***	20.10 ***	20.04 ***
	(1.915)	(1.924)	(1.973)	(1.976)	(1.669)	(1.673)	(1.323)	(1.323)	(1.316)	(1.328)	(1.617)	(1.628)	(1.155)	(1.155)	(1.383)	(1.383)	(1.455)	(1.461)	(1.565)	(1.568)	(1.589)	(1.585)
dD_t-2	-9.23 ***	-9.08 ***	-7.21 ***	-7.07 ***	-3.46	-3.50	-4.48 ***	-4.42 ***	-3.95 **	-4.24 **	-2.98	-3.08	-2.50	-2.52	-1.53	-1.12	0.93	0.34	4.38 **	4.29 **	0.95	0.94
	(2.771)	(2.765)	(2.658)	(2.648)	(2.165)	(2.167)	(1.623)	(1.623)	(1.799)	(1.803)	(2.357)	(2.362)	(1.703)	(1.700)	(1.939)	(1.934)	(2.040)	(2.054)	(1.782)	(1.793)	(1.760)	(1.757)
dD_t+2	8.46 ***	8.30 ***	13.82 ***	12.81 ***	12.40 ***	12.49 ***	12.03 ***	12.16 ***	5.99 ***	6.03 ***	8.15 ***	8.19 ***	6.30 ***	6.05 ***	10.46 ***	9.90 ***	12.07 ***	12.36 ***	18.00 ***	18.08 ***	22.23 ***	21.80 ***
	(2.102)	(2.098)	(2.170)	(2.165)	(1.850)	(1.854)	(1.474)	(1.474)	(1.369)	(1.373)	(1.579)	(1.579)	(1.154)	(1.154)	(1.538)	(1.537)	(1.645)	(1.651)	(1.853)	(1.862)	(2.035)	(2.037)
dM_t+2	-0.34 ***	-0.33 ***	-0.38 ***	-0.39 ***	0.29 ***	0.29 ***	0.18 ***	0.19 ***	0.18 ***	0.18 ***	0.13 ***	0.14 ***	-0.32 ***	-0.32 ***	-0.39 ***	-0.39 ***	0.18 ***	0.18 ***	-0.07 ***	-0.07 ***	-0.24 ***	-0.25 ***
	(0.012)	(0.012)	(0.027)	(0.027)	(0.015)	(0.016)	(0.007)	(0.007)	(0.006)	(0.006)	(0.010)	(0.010)	(0.007)	(0.007)	(0.012)	(0.012)	(0.010)	(0.010)	(0.017)	(0.017)	(0.019)	(0.019)
C_t	0.68 ***	1.05 ***	1.03 ***	1.86 ***	1.01 ***	0.92 ***	1.13 ***	1.12 ***	0.92 ***	1.13 ***	1.50 ***	1.57 ***	0.94 ***	0.94 ***	0.44 **	0.67 ***	0.62 ***	0.72 ***	0.74 ***	0.76 ***	0.59 **	0.79 ***
	(0.263)	(0.379)	(0.275)	(0.361)	(0.261)	(0.280)	(0.227)	(0.227)	(0.206)	(0.228)	(0.235)	(0.294)	(0.159)	(0.213)	(0.187)	(0.240)	(0.240)	(0.262)	(0.246)	(0.256)	(0.248)	(0.270)
dC_t-2		-0.07		0.18		0.02		0.18		0.50 **		0.24		-0.32		-0.23		0.49 **		0.13		0.01
		(0.388)		(0.338)		(0.199)		(0.199)		(0.238)		(0.309)		(0.220)		(0.247)		(0.242)		(0.262)		(0.304)
dC_t+2		0.90 ***		1.74 ***		-0.27		-0.33 **		0.05		-0.31 *		0.47 ***		0.97 ***		-0.38		-0.05		0.96 ***
		(0.290)		(0.357)		(0.259)		(0.161)		(0.142)		(0.171)		(0.152)		(0.213)		(0.251)		(0.247)		(0.270)
N	1571	1569	1717	1715	1777	1775	1853	1851	1821	1819	1854	1852	2007	2005	2115	2113	2157	2155	2100	2098	2001	1999
Adjusted R^2	0.48	0.48	0.23	0.24	0.31	0.31	0.43	0.43	0.46	0.46	0.28	0.28	0.61	0.61	0.45	0.45	0.30	0.30	0.22	0.22	0.30	0.30

Note: * refers to significance at 10%, ** to significance at 5%, and *** to significance at the 1% level; M = Market capitalization, E = Earnings, NA = Net Assets, RD = R&D, I = Interest, D = Dividends, C = Cash and equivalents.

Appendix I – Regression output for transformed data with slope dummies

Fama-MacBeth results Transformed variables	**Basic model**	**Extended model**	**Basic model with ECM2a dummies**	**Extended model with ECM2a dummies**	**Basic model with ECM2b dummies**	**Extended model with ECM2b dummies**
Intercept	-0.69	-0.71	-0.75	-0.76	-0.75	-0.76
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
E_t	-0.48	-0.50	-0.43	-0.45	-0.42	-0.44
	(0.33)	(0.34)	(0.33)	(0.34)	(0.33)	(0.34)
dE_t-2	-0.15	-0.15	-0.13	-0.13	-0.13	-0.13
	(0.25)	(0.25)	(0.25)	(0.25)	(0.25)	(0.25)
dE_t+2	-0.32	-0.35	-0.31	-0.34	-0.31	-0.34
	(0.23)	(0.23)	(0.23)	(0.23)	(0.23)	(0.23)
dNA_t-2	-0.42	-0.42	-0.41	-0.41	-0.41	-0.41
	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
dNA_t+2	0.36	0.36	0.35	0.35	0.36	0.36
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
RD_t	5.68	5.53	5.35	5.22	5.51	5.38
	(1.32)	(1.32)	(1.32)	(1.32)	(1.32)	(1.32)
dRD_t-2	1.62	1.39	1.37	1.16	1.44	1.23
	(3.91)	(3.90)	(3.91)	(3.90)	(3.90)	(3.90)
dRD_t+2	5.80	5.83	5.74	5.78	5.70	5.74
	(3.37)	(3.37)	(3.37)	(3.36)	(3.37)	(3.36)
I_t	-9.72	-9.45	-9.25	-9.05	-9.30	-9.09
	(2.37)	(2.38)	(2.37)	(2.38)	(2.37)	(2.38)
dI_t-2	0.15	0.08	0.19	0.12	0.15	0.08
	(2.69)	(2.69)	(2.69)	(2.68)	(2.69)	(2.68)
dI_t+2	-2.26	-2.25	-2.14	-2.14	-2.05	-2.06
	(2.49)	(2.49)	(2.49)	(2.49)	(2.49)	(2.49)
D_t	13.71	13.65	13.76	13.72	13.81	13.76
	(1.54)	(1.55)	(1.54)	(1.54)	(1.54)	(1.54)
dD_t-2	-2.64	-2.68	-2.65	-2.67	-2.57	-2.60
	(2.05)	(2.05)	(2.05)	(2.05)	(2.05)	(2.05)
dD_t+2	11.81	11.65	11.79	11.65	11.75	11.60
	(1.71)	(1.71)	(1.70)	(1.71)	(1.70)	(1.71)
dM_t+2	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
C_t	**0.87**	**1.05**	**1.43**	**1.55**	**1.36**	**1.48**
	(0.23)	(0.27)	(0.43)	(0.44)	(0.45)	(0.46)
C_t*dum1	-	-	***2.71***	***2.71***	***3.70***	***3.66***
			(1.12)	(1.12)	(1.42)	(1.42)
C_t*dum3	-	-	***-0.48***	***-0.45***	***-0.36***	***-0.33***
			(0.38)	(0.38)	(0.40)	(0.40)
dC_t-2	-	0.10	-	0.08	-	0.07
		(0.27)		(0.27)		(0.27)
dC_t+2	-	0.34	-	0.31	-	0.32
		(0.23)		(0.23)		(0.23)
N	11	11	11	11	11	11
Adjusted R^2	0.369	0.371	0.372	0.374	0.372	0.374

Annual regressions Transformed data Slope ECM2a dummies	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010	
	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended
Intercept	-0.74 ***	-0.76 ***	-0.75 ***	-0.82 ***	-1.01 ***	-0.99 ***	-0.89 ***	-0.88 ***	-0.78 ***	-0.79 ***	-0.58 ***	-0.58 ***	-0.58 ***	-0.60 ***	-0.49 ***	-0.53 ***	-0.93 ***	-0.93 ***	-0.73 ***	-0.73 ***	-0.72 ***	-0.74 ***
	(0.076)	(0.076)	(0.076)	(0.077)	(0.063)	(0.064)	(0.055)	(0.055)	(0.053)	(0.054)	(0.063)	(0.064)	(0.047)	(0.048)	(0.054)	(0.055)	(0.060)	(0.061)	(0.065)	(0.066)	(0.064)	(0.064)
E_t	1.39 ***	1.28 **	1.47 ***	1.13 **	0.18	0.25	0.06	0.13	-0.46 *	-0.30	-0.58 *	-0.62 **	-0.03	-0.09	-0.65 **	-0.82 **	-1.49 ***	-1.34 ***	-2.05 ***	-2.02 ***	-2.58 ***	-2.57 ***
	(0.524)	(0.525)	(0.521)	(0.523)	(0.363)	(0.371)	(0.249)	(0.254)	(0.265)	(0.276)	(0.305)	(0.312)	(0.235)	(0.236)	(0.319)	(0.319)	(0.286)	(0.293)	(0.282)	(0.288)	(0.314)	(0.317)
dE_t-2	1.01 **	0.99 **	1.89 ***	1.80 ***	-0.31	-0.30	-0.42 ***	-0.41 ***	-0.55 ***	-0.50 ***	-0.53 **	-0.55 **	-0.27	-0.24	-0.09	-0.06	-0.34	-0.37 *	-0.97 ***	-0.97 ***	-0.89 ***	-0.81 ***
	(0.484)	(0.483)	(0.482)	(0.480)	(0.224)	(0.224)	(0.096)	(0.097)	(0.107)	(0.109)	(0.221)	(0.223)	(0.202)	(0.202)	(0.281)	(0.280)	(0.222)	(0.222)	(0.212)	(0.212)	(0.183)	(0.184)
dE_t+2	-0.19	-0.28	0.00	-0.20	0.01	0.08	-0.30	-0.21	-0.66 ***	-0.67 ***	-0.55 **	-0.53 **	0.46 ***	0.38 **	0.18	0.04	-1.08 ***	-0.99 ***	-0.35	-0.34	-0.95 ***	-1.06 ***
	(0.231)	(0.235)	(0.329)	(0.330)	(0.297)	(0.303)	(0.196)	(0.199)	(0.174)	(0.174)	(0.220)	(0.220)	(0.149)	(0.152)	(0.231)	(0.233)	(0.252)	(0.257)	(0.222)	(0.226)	(0.243)	(0.245)
dNA_t-2	-0.46 ***	-0.45 ***	-0.17 *	-0.19 *	-0.28 ***	-0.28 ***	-0.12 *	-0.12 *	-0.30 ***	-0.28 ***	-0.51 ***	-0.52 ***	-0.43 ***	-0.42 ***	-0.60 ***	-0.59 ***	-0.30 ***	-0.29 ***	-0.43 ***	-0.43 ***	-0.95 ***	-0.93 ***
	(0.109)	(0.109)	(0.105)	(0.105)	(0.081)	(0.081)	(0.067)	(0.067)	(0.079)	(0.079)	(0.097)	(0.097)	(0.069)	(0.069)	(0.076)	(0.076)	(0.083)	(0.083)	(0.088)	(0.089)	(0.103)	(0.103)
dNA_t+2	0.34 ***	0.32 ***	0.56 ***	0.55 ***	0.03	0.03	0.06	0.08 *	0.09 **	0.10 **	0.06	0.08	0.37 ***	0.35 ***	0.76 ***	0.75 ***	0.31 ***	0.32 ***	0.63 ***	0.63 ***	0.68 ***	0.67 ***
	(0.077)	(0.077)	(0.103)	(0.103)	(0.083)	(0.083)	(0.045)	(0.046)	(0.040)	(0.040)	(0.049)	(0.050)	(0.044)	(0.045)	(0.070)	(0.070)	(0.081)	(0.081)	(0.077)	(0.077)	(0.085)	(0.085)
RD_t	8.47 ***	8.27 ***	10.20 ***	9.33 ***	4.98 ***	5.00 ***	6.94 ***	6.88 ***	5.17 ***	5.09 ***	4.07 ***	3.92 ***	4.40 ***	4.59 ***	5.14 ***	4.85 ***	2.39 *	2.37 *	2.96 **	2.97 **	4.12 ***	4.15 ***
	(2.256)	(2.253)	(1.801)	(1.801)	(1.167)	(1.167)	(0.920)	(0.922)	(0.945)	(0.945)	(1.320)	(1.322)	(1.036)	(1.038)	(1.191)	(1.188)	(1.262)	(1.262)	(1.264)	(1.267)	(1.386)	(1.383)
dRD_t-2	9.19 **	9.00 *	4.82	4.42	3.00	2.88	4.67 *	4.73 *	0.07	-0.41	1.03	0.90	2.57	2.97	0.97	0.45	2.69	2.53	-4.42	-4.39	-9.49	-10.31 *
	(4.601)	(4.595)	(3.791)	(3.771)	(3.015)	(3.017)	(2.792)	(2.790)	(2.719)	(2.727)	(3.532)	(3.532)	(3.283)	(3.279)	(3.616)	(3.601)	(4.309)	(4.307)	(5.141)	(5.145)	(6.173)	(6.162)
dRD_t+2	-1.82	-2.24	5.45	5.23	5.29 *	5.41 *	-0.83	-0.56	4.64 *	4.50 *	3.67	3.91	2.37	2.51	9.47 ***	9.29 ***	16.59 ***	16.92 ***	12.39 ***	12.37 ***	5.95	6.26
	(2.886)	(2.883)	(3.862)	(3.844)	(2.947)	(2.950)	(2.347)	(2.348)	(2.439)	(2.439)	(2.426)	(2.430)	(2.394)	(2.392)	(3.496)	(3.482)	(4.018)	(4.017)	(4.367)	(4.369)	(5.850)	(5.837)
I_t	-9.40 ***	-9.10 ***	-11.64 ***	-9.97 ***	-10.07 ***	-10.52 ***	-9.04 ***	-9.58 ***	-10.85 ***	-10.72 ***	-11.88 ***	-12.05 ***	-7.30 ***	-6.91 ***	-7.57 ***	-6.74 ***	-8.97 ***	-9.08 ***	-10.08 ***	-10.07 ***	-4.98 **	-4.79 **
	(2.893)	(2.889)	(3.000)	(3.008)	(2.448)	(2.480)	(2.010)	(2.022)	(2.074)	(2.078)	(2.489)	(2.489)	(1.846)	(1.855)	(2.235)	(2.238)	(2.359)	(2.363)	(2.381)	(2.386)	(2.381)	(2.377)
dI_t-2	-3.23	-3.56	-6.12 *	-5.75	0.76	0.59	1.87	1.66	7.85 ***	7.65 ***	10.49 ***	10.67 ***	7.29 ***	7.26 ***	0.08	-0.16	-4.20	-4.37	-6.92 **	-6.93 **	-5.78 **	-5.74 **
	(3.303)	(3.298)	(3.571)	(3.552)	(2.543)	(2.551)	(1.881)	(1.882)	(2.072)	(2.077)	(2.929)	(2.933)	(2.315)	(2.312)	(2.733)	(2.721)	(2.801)	(2.801)	(2.715)	(2.717)	(2.692)	(2.685)
dI_t+2	-0.20	-0.08	-7.09 **	-7.11 **	-4.98 *	-5.01 *	-3.42 *	-3.68 *	-4.61 **	-4.55 **	3.31 *	2.92	-3.61 **	-3.40 **	-4.13 *	-4.03 *	9.23 ***	9.49 ***	2.27	2.28	-10.29 ***	-10.40 ***
	(2.421)	(2.419)	(3.476)	(3.457)	(3.022)	(3.023)	(1.935)	(1.937)	(1.970)	(1.972)	(1.928)	(1.937)	(1.483)	(1.481)	(2.322)	(2.312)	(2.830)	(2.832)	(2.921)	(2.922)	(3.092)	(3.084)
D_t	4.49 **	4.57 **	10.32 ***	10.35 ***	15.70 ***	15.59 ***	13.93 ***	13.82 ***	14.09 ***	13.71 ***	12.19 ***	12.10 ***	9.82 ***	10.01 ***	15.10 ***	15.31 ***	16.97 ***	16.74 ***	18.42 ***	18.41 ***	20.34 ***	20.28 ***
	(1.913)	(1.922)	(1.964)	(1.970)	(1.671)	(1.673)	(1.321)	(1.321)	(1.308)	(1.320)	(1.611)	(1.622)	(1.153)	(1.154)	(1.383)	(1.382)	(1.455)	(1.461)	(1.567)	(1.570)	(1.591)	(1.587)
dD_t-2	-9.24 ***	-9.09 ***	-7.70 ***	-7.43 ***	-3.58 *	-3.64 *	-4.39 ***	-4.31 ***	-3.90 **	-4.18 **	-2.97	-3.04	-2.33	-2.35	-1.66	-1.25	0.97	0.40	4.46 **	4.37 **	1.20	1.19
	(2.769)	(2.763)	(2.648)	(2.641)	(2.167)	(2.168)	(1.624)	(1.622)	(1.789)	(1.793)	(2.348)	(2.353)	(1.700)	(1.697)	(1.938)	(1.932)	(2.039)	(2.054)	(1.783)	(1.793)	(1.761)	(1.758)
dD_t+2	8.66 ***	8.49 ***	13.76 ***	12.83 ***	12.38 ***	12.48 ***	12.17 ***	12.31 ***	6.02 ***	6.09 ***	8.21 ***	8.25 ***	6.23 ***	5.99 ***	10.36 ***	9.79 ***	11.86 ***	12.16 ***	17.91 ***	17.99 ***	22.19 ***	21.76 ***
	(2.102)	(2.099)	(2.160)	(2.157)	(1.850)	(1.854)	(1.470)	(1.471)	(1.361)	(1.365)	(1.575)	(1.575)	(1.151)	(1.152)	(1.539)	(1.537)	(1.648)	(1.654)	(1.854)	(1.863)	(2.033)	(2.035)
dM_t+2	-0.34 ***	-0.33 ***	-0.38 ***	-0.39 ***	0.28 ***	0.29 ***	0.18 ***	0.18 ***	0.17 ***	0.17 ***	0.13 ***	0.14 ***	-0.31 ***	-0.32 ***	-0.39 ***	-0.39 ***	0.18 ***	0.18 ***	-0.07 ***	-0.07 ***	-0.24 ***	-0.25 ***
	(0.012)	(0.012)	(0.027)	(0.027)	(0.016)	(0.016)	(0.007)	(0.007)	(0.006)	(0.006)	(0.010)	(0.010)	(0.007)	(0.007)	(0.012)	(0.012)	(0.010)	(0.010)	(0.017)	(0.017)	(0.019)	(0.019)
C_t	1.50 ***	1.73 ***	2.99 ***	3.45 ***	1.53 ***	1.45 ***	2.08 ***	2.09 ***	1.87 ***	2.05 ***	2.14 ***	2.17 ***	1.06 ***	1.05 ***	0.42	0.63 *	0.91 **	1.02 **	0.73	0.73	0.53	0.67
	(0.515)	(0.566)	(0.569)	(0.590)	(0.523)	(0.528)	(0.436)	(0.436)	(0.357)	(0.367)	(0.389)	(0.418)	(0.272)	(0.297)	(0.319)	(0.341)	(0.427)	(0.436)	(0.447)	(0.451)	(0.423)	(0.434)
C_t*dum1	2.59 **	2.50 **	3.25 **	3.09 **	1.89	2.02	3.00 ***	3.14 ***	3.89 ***	3.92 ***	3.69 ***	3.76 ***	2.41 ***	2.35 ***	2.07 **	2.13 **	2.14 *	2.11 *	2.04	2.02	2.85 **	2.72 **
	(1.257)	(1.255)	(1.429)	(1.422)	(1.240)	(1.244)	(1.136)	(1.137)	(0.967)	(0.967)	(0.985)	(0.986)	(0.691)	(0.690)	(0.858)	(0.855)	(1.162)	(1.161)	(1.324)	(1.327)	(1.226)	(1.224)
C_t*dum3	-0.78 *	-0.70	-1.91 ***	-1.67 ***	-0.47	-0.51	-0.88 **	-0.89 **	-0.85 ***	-0.82 ***	-0.59 *	-0.58	-0.04	-0.04	0.11	0.13	-0.22	-0.24	0.12	0.12	0.22	0.27
	(0.471)	(0.472)	(0.508)	(0.510)	(0.469)	(0.471)	(0.387)	(0.387)	(0.315)	(0.316)	(0.354)	(0.355)	(0.245)	(0.246)	(0.285)	(0.285)	(0.383)	(0.384)	(0.392)	(0.392)	(0.374)	(0.373)
dC_t-2		-0.13		0.04		0.00		0.18		0.50 **		0.19		-0.31		-0.24		0.48 **		0.12		0.00
		(0.388)		(0.339)		(0.199)		(0.198)		(0.237)		(0.308)		(0.220)		(0.248)		(0.242)		(0.262)		(0.303)
dC_t+2		0.86 ***		1.63 ***		-0.32		-0.36 **		0.01		-0.33 **		0.46 ***		0.98 ***		-0.39		-0.06		0.96 ***
		(0.290)		(0.357)		(0.260)		(0.160)		(0.142)		(0.170)		(0.152)		(0.213)		(0.252)		(0.247)		(0.270)
N	1569	1567	1715	1713	1775	1773	1851	1849	1819	1817	1852	1850	2005	2003	2113	2111	2155	2153	2098	2096	1999	1997
Adjusted R^2	0.48	0.48	0.24	0.25	0.31	0.31	0.44	0.44	0.46	0.47	0.28	0.28	0.61	0.61	0.45	0.46	0.30	0.30	0.22	0.22	0.30	0.30

Note: *refers to significance at 10%, **to significance at 5%, and ***to significance at the 1% level; M = Market capitalization, E = Earnings, NA = Net Assets, RD = R&D, I = Interest, D = Dividends, C = Cash and equivalents; Excess Cash measure 2a is calculated as CCE/TA - industry mean CCE/TA.

Annual regressions Transformed data	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010	
Slope ECM2b dummies	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended
Intercept	-0.74 ***	-0.77 ***	-0.77 ***	-0.84 ***	-1.02 ***	-1.00 ***	-0.87 ***	-0.85 ***	-0.81 ***	-0.82 ***	-0.56 ***	-0.56 ***	-0.58 ***	-0.59 ***	-0.49 ***	-0.54 ***	-0.91 ***	-0.91 ***	-0.73 ***	-0.73 ***	-0.73 ***	-0.75 ***
	(0.076)	(0.077)	(0.078)	(0.079)	(0.064)	(0.066)	(0.056)	(0.057)	(0.054)	(0.055)	(0.065)	(0.065)	(0.048)	(0.049)	(0.054)	(0.056)	(0.062)	(0.063)	(0.067)	(0.068)	(0.065)	(0.066)
E_t	1.45 ***	1.34 **	1.54 ***	1.20 **	0.19	0.25	0.05	0.12	-0.48 *	-0.31	-0.59 *	-0.62 **	-0.05	-0.12	-0.64 **	-0.81 **	-1.48 ***	-1.33 ***	-2.04 ***	-2.01 ***	-2.55 ***	-2.54 ***
	(0.526)	(0.526)	(0.521)	(0.524)	(0.362)	(0.370)	(0.251)	(0.255)	(0.264)	(0.276)	(0.306)	(0.313)	(0.235)	(0.236)	(0.319)	(0.319)	(0.286)	(0.293)	(0.282)	(0.288)	(0.313)	(0.316)
dE_t-2	1.00 **	0.98 **	1.95 ***	1.85 ***	-0.31	-0.30	-0.43 ***	-0.42 ***	-0.55 ***	-0.51 ***	-0.56 **	-0.58 ***	-0.29	-0.27	-0.08	-0.05	-0.34	-0.37 *	-0.97 ***	-0.97 ***	-0.88 ***	-0.80 ***
	(0.484)	(0.483)	(0.482)	(0.479)	(0.223)	(0.224)	(0.096)	(0.097)	(0.107)	(0.109)	(0.222)	(0.223)	(0.202)	(0.202)	(0.281)	(0.280)	(0.222)	(0.222)	(0.211)	(0.212)	(0.183)	(0.184)
dE_t+2	-0.18	-0.27	0.03	-0.17	0.01	0.08	-0.28	-0.20	-0.71 ***	-0.71 ***	-0.54 **	-0.51 **	0.46 ***	0.38 **	0.20	0.05	-1.07 ***	-0.99 ***	-0.35	-0.34	-0.93 ***	-1.04 ***
	(0.231)	(0.235)	(0.329)	(0.330)	(0.296)	(0.302)	(0.196)	(0.199)	(0.174)	(0.174)	(0.220)	(0.221)	(0.150)	(0.152)	(0.231)	(0.233)	(0.252)	(0.257)	(0.222)	(0.226)	(0.243)	(0.244)
dNA_t-2	-0.45 ***	-0.44 ***	-0.19 *	-0.20 *	-0.28 ***	-0.28 ***	-0.12 *	-0.12 *	-0.30 ***	-0.28 ***	-0.51 ***	-0.52 ***	-0.43 ***	-0.42 ***	-0.59 ***	-0.58 ***	-0.30 ***	-0.29 ***	-0.43 ***	-0.43 ***	-0.95 ***	-0.93 ***
	(0.109)	(0.110)	(0.105)	(0.104)	(0.081)	(0.081)	(0.067)	(0.067)	(0.079)	(0.079)	(0.097)	(0.097)	(0.069)	(0.069)	(0.076)	(0.076)	(0.083)	(0.083)	(0.088)	(0.088)	(0.103)	(0.103)
dNA_t+2	0.34 ***	0.33 ***	0.56 ***	0.56 ***	0.03	0.03	0.06	0.08 *	0.10 **	0.10 **	0.05	0.07	0.37 ***	0.36 ***	0.75 ***	0.74 ***	0.31 ***	0.32 ***	0.63 ***	0.64 ***	0.69 ***	0.68 ***
	(0.077)	(0.077)	(0.103)	(0.103)	(0.083)	(0.083)	(0.045)	(0.046)	(0.040)	(0.040)	(0.049)	(0.050)	(0.044)	(0.045)	(0.070)	(0.070)	(0.081)	(0.081)	(0.076)	(0.077)	(0.084)	(0.084)
RD_t	8.76 ***	8.56 ***	10.60 ***	9.69 ***	5.10 ***	5.13 ***	7.18 ***	7.14 ***	5.31 ***	5.22 ***	4.33 ***	4.19 ***	4.54 ***	4.73 ***	5.31 ***	5.02 ***	2.50 **	2.48 **	2.86 **	2.87 **	4.13 ***	4.17 ***
	(2.235)	(2.232)	(1.792)	(1.792)	(1.162)	(1.163)	(0.919)	(0.921)	(0.942)	(0.943)	(1.322)	(1.325)	(1.039)	(1.041)	(1.185)	(1.183)	(1.260)	(1.260)	(1.265)	(1.268)	(1.382)	(1.379)
dRD_t-2	9.41 **	9.24 **	4.80	4.44	3.02	2.91	4.54	4.60	0.05	-0.43	1.20	1.08	2.69	3.09	1.31	0.80	2.60	2.46	-4.73	-4.71	-9.04	-9.91
	(4.584)	(4.578)	(3.781)	(3.761)	(3.012)	(3.013)	(2.799)	(2.797)	(2.718)	(2.725)	(3.546)	(3.546)	(3.289)	(3.285)	(3.615)	(3.600)	(4.310)	(4.308)	(5.136)	(5.139)	(6.149)	(6.137)
dRD_t+2	-1.62	-2.05	4.53	4.41	5.49 *	5.61 *	-0.78	-0.52	4.67 *	4.52 *	3.67	3.89	2.22	2.35	9.22 ***	9.02 ***	16.87 ***	17.14 ***	12.53 ***	12.52 ***	5.92	6.23
	(2.879)	(2.877)	(3.862)	(3.842)	(2.942)	(2.945)	(2.354)	(2.355)	(2.435)	(2.435)	(2.434)	(2.438)	(2.400)	(2.397)	(3.500)	(3.486)	(4.022)	(4.021)	(4.362)	(4.365)	(5.836)	(5.823)
I_t	-9.54 ***	-9.23 ***	-11.62 ***	-9.90 ***	-9.90 ***	-10.36 ***	-9.28 ***	-9.80 ***	-10.64 ***	-10.49 ***	-12.26 ***	-12.43 ***	-7.30 ***	-6.92 ***	-7.51 ***	-6.68 ***	-9.10 ***	-9.21 ***	-10.06 ***	-10.04 ***	-5.08 **	-4.90 **
	(2.890)	(2.885)	(2.998)	(3.006)	(2.450)	(2.482)	(2.020)	(2.032)	(2.072)	(2.076)	(2.494)	(2.495)	(1.850)	(1.859)	(2.236)	(2.238)	(2.358)	(2.361)	(2.376)	(2.381)	(2.375)	(2.371)
dI_t-2	-3.41	-3.72	-5.97 *	-5.62	0.93	0.77	1.85	1.65	7.89 ***	7.69 ***	10.53 ***	10.69 ***	7.17 ***	7.12 ***	-0.13	-0.37	-4.36	-4.53	-6.92 **	-6.94 **	-5.92 **	-5.87 **
	(3.303)	(3.298)	(3.569)	(3.549)	(2.544)	(2.551)	(1.886)	(1.886)	(2.070)	(2.074)	(2.937)	(2.941)	(2.318)	(2.315)	(2.733)	(2.721)	(2.798)	(2.798)	(2.710)	(2.712)	(2.683)	(2.676)
dI_t+2	-0.23	-0.09	-7.10 **	-7.12 **	-5.11 *	-5.16 *	-3.40 *	-3.65 *	-4.66 **	-4.61 **	3.70 *	3.34 *	-3.64 **	-3.44 **	-4.07 *	-3.96 *	9.47 ***	9.70 ***	2.53	2.55	-10.07 ***	-10.18 ***
	(2.423)	(2.421)	(3.476)	(3.455)	(3.019)	(3.020)	(1.939)	(1.941)	(1.968)	(1.970)	(1.934)	(1.942)	(1.485)	(1.484)	(2.322)	(2.313)	(2.831)	(2.833)	(2.921)	(2.922)	(3.085)	(3.077)
D_t	4.42 **	4.52 **	10.41 ***	10.41 ***	15.71 ***	15.60 ***	13.96 ***	13.85 ***	14.24 ***	13.86 ***	12.23 ***	12.12 ***	9.80 ***	9.99 ***	15.10 ***	15.30 ***	17.04 ***	16.80 ***	18.56 ***	18.55 ***	20.42 ***	20.36 ***
	(1.916)	(1.923)	(1.963)	(1.969)	(1.669)	(1.672)	(1.323)	(1.323)	(1.307)	(1.318)	(1.617)	(1.629)	(1.157)	(1.157)	(1.383)	(1.382)	(1.455)	(1.461)	(1.567)	(1.570)	(1.587)	(1.582)
dD_t-2	-9.27 ***	-9.12 ***	-7.11 ***	-6.91 ***	-3.63 *	-3.68 *	-4.41 ***	-4.34 ***	-3.86 **	-4.15 **	-2.91	-2.99	-2.36	-2.39	-1.68	-1.27	1.00	0.42	4.64 ***	4.54 **	1.30	1.30
	(2.766)	(2.760)	(2.643)	(2.637)	(2.165)	(2.167)	(1.624)	(1.623)	(1.786)	(1.790)	(2.354)	(2.359)	(1.702)	(1.699)	(1.939)	(1.933)	(2.040)	(2.055)	(1.784)	(1.794)	(1.756)	(1.754)
dD_t+2	8.49 ***	8.33 ***	13.61 ***	12.67 ***	12.45 ***	12.55 ***	12.14 ***	12.28 ***	5.98 ***	6.05 ***	8.12 ***	8.16 ***	6.23 ***	5.99 ***	10.33 ***	9.75 ***	11.98 ***	12.27 ***	17.96 ***	18.04 ***	21.91 ***	21.46 ***
	(2.098)	(2.095)	(2.161)	(2.158)	(1.849)	(1.853)	(1.475)	(1.476)	(1.360)	(1.363)	(1.578)	(1.578)	(1.154)	(1.154)	(1.539)	(1.537)	(1.647)	(1.653)	(1.851)	(1.859)	(2.029)	(2.031)
dM_t+2	-0.34 ***	-0.33 ***	-0.38 ***	-0.39 ***	0.28 ***	0.29 ***	0.18 ***	0.18 ***	0.18 ***	0.18 ***	0.13 ***	0.14 ***	-0.31 ***	-0.32 ***	-0.39 ***	-0.39 ***	0.18 ***	0.18 ***	-0.07 ***	-0.07 ***	-0.24 ***	-0.25 ***
	(0.012)	(0.012)	(0.027)	(0.027)	(0.016)	(0.016)	(0.007)	(0.007)	(0.006)	(0.006)	(0.010)	(0.010)	(0.007)	(0.007)	(0.012)	(0.012)	(0.010)	(0.010)	(0.017)	(0.017)	(0.019)	(0.019)
C_t	1.54 ***	1.76 ***	3.07 ***	3.60 ***	1.63 ***	1.54 ***	1.63 ***	1.64 ***	2.16 ***	2.36 ***	1.96 ***	2.00 ***	1.02 ***	1.00 ***	0.48	0.70 **	0.57	0.64	0.54	0.56	0.40	0.53
	(0.567)	(0.603)	(0.616)	(0.635)	(0.550)	(0.554)	(0.457)	(0.457)	(0.375)	(0.384)	(0.407)	(0.434)	(0.279)	(0.303)	(0.329)	(0.349)	(0.452)	(0.459)	(0.467)	(0.471)	(0.441)	(0.449)
C_t*dum1	4.12 **	3.99 **	5.86 ***	5.45 ***	2.99 **	3.13 **	2.46 *	2.56 *	5.56 ***	5.62 ***	3.16 ***	3.18 ***	1.97 **	1.86 **	2.58 **	2.73 **	2.67	2.49	3.78 **	3.77 **	5.57 ***	5.43 ***
	(1.643)	(1.642)	(1.801)	(1.794)	(1.462)	(1.467)	(1.412)	(1.413)	(1.272)	(1.272)	(1.221)	(1.221)	(0.829)	(0.828)	(1.092)	(1.089)	(1.653)	(1.653)	(1.628)	(1.628)	(1.578)	(1.575)
C_t*dum3	-0.75	-0.68	-1.87 ***	-1.70 ***	-0.53	-0.56	-0.43	-0.46	-1.10 ***	-1.08 ***	-0.38	-0.38	0.00	0.01	0.06	0.08	0.17	0.19	0.40	0.40	0.50	0.56
	(0.511)	(0.514)	(0.545)	(0.546)	(0.487)	(0.488)	(0.402)	(0.402)	(0.326)	(0.326)	(0.365)	(0.366)	(0.249)	(0.250)	(0.290)	(0.291)	(0.397)	(0.398)	(0.402)	(0.402)	(0.382)	(0.382)
dC_t-2		-0.16		0.05		-0.01		0.18		0.51 **		0.20		-0.30		-0.24		0.48 **		0.14		-0.03
		(0.390)		(0.339)		(0.199)		(0.199)		(0.237)		(0.309)		(0.221)		(0.248)		(0.242)		(0.261)		(0.303)
dC_t+2		0.86 ***		1.65 ***		-0.32		-0.35 **		0.02		-0.32 *		0.46 ***		0.99 ***		-0.36		-0.05		0.97 ***
		(0.290)		(0.356)		(0.259)		(0.161)		(0.141)		(0.171)		(0.152)		(0.213)		(0.252)		(0.247)		(0.269)
N	1569	1567	1715	1713	1775	1773	1851	1849	1819	1817	1852	1850	2005	2003	2113	2111	2155	2153	2098	2096	1999	1997
Adjusted R^2	0.48	0.48	0.24	0.25	0.31	0.31	0.43	0.43	0.47	0.47	0.28	0.28	0.61	0.61	0.45	0.46	0.30	0.30	0.22	0.22	0.30	0.31

Note: *refers to significance at 10%, **to significance at 5%, and ***to significance at the 1% level; M = Market capitalization, E = Earnings, NA = Net Assets, RD = R&D, I= Interest, D = Dividends, C = Cash and equivalents; Excess Cash measure 2a is calculated as CCE/TA - industry mean CCE/TA.

Appendix J– Regression output for transformed data with slope and intercept dummies

Fama-MacBeth results Transformed variables	Basic model	Extended model	Basic model with ECM2a dummies	Extended model with ECM2a dummies	Basic model with ECM2b dummies	Extended model with ECM2b dummies
Intercept	-0.69	-0.71	-0.79	-0.80	-0.78	-0.79
	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)	(0.07)
E_t	-0.48	-0.50	-0.38	-0.40	-0.40	-0.42
	(0.33)	(0.34)	(0.33)	(0.34)	(0.33)	(0.34)
dE_t-2	-0.15	-0.15	-0.12	-0.12	-0.13	-0.12
	(0.25)	(0.25)	(0.25)	(0.25)	(0.25)	(0.25)
dE_t+2	-0.32	-0.35	-0.29	-0.32	-0.29	-0.33
	(0.23)	(0.23)	(0.23)	(0.23)	(0.23)	(0.23)
dNA_t-2	-0.42	-0.42	-0.41	-0.40	-0.41	-0.40
	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
dNA_t+2	0.36	0.36	0.35	0.35	0.35	0.35
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
RD_t	5.68	5.53	5.24	5.11	5.49	5.37
	(1.32)	(1.32)	(1.32)	(1.32)	(1.32)	(1.32)
dRD_t-2	1.62	1.39	1.39	1.18	1.53	1.32
	(3.91)	(3.90)	(3.90)	(3.90)	(3.90)	(3.90)
dRD_t+2	5.80	5.83	5.85	5.89	5.78	5.82
	(3.37)	(3.37)	(3.36)	(3.36)	(3.37)	(3.36)
I_t	-9.72	-9.45	-9.16	-8.96	-9.19	-8.99
	(2.37)	(2.38)	(2.38)	(2.38)	(2.38)	(2.38)
dI_t-2	0.15	0.08	0.16	0.09	0.11	0.05
	(2.69)	(2.69)	(2.68)	(2.68)	(2.69)	(2.68)
dI_t+2	-2.26	-2.25	-2.00	-2.01	-1.97	-1.97
	(2.49)	(2.49)	(2.49)	(2.49)	(2.49)	(2.49)
D_t	13.71	13.65	13.85	13.81	13.83	13.79
	(1.54)	(1.55)	(1.54)	(1.54)	(1.54)	(1.54)
dD_t-2	-2.64	-2.68	-2.58	-2.59	-2.53	-2.55
	(2.05)	(2.05)	(2.05)	(2.05)	(2.05)	(2.05)
dD_t+2	11.81	11.65	11.74	11.60	11.72	11.57
	(1.71)	(1.71)	(1.70)	(1.70)	(1.70)	(1.71)
dM_t+2	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
C_t	**0.87**	**1.05**	**1.79**	**1.89**	**1.66**	**1.77**
	(0.23)	(0.27)	(0.47)	(0.48)	(0.50)	(0.51)
dum1	-	-	0.18	0.18	0.11	0.11
			(0.09)	(0.09)	(0.09)	(0.09)
dum3	-	-	-0.03	-0.04	0.06	0.06
			(0.15)	(0.16)	(0.18)	(0.18)
C_t*dum1	-	-	***-0.33***	***-0.30***	***1.45***	***1.43***
			(1.78)	(1.78)	(2.20)	(2.20)
C_t*dum3	-	-	***-0.60***	***-0.55***	***-0.75***	***-0.70***
			(0.68)	(0.68)	(0.75)	(0.75)
dC_t-2	-	0.10	-	0.06	-	0.06
		(0.27)		(0.27)		(0.27)
dC_t+2	-	0.34	-	0.30	-	0.32
		(0.23)		(0.23)		(0.23)
N	11	11	11	11	11	11
Adjusted R^2	0.369	0.371	0.373	0.376	0.373	0.375

Annual regressions Transformed data Slope and intercept ECM2a dummies	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010	
	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended	Basic	Extended
Intercept	-0.79 ***	-0.81 ***	-0.83 ***	-0.89 ***	-1.01 ***	-0.99 ***	-0.91 ***	-0.90 ***	-0.82 ***	-0.83 ***	-0.61 ***	-0.61 ***	-0.62 ***	-0.63 ***	-0.50 ***	-0.54 ***	-0.98 ***	-0.98 ***	-0.81 ***	-0.81 ***	-0.77 ***	-0.79 ***
	(0.078)	(0.079)	(0.080)	(0.081)	(0.066)	(0.067)	(0.058)	(0.059)	(0.057)	(0.057)	(0.067)	(0.067)	(0.051)	(0.051)	(0.057)	(0.058)	(0.064)	(0.065)	(0.071)	(0.072)	(0.070)	(0.070)
E_t	1.45 ***	1.34 **	1.54 ***	1.21 **	0.20	0.27	0.07	0.14	-0.44 *	-0.28	-0.52 *	-0.56 *	0.02	-0.05	-0.62 *	-0.78 **	-1.42 ***	-1.27 ***	-1.96 ***	-1.94 ***	-2.47 ***	-2.48 ***
	(0.527)	(0.528)	(0.520)	(0.522)	(0.364)	(0.373)	(0.250)	(0.254)	(0.265)	(0.276)	(0.305)	(0.313)	(0.236)	(0.237)	(0.320)	(0.320)	(0.286)	(0.293)	(0.282)	(0.288)	(0.315)	(0.318)
dE_t-2	1.04 **	1.02 **	1.89 ***	1.80 ***	-0.31	-0.31	-0.42 ***	-0.41 ***	-0.54 ***	-0.50 ***	-0.47 **	-0.50 **	-0.25	-0.23	-0.08	-0.05	-0.33	-0.36	-0.95 ***	-0.95 ***	-0.90 ***	-0.82 ***
	(0.483)	(0.483)	(0.481)	(0.479)	(0.224)	(0.224)	(0.096)	(0.097)	(0.107)	(0.109)	(0.222)	(0.223)	(0.202)	(0.202)	(0.281)	(0.280)	(0.221)	(0.221)	(0.211)	(0.211)	(0.183)	(0.184)
dE_t+2	-0.17	-0.26	0.06	-0.14	0.02	0.09	-0.29	-0.21	-0.68 ***	-0.69 ***	-0.54 **	-0.52 **	0.47 ***	0.39 ***	0.20	0.05	-1.05 ***	-0.96 ***	-0.32	-0.31	-0.89 ***	-1.00 ***
	(0.231)	(0.235)	(0.328)	(0.330)	(0.297)	(0.303)	(0.196)	(0.199)	(0.174)	(0.174)	(0.220)	(0.220)	(0.149)	(0.152)	(0.232)	(0.233)	(0.252)	(0.257)	(0.222)	(0.226)	(0.244)	(0.246)
dNA_t-2	-0.45 ***	-0.44 ***	-0.16	-0.18 *	-0.28 ***	-0.28 ***	-0.12 *	-0.12 *	-0.30 ***	-0.28 ***	-0.50 ***	-0.51 ***	-0.43 ***	-0.42 ***	-0.59 ***	-0.59 ***	-0.29 ***	-0.28 ***	-0.42 ***	-0.42 ***	-0.94 ***	-0.93 ***
	(0.109)	(0.109)	(0.105)	(0.105)	(0.081)	(0.081)	(0.067)	(0.067)	(0.079)	(0.079)	(0.097)	(0.097)	(0.069)	(0.069)	(0.076)	(0.076)	(0.083)	(0.083)	(0.088)	(0.088)	(0.103)	(0.103)
dNA_t+2	0.33 ***	0.32 ***	0.57 ***	0.56 ***	0.03	0.03	0.06	0.08 *	0.09 **	0.10 **	0.06	0.08	0.37 ***	0.35 ***	0.75 ***	0.74 ***	0.30 ***	0.31 ***	0.62 ***	0.62 ***	0.68 ***	0.67 ***
	(0.077)	(0.077)	(0.103)	(0.102)	(0.083)	(0.083)	(0.045)	(0.046)	(0.040)	(0.040)	(0.049)	(0.050)	(0.044)	(0.045)	(0.071)	(0.070)	(0.081)	(0.081)	(0.077)	(0.077)	(0.084)	(0.085)
RD_t	8.39 ***	8.21 ***	10.02 ***	9.16 ***	4.94 ***	4.95 ***	6.91 ***	6.85 ***	5.10 ***	5.01 ***	3.92 ***	3.78 ***	4.33 ***	4.52 ***	5.15 ***	4.86 ***	2.44 *	2.42 *	2.49 *	2.51 **	3.95 ***	3.99 ***
	(2.254)	(2.251)	(1.798)	(1.799)	(1.171)	(1.171)	(0.922)	(0.925)	(0.945)	(0.945)	(1.320)	(1.323)	(1.037)	(1.039)	(1.191)	(1.189)	(1.259)	(1.259)	(1.268)	(1.271)	(1.385)	(1.382)
dRD_t-2	9.06 **	8.92 *	5.00	4.61	2.99	2.87	4.66 *	4.72 *	-0.02	-0.53	1.00	0.88	2.71	3.10	1.10	0.60	3.24	3.08	-4.79	-4.75	-9.66	-10.46 *
	(4.593)	(4.588)	(3.781)	(3.763)	(3.017)	(3.019)	(2.793)	(2.791)	(2.720)	(2.728)	(3.529)	(3.529)	(3.286)	(3.282)	(3.617)	(3.602)	(4.303)	(4.301)	(5.129)	(5.132)	(6.164)	(6.154)
dRD_t+2	-1.72	-2.13	5.53	5.33	5.27 *	5.38 *	-0.74	-0.49	4.58 *	4.43 *	3.42	3.68	2.34	2.48	9.32 ***	9.10 ***	16.84 ***	17.16 ***	13.45 ***	13.42 ***	6.12	6.40
	(2.881)	(2.879)	(3.851)	(3.834)	(2.948)	(2.951)	(2.351)	(2.351)	(2.438)	(2.438)	(2.428)	(2.433)	(2.396)	(2.394)	(3.498)	(3.483)	(4.010)	(4.010)	(4.365)	(4.367)	(5.842)	(5.831)
I_t	-9.24 ***	-8.97 ***	-11.17 ***	-9.58 ***	-10.09 ***	-10.55 ***	-8.97 ***	-9.52 ***	-10.76 ***	-10.61 ***	-12.23 ***	-12.36 ***	-7.04 ***	-6.67 ***	-7.51 ***	-6.65 ***	-8.99 ***	-9.10 ***	-9.75 ***	-9.76 ***	-4.98 **	-4.80 **
	(2.888)	(2.884)	(2.997)	(3.004)	(2.449)	(2.481)	(2.016)	(2.030)	(2.074)	(2.078)	(2.496)	(2.497)	(1.852)	(1.860)	(2.239)	(2.241)	(2.357)	(2.360)	(2.377)	(2.381)	(2.381)	(2.378)
dI_t-2	-3.50	-3.79	-6.06 *	-5.69	0.77	0.60	1.88	1.67	7.84 ***	7.62 ***	10.32 ***	10.50 ***	7.26 ***	7.23 ***	0.12	-0.12	-4.48	-4.64 *	-6.85 **	-6.87 **	-5.55 **	-5.50 **
	(3.298)	(3.294)	(3.562)	(3.544)	(2.544)	(2.552)	(1.882)	(1.882)	(2.072)	(2.076)	(2.927)	(2.932)	(2.314)	(2.311)	(2.733)	(2.721)	(2.799)	(2.799)	(2.705)	(2.707)	(2.691)	(2.685)
dI_t+2	-0.02	0.11	-6.68 *	-6.70 *	-4.98 *	-5.02 *	-3.36 *	-3.64 *	-4.57 **	-4.51 **	3.22 *	2.87	-3.46 **	-3.26 **	-4.01 *	-3.89 *	9.46 ***	9.72 ***	2.46	2.46	-10.09 ***	-10.19 ***
	(2.419)	(2.418)	(3.469)	(3.450)	(3.024)	(3.024)	(1.938)	(1.940)	(1.969)	(1.971)	(1.930)	(1.938)	(1.484)	(1.483)	(2.324)	(2.314)	(2.827)	(2.830)	(2.910)	(2.912)	(3.089)	(3.081)
D_t	4.36 **	4.47 **	10.18 ***	10.23 ***	15.74 ***	15.63 ***	13.91 ***	13.80 ***	14.18 ***	13.78 ***	12.39 ***	12.30 ***	9.92 ***	10.11 ***	15.20 ***	15.40 ***	17.10 ***	16.87 ***	18.85 ***	18.83 ***	20.52 ***	20.46 ***
	(1.910)	(1.919)	(1.960)	(1.965)	(1.674)	(1.677)	(1.322)	(1.321)	(1.310)	(1.322)	(1.611)	(1.623)	(1.155)	(1.156)	(1.384)	(1.383)	(1.453)	(1.459)	(1.565)	(1.567)	(1.590)	(1.587)
dD_t-2	-9.19 ***	-9.05 ***	-8.00 ***	-7.69 ***	-3.58 *	-3.64 *	-4.35 ***	-4.28 ***	-3.96 **	-4.25 **	-2.87	-2.93	-2.15	-2.18	-1.57	-1.15	0.98	0.39	4.85 ***	4.78 ***	1.48	1.48
	(2.769)	(2.764)	(2.643)	(2.636)	(2.168)	(2.170)	(1.625)	(1.624)	(1.788)	(1.792)	(2.345)	(2.351)	(1.703)	(1.700)	(1.940)	(1.934)	(2.038)	(2.053)	(1.779)	(1.790)	(1.762)	(1.760)
dD_t+2	8.48 ***	8.32 ***	13.37 ***	12.48 ***	12.39 ***	12.48 ***	12.20 ***	12.34 ***	6.00 ***	6.08 ***	8.31 ***	8.34 ***	6.15 ***	5.91 ***	10.37 ***	9.79 ***	11.85 ***	12.15 ***	17.98 ***	18.04 ***	22.08 ***	21.65 ***
	(2.099)	(2.097)	(2.157)	(2.155)	(1.852)	(1.856)	(1.471)	(1.472)	(1.363)	(1.366)	(1.574)	(1.574)	(1.152)	(1.152)	(1.541)	(1.539)	(1.646)	(1.652)	(1.847)	(1.856)	(2.031)	(2.034)
dM_t+2	-0.34 ***	-0.33 ***	-0.38 ***	-0.39 ***	0.28 ***	0.29 ***	0.18 ***	0.18 ***	0.17 ***	0.17 ***	0.13 ***	0.14 ***	-0.32 ***	-0.32 ***	-0.39 ***	-0.39 ***	0.18 ***	0.18 ***	-0.07 ***	-0.06 ***	-0.24 ***	-0.25 ***
	(0.012)	(0.012)	(0.027)	(0.027)	(0.016)	(0.016)	(0.007)	(0.007)	(0.006)	(0.006)	(0.010)	(0.010)	(0.007)	(0.007)	(0.012)	(0.012)	(0.010)	(0.010)	(0.017)	(0.017)	(0.019)	(0.019)
C_t	2.03 ***	2.19 ***	3.80 ***	4.20 ***	1.56 ***	1.50 ***	2.26 ***	2.25 ***	2.18 ***	2.38 ***	2.42 ***	2.44 ***	1.32 ***	1.30 ***	0.49	0.72 *	1.31 ***	1.42 ***	1.35 ***	1.34 ***	0.93 **	1.06 **
	(0.553)	(0.597)	(0.619)	(0.634)	(0.571)	(0.574)	(0.479)	(0.480)	(0.390)	(0.401)	(0.422)	(0.450)	(0.302)	(0.322)	(0.353)	(0.372)	(0.468)	(0.476)	(0.501)	(0.505)	(0.475)	(0.485)
dum1	0.18 **	0.17 *	0.34 ***	0.33 ***	0.04	0.05	0.06	0.06	0.15 **	0.15 **	0.21 **	0.21 **	0.12 **	0.12 *	0.06	0.07	0.25 ***	0.25 ***	0.37 ***	0.37 ***	0.24 **	0.23 **
	(0.088)	(0.088)	(0.100)	(0.099)	(0.091)	(0.091)	(0.080)	(0.080)	(0.077)	(0.077)	(0.091)	(0.091)	(0.062)	(0.062)	(0.071)	(0.071)	(0.088)	(0.088)	(0.098)	(0.098)	(0.095)	(0.095)
dum3	0.32 **	0.30 **	0.16	0.13	-0.07	-0.06	0.07	0.04	0.09	0.10	-0.14	-0.12	0.07	0.07	-0.16	-0.19	-0.23	-0.24	-0.27	-0.27	-0.19	-0.18
	(0.145)	(0.145)	(0.137)	(0.138)	(0.139)	(0.140)	(0.128)	(0.131)	(0.132)	(0.132)	(0.173)	(0.173)	(0.133)	(0.134)	(0.159)	(0.159)	(0.177)	(0.177)	(0.184)	(0.184)	(0.193)	(0.193)
C_t*dum1	-0.38	-0.33	-2.88	-2.88	1.10	1.15	1.95	2.08	1.62	1.62	0.72	0.88	0.85	0.85	1.16	1.10	-2.33	-2.32	-4.39 **	-4.39 **	-1.09	-1.10
	(1.965)	(1.961)	(2.326)	(2.314)	(2.063)	(2.064)	(1.763)	(1.762)	(1.515)	(1.514)	(1.589)	(1.590)	(1.056)	(1.054)	(1.357)	(1.351)	(1.907)	(1.905)	(2.128)	(2.129)	(1.958)	(1.953)
C_t*dum3	-2.15 ***	-2.02 ***	-2.97 ***	-2.63 ***	-0.25	-0.33	-1.22 *	-1.14 *	-1.30 **	-1.33 **	-0.35	-0.41	-0.40	-0.39	0.54	0.64	0.28	0.30	0.60	0.60	0.61	0.61
	(0.718)	(0.722)	(0.761)	(0.768)	(0.753)	(0.757)	(0.642)	(0.650)	(0.564)	(0.564)	(0.671)	(0.671)	(0.490)	(0.494)	(0.588)	(0.590)	(0.754)	(0.754)	(0.760)	(0.761)	(0.788)	(0.788)
dC_t-2		-0.19		0.02		-0.01		0.19		0.51 **		0.17		-0.32		-0.22		0.49 **		0.06		-0.04
		(0.388)		(0.340)		(0.200)		(0.201)		(0.237)		(0.308)		(0.221)		(0.249)		(0.241)		(0.261)		(0.304)
dC_t+2		0.82 ***		1.60 ***		-0.32		-0.36 **		0.01		-0.31 *		0.45 ***		0.99 ***		-0.39		-0.07		0.94 ***
		(0.290)		(0.356)		(0.261)		(0.162)		(0.142)		(0.170)		(0.152)		(0.213)		(0.251)		(0.247)		(0.270)
N	1567	1565	1713	1711	1773	1771	1849	1847	1817	1815	1850	1848	2003	2001	2111	2109	2153	2151	2096	2094	1997	1995
Adjusted R^2	0.4794	0.4814	0.2442	0.2524	0.3071	0.3069	0.4352	0.4362	0.4652	0.4660	0.2837	0.2843	0.6126	0.6141	0.4505	0.4556	0.3006	0.3017	0.2268	0.2261	0.3029	0.3065

Note: *refers to significance at 10%, **to significance at 5%, and ***to significance at the 1% level; M = Market capitalization, E = Earnings, NA = Net Assets, RD = R&D, I = Interest, D = Dividends, C = Cash and equivalents; Excess Cash measure 2a is calculated as CCE/TA - industry mean CCE/TA.

Annual regressions Transformed data Slope and intercept ECM2b dummies	2000 Basic	2000 Extended	2001 Basic	2001 Extended	2002 Basic	2002 Extended	2003 Basic	2003 Extended	2004 Basic	2004 Extended	2005 Basic	2005 Extended
Intercept	-0.80 ***	-0.82 ***	-0.86 ***	-0.92 ***	-1.01 ***	-1.00 ***	-0.86 ***	-0.85 ***	-0.81 ***	-0.83 ***	-0.58 ***	-0.57 ***
	(0.079)	(0.080)	(0.082)	(0.083)	(0.068)	(0.070)	(0.061)	(0.062)	(0.058)	(0.059)	(0.069)	(0.070)
E_t	1.46 ***	1.34 **	1.56 ***	1.23 **	0.18	0.24	0.04	0.12	-0.48 *	-0.31	-0.57 *	-0.60 *
	(0.527)	(0.528)	(0.520)	(0.523)	(0.363)	(0.372)	(0.251)	(0.255)	(0.265)	(0.277)	(0.307)	(0.314)
dE_t-2	1.04 **	1.01 **	1.94 ***	1.84 ***	-0.30	-0.30	-0.44 ***	-0.43 ***	-0.55 ***	-0.50 ***	-0.54 **	-0.56 **
	(0.483)	(0.482)	(0.480)	(0.478)	(0.224)	(0.224)	(0.096)	(0.097)	(0.107)	(0.109)	(0.222)	(0.224)
dE_t+2	-0.17	-0.25	0.06	-0.14	0.01	0.08	-0.28	-0.20	-0.71 ***	-0.72 ***	-0.53 **	-0.50 **
	(0.231)	(0.235)	(0.328)	(0.329)	(0.297)	(0.303)	(0.196)	(0.199)	(0.174)	(0.174)	(0.221)	(0.221)
dNA_t-2	-0.44 ***	-0.43 ***	-0.17	-0.18 *	-0.28 ***	-0.28 ***	-0.12 *	-0.12 *	-0.30 ***	-0.28 ***	-0.51 ***	-0.52 ***
	(0.109)	(0.110)	(0.105)	(0.105)	(0.081)	(0.081)	(0.067)	(0.067)	(0.079)	(0.079)	(0.097)	(0.097)
dNA_t+2	0.33 ***	0.32 ***	0.57 ***	0.57 ***	0.03	0.03	0.06	0.08 *	0.10 **	0.10 **	0.05	0.07
	(0.077)	(0.077)	(0.103)	(0.102)	(0.083)	(0.083)	(0.045)	(0.046)	(0.040)	(0.040)	(0.049)	(0.050)
RD_t	8.92 ***	8.73 ***	10.59 ***	9.68 ***	5.12 ***	5.15 ***	7.19 ***	7.17 ***	5.30 ***	5.22 ***	4.29 ***	4.14 ***
	(2.231)	(2.228)	(1.789)	(1.790)	(1.165)	(1.165)	(0.919)	(0.922)	(0.944)	(0.944)	(1.324)	(1.327)
dRD_t-2	9.79 **	9.64 **	5.10	4.71	3.04	2.92	4.52	4.57	0.05	-0.44	1.16	1.04
	(4.575)	(4.569)	(3.777)	(3.758)	(3.015)	(3.017)	(2.799)	(2.797)	(2.719)	(2.727)	(3.548)	(3.547)
dRD_t+2	-1.43	-1.84	4.62	4.50	5.48 *	5.61 *	-0.72	-0.48	4.65 *	4.49 *	3.62	3.85
	(2.873)	(2.871)	(3.854)	(3.836)	(2.944)	(2.947)	(2.357)	(2.358)	(2.437)	(2.436)	(2.438)	(2.442)
I_t	-9.19 ***	-8.91 ***	-11.01 ***	-9.38 ***	-9.91 ***	-10.37 ***	-9.16 ***	-9.65 ***	-10.60 ***	-10.44 ***	-12.36 ***	-12.49 ***
	(2.885)	(2.881)	(2.998)	(3.004)	(2.452)	(2.483)	(2.025)	(2.040)	(2.074)	(2.078)	(2.509)	(2.510)
dI_t-2	-3.61	-3.89	-6.08 *	-5.71	0.91	0.76	1.83	1.64	7.86 ***	7.65 ***	10.58 ***	10.75 ***
	(3.296)	(3.291)	(3.565)	(3.546)	(2.547)	(2.555)	(1.886)	(1.887)	(2.071)	(2.075)	(2.939)	(2.944)
dI_t+2	0.15	0.30	-6.63 *	-6.65 *	-5.11 *	-5.16 *	-3.25 *	-3.51 *	-4.67 **	-4.61 **	3.71 *	3.36 *
	(2.421)	(2.420)	(3.471)	(3.451)	(3.021)	(3.021)	(1.942)	(1.945)	(1.970)	(1.971)	(1.938)	(1.946)
D_t	4.40 **	4.54 **	10.28 ***	10.35 ***	15.73 ***	15.62 ***	13.91 ***	13.81 ***	14.19 ***	13.79 ***	12.28 ***	12.18 ***
	(1.913)	(1.921)	(1.961)	(1.965)	(1.672)	(1.675)	(1.324)	(1.324)	(1.310)	(1.322)	(1.619)	(1.630)
dD_t-2	-9.07 ***	-8.93 ***	-7.45 ***	-7.18 ***	-3.63 *	-3.68 *	-4.39 ***	-4.32 ***	-3.86 **	-4.16 **	-2.86	-2.93
	(2.766)	(2.761)	(2.643)	(2.635)	(2.167)	(2.168)	(1.625)	(1.624)	(1.789)	(1.793)	(2.356)	(2.361)
dD_t+2	8.41 ***	8.24 ***	13.39 ***	12.48 ***	12.46 ***	12.56 ***	12.04 ***	12.20 ***	6.02 ***	6.09 ***	8.14 ***	8.17 ***
	(2.093)	(2.091)	(2.156)	(2.154)	(1.850)	(1.854)	(1.477)	(1.478)	(1.364)	(1.367)	(1.580)	(1.580)
dM_t+2	-0.34 ***	-0.33 ***	-0.38 ***	-0.39 ***	0.28 ***	0.29 ***	0.18 ***	0.18 ***	0.18 ***	0.18 ***	0.13 ***	0.14 ***
	(0.012)	(0.012)	(0.027)	(0.027)	(0.016)	(0.016)	(0.007)	(0.007)	(0.006)	(0.006)	(0.010)	(0.010)
C_t	2.20 ***	2.35 ***	4.09 ***	4.56 ***	1.55 **	1.48 **	1.61 ***	1.62 ***	2.20 ***	2.41 ***	2.10 ***	2.15 ***
	(0.625)	(0.654)	(0.692)	(0.705)	(0.614)	(0.617)	(0.513)	(0.514)	(0.420)	(0.430)	(0.447)	(0.473)
dum1	0.15 *	0.14 *	0.26 ***	0.26 ***	-0.02	-0.02	-0.04	-0.04	0.00	0.00	0.09	0.09
	(0.084)	(0.084)	(0.092)	(0.092)	(0.086)	(0.086)	(0.077)	(0.077)	(0.075)	(0.075)	(0.092)	(0.092)
dum3	0.46 ***	0.45 ***	0.31 *	0.27 *	-0.04	-0.03	0.17	0.15	0.09	0.11	-0.03	-0.01
	(0.171)	(0.171)	(0.162)	(0.162)	(0.162)	(0.164)	(0.146)	(0.149)	(0.153)	(0.153)	(0.193)	(0.194)
C_t*dum1	1.18	1.23	0.56	0.13	3.38	3.48	3.45 *	3.52 *	5.64 ***	5.66 ***	1.71	1.75
	(2.394)	(2.390)	(2.655)	(2.643)	(2.249)	(2.251)	(2.054)	(2.053)	(1.887)	(1.886)	(1.966)	(1.965)
C_t*dum3	-2.67 ***	-2.56 ***	-3.60 ***	-3.29 ***	-0.35	-0.43	-0.98	-0.94	-1.40 **	-1.43 **	-0.37	-0.45
	(0.820)	(0.825)	(0.866)	(0.873)	(0.831)	(0.835)	(0.698)	(0.708)	(0.621)	(0.621)	(0.728)	(0.729)
dC_t-2		-0.22		-0.01		-0.01		0.22		0.51 **		0.20
		(0.389)		(0.340)		(0.200)		(0.201)		(0.237)		(0.310)
dC_t+2		0.83 ***		1.63 ***		-0.32		-0.32 **		0.02		-0.32 *
		(0.290)		(0.355)		(0.260)		(0.162)		(0.141)		(0.171)
N	1567	1565	1713	1711	1773	1771	1849	1847	1817	1815	1850	1848
Adjusted R^2	0.4801	0.4822	0.2443	0.2528	0.3077	0.3075	0.4329	0.4338	0.4655	0.4664	0.2778	0.2786

Annual regressions Transformed data Slope and intercept ECM2b dummies	2006 Basic	2006 Extended	2007 Basic	2007 Extended	2008 Basic	2008 Extended	2009 Basic	2009 Extended	2010 Basic	2010 Extended
Intercept	-0.60 ***	-0.61 ***	-0.51 ***	-0.55 ***	-0.96 ***	-0.95 ***	-0.80 ***	-0.80 ***	-0.76 ***	-0.78 ***
	(0.051)	(0.052)	(0.058)	(0.059)	(0.066)	(0.067)	(0.073)	(0.074)	(0.071)	(0.072)
E_t	-0.04	-0.10	-0.61 *	-0.77 **	-1.43 ***	-1.29 ***	-1.96 ***	-1.94 ***	-2.51 ***	-2.51 ***
	(0.235)	(0.236)	(0.320)	(0.320)	(0.286)	(0.293)	(0.282)	(0.289)	(0.314)	(0.317)
dE_t-2	-0.28	-0.26	-0.07	-0.05	-0.32	-0.35	-0.96 ***	-0.96 ***	-0.88 ***	-0.80 ***
	(0.202)	(0.202)	(0.281)	(0.280)	(0.222)	(0.222)	(0.211)	(0.211)	(0.183)	(0.184)
dE_t+2	0.46 ***	0.38 **	0.21	0.06	-1.05 ***	-0.97 ***	-0.32	-0.31	-0.91 ***	-1.02 ***
	(0.150)	(0.152)	(0.231)	(0.233)	(0.252)	(0.257)	(0.222)	(0.226)	(0.243)	(0.245)
dNA_t-2	-0.43 ***	-0.42 ***	-0.59 ***	-0.58 ***	-0.30 ***	-0.29 ***	-0.42 ***	-0.42 ***	-0.95 ***	-0.93 ***
	(0.069)	(0.069)	(0.076)	(0.076)	(0.083)	(0.083)	(0.088)	(0.088)	(0.103)	(0.103)
dNA_t+2	0.37 ***	0.35 ***	0.75 ***	0.74 ***	0.31 ***	0.32 ***	0.63 ***	0.63 ***	0.69 ***	0.67 ***
	(0.044)	(0.045)	(0.070)	(0.070)	(0.081)	(0.081)	(0.076)	(0.077)	(0.084)	(0.084)
RD_t	4.47 ***	4.67 ***	5.28 ***	4.99 ***	2.56 **	2.54 **	2.61 **	2.63 **	4.09 ***	4.12 ***
	(1.040)	(1.042)	(1.186)	(1.183)	(1.259)	(1.260)	(1.270)	(1.272)	(1.382)	(1.379)
dRD_t-2	2.63	3.03	1.29	0.79	2.98	2.84	-4.63	-4.60	-9.08	-9.93
	(3.294)	(3.290)	(3.615)	(3.600)	(4.310)	(4.308)	(5.136)	(5.139)	(6.149)	(6.137)
dRD_t+2	2.26	2.40	9.14 ***	8.90 **	16.70 ***	16.98 ***	13.26 ***	13.24 ***	6.03	6.34
	(2.401)	(2.399)	(3.501)	(3.486)	(4.020)	(4.019)	(4.371)	(4.374)	(5.838)	(5.826)
I_t	-7.14 ***	-6.78 ***	-7.43 ***	-6.57 ***	-9.19 ***	-9.31 ***	-10.05 ***	-10.04 ***	-5.09 **	-4.90 **
	(1.856)	(1.864)	(2.238)	(2.240)	(2.356)	(2.360)	(2.376)	(2.381)	(2.379)	(2.376)
dI_t-2	7.15 ***	7.11 ***	-0.05	-0.30	-4.57	-4.74 *	-7.03 ***	-7.04 ***	-5.77 **	-5.72 **
	(2.320)	(2.317)	(2.733)	(2.721)	(2.798)	(2.797)	(2.706)	(2.708)	(2.687)	(2.680)
dI_t+2	-3.59 **	-3.38 **	-3.99 *	-3.86 *	9.39 ***	9.62 ***	2.36	2.38	-10.02 ***	-10.13 ***
	(1.488)	(1.487)	(2.323)	(2.313)	(2.831)	(2.833)	(2.916)	(2.918)	(3.086)	(3.078)
D_t	9.83 ***	10.03 ***	15.19 ***	15.39 ***	17.06 ***	16.83 ***	18.80 ***	18.79 ***	20.47 ***	20.41 ***
	(1.159)	(1.159)	(1.384)	(1.383)	(1.454)	(1.460)	(1.566)	(1.569)	(1.588)	(1.584)
dD_t-2	-2.30	-2.33	-1.56	-1.15	0.88	0.31	4.96 ***	4.88 ***	1.42	1.41
	(1.705)	(1.702)	(1.941)	(1.934)	(2.043)	(2.058)	(1.784)	(1.795)	(1.758)	(1.755)
dD_t+2	6.19 ***	5.95 ***	10.33 ***	9.76 ***	11.99 ***	12.28 ***	17.93 ***	18.00 ***	21.98 ***	21.53 ***
	(1.154)	(1.155)	(1.542)	(1.540)	(1.646)	(1.653)	(1.848)	(1.856)	(2.030)	(2.033)
dM_t+2	-0.32 ***	-0.32 ***	-0.39 ***	-0.39 ***	0.18 ***	0.18 ***	-0.07 ***	-0.07 ***	-0.24 ***	-0.25 ***
	(0.007)	(0.007)	(0.012)	(0.012)	(0.010)	(0.010)	(0.017)	(0.017)	(0.019)	(0.019)
C_t	1.16 ***	1.13 ***	0.60 *	0.83 **	0.97 *	1.04 **	1.07 **	1.07 **	0.67	0.79
	(0.309)	(0.329)	(0.366)	(0.383)	(0.503)	(0.507)	(0.523)	(0.528)	(0.490)	(0.500)
dum1	0.05	0.05	0.08	0.08	0.20 **	0.19 **	0.30 ***	0.30 ***	0.15	0.14
	(0.063)	(0.063)	(0.073)	(0.073)	(0.090)	(0.090)	(0.104)	(0.104)	(0.103)	(0.103)
dum3	0.12	0.12	-0.16	-0.20	-0.08	-0.08	-0.17	-0.16	-0.02	0.00
	(0.150)	(0.150)	(0.183)	(0.183)	(0.205)	(0.205)	(0.198)	(0.198)	(0.216)	(0.216)
C_t*dum1	1.17	1.07	1.10	1.18	-1.89	-2.02	-2.74	-2.72	2.37	2.39
	(1.261)	(1.259)	(1.721)	(1.714)	(2.645)	(2.645)	(2.727)	(2.728)	(2.693)	(2.686)
C_t*dum3	-0.42	-0.40	0.46	0.59	0.15	0.18	0.58	0.58	0.40	0.41
	(0.526)	(0.531)	(0.645)	(0.648)	(0.836)	(0.836)	(0.802)	(0.803)	(0.846)	(0.846)
dC_t-2		-0.32		-0.22		0.47 *		0.10		-0.03
		(0.222)		(0.249)		(0.242)		(0.261)		(0.304)
dC_t+2		0.45 ***		1.00 ***		-0.37		-0.06		0.96 ***
		(0.153)		(0.213)		(0.252)		(0.247)		(0.269)
N	2003	2001	2111	2109	2153	2151	2096	2094	1997	1995
Adjusted R^2	0.6108	0.6123	0.4505	0.4557	0.2985	0.2995	0.2256	0.2250	0.3045	0.3082

Note: *refers to significance at 10%, **to significance at 5%, and ***to significance at the 1% level; M = Market capitalization, E = Earnings, NA = Net Assets, RD = R&D, I = Interest, D = Dividends, C = Cash and equivalents; Excess Cash measure 2a is calculated as CCE/TA - industry mean CCE/TA.