Rev Quant Finan Acc (2016) 47:699–732
DOI 10.1007/s11156-015-0517-1

ORIGINAL RESEARCH

Motives for corporate cash holdings: the CEO optimism effect

Winifred Huang-Meier[1] · **Neophytos Lambertides**[2] · **James M. Steeley**[1]

Published online: 17 May 2015

Abstract We examine the chief executive officer (CEO) optimism effect on managerial motives for cash holdings and find that optimistic and non-optimistic managers have significantly dissimilar purposes for holding more cash. This is consistent with both theory and evidence that optimistic managers are reluctant to use external funds. Optimistic managers hoard cash for growth opportunities, use relatively more cash for capital expenditure and acquisitions, and save more cash in adverse conditions. By contrast, they hold fewer inventories and receivables and their precautionary demand for cash holdings is less than that of non-optimistic managers. In addition, we consider debt conservatism in our model and find no evidence that optimistic managers' cash hoarding is related to their preference to use debt conservatively. We also document that optimistic managers hold more cash in bad times than non-optimistic managers do. Our work highlights the crucial role that CEO characteristics play in shaping corporate cash holding policy.

Keywords Cash holdings · Liquidity · Cash holdings motive · CEO optimism

JEL Classification G30 · G32 · G02

✉ Winifred Huang-Meier
w.huang-meier@aston.ac.uk

Neophytos Lambertides
n.lambertides@cut.ac.cy

James M. Steeley
j.m.steeley@aston.ac.uk

[1] Finance Group, Aston Business School, Aston University, Birmingham B4 7ET, UK

[2] Department of Commerce, Finance and Shipping, Cyprus University of Technology, 3603 Lemesos, Cyprus

1 Introduction

The role of cash reserves in corporate financing and investment decisions is changing. Keynes (1936) emphasizes that a demand for corporate cash savings occurs only when a firm is financially constrained. Conversely, if a firm is financially unconstrained, it does not need cash savings for future investments, because it can access capital markets freely. How much cash a firm should hold in reserve has been paid more attention in recent years as the role and interests of managers have been increasingly taken into account. Jensen (1986) argues that the quantity of cash that will be held is influenced by the self-interest of managers, who may not always use cash reserves for activities that maximize shareholder wealth. Recent studies have linked liquidity management to management entrenchment, for example, studies on corporate governance linked to the value of cash (Dittmar and Mahrt-Smith 2007; Lee and Lee 2009; and Iskandar-Datta and Jia 2014) and the level of cash reserves (Harford et al. 2008), and the effect of chief executive officers' (CEO) professional experience on corporate debt and cash policies (Dittmar and Duchin 2014).

While prior studies show that the use and value of cash holdings vary by corporate financial constraint status, corporate governance conditions, shareholder protection regulations, and across countries,[1] less attention has been paid to examining whether biased managerial beliefs affect the motives for corporate cash holdings. To fill the gap in this literature, this paper investigates whether CEO optimism has an influence on a manager's motivations for cash accumulation. Specifically, we examine each cash holding motive including debt capacity, hedge needs for investment, growth opportunity, acquisitions and precautionary savings and compare them between firms governed by optimistic and non-optimistic managers.

Within the field of behavioral corporate finance, optimism has been most closely identified with situations of managers under-estimating the risk attached to certain decisions (Heaton 2002; Englmaier 2010). This definition has also been used in the context of managerial overconfidence (Malmendier and Tate 2005a), although the term overconfidence is more generally associated with situations where managers are over-estimating the returns or rewards associated with certain decisions (Hackbarth 2008; Malmendier and Tate 2008). However, the managerial characteristic of over-estimating rewards has also been labelled as optimism (Heaton 2002; Englmaier 2010). Although our approach is most closely related to those studies that use the term optimism (e.g., Puri and Robinson 2007; Campbell et al. 2011), these studies and this paper do not preclude the possibility of a role for managerial overconfidence. The difficulty in distinguishing between optimism and overconfidence is further compounded by the literature itself using similar options holdings

[1] Other studies relate cash policy to different issues. For example, Almeida et al. (2004) examine the propensity to save cash out of cash flow for financially constrained firms. Faulkender and Wang (2006) examine the marginal value of an extra dollar to shareholders to show that the value of cash differs across firms. Pinkowitz et al. (2006) examine the value of cash across countries and find that the value of cash matters less than in countries with better investor protection. Acharya et al. (2007) document that the demand for liquidity (higher cash) by financially constrained firms is highly dependent on the level of hedging needs. Dittmar and Mahrt-Smith (2007) study that the shareholders of poorly and well-governed firms have dramatically different values of cash. Riddick and Whited (2009) study that firms save more out of cash flows when external financing is costly or when they have lumpy investment projects. Hill et al. (2014) show that firms with stronger political connections hold lower cash balances. Other studies investigate corporate cash holdings for specific targets, including those of Ozkan and Ozkan (2004) for the UK, Pinkowitz and Williamson (2001) for Japan, Ferreira and Vilela (2004) for European countries, and Drobetz and Grüninger (2007) for Switzerland.

data in empirical applications.[2] In this paper, we use the term optimism to maintain consistency with Campbell et al. (2011), as our methodology most closely follows this earlier study. Readers, however, will still see the term overconfidence mentioned in this paper when we refer to corresponding prior studies.

There is a growing literature that indicates managers make biased decisions on financial and investment policies when their judgment is distorted by optimism. We summarize optimistic managers' major characteristics, that are distinct from non-optimistic managers, here: First, biased managers prefer internal funds to external funds for investment projects and are more likely than other managers to raise debt than equity (Heaton 2002; Malmendier and Tate 2005a).[3] Second, firms managed by overconfident managers pay less dividends (Cordeiro 2009; Deshmukh et al. 2010). That is, overconfident managers overestimate firms' future performance and prefer retaining cash flows for potential investment opportunities. In turn, they are reluctant to pay dividends to shareholders. Third, optimistic and overconfident managers overinvest if they overvalue firm future earnings (Malmendier and Tate 2005a, b; Puri and Robinson 2007) and underinvest [and reject positive net present value (NPV) projects] if they have to seek external funds (Heaton 2002). Fourth, Liu and Taffler (2008) and Malmendier and Tate (2008) find that overconfident CEOs are more likely to conduct mergers and acquisitions than non-optimistic CEOs.

Although prior studies have examined the impact of CEO optimism and overconfidence on corporate decisions, relatively few prior investigations try to determine differences between optimistic and non-optimistic managers in controlling and operating firm liquid assets (motives for cash holdings). To the best of our knowledge, the most relevant papers, though indirectly related, to a connection between CEO overconfidence and cash holdings are those of Malmendier and Tate (2008), Malmendier et al. (2011) and Ferris et al. (2013). Malmendier and Tate (2008) shows that overconfident CEOs prefer cash and debt financing for their acquisitions and overpay for them. Malmendier et al. (2011) finds that non-optimistic CEOs are less likely than overconfident CEOs to use cash financing. Ferris et al. (2013) provides strong evidence that overconfident CEOs use more cash to finance their acquisitions than non-overconfident CEOs, particularly for firms headquartered in common law countries. If optimistic managers' financing strategies are self-limited and distinct from those of non-optimistic managers, the issue of what motives optimistic managers may have for holding and spending their cash is well disposed for investigation. There is currently no study addressing this issue. Therefore, our study adds to this literature by seeking to understand how optimistic managers deal with their cash balances, and by doing so to shed more light on both CEO optimism and cash policy.

To test our key hypothesis that optimistic and non-optimistic managers have dissimilar motivations for holding cash, our first step is to collect CEO data from ExecuComp

[2] For instance, Campbell et al. (2011) use ExecuComp's exercisable options data as the proxy for CEO optimism, which in their setting is closely related to the CEO overconfidence measure of Malmendier and Tate (2005a), who use a dataset combining stock ownership and a set of option packages provided by Brian Hall and David Yermack from Hall and Liebman (1998) and Yermack (1995).

[3] In general, external financing is more expensive than internal financing for firms, particularly for financially constrained firms. Biased managers are much more reluctant to use outside financing than rational managers, since they believe firm value is underestimated in the financial markets and the cost of external financing is thus overpriced. Malmendier and Tate (2005a) find that corporate investment decisions made by overconfident chief executive officers (CEOs) are substantially related to internal funds. Heaton (2002) builds a model to show that optimistic managers will decline positive NPV projects if they have to fund externally for these projects. Hackbarth (2008) shows theoretically that biased managers have higher debt levels than unbiased managers.

database and firm-level data from CRSP/Compustat database between 1992 and 2010. Following Campbell et al. (2011), we use their option-based CEO optimism measure to identify a CEO to be optimistic or non-optimistic if s/he holds options very deep in the money. A CEO who holds options more than 100 % in-the-money is considered to be relatively optimistic. A detailed explanation of the CEO optimism measure is introduced in Sect. 3.[4] We also consider a less stringent 67 % cutoff, which allows us to examine the extent of the CEO optimism effect on the motives for holding cash. This options based measure is widely used in models designed to understand managerial decision making in firms, and there is therefore value in maintaining consistency with these parallel literatures. For example, studies have observed that executives will exercise their options, when there are restrictions and regulations on short-selling their shares (Malmendier and Tate 2005a, b). Such exercise activity, or indeed the continued holding of in-the-money options, will reflect the manager's perspective on their firm. This could reasonably be assumed to reflect a level of optimism. Since managers normally own a large amount of options, which puts them in a situation of high exposure to the idiosyncratic risk of their firms, holding on to deep in-the-money options reflects a high level of optimism.[5] Influential studies that have used this measurement approach include Billett and Qian (2008), Liu and Taffler (2008), Campbell et al. (2011), and Hirshleifer et al. (2012).

In addition, we examine an alternative CEO optimism measure, firm investment levels, as a further robustness test. As emphasized by Campbell et al. (2011), this should avoid the direct connection between managerial incentives and managerial compensations. We use this as a reflection of how positive a manager feels towards the firm's investment activity and its future performance. The regression models for examining motives for cash holdings that we use in this paper draw upon the models proposed by Opler et al. (1999) and Bates et al. (2009), who find that average firms would hold more cash if their growth opportunities are strong.

Our results can be summarized as follows.[6] First, we confirm that both optimistic and non-optimistic managers accumulate cash over the sample period. However, optimistic managers tend to hold more cash than non-optimistic managers. The mean cash ratio of optimistic managers is 0.145, higher than the value of 0.120 for non-optimistic managers. This is consistent with theories that optimistic managers pay less dividends and prefer to

[4] The managers may become risk averse and hoard cash if they have a high ownership share. In that case, this measure may be less related to their level of optimism. However, our later findings show that the interaction term of managerial ownership percentage and CEO optimism is negative and significant, which means, ceteris paribus, that optimistic managers hold less cash than non-optimistic managers as their share ownership increases. This would seem to suggest that holding deep-in-the-money options is not reflecting the same managerial characteristics as holding many shares. Another possible weakness of the measure is that new CEOs might have different incentives to pursue higher cash balances if their options are way out of the money. However, the option-based optimism measure that we apply in our study considers the exercising status beyond the vesting period. This means that new CEOs are likely to be excluded. We also consider an alternative measure of optimism, based on firm investment levels, which we describe below. Our findings from either measure are consistent.

[5] In the study of the tradeoff between undiversified executives and their exercisable options by Hall and Murphy (2002), the authors find that risk-averse and undiversified executives (defined as those that hold more than 67 % of their wealth in company stock) hold in-the-money options less longer than relatively less risk-averse and less undiversified executives. That is, greater risk aversion and under-diversification lead the manager to exercise options early or immediately after the vesting period. From this we could reasonably infer that a manager who is risk-averse and undiversified can be considered to be optimistic if they persist in holding deep in-the-money options, since this would not be expected if they are risk averse and hold too many shares.

[6] All models include year and industry fixed effects and the results are robust to clustering standard errors by firm for heteroskedasticity and arbitrary serial correlation.

utilize internal funds. Second, optimistic managers tend to reserve more cash for larger deals. We find a positive and significant relation between cash holdings and research and development (R&D) spending for firms managed by optimistic managers. Third, optimistic managers have relatively more volatile cash balances. Our results indicate that the cash balances of optimistic managers vary more than those of non-optimistic managers and do so in response to changes in R&D spending. Absolute cash changed by $3.11 per $1.00 of R&D for optimistic firms, which is more than double that in the case of non-optimistic firms (where absolute cash changed by $1.50 per $1.00 increase in R&D). By contrast, cash balances for optimistic firms do not respond to acquisitions or capital investment differently to those of non-optimistic firms. Fourth, capital expenditures and acquisition expenditures are negatively correlated with cash holdings, meaning that firms with optimistic managers take on more cash-financed capital investment and acquisitions. Fifth, CEO optimism leads firms to hold fewer inventories and receivables. Unlike IPO firms with sufficient money, non-IPO optimistic firms that plan to reserve more cash have to reduce their net working capital. We also report that optimistic managers save less than non-optimistic managers for precautionary purposes. This relates to the theory that optimistic managers underestimate risk. Their cash saving motives are mainly for growth opportunities, not for future uncertainty. Finally, we find that optimistic managers are more sensitive to market conditions and save more cash than non-optimistic managers when times are bad. Our results are robust to a variety of model specifications and alternative CEO optimism measures (firm investment).

The next section discusses the research design. Section 3 describes the data, including sample selection and the main measures of optimistic managers, and presents some summary statistics. Section 4 presents the main empirical analysis, including robustness tests, and Sect. 5 concludes the paper.

2 Research design

Our work is motivated by the study of Heaton (2002) who emphasizes that optimistic CEOs systematically overestimate firm performance and tend to overinvest in negative NPV projects and underinvest in positive NPV projects if they have to seek external funds as a consequence. Similarly, we consider optimistic CEOs as managers who expect future outcomes to be better than they really are. The objective of our study is to see whether this overinvestment–underinvestment trade-off triggers optimistic managers to vary their cash balances over time, so that cash holdings may appear to be at different levels to those of non-optimistic firms and possibly more volatile. Consistent with the prior studies that have shown that optimistic managers have different characteristics that influence their decision making, we also seek to determine whether the motivations for hoarding cash and the use of cash holdings are different in firms governed by optimistic managers.

Our modeling approach uses the cross section regression developed by Opler et al. (1999) and Bates et al. (2009), which they used to identify the determinants of cash holdings by firms. The model regresses the cash-to-asset ratio onto determinants reflecting investment opportunities (including the market-to-book ratio and capital expenditures), size, leverage, growth opportunities, dividends, large investments (acquisition activities), and precautionary savings motives. Also, following Opler et al. (1999) and Ozkan and Ozkan (2004), we add two new control variables—managerial ownership percentage and the square of managerial ownership percentage to capture the concave relationship

between cash holdings and managerial ownership, which these and other studies have identified.[7]

We recast the above cash holdings model by adding interaction terms involving CEO optimism. Therefore, our model not only examines the determinants of cash holdings for average firms but also effectively shows the incremental impact of CEO optimism on cash holdings associated with firm characteristics. The cash model for each firm i at year t is

$$\begin{aligned} Cash_{i,t} = {} & \alpha_0 + \alpha_1 Q_{i,t} + \alpha_2 Size_{i,t} + \alpha_3 Cashflow_{i,t} + \alpha_4 NWC_{i,t} + \alpha_5 Capex_{i,t} \\ & + \alpha_6 Laglev_{i,t-1} + \alpha_7 R\&D_{i,t} + \alpha_8 Divdu_{i,t} + \alpha_9 Acq_{i,t} + \alpha_{10} Indusig_{i,t} \\ & + \alpha_{11} Own_{i,t} + \alpha_{12} Own2_{i,t} + \alpha_{13} D_{i,t} + \alpha_{14} D_{i,t} \times Q_{i,t} + \alpha_{15} D_{i,t} \times Size_{i,t} \\ & + \alpha_{16} D_{i,t} \times Cashflow_{i,t} + \alpha_{17} D_{i,t} \times NWC_{i,t} + \alpha_{18} D_{i,t} \times Capex_{i,t} \\ & + \alpha_{19} D_{i,t} \times Laglev_{i,t} + \alpha_{20} D_{i,t} \times R\&D_{i,t} + \alpha_{21} D_{i,t} \times Divdu_{i,t} \\ & + \alpha_{22} D_{i,t} \times Acq_{i,t} + \alpha_{23} D_{i,t} \times Indusig_{i,t} + \alpha_{24} D_{i,t} \times Own_{i,t} + \alpha_{25} D_{i,t} \times Own2_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{1}$$

where the dependent variable is the proxy for cash holdings and the explanatory variables include a set of firm characteristics and these variables interacted with the CEO optimism dummy variable.

Firms have several motives to save more cash, such as investment opportunities, financial distress costs, growth opportunities, and industry cash flow risk. The main proxies for investment opportunities are the market-to-book ratio (Q) and capital expenditures (*Capex*). The variable *R&D* represents the role of growth opportunities. When firms expand their technology development and performance, they may increase their cash levels to support this. Firms may issue debt for investment opportunities, which mean that they would not need to use cash to fund all projects. For optimistic managers, internal funding is prioritized; they therefore consider the allocation of cash and debt funds on these projects particularly important. The variable *Indusig*, or industry sigma, measures cash flow risk, which is the proxy for the precautionary saving motive. The greater cash flow risk, the more cash is reserved.[8]

The variable *Size* captures the economies of scales in cash and we expect a negative relation between cash holdings and firm size. The cash flow-to-assets ratio (*Cashflow*) can be either negatively or positively related to cash holdings (e.g., Kim et al. 1998; Almeida et al. 2004). Firms with greater earnings or those presumed to be less risky and thus having more investment opportunities are expected to have a lower demand for cash. By contrast, financially constrained firms are expected to save more cash out of cash flow. Net working capital (*NWC*) can be regarded as a substitute for cash, leading to an expected negative relation between net working capital and cash holdings.[9] Leverage can have two potentially opposing effects on cash balances. Firms may use cash to pay debt if they are intent on reducing their leverage level while their financial status is constrained. Alternatively, if firms have greater hedging needs, they may prefer to hold more cash than to lower their debt capacity (Acharya et al. 2007). In our study, we use the 1-year lagged value of leverage (*Laglev*) to avoid a possible endogeneity issue caused by a correlation between

[7] Managerial ownership has been found to influence cash holdings in many countries, see, for example, Luo and Hachiya (2005) for Japan and Yu et al. (2015) for Taiwan.

[8] Han and Qiu (2007) and Riddick and Whited (2009) show that cash flow shocks do matter for corporate propensity for savings. There is a positive relation between a firm's income uncertainty and cash savings.

[9] The net working capital ratio in this paper is net of cash. Thus, a negative relation between the cash ratio and the net working capital ratio is expected in the regression analysis.

cash and leverage through contemporaneous interest expenses. Acquisition activities (*Acq*) are large investments that represent cash outflows and have a negative relation with cash. The more acquisition expenditures, the more cash outflows and the less cash holdings. Companies save less cash when it comes to any increase in acquisition expenditures. The variables, percentage of managerial ownership (*Own*) and the square of the percentage of managerial ownership (*Own2*), are included to capture the concave relationship between managerial ownership and cash holdings. In general, it is shareholders' interest for managers not to hold idle cash. Due to managerial risk aversion, however, managers will tend to hold more cash when their ownership percentage increases. When it becomes too costly to hold more cash and their cash holdings are above an optimal level, managers may seek to reduce cash holdings, giving rise to a concave relationship with ownership. The data used to measure each of the explanatory variables is described in Sect. 3 below and in more detail in Appendix 1.

To capture the effects of managerial optimism, we add to the base-line determinants of cash holdings a dummy variable (*D*) that indicates whether the manager of the firm is optimistic or not. The proxy for CEO optimism is determined by the average percent moneyness of the options held by a CEO. The details of the optimism measure are given in Sect. 3 below. In addition, we include interaction terms of the optimism dummy variable with each of the potential determinants of cash flow holdings. This design helps to explicitly explain whether optimistic managers have distinct cash-financing plans and how differently they hoard cash.

We also examine a number of augmented specifications of the cash model as robustness checks. First, we examine whether there is a tendency for firms to reduce their net working capital (which contains noncash components of liquid assets) to hoard cash. To do so, firms that have gone public in the past 5 years are excluded from the model because initial public offering (IPO) firms hold large amounts of cash from issuing equity. Excluding IPO firms enables us to distinguish the sources of cash hoarding. Next, we incorporate the sum of net debt and equity issuance to assets as an additional variable in the cash holdings model to make sure our findings are not related to net issuances. In further analysis, we control for any influence of debt conservatism and market conditions. As a final robustness check, we follow Campbell et al. (2011) and use firm investment data to measure optimism. This is because the results of Malmendier and Tate (2005a, b), Campbell et al. (2011) and Gervais et al. (2011) show that managerial optimism appears to have influence on firm investment.

3 Data description and summary statistics

3.1 Data selection and CEO optimism measures

We first consider all CEO-firm data in the *ExecuComp* database between 1992 and 2010. Firms are included in the final sample if they meet the following screening criteria: (1) the firm is not a utility firm (Standard Industrial Classification, hereafter SIC, codes between 4900 and 4999) or a financial service firm (SIC codes between 6000 and 6999);[10] (2) each firm included in the sample has valid compensation and firm-level data for at least 2 years.

[10] Utility companies' cash holdings may relate to regulatory supervision across many states. Financial companies have a number of main businesses involving inventories of marketable securities that are part of cash.

These criteria result in 1001 observations in the optimism sample and 4902 observations in the non-optimistic sample. Table 1 summarizes the data selection process and outcome.

Following Campbell et al. (2011) our measures of CEO optimism are based on vested option holdings.[11] Optimistic managers are defined as holding exercisable options with over 100 % moneyness, while non-optimistic managers are defined as holding options that have <100 % moneyness.[12] To calculate the average percentage of the options' moneyness, we use two variables: the realizable value per option (*RV*) and the estimated average exercise price of the option (*AEP*). The variable *RV* is defined as the total realizable value of the exercisable options (OPT_UNEX_EXER_EST_VAL) divided by the total number of exercisable options (OPT_UNEX_EXER_NUM).[13] The variable *AEP* is the value of the stock's closing price at the fiscal year-end (*Compustat* item #199) minus *RV*. We can obtain the average percentage of option moneyness from the calculation of *RV/AEP*.

Although the optimism benchmark is designed to separate managers who are comparatively positive about the future from those that are not so positive, it is possible that firms holding options with moneyness near the 100 % boundary may be less well identified as optimistic or non-optimsitic. The approach to dealing with this in prior studies has been to consider an alternative boundary point, and we adopt that approach here also. We follow the alternative definition of Campbell et al. (2011) that optimistic managers are those having stock options with a moneyness in excess of 67 %, which is itself inspired by the overconfidence measure of Malmendier and Tate (2005a). Our sample with the 67 % cutoff generated 1908 optimistic observations and 6790 non-optimistic observations. Campbell et al. (2011) conduct two validation analyses of their classification of optimistic managers to show that their method contains findings consistent with those of Malmendier and Tate (2005a). Their examination also confirms the similarity of the classification of optimistic CEOs to that used by Malmendier and Tate (2005a).

We collect firm-level data on a variety of firm characteristics from the *Centre for Research in Security Prices* (*CRSP*)/*Compustat* database. These include the data for the explanatory variables proposed in Eq. (1) of Sect. 2. A detailed description of each of the variables is contained in the Appendix 1. Missing *R&D* observations are set to zero.[14] Net working capital is separated from cash and short-term investments. All accounting data are adjusted by the consumer price index in 2010. In accordance with Bates et al. (2009), the variables are winsorized as follows. The top tail of *Q* is winsorized at the 1 % level. The bottom tails of the cash flow-to-assets ratio and the net working capital-to-assets ratio are winsorized at the 1 % level. The capital expenditure-to-assets ratio, the R&D-to-sales ratio,

[11] The CEO optimism measure of Campbell et al. (2011) is also used by Malmendier et al. (2011) and Hirshleifer et al. (2012). Malmendier et al. (2011) use this measure alongside their own options-based measure and find consistent results after controlling for debt conservatism and market conditions. Hirshleifer et al. (2012) use this measure to study the relation between CEO optimism and investment in innovation.

[12] These definitions are inspired by the work of Campbell et al. (2011), who create measures of CEO optimism based on stock option holding. They classify high-optimistic managers as those who hold exercisable options that are more than 100 % in the money, in a given year. To be classified as high-optimistic in a given year, managers must have held options that are more than 100 % in the money for at least two of the years in the sample. In this paper, we focus on optimistic managers; thus we use the high-optimistic measure to define an optimistic manager. Their paper defines rational–optimistic managers who hold and/or exercise options with moneyness between 30 and 100 %. In addition, they define low-optimistic managers as those who exercise options that are <30 % in the money and do not hold options >30 % in the money. We group these latter two cases and define moneyness less than 100 % non-optimistic.

[13] The *ExecuComp* item identifiers are provided in parentheses.

[14] It is common for corporate finance studies to set missing R&D values to zero (e.g., Opler et al. 1999; Faulkender and Wang 2006; Dittmar and Mahrt-Smith 2007; Bates et al. 2009).

Table 1 Data selection

	No. firms	Observations
All CEOs available in the *ExecuComp* database from 1992 to 2010	3190	29,416
Less: with SIC codes 4000–4999 and 6000–6999	(907)	(7562)
Subtotal	2283	21,854
Less: without option data	(87)	(2793)
Subtotal	2196	19,061
Less: without valid stock close price or moneyness data	(4)	(89)
Subtotal	2192	18,972
Less: without compensation data for at least 2 years	(125)	(692)
Subtotal	2067	18,280
Less: without valid firm-level data from *CRSP*/*Compustat*	(604)	(9376)
Subtotal	1463	8904
Less: firms with only 1 year of data	(183)	(183)
Subtotal	1280	8721
Less: not valid R&D/sales computed	(3)	(23)
Subtotal	1277	8698
Less: without managerial ownership data	(42)	(1976)
Subtotal	1230	6722
Less: missing data after obtaining lagged leverage for an endogeneity issue	(36)	(819)
Subtotal	1194	5903
Less: non-optimistic sample that has moneyness <100 % or only 100 % moneyness once***	–	(4902)*
Total: optimistic sample (firm-year observations) for the 100 % bound***	–	1001**

This table summarizes the steps of sampling compensation data (CEO information) from the *ExecuComp* and company data from the *CRSP*/*Compustat* merged database from 1992 to 2010. We exclude firms with SIC codes 4000–4999 (utilities firms) and 6000–6999 (financial firms). Note that there are duplicate firms but unique firm-year observations between optimistic and non-optimistic groups

* The non-optimistic sample of 4902 observations features 1120 firms

** The optimism sample of 1001 observations features 407 firms

*** For the 67 % bound: the non-optimistic sample includes 4320 observations and 1076 firms. The optimism sample includes 1583 observations and 560 firms

the acquisitions-to-assets ratio, and the industry cash flow risk are winsorized at the 1 % level. The 1-year lagged value of the leverage-to-assets ratio is winsorized to lie between 0 and 1.

3.2 Summary statistics

Table 2 presents summary statistics of the dependent and explanatory variables for optimistic managers and non-optimistic managers based on two panels using the 100 and 67 % CEO optimism cutoffs, respectively.

The cash ratio is right-skewed for both groups, which is in line with the literature (e.g., Kim et al. 1998; Almeida et al. 2004; Ferreira and Vilela 2004; Bates et al. 2009). The mean and median values for the cash ratio of optimistic managers (for the 100 % cut-off) are 14.5 and 8.7 %, respectively, statistically higher ($p < 0.01$) than those of non-

Table 2 Summary statistics for optimistic and non-optimistic groups

Variables	Mean	1st quartile	Median	3rd quartile	SD	Mean	1st quartile	Median	3rd quartile	SD	*t* test on two groups
100 % cutoff	Optimistic group (no. of firms = 407; obs. = 1001)					Non-optimistic group (no. of firms = 1120; obs. = 4902)					
Cash	0.145	0.025	0.087	0.211	0.157	0.120	0.020	0.060	0.165	0.146	−4.56***
Q	3.216	1.803	2.651	4.015	1.908	1.943	1.231	1.602	2.258	1.167	−20.35***
Size	7.297	6.311	7.124	8.129	1.346	7.357	6.351	7.220	8.284	1.472	1.26
Cashflow	0.123	0.089	0.119	0.152	0.060	0.080	0.051	0.083	0.116	0.074	−19.81***
NWC	0.102	0.004	0.086	0.194	0.143	0.103	0.001	0.091	0.196	0.152	0.24
Capex	0.069	0.031	0.052	0.088	0.058	0.055	0.023	0.041	0.070	0.049	−7.41***
Laglev	0.183	0.040	0.165	0.282	0.162	0.227	0.076	0.216	0.335	0.181	7.63***
R&D	0.036	0.000	0.001	0.054	0.058	0.029	0.000	0.000	0.025	0.058	−3.60***
Divdu	0.490	0.000	0.000	1.000	0.500	0.595	0.000	1.000	1.000	0.491	6.10***
Acq	0.042	0.000	0.004	0.051	0.076	0.028	0.000	0.001	0.024	0.059	−5.79***
Indusig	0.083	0.052	0.084	0.107	0.035	0.078	0.046	0.073	0.102	0.038	−3.63***
Own	0.024	0.002	0.006	0.022	0.046	0.023	0.001	0.003	0.012	0.059	−0.66
Own2	0.003	0.000	0.000	0.000	0.010	0.004	0.000	0.000	0.000	0.021	2.93***
67 % cutoff	Optimistic group (no. of firms = 560; obs. = 1583)					Non-optimistic group (no. of firms = 1076; obs. = 4320)					
Cash	0.129	0.022	0.069	0.188	0.150	0.122	0.020	0.061	0.170	0.148	−1.65*
Q	2.883	1.667	2.324	3.502	1.723	1.893	1.204	1.563	2.157	1.162	−21.16***
Size	7.416	6.398	7.276	8.284	1.390	7.322	6.322	7.184	8.246	1.473	−2.26**
Cashflow	0.115	0.082	0.111	0.144	0.061	0.077	0.049	0.080	0.114	0.076	−19.92***
NWC	0.098	−0.002	0.084	0.190	0.145	0.105	0.004	0.092	0.198	0.152	1.62
Capex	0.066	0.028	0.050	0.085	0.056	0.054	0.023	0.040	0.069	0.048	−7.44***
Laglev	0.196	0.060	0.183	0.294	0.160	0.228	0.073	0.216	0.339	0.185	6.50***
R&D	0.031	0.000	0.000	0.036	0.054	0.030	0.000	0.000	0.026	0.060	−0.64
Divdu	0.543	0.000	1.000	1.000	0.498	0.590	0.000	1.000	1.000	0.492	3.23***
Acq	0.041	0.000	0.004	0.047	0.074	0.026	0.000	0.000	0.022	0.057	−7.02***

Table 2 continued

67 % cutoff	Optimistic group (no. of firms = 560; obs. = 1583)					Non-optimistic group (no. of firms = 1076; obs. = 4320)					
Indusig	0.081	0.050	0.081	0.103	0.035	0.079	0.046	0.073	0.102	0.038	−1.89*
Own	0.023	0.001	0.005	0.019	0.049	0.023	0.001	0.003	0.011	0.059	0.03
Own2	0.003	0.000	0.000	0.000	0.014	0.004	0.000	0.000	0.000	0.021	2.26**

The sample includes *CRSP/Compustat* firm-year observations from 1992 to 2010. We define CEOs as optimistic (non-optimistic) if they hold exercisable options that have more (less) than 100 or 67 % moneyness. The variable *Cash* is the cash-to-assets ratio; *Q* is the market-to-book ratio; *Size* is the logarithm of total assets; *Cashflow* is operating income before depreciation minus total interest and related expenses minus total income taxes minus dividends, all divided by total assets; *NWC* is working capital from balance sheets minus cash and short-term investments, divided by assets; *Capex* is capital expenditures scaled by total assets; *Laglev* is the 1-year lagged value of total long-term debt plus debt in current liabilities, divided by total assets; *R&D* is R&D expenditures divided by sales; *Divdu* is a dividend dummy that equals to 1 if a firm pays dividends, otherwise zero; *Acq* is acquisitions divided by total assets; *Indusig* is the industry cash flow risk; *Own* and *Own2* are CEO ownership percentage and the square of ownership percentage, respectively. All variable definitions are given in the Appendix 1. The last column reports the *t* values of means tests between the optimistic and non-optimistic groups across variables

***, **, and * Statistical significance at the 1, 5, and 10 % levels

optimistic managers (12.0 and 6.0 %, respectively), consistent with our expectations. This also strongly supports prior studies of the effects of CEO optimism, which find that optimistic and overconfident CEOs demand internal funds, prefer to pay less dividends, overinvest in projects, and invest in more acquisitions than non-optimistic managers.

Optimistic managers seem to undertake bigger investment than non-optimistic managers, since all their mean and median values for *Q*, capital expenditures, *R&D*, and acquisitions are higher than for non-optimistic managers. The mean *Q* for optimistic managers is 3.216, which is higher ($p < 0.01$) than the mean of non-optimistic managers (1.943), suggesting that optimistic managers have better future investment opportunities than non-optimistic managers.[15] The upper quartile of optimistic managers has two times more R&D expenditures and acquisition outflows than the corresponding quartile of non-optimistic managers. These figures indicate that optimistic managers have larger investments than non-optimistic managers.

The mean and median leverage of firms with optimistic managers are 18.3 and 16.5 %, respectively, lower than the figures of 22.7 and 21.6 %, respectively, of firms with non-optimistic managers ($p < 0.01$). This information implies that, on average, firms with optimistic managers have less debt issuance than non-optimistically managed firms, which is consistent with the evidence of Malmendier et al. (2011), where firms with overconfident managers are debt conservative and issue debt to levels lower than the point of maximum tax benefits.

We also notice that the percentage of dividend-paying firms in the optimistic group is 49 %. This is significantly less than the corresponding figure of 59.5 % in the non-optimistic group. These statistics are consistent with the theory that most firms governed by optimistic managers are less likely to pay dividends. When the optimism criterion is loosened, which means that the cutoff is changed from 100 to 67 % moneyness, the number of dividend payers in the optimistic group increases to 54.3 %, which is significantly different from 59 % of the non-optimistic group at the 1 % significance level. Also, the difference in the managerial ownership percentage between optimistic and non-optimistic groups is statistically insignificant. However, the square term of managerial ownership in the optimistic group is slightly lower than that of the non-optimistic group.

Table 3 shows the Pearson correlation matrices of the set of exogenous variables with each other and the cash holdings for the optimistic and non-optimistic groups based on both the 100 and 67 % CEO optimism cutoffs (panels A and B, respectively). Cash holdings are positively related to the market-to-book ratio, R&D spending, and industry cash flow risk ($p < 0.01$) in both the optimistic and non-optimistic groups. In particular, cash has a closer relation with *R&D* in the optimistic group than in the non-optimistic group. We also find that cash in firms with optimistic managers has weaker connections with their lagged leverage levels and acquisition expenditures compared to that in firms with non-optimistic managers. The debt conservatism measure, *Kink*, is positively related to cash holdings, and the relationship is stronger in the optimistic group than in the non-optimistic group. It is also worth noting that the correlations between cash holdings and managerial ownership variables (*Own* and *Own2*) are positive and significant in the non-optimistic group and not significantly different from zero in the optimistic group.

[15] One might be tempted to argue that high-Q optimistic firms should have lower cash holdings than low-Q optimistic firms as they can use more cash flows to finance future growth options. To examine this issue, we separate high-Q firms from low-Q firms within each group (optimistic and rational). The classification of Q ratios into high and low is based on its mean value. Appendix 2 shows the result that the mean cash holdings of the optimistic group with high Q ratios is higher than for the optimistic group with low Q ratios ($p < 0.01$). A similar result is found when we partition the sample by R&D, instead of Q.

Table 3 Pearson correlation matrix

	Optimistic group									
	Cash	Q	Size	Cashflow	NWC	Capex	Laglev	R&D	Divdu	Acq
Panel A: 100 % cutoff										
Non-optimistic group										
Cash		0.43***	−0.21***	0.08*	−0.17***	−0.21***	−0.39***	0.53***	−0.16***	−0.24***
Q	0.32***		−0.06	0.32***	−0.17***	−0.08**	−0.30***	0.41***	−0.04	−0.10**
Size	−0.24***	−0.02		−0.11***	−0.32***	0.08*	0.19***	0.00	0.24***	−0.01
Cashflow	−0.10***	0.32***	0.08***		−0.01	0.29***	−0.18***	0.02	−0.07*	−0.14***
NWC	−0.17***	−0.13***	−0.34***	0.04*		−0.17***	−0.05	−0.13***	0.05	−0.05
Capex	−0.18***	0.00	−0.01	0.26***	−0.18***		0.04	−0.15***	−0.01	−0.19***
LagLev	−0.37***	−0.12***	0.20***	−0.09***	−0.16***	−0.01		−0.26***	−0.11**	0.04
R&D	0.50***	0.23***	−0.10***	−0.19***	−0.12***	−0.13***	−0.18***		−0.17***	0.00
Divdu	−0.23***	0.01	0.27***	0.05***	0.00	0.02	−0.02	−0.26***		0.00
Acq	−0.13***	−0.01	0.02	0.01	−0.04*	−0.12***	−0.05**	0.02	0.02	
Indusig	0.23***	0.11***	−0.10***	−0.04**	−0.10***	−0.02	−0.07***	0.36***	−0.13***	0.05**
Own	0.07***	0.05**	−0.23***	0.08***	0.10***	0.01	−0.11***	−0.06***	−0.03*	−0.03
Own2	0.04**	0.04**	−0.13***	0.07***	0.02	0.02	−0.06***	−0.05**	−0.02	−0.01
Kink	0.29***	0.42***	−0.04*	0.17***	0.00	−0.06***	−0.39***	0.18***	0.12***	0.03*
BHR	−0.03*	0.04*	−0.06***	−0.03*	0.03*	0.04*	0.00	−0.02	0.07***	0.01
LagBHR	−0.09***	−0.01	−0.09***	0.05***	0.08***	0.11***	−0.03	−0.06***	0.10***	0.06***
SD	0.01	−0.04**	0.03*	0.00	−0.02	−0.03*	0.05***	0.01	−0.06***	−0.02
Lagstdev	−0.02	−0.04**	0.02	−0.03*	−0.03	−0.06***	0.10***	0.00	−0.05***	−0.03
Panel B: 67 % cutoff										
Non-optimistic group										
Cash		0.44***	−0.24***	0.04	−0.18***	−0.19***	−0.38***	0.53***	−0.19***	−0.20***
Q	0.32***		−0.08***	0.33***	−0.20***	−0.04	−0.29***	0.40***	−0.08**	−0.07**

Table 3 continued

	Optimistic group									
	Cash	Q	Size	Cashflow	NWC	Capex	Laglev	R&D	Divdu	Acq
Size	−0.23***	−0.02		−0.11***	−0.34***	0.06*	0.18***	−0.07**	0.26***	−0.01
Cashflow	−0.10***	0.31***	0.09***		−0.02	0.31***	−0.16***	0.00	−0.12***	−0.10***
NWC	−0.17***	−0.10***	−0.34***	0.06***		−0.16***	−0.06*	−0.10***	0.02	−0.04
Capex	−0.17***	0.00	−0.02	0.25***	−0.18***		0.02	−0.14***	−0.02	−0.19***
LagLev	−0.37***	−0.11***	0.21***	−0.09***	−0.17***	−0.01		−0.24***	−0.09**	0.01
R&D	0.50***	0.23***	−0.09***	−0.19***	−0.13***	−0.13***	−0.18***		−0.19***	0.03
Divdu	−0.23***	0.02	0.27***	0.08***	0.01	0.02	−0.01	−0.27***		0.00
Acq	−0.13***	−0.02	0.02	0.01	−0.04*	−0.11***	−0.05**	0.02	0.02	
Indusig	0.23***	0.11***	−0.10***	−0.04*	−0.11***	−0.01	−0.08***	0.36***	−0.13***	0.03*
Own	0.08***	0.07***	−0.22***	0.09***	0.09***	0.01	−0.13***	−0.06***	−0.02	−0.03
Own2	0.05**	0.06***	−0.13***	0.08***	0.02	0.02	−0.07***	−0.05**	−0.02	−0.01
Kink	0.30***	0.41***	−0.05**	0.16***	0.02	−0.06***	−0.39***	0.18***	0.13***	0.02
BHR	−0.04*	0.03*	−0.07***	−0.03	0.04*	0.04**	0.00	−0.03*	0.08***	0.01
LagBHR	−0.09***	0.00	−0.10***	0.06***	0.08***	0.13***	−0.03	−0.06***	0.11***	0.06***
SD	0.01	−0.04*	0.04*	0.00	−0.03	−0.04*	0.05**	0.01	−0.06***	−0.01
Cash	−0.02	−0.04**	0.03*	−0.04*	−0.02	−0.07***	0.10***	0.00	−0.04**	−0.03

	Optimistic group							
	Indusig	Own	Own2	Kink	BHR	LagBHR	SD	Lagstdev
Panel A: 100 % cutoff								
Non-optimistic group								
Cash	0.25***	−0.03	−0.02	0.38***	0.00	−0.03	0.05	0.12***
Q	0.26***	−0.05	−0.06	0.45***	0.08*	0.07*	0.09**	0.13***
Size	−0.08**	−0.24***	−0.11***	−0.04	−0.03	−0.03	−0.02	−0.01

Table 3 continued

	Optimistic group							
	Indusig	Own	Own2	Kink	BHR	LagBHR	SD	Lagstdev
Cashflow	0.03	0.01	−0.01	0.26***	−0.02	0.02	0.02	0.03
NWC	−0.06*	0.09**	0.08*	−0.03	0.00	0.04	0.00	−0.02
Capex	−0.13***	0.04	0.01	−0.08*	0.02	0.07*	−0.08*	−0.15***
LagLev	−0.18***	−0.11***	−0.09**	−0.45***	−0.01	0.02	0.00	−0.01
R&D	0.44***	−0.10**	−0.07*	0.36***	0.03	0.02	0.08*	0.09**
Divdu	0.00	−0.08*	−0.04	0.10**	0.07*	0.05	−0.05	−0.05
Acq	0.05	−0.03	−0.05	−0.11***	−0.01	0.02	−0.01	−0.05
Indusig		−0.04	−0.02	0.20***	0.03	0.01	0.01	−0.05
Own	−0.03*		0.89***	−0.05	−0.09**	−0.03	0.04	−0.03
Own2	−0.02	0.89***		−0.05	−0.08**	−0.03	0.03	−0.03
Kink	0.06***	0.09***	0.07***		−0.03	−0.03	0.03	0.10**
BHR	0.04*	0.02	0.01	−0.04**		0.12***	−0.42***	−0.06*
LagBHR	0.01	0.04*	0.02	0.03	0.01		−0.15***	−0.45***
SD	−0.06***	−0.02	−0.01	−0.03*	−0.48***	−0.32***		0.52***
Lagstdev	−0.11***	0.00	0.00	−0.07***	0.06***	−0.55***	0.50***	
Panel B: 67 % cutoff								
Non-optimistic group								
Cash	0.27***	−0.01	−0.02	0.35***	0.01	−0.02	0.03	0.10***
Q	0.24***	−0.05	−0.06*	0.46***	0.06*	0.06*	0.06*	0.09***
Size	−0.11***	−0.24***	−0.13***	−0.02	−0.03	−0.05	0.00	−0.02
Cashflow	0.02	0.02	−0.01	0.24***	−0.04	0.03	0.03	0.02
NWC	−0.06**	0.10***	0.07**	−0.07**	0.00	0.07**	0.00	−0.03
Capex	−0.11***	0.04	0.01	−0.07**	0.01	0.06*	−0.04	−0.10***
LagLev	−0.14***	−0.05	−0.03	−0.44***	−0.01	−0.01	0.02	0.02

Table 3 continued

	Optimistic group							
	Indusig	Own	Own2	Kink	BHR	LagBHR	SD	Lagstdev
R&D	0.42***	−0.07**	−0.05*	0.32***	0.05	0.02	0.04	0.05*
Divdu	−0.05*	−0.10***	−0.04	0.09***	0.05*	0.03	−0.05*	−0.07**
Acq	0.08**	−0.03	−0.05	−0.06*	0.00	0.02	−0.03	−0.05
Indusig		−0.01	−0.01	0.17***	0.05*	0.02	−0.01	−0.05*
Own	−0.04*		0.89***	−0.06**	−0.04	−0.02	0.03	0.00
Own2	−0.02	0.89***		−0.07**	−0.03	−0.01	0.01	−0.02
Kink	0.06***	0.12***	0.09***		−0.02	0.00	0.00	0.03
BHR	0.03	0.02	0.01	−0.05**		0.06*	−0.43***	−0.02
LagBHR	0.01	0.04**	0.02	0.03	0.01		−0.19***	−0.49***
SD	−0.06***	−0.02	−0.02	−0.03	−0.48***	−0.33***		0.52***
Cash	−0.12***	−0.01	0.00	−0.06***	0.07***	−0.55***	0.50***	

This table summarizes a set of Pearson correlations matrices for the optimistic and non-optimistic groups, respectively. Correlations among the independent variables and *Cash* for the optimistic group are above the leading diagonal of the correlation matrix, while the corresponding correlations for the non-optimistic group are below the leading diagonal. Firm-years are in the optimistic group if the manager's option holding moneyness is above 100 % (panel A) or 67 % (panel B); otherwise they are in the non-optimistic groups. Variables include *Cash* (the cash-to-assets ratio), *Q* (the market-to-book ratio), *Size* (the logarithm of total assets), *Cashflow* (operating income before depreciation minus total interest and related expenses minus total income taxes minus dividends, divided by total assets), *NWC* (working capital from balance sheet minus cash and short-term investments, divided by assets), *Capex* (capital expenditures scaled by total assets), *Laglev* (the 1-year lagged value of total long-term debt plus debt in current liabilities, divided by total assets), *R&D* (R&D expenditures divided by sales), *Divdu* (dividend dummy equal to 1 if a firm pays dividends, otherwise zero), *Acq* (acquisitions divided by total assets), *Indusig* (industry cash flow risk), *Own* (CEO ownership percentage), *Own2* (the square of *Own*), *NI* (debt issuance plus equity sales minus debt retirement and minus equity repurchases, divided by total assets), the interaction terms (defined as *D* interacted with each independent variable), *Kink* (debt conservatism), *BHR* (the buy-and-hold market returns), *lagBHR* (1-year lagged BHR), *Stdev* (the standard deviation of market index returns), and *lagStdev* (1-year lagged Stdev). All variable definitions are given in the Appendix 1

***, **, and * Statistical significance at the 1, 5, and 10 % levels, respectively

Table 4 Average cash ratios from 1992 to 2010

Year	Full sample		Optimistic group			Non-optimistic group		
	N	Average cash ratio	N	Average cash ratio	Δ Average cash ratio	N	Average cash ratio	Δ Average cash ratio
1993	150	0.087	10.67 %	0.126		89.33 %	0.083	
1994	170	0.089	10.00 %	0.127	0.001	90.00 %	0.085	0.002
1995	171	0.093	16.37 %	0.153	0.026	83.63 %	0.081	−0.004
1996	194	0.093	19.59 %	0.133	−0.02	80.41 %	0.083	0.002
1997	242	0.098	25.21 %	0.117	−0.016	74.79 %	0.091	0.008
1998	358	0.094	19.27 %	0.129	0.012	80.73 %	0.086	−0.005
1999	360	0.093	18.89 %	0.178	0.049	81.11 %	0.073	−0.013
2000	371	0.094	19.14 %	0.181	0.003	80.86 %	0.074	0.001
2001	374	0.112	17.38 %	0.17	−0.011	82.62 %	0.100	0.026
2002	399	0.133	12.53 %	0.146	−0.024	87.47 %	0.132	0.032
2003	433	0.145	17.78 %	0.186	0.040	82.22 %	0.136	0.004
2004	427	0.146	20.84 %	0.16	−0.026	79.16 %	0.143	0.007
2005	452	0.144	23.23 %	0.137	−0.023	76.77 %	0.147	0.004
2006	393	0.133	22.39 %	0.115	−0.022	77.61 %	0.138	−0.009
2007	500	0.137	18.60 %	0.103	−0.012	81.40 %	0.145	0.007
2008	462	0.137	7.58 %	0.125	0.022	92.42 %	0.138	−0.007
2009	447	0.169	6.94 %	0.156	0.031	93.06 %	0.17	0.032
Mean	347	0.117	16.85 %	0.144	0.002	83.15 %	0.112	0.005
SD		0.026	0.053	0.024	0.024	0.053	0.031	0.013

t test: two-sample test of equality of means (optimistic vs. non-optimistic groups) assuming unequal variances

Average cash ratio	$t = 3.192$, p value $= 0.003$
Δ average cash ratio	$t = -0.500$, p value $= 0.621$

F test: two sample test of equality of variances (optimistic vs. non-optimistic groups)

Average cash ratio	$F_{16,16} = 0.608$, p value $= 0.329$
Δ average cash ratio	$F_{15,15} = 3.367$, p value $= 0.025$

This table reports the number of observations and average cash ratios (the mean of each firm-year observation's ratio of cash holdings to total assets) for the full sample and the two sub-samples (optimistic and non-optimistic groups) from 1992 to 2010. We also present the change in (Δ) the average cash ratio for the two sub-samples. The total number of observations in the full sample is 5903, including an optimistic group of 1001 and a non-optimistic group of 4902. After matching with managerial ownership data and estimating the 1-year lagged leverage, the effective period for our sample is between 1993 and 2009

Table 4 reports the number of firm-year observations and the average cash ratio in each year for the two groups, separated and aggregated, from 1993 to 2009.[16] The average percentage of optimistic firm-year observations in the full sample is 16.85 %. We notice that the number of such observations has fallen since 2007 and dropped to only 6.94 % in 2009. These statistics imply that fewer managers are optimistic during US recession periods. In 2008 and 2009, the US economy experienced a serious housing bubble, a job cut crisis, and decreases in consumption, personal income, and real gross domestic product. There are

[16] After matching the sample with ownership data and estimating the one-year lagged leverage, the effective period for our analysis is between 1993 and 2009.

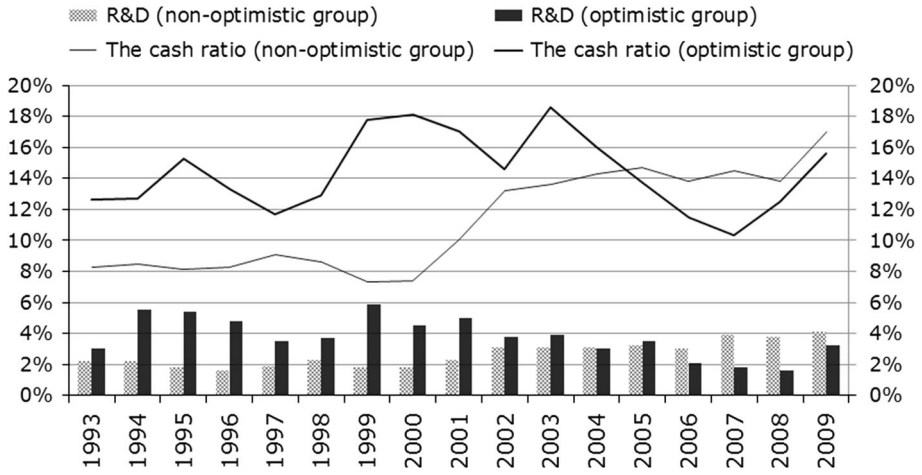

Fig. 1 Average cash ratios and R&D expenditures ratios of optimistic and non-optimistic groups

relatively more optimistic managers during bull periods, for example, from July 1994 to September 2000 and from March 2003 to December 2006.[17] Moreover, the variability of cash balances in the optimistic group is greater than that in the non-optimistic group over the sample period ($p < 0.01$). Figure 1 virtually shows the difference using the average R&D-to-sales ratio of optimistic and non-optimistic groups from 1993 to 2009. Firms with optimistic CEOs have much greater (less) R&D expenditures than non-optimistically managed firms from 1993 to 2005 (2006–2009), in line with the period of their big cash hoards.

4 Empirical analysis

4.1 What factors dominate the tendency of corporations to hoard cash?

The summary statistics show that the cash holdings of our full sample and two sub-sample groups (optimistic and non-optimistic) have increased in recent years. We begin by examining whether the increase in cash holdings can be explained by firm characteristics, without the inclusion of the CEO optimism effect. Since the ordinary least squares (OLS) model may be inappropriate if the distribution of the dependent variable (*Cash* in our case) is highly positively skewed in the (0, 1) range, we also employ the beta distribution (Beta) model which is well suited for use in proportional data analysis, as a robustness tool.[18] In Table 5, Panel A, we provide summary statistics of the distribution of cash holdings for the full sample to that clearly shows the high positive skewness of *Cash*. Figure 2 also shows the skewness in the ratio whereby the majority of our sample has the cash ratio ranging between 0 and 20 %. These findings support our use of the Beta distribution model.

In Panel B of Table 5, we show both OLS and Beta regression results. All models in our study include year and industry fixed effects. The standard errors are adjusted for firm

[17] The starting and ending points of the bull and bear markets are based on the data of Cunado et al. (2008).

[18] We thank an anonymous referee for suggesting the use of the beta distribution. Examples of the development and application of the beta distribution in regression models include Kieschnick and McCullough (2003), Wagner (2001), and Berggren et al. (2014).

Table 5 Regression estimating the determinants of cash holdings without CEO optimism effect

Panel A: Summary statistics of cash/assets						
	Mean	0.124	1st quartile	0.020	Skewness	1.921
	Min.	0.000	Median	0.064	SD	0.149
	Max.	0.918	3rd quartile	0.175	Kurtosis	6.957
Panel B: Regressions						
Model			1 (OLS)		2 (beta)	
Dependent variable			Cash/assets		Cash/assets	
Q			0.018*** (0.003)		0.126*** (0.015)	
Size			−0.020*** (0.003)		−0.113*** (0.017)	
Cashflow			−0.052 (0.055)		0.049 (0.335)	
NWC			−0.298*** (0.027)		−1.958*** (0.185)	
Capex			−0.677*** (0.071)		−5.112*** (0.500)	
Laglev			−0.218*** (0.022)		−2.065*** (0.169)	
R&D			0.734*** (0.077)		3.977*** (0.457)	
Divdu			−0.021*** (0.006)		−0.166*** (0.045)	
Acq			−0.422*** (0.025)		−3.392*** (0.196)	
Indusig			0.024 (0.079)		0.435 (0.622)	
Own			0.194 (0.147)		0.615 (0.998)	
Own2			−0.289 (0.254)		−0.559 (1.929)	
Total obs.			5903		5842	
Adj. *R* squared (OLS); Chi-2 (beta)			0.528		2451.3***	

The dependent variable in all regressions is the cash-to-asset ratio. The independent variables include *Q* (the market-to-book ratio), *Size* (the logarithm of total assets), *Cashflow* (operating income before depreciation minus total interest and related expenses minus total income taxes minus dividends, divided by total assets), *NWC* (working capital from balance sheet minus cash and short-term investments, divided by assets), *Capex* (capital expenditures scaled by total assets), *Laglev* (the 1-year lagged value of total long-term debt plus debt in current liabilities, divided by total assets), *R&D* (R&D expenditures divided by sales), *Divdu* (dividend dummy equal to 1 if a firm pays dividends, otherwise zero), *Acq* (acquisitions divided by total assets), *Indusig* (industry cash flow risk), *Own* (CEO ownership percentage), and *Own2* (the square of *Own*). All variable definitions are given in the Appendix 1. This model includes year and industry fixed effects. The standard errors adjusted for clustering by firm are reported in parentheses

***, **, and * Statistical significance at the 1, 5, and 10 % levels, respectively

clustering. The sign and significance of all variables are consistent with our predictions (in the Appendix 1) and those documented by Opler et al. (1999) and Bates et al. (2009).

The results for both models are qualitatively similar. Specifically, both models show that *R&D* captures the main incentive to demand excessive cash. In the OLS model, the

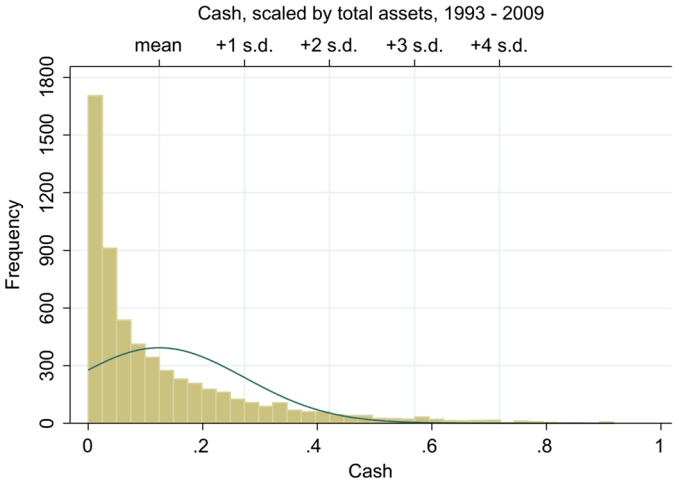

Fig. 2 The distribution of cash for the whole sample including optimistic and non-optimistic managers

coefficient of R&D is 0.734, implying that a 10 % increase in the ratio of R&D to sales needs a \$0.00734 increase in cash holdings (scaled by total assets). The Beta model implies a \$0.03977 increase in cash holdings for every 10 % increase in the ratio of R&D to sales. Net working capital, capital expenditures, leverage, and acquisition activities have strong negative coefficients. The less net working capital, the more cash holdings. This result implies that firms hoarding more cash now than before have less inventory and receivables. In addition, the statistically significant coefficients of capital expenditures [−0.677 (OLS); −5.112 (Beta)] and acquisition expenditures [−0.422 (OLS); −3.392 (Beta)] show that big investment expenses lead firms to consume their cash holdings, while there is a steady increase in cash holdings for the full sample over the period.

Leverage can be negatively or positively related to cash holdings. If firms have great hedge needs for future investment, they will prefer holding more cash than lowering leverage, leading to a positive relation between leverage and cash holdings. However, if firms' financing sources are restrained, to some extent these firms need to use cash to reduce their leverage in case of default. The coefficient of *Laglev* estimated in our regressions is negative ($p < 0.01$ in both models), implying that average firms' debt capacity is constrained and firms will spend more cash to reduce leverage.

The coefficient of the dividend dummy is negative ($p < 0.01$). In general, dividend-paying firms hold less cash than non–dividend-paying firms, which is consistent with the OLS statistics of Bates et al. (2009). Dividend-paying firms are likely to have less financial distress. For that reason, they have less incentive to save cash for paying dividends. The relation between cash and industry cash flow risk is positive but insignificant in both models. This result may due to the sample including IPO firms, which are likely to be cash rich immediately after the IPO. We examine this issue later. We find that *Own* is positively related and *Own2* is negatively related to *Cash*, but both relations are not statistically significant in either model (in line with Opler et al. 1999).[19] Overall, both models show similar effects of firm

[19] Opler et al. (1999) find that cash holdings are positively related to low levels of managerial ownership (the low level of ownership is defined as a benchmark of 5 %). At high levels of ownership, cash holdings are negatively related to ownership.

characteristics on cash holdings. Since the Beta model considers the shape of the non-normal distribution of cash holdings, we use the Beta model for all subsequent regression analyses.

4.2 Does CEO optimism lead firms to save and use cash differently?

To examine whether CEO optimism influences their motives for corporate cash holdings, we extend the Beta regression model in Table 5 by including the interaction terms of the firm characteristics with CEO optimism dummy variable. Results are shown in Table 6. Models 1 and 2 of Table 6 provide regression results of Eq. (1). We find that the CEO optimism effect does not affect the overall cash holdings (which can be seen from the estimated coefficient on the optimism dummy variable, D). However, results show that $R\&D$ is the crucial determinant that leads the optimistic group to have increased cash hoards over the sample period. The coefficient on $D \times R\&D$ in Model 1 (100 % CEO optimism cutoff) is statistically significant, suggesting that firms with optimistic managers have a greater incentive to save for growth opportunities. It is approximately 13.83 cents more than firms with non-optimistic managers for each 10 % increase for $R\&D$. Consistent with Ferris et al. (2013), firms with optimistic managers undertake more cash-financed acquisition activities. The estimate of $D \times Acq$ in Model 1 shows that they use 10.82 cents ($p < 0.05$) more for each 10 % invested in acquisitions than non-optimistic-CEO firms. These findings indicate that firms governed by optimistic managers have higher propensities to save for growth opportunities and more large and cash-financed deals than other managers, and can explain the variability in cash holdings seen in Fig. 1. Coefficients on $D \times Indusig$ and $D \times Own$ are -2.049 ($p < 0.10$) and -3.636 ($p < 0.05$), indicating optimistic-CEO firms have fewer precautionary savings and save less with increases in the CEO's ownership percentage than non-optimistic-CEO firms. Only the results with $R\&D$ remain significant when we use a wider CEO optimism cutoff (upper the 67 % moneyness).[20] This means that only the extremely optimistic group has this characteristic.

So far, we found that optimistic managers and non-optimistic managers have different cash holding motives. Our next examination is on whether optimistic managers vary firms' cash balances over time more than non-optimistic managers. Models 3 and 4 of Table 6 re-estimate Models 1 and 2 using the absolute cash ratio change.[21] We replace *laglev* with *Lev* (leverage in year t) as there is no endogeneity issue with cash change. Model 3 shows that the 1.61 ($p < 0.05$) greater variation in cash balances is explained by $R\&D$ for firms with optimistic managers. This test further supports those findings that the optimistic group has relatively volatile cash balances, as seen earlier in Fig. 1 and the results in Table 6. When the optimism boundary is relaxed to 67 %, the coefficient of $R\&D$ is insignificant. This implies that cash balances are sensitive to a relatively stronger level of the CEO optimistic effect.

[20] We also examined the model with year and industry fixed effects (with clustered by firm standard errors) with the addition of R&D fixed effects to control for the possibility that the relation between R&D, optimism and cash holdings is being driven by R&D intensive firms. The fixed effects partition the firms into five groups, zero R&D activity and four quartiles of positive R&D activity. We find that optimistic managers, even in low R&D intensive firms, have higher cash holdings for R&D than do non-optimistic managers.

[21] The absolute cash ratio change is defined as the absolute value of the current cash ratio minus the lagged cash ratio. Our data period for calculating the absolute cash change is between 1992 and 2010 and so the final sample period for this absolute-cash-change model is from 1993 to 2010.

Table 6 Regressions estimating determinants of cash holdings with CEO optimism effect: baseline results

Model	1	2	3	4
CEO optimism cutoff	100 % cutoff	67 % cutoff	100 % cutoff	67 % cutoff
Dependent variable	Cash/assets	Cash/assets	Absolute cash changes	Absolute cash changes
D	0.032	−0.041	−0.031	−0.032
	(0.066)	(0.058)	(0.049)	(0.043)
D × Q	−0.035	−0.031	−0.052**	−0.038
	(0.025)	(0.025)	(0.024)	(0.025)
D × Size	−0.072**	−0.055*	−0.026	−0.011
	(0.032)	(0.028)	(0.030)	(0.026)
D × Cashflow	0.387	−0.366	1.283	1.603**
	(0.665)	(0.605)	(0.900)	(0.730)
D × NWC	−0.339	−0.063	−0.072	−0.043
	(0.295)	(0.279)	(0.301)	(0.276)
D × Capex	−0.129	0.164	−0.746	−1.410**
	(0.687)	(0.638)	(0.675)	(0.656)
D × Laglev	0.296	0.308		
	(0.250)	(0.224)		
D × Lev			−0.273	−0.222
			(0.255)	(0.265)
D × R&D	1.383*	1.248*	1.610**	1.012
	(0.789)	(0.718)	(0.769)	(0.676)
D × Divdu	0.124	0.086	−0.004	−0.004
	(0.078)	(0.070)	(0.070)	(0.068)
D × Acq	−1.082**	−0.531	0.463	0.455
	(0.438)	(0.365)	(0.575)	(0.542)
D × Indusig	−2.049*	−0.058	0.210	−0.370
	(1.130)	(0.974)	(1.065)	(0.910)
D × Own	−3.636**	−2.295	−1.660	−1.481
	(1.710)	(1.436)	(1.713)	(1.709)
D × Own2	9.374	5.547	6.946	4.975
	(6.147)	(3.466)	(5.359)	(4.807)
Optimistic/total obs.	987/5842	1563/5842	978/5840	1259/4683
Chi^2	2706.4***	2691.4***	1036.9***	626.9***

The sample includes CEO-year data from *ExecuComp* and firm-year data from the *CRSP*/*Compustat* merged database between 1992 and 2010. We exclude utility firms (SIC codes 4900–4990) and financial firms (SIC codes 6000–6990). For the dependent variable, models 1 and 2 use the cash-to-assets ratio while models 3 and 4 use the absolute change in cash holdings (the difference between current cash ratio and lagged cash ratio). The independent variables include *D* (CEO optimism dummy), *Q* (the market-to-book ratio), *Size* (the logarithm of total assets), *Cashflow* (operating income before depreciation minus total interest and related expenses minus total income taxes minus dividends, divided by total assets), *NWC* (working capital from balance sheet minus cash and short-term investments, divided by assets), *Capex* (capital expenditures scaled by total assets), *Lev* (total long-term debt plus debt in current liabilities, divided by total assets), *Laglev* (the 1-year lagged value of *Lev*), *R&D* (R&D expenditures divided by sales), *Divdu* (dividend dummy equal to 1 if a firm pays dividends, otherwise zero), *Acq* (acquisitions divided by total assets), *Indusig* (industry cash flow risk), *Own* (CEO ownership percentage), *Own2* (the square of *Own*), and the interaction terms (defined as *D* interacted with each independent variable). All variable definitions are given in the Appendix 1. The standard errors adjusted for clustering by firm are reported in parentheses. To save space, this table only displays the results for *D* and variables interacting with *D*. All regressions include cash holdings controls, year and industry fixed effects. The full results are available upon request

*, **, and *** Significance at the 10, 5, and 1 % levels, respectively

4.3 Model specification robustness

Our sample heretofore contains some firms that have gone public within the last 5 years and their cash holdings are thus at a high level because of lumpy capital raising. In theory, these IPO firms are cash rich and have no need to save cash from holding less non-cash net working capital. In this section, we exclude young firms in our sample to eliminate the specific effect attributable to IPO firms. Using the sample of non-IPO firms, we control three issues to strengthen our test on the CEO optimism effect on corporate cash holdings motives. We incorporate net issuances to assets to control for the possibility that the increase in cash holdings may result from issuing more equity and debt. The net issuances (*NI*) are measured as the total of debt issuance and equity sales minus the sum of debt retirement and equity repurchases. The bottom tail of *NI* is winsorized at the 1 % level.

Models 1 and 2 of Table 7 augment Eq. (1) by including the net issuance variable. With this adjusted specification, the optimistic group continues to have a stronger savings motive for growth opportunities and uses more cash-financed capital investment and acquisitions than the non-optimistic group. There is a significant difference in the increase in cash through debt and equity issuance between the optimistic and non-optimistic samples. Since external funds are limited to optimistic-manager firms, these firms intend to save more cash out of cash flow and save more money raised from issuance. Furthermore, an estimate of -0.551 ($p < 0.10$) for $D \times NWC$ indicates that optimistic managers hold even fewer inventories and receivables than non-optimistic managers. This is because optimistic managers lean excessively on internal funds, which leads them to act as though they are financially constrained. As such, the likelihood that these firms would substitute net working capital for cash increases because net working capital consists of non-cash financial assets. The precautionary savings motive is negatively associated with an increase in cash at the 5 % significance level, signalling that the desire to undertake precautionary savings is relatively weak for optimistic managers. This finding is in line with the theory that optimistic managers underestimate the inherent uncertainty and riskiness of earnings (e.g., Heaton 2002; Goel and Thakor 2008; Hackbarth 2008; Gervais et al. 2011).

Interestingly, the estimated coefficients of $D \times Own$ and $D \times Own2$ are -3.557 ($p < 0.05$) and 10.359 ($p < 0.10$) in this specification. These results show that CEO optimism has an effect on the relationship between cash holdings and managerial ownership. We recall that the positive part of the concave relation (between cash holdings and ownership percentage) for non-optimistic managers comes from the increase in managerial risk aversion. Optimistic managers, however, are relatively less risk averse than non-optimistic managers. Consistently we do not find the concave relation with the CEO optimism effect. Instead, a convex relation between cash holdings and ownership percentage is statistically significant in the optimistic group. The negative part of the convex relation possibly shows that optimistic managers are concerned with the cost of cash holdings with moderate levels of ownership. The positive part of the convex relation can possibly be derived from the increasing level of risk aversion by holding more shares. It then causes optimistic managers to hold more cash when their ownership increases.

With the 67 % CEO optimism cutoff, the industry sigma and *NWC* variables that proxy for precautionary savings and substitution for cash, respectively, are insignificant for optimistic managers. This result indicates that the relation between optimism and underestimation of risk depends upon the definition of optimism. Similarly, optimistic CEOs' cash demand from internal liquid assets seems to relate to how excessively optimistic CEOs are about future investment opportunities. We also note that the Chi square value is slightly higher with this *NI* specification.

Table 7 Regressions estimating determinants of cash holdings (excluding IPO Firms): other specifications

Model	1	2	3	4	5	6
CEO optimism cutoff	100 % cutoff	67 % cutoff	100 % cutoff	67 % cutoff	100 % cutoff	67 % cutoff
D	−0.004	−0.056	−0.680***	−0.508**	−0.634**	−0.278
	(0.069)	(0.060)	(0.257)	(0.258)	(0.281)	(0.282)
D × Q	−0.033	−0.027	−0.033	−0.018	−0.039	−0.027
	(0.025)	(0.024)	(0.042)	(0.043)	(0.042)	(0.044)
D × Size	−0.054*	−0.041	−0.066**	−0.051	−0.066**	−0.049
	(0.030)	(0.028)	(0.032)	(0.031)	(0.032)	(0.031)
D × Cashflow	1.549**	0.351	1.265*	0.332	1.260*	0.311
	(0.782)	(0.716)	(0.763)	(0.716)	(0.761)	(0.714)
D × NWC	−0.551*	−0.188	−0.488	−0.212	−0.536*	−0.250
	(0.289)	(0.285)	(0.313)	(0.320)	(0.307)	(0.317)
D × Capex	−1.199	−0.556	−1.274*	−0.854	−1.351*	−0.919
	(0.735)	(0.696)	(0.762)	(0.727)	(0.766)	(0.731)
D × Laglev	0.395	0.399*	0.308	0.263	0.296	0.236
	(0.257)	(0.234)	(0.291)	(0.281)	(0.292)	(0.282)
D × R&D	1.364*	1.216*	1.414*	1.302*	1.394*	1.232
	(0.780)	(0.715)	(0.826)	(0.785)	(0.831)	(0.782)
D × Divdu	0.108	0.063	0.188**	0.105	0.184**	0.097
	(0.078)	(0.071)	(0.080)	(0.074)	(0.081)	(0.074)
D × Acq	−2.509***	−1.581***	−2.957***	−1.905***	−3.004***	−1.923***
	(0.559)	(0.503)	(0.665)	(0.650)	(0.674)	(0.667)
D × Indusig	−2.441**	−0.364	−2.708**	−0.645	−2.602**	−0.500
	(1.104)	(0.979)	(1.098)	(0.988)	(1.095)	(0.987)
D × Own	−3.557**	−2.479*	−4.222**	−3.328**	−4.171**	−3.353**
	(1.640)	(1.427)	(1.746)	(1.531)	(1.768)	(1.534)
D × Own2	10.359*	6.574*	11.367*	8.696**	11.403*	8.900**
	(5.706)	(3.440)	(5.845)	(4.107)	(5.977)	(4.122)
D × NI	1.696***	1.308***	1.522**	1.182	1.493**	1.132
	(0.505)	(0.487)	(0.653)	(0.723)	(0.665)	(0.749)
D × Kink			−0.011	−0.015	−0.011	−0.014
			(0.013)	(0.012)	(0.013)	(0.012)
D × BHR					−0.084	0.065
					(0.202)	(0.162)
D × lagBHR					0.383**	0.434***
					(0.193)	(0.166)
D × Stdev					−2.222	0.472
					(2.213)	(1.893)
D × lagStdev					2.984	3.841*
					(2.488)	(2.303)
Kink control			√	√	√	√

Table 7 continued

Model	1	2	3	4	5	6
CEO optimism cutoff	100 % cutoff	67 % cutoff	100 % cutoff	67 % cutoff	100 % cutoff	67 % cutoff
Market conditions controls					√	√
Optimistic/ total obs.	948/5524	1503/5524	870/4827	1373/4827	870/4827	1373/4827
Chi^2	3158.2***	3077.7***	2988.5***	2837.7***	3056.0***	2929.0***

The dependent variable is the cash-to-assets ratio. The reported independent variables are *D* (CEO optimism dummy), *Q* (the market-to-book ratio), *Size* (the logarithm of total assets), *Cashflow* (cash flow, divided by total assets), *NWC* (working capital from balance sheet − cash and short-term investments, divided by assets), *Capex* (capital expenditures scaled by total assets), *Laglev* (the 1-year lagged value of total long-term debt plus debt in current liabilities, divided by total assets), *R&D* (R&D expenditures divided by sales), *Divdu* (dividend dummy = 1 if a firm pays dividends, otherwise 0), *Acq* (acquisitions divided by total assets), *Indusig* (industry cash flow risk), *Own* (CEO ownership percentage), *Own2* (the square of *Own*), *NI* (debt issuance + equity sales − debt retirement − equity repurchases, divided by total assets), the interaction terms (*D* interacted with each independent variable), *Kink* (debt conservatism), *BHR* (the buy-and-hold market returns), *lagBHR* (1-year lagged BHR), *Stdev* (the standard deviation of market index returns), and *lagStdev* (1-year lagged Stdev). All variable definitions are given in the Appendix 1. The standard errors adjusted for clustering by firm are reported in parentheses. To save space, this table only displays the results for *D* and variables interacting with *D*. All regressions include cash holdings controls, year and industry fixed effects. The full results are available upon request

*, **, and *** Significance at the 10, 5, and 1 % levels, respectively

Malmendier et al. (2011) have addressed the issue that if overconfident CEOs are debt and equity conservative, then they would prefer using internal finance rather than external finance. Our second augmented specification allows us to test the relation between debt conservatism and the CEO optimism effect on cash holding motives. We incorporate debt conservatism, measured by the variable (*Kink*), and its interaction with the CEO optimism effect (*D*) into the model. *Kink* is the amount of interest required to make the tax rate function slope downward, divided by the actual interest expense (Graham 2000). The greater the value of *Kink*, the more debt conservative the firm is.[22] We match our previous non-IPO sample with kink data and obtain 4827 firm-year observations between 1993 and 2009. We compute the Pearson–Spearman correlations between *Kink* and the presented cash holdings variables.[23] These results show that *Kink* is not highly correlated with our variables, thus allowing *Kink* to be added to our regression models as another explanatory variable without collinearity concerns.

Models 3 and 4 of Table 7 present results to include the variables *Kink* and $D \times Kink$ for the 100 and 67 % cutoffs, respectively. Results are consistent with our findings that the motives for cash holdings are significantly different between optimistic and non-optimistic managers, even when optimistic managers are debt conservative. An alternative way to examine whether the results are not driven by debt conservatism is to have the three-way interactions (CEO optimism, cash holdings controls, and *Kink*) included in the model. Results are reported in the Appendix 3. We find a relatively low effect (in the 100 % cutoff) or

[22] The variable *Kink* was developed by John Graham and is available until 2009. Our sample period for examining this specification therefore ends in 2009. We would like to thank John Graham for providing us with the *Kink* data.

[23] The Pearson-Spearman correlations table is available upon request.

even no significant effect (in the 67 % cutoff) of debt conservatism on the sensitivity of cash holdings and growth opportunities for the optimistic sample. This finding indicates that debt conservatism is not the main reason optimistic managers hoard cash for growth opportunities. We therefore document that the incentive for firms with optimistic managers to hold more cash for growth opportunities does not appear to be heavily influenced by firm debt conservatism. We also find that companies with more acquisition expenses and a higher leverage ratio are less responsive to cash hoarding in determining firm debt conservatism.

Lins et al. (2010) document that excess cash holdings are mainly for future cash flow shocks in bad times while credit lines are used for future investment potentials when times are good. Although the focus of our study and theirs is different, controlling for market-type factors can help us analyze the sensitivity of firm characteristics determining cash holdings to market conditions.

For Models 5 and 6 of Table 7, we employ four proxies for market conditions on top of the inclusion of net issuances and debt conservatism to the regression model based on the 100 and 67 % cutoff, respectively. The first two measures are current and lagged buy-and-hold market returns; the last two are current and lagged standard deviations of market returns. We compute the product of the monthly *CRSP* NYSE/AMEX/NASDAQ/Arca value-weighted market index over 1 year and over 1 lagged year, corresponding to the firm fiscal year buy-and-hold returns (*BHR*) and 1-year-lagged buy-and-hold returns (*lagBHR*), respectively. We also calculate the standard deviations of the monthly *CRSP* market index over 1 year and over 1 lagged year to capture market volatility (*Stdev*) and 1-year-lagged market volatility (*lagStdev*), respectively. The results based on the 100 % cutoff remain qualitatively similar to those without the market conditions variables in Table 7. The extremely optimistic group is found to have distinct cash holding behavior for growth opportunities and precautionary motives. This result is not repeated in the 67 % cutoff, which suggests that corporate cash policies are sensitive to the definition of CEO optimism. We also find that the optimistic group would save more cash when times are bad (the estimates of $D \times lagBHR$ are 0.383, $p < 0.05$ in the 100 % cutoff and 0.434, $p < 0.01$ in the 67 % cutoff).

4.4 Robustness to an alternative measure of optimism

We use an alternative measure of CEO optimism as a robustness check for the effect of CEO optimism on corporate cash holdings and find further consistency in our results. Our alternative measure comes from the work of Campbell et al. (2011) who suggest firm characteristic as another managerial optimism measure. Goel and Thakor (2008) document that firms with extremely overconfident managers tend to overinvest in risky projects. Thus, corporate decisions on investment inputs could be influenced by CEO optimism (e.g., Campbell et al. 2011; Gervais et al. 2011). The work of Malmendier and Tate (2005a), Malmendier et al. (2011) and Hirshleifer et al. (2012) also indicates that the relation between overconfidence and investments is positive. With this important notion in mind, we use firm investment inputs to construct the alternative measure of CEO optimism.

To begin, we sort firms each year based on three separate industry-adjusted investment rates: (1) the capital investment rate (used in Campbell et al. 2011), (2) the acquisition investment rate, and (3) the R&D investment rate.[24] We identify optimistic managers as

[24] The industry-adjusted capital (acquisition; R&D) investment rate is defined as the capital (acquisition; R&D) investment rate minus the median of capital (acquisition; R&D) investment rates in the same industry. Capital expenditures are scaled by property, plant, and equipment; acquisition and R&D expenses are scaled by book assets.

those for firms in the union of the top quintiles of each of the three investment rate groups for 1 or 2 consecutive years, respectively. In Table 8, Model 1 reports the results where firms are in the top group of investment rate for 1 year while Model 2 restricts the requirement to 2 consecutive years. This method yields a sample of 4736 (4695) total

Table 8 Regressions of cash holdings: alternative CEO optimism measures based on investment inputs

Model In the top quintile investment rate group for	1 One year	2 Two successive years
D	0.107	0.042
	(0.119)	(0.115)
D × Q	−0.028	−0.011
	(0.046)	(0.048)
D × Size	0.024	−0.005
	(0.038)	(0.036)
D × Cashflow	0.151	0.481
	(0.657)	(0.714)
D × NWC	−0.097	−0.251
	(0.394)	(0.390)
D × Capex	0.143	0.121
	(1.078)	(1.145)
D × Laglev	0.502	0.544
	(0.437)	(0.378)
D × R&D	4.222*	2.108*
	(2.295)	(1.257)
D × Divdu	−0.279**	−0.230**
	(0.113)	(0.113)
D × Acq	−0.539	−1.132
	(0.697)	(0.748)
D × Indusig	0.021	0.261
	(1.336)	(1.448)
D × Own	−4.806*	−4.740
	(2.615)	(2.951)
D × Own2	18.878	19.283
	(12.158)	(14.685)
D × NI	−1.057	−0.049
	(0.776)	(0.596)
D × Kink	−0.013	−0.012
	(0.015)	(0.015)
D × BHR	−0.267	−0.172
	(0.170)	(0.184)
D × lagBHR	0.620***	0.361*
	(0.215)	(0.211)
D × Stdev	−2.374	−2.450
	(2.193)	(2.448)

Table 8 continued

Model In the top quintile investment rate group for	1 One year	2 Two successive years
D × lagStdev	6.903***	5.717**
	(2.655)	(2.752)
Optimistic/total Obs.	954/4736	847/4695
Chi^2	2828.9***	2809.2***

The dependent variable in all regressions is the cash-to-assets ratio. Firms are sorted separately each year based on three industry-adjusted investment rates: (1) capital, (2) acquisition, and (3) R&D. Optimism is defined if the firm belongs to at least one top quintile investment rate group for at least 1 or 2 successive years. The reported independent variables include *D* (CEO optimism dummy), *Q* (the market-to-book ratio), *Size* (the logarithm of total assets), *Cashflow* (cash flow, divided by total assets), *NWC* (working capital from balance sheet − cash and short-term investments, divided by assets), *Capex* (capital expenditures scaled by total assets), *Laglev* (the 1-year lagged value of total long-term debt plus debt in current liabilities, divided by total assets), *R&D* (R&D expenditures divided by sales), *Divdu* (dividend dummy = 1 if a firm pays dividends, otherwise 0), *Acq* (acquisitions divided by total assets), *Indusig* (industry cash flow risk), *Own* (CEO ownership percentage), *Own2* (the square of *Own*), *NI* (debt issuance + equity sales − debt retirement − equity repurchases, divided by total assets), the interaction terms (*D* interacted with each independent variable), *Kink* (debt conservatism), *BHR* (the buy-and-hold market returns), *lagBHR* (1-year lagged BHR), *Stdev* (the standard deviation of market index returns), and *lagStdev* (1-year lagged Stdev). All variable definitions are given in the Appendix 1. The standard errors adjusted for clustering by firm are reported in parentheses. To save space, this table only display the results for variables interacting with the optimism dummy. All regressions include cash holdings controls, Kink controls, market conditions controls, and year and industry fixed effects. The full results are available upon request

*, **, and *** Significance at the 10, 5, and 1 % levels, respectively

CEO-firm-year observations for Model 1 (2) and there are 954 (847) in the optimism subsample.

We find results consistent with the earlier findings that CEO optimism leads firms to have different cash holdings models. That is, using capital expenditures/acquisitions/R&D expenses to classify optimistic managers, we find evidence similar to that of our main analysis: Firms with optimistic managers save more cash for R&D opportunities. Moreover, the optimistic group pays less cash dividends than the non-optimistic group, which is consistent to the finding of Deshmukh et al. (2010) that optimistic managers highly value their cash for investments than as dividends. We highlight another finding: that the optimistic group's cash holdings are significantly more sensitive to the lagged market returns and the lagged variation in market conditions than the non-optimistic group. The potential explanation is that it is relatively costly for investment-intensive optimistic firms to adjust the flows of investment since their financial policies are less flexible than others. To insure smooth investments when markets are volatile, these investment-intensive optimistic firms prefer to hold high cash balances. This finding is consistent with Brown and Peterson (2011), who find that R&D smoothing with cash reserves is particularly valued by financially constrained firms. Most importantly, our study is the first to link the characteristic of CEO optimism to the market fluctuation sensitivity of investment-intensive firms. The optimism measure based on firm level data provides new insights into the role of high-investment optimistic firms' cash holdings on investment smoothing. Finally, we note that by controlling for managerial ownership, CEO optimism slightly impacts the relation between cash holdings and managerial ownership. However, only the coefficient of

$D \times Own$ is significant ($p < 10$ %) in the case of being in the top quintile investment rate of group for 1 year.

5 Concluding remarks

In this paper, we examine the CEO optimism effect on cash holdings between 1992 and 2010. Our main results show that CEO optimism leads firms to save and allocate their cash distinctly from other firms; in particular, their cash holdings are greater and more volatile. This finding is consistent with the opposing incentives to underinvest when external finance undervalues the firm and to overinvest as a manager overestimates future earnings. CEO optimism is found to have a statistically significant effect on corporate cash holding behavior. Our results are robust to alternative optimism measures.

In our examination of the impact of CEO optimism on cash holdings, the cash holdings of firms with optimistic managers are mostly used to fund growth opportunities. These firms save more cash for R&D than firms with non-optimistic managers. This result is echoed in the time variation in cash holdings that is seen to strongly mirror movements in R&D expenditures for firms with optimistic managers.

Further investigation uses a sample without IPO firms as these firms are normally cash rich. We include more control variables step by step in order to further ensure robustness. First, we showed that net issuances play an important role in increasing cash holdings. Since optimistic managers are reluctant to seek for external funds, restricted financing behavior leads them to increase their cash used for investments, such as acquisitions and capital expenditures. Moreover, firms with optimistic managers require less cash reserves for precautionary savings and inventories and receivables. By contrast, firms with non-optimistic managers seem to hold more cash for precautionary savings purposes. Second, we consider debt conservatism in our model and find no evidence that optimistic managers' cash hoarding is related to their preference to use debt conservatively. More notably, we document that optimistic managers hold more cash in bad times than non-optimistic managers do. In other words, the relation between corporate cash policy and CEO optimism is slightly sensitive to the market timing. Our final robustness tests support our main findings and suggest that investment-intensive optimistic firms would hold more cash for investment smoothing than non-optimistic firms.

Acknowledgments The authors thank Panayiotis Andreou, Jiyoon Lee, Christodoulos Louca, Lukas Roth, Lenos Trigeorgis, as well as the seminar participants at the 2013 Annual Meeting of the Academy of Behavioral Finance and Economics in Chicago, the 2013 European Finance Association Meeting in Cambridge, the 2012 British Accounting and Finance Association Annual Conference in Brighton, and the 2012 Multinational Financial Society Annual Conference in Krakow for discussions and helpful comments. We are also grateful to John Graham for providing the data on his kink measure of debt conservatism. This research reported herein was supported by a Leverhulme Trust Research Project Grant during 2010–2012.

Appendix 1

See Table 9.

Table 9 Each variable utilized in the cash holdings model

Variables	Definition, computation with *Compustat* item number (#)	Proxy (correlation with cash)
Cash	Cash and short-term investments divided by total assets; #1/#6	Cash holdings
Q	Market value of assets divided by the book value of assets (market value of assets is the total of the book value of assets and the market value of equity minus the book value of equity; the book value of assets is total assets; the market value of equity is common shares outstanding multiplied by the closing price; the book value of equity is total common equity); [#6 + (#25 × #199) − #60]/#6	Investment opportunities (+)
Size	The natural logarithm of total assets; ln(#6)	Economies of scale (−)
Cashflow	Operating income before depreciation minus total interest and related expenses minus total income taxes minus dividends, divided by total assets; (#13 − #15 − #16 − #21)/#6	Earnings (+) Liquidity demand (−)
NWC	Working capital from balance sheets minus cash and short-term investments, divided by total assets; (#179 − #1)/#6	Substitute for cash (−)
Capex	Capital expenditures scaled by total assets; #128/#6	Debt capacity (−) Financial distress costs (+) Investment opportunities (+)
Lev	The ratio of leverage to assets is measured as total long-term debt plus debt in current liabilities, divided by total assets (#9 + #34)/#6	Hedge needs for future investment against income shortfalls (−; +)
Laglev	The 1-year lagged value of *Lev*	
R&D	R&D expenditures divided by net sales; #46/#12 (set to zero if #46 is missing)	Growth opportunities (+) Financial distress costs (+)
Divdu	Dividend payout dummy; if the company pays common dividends (#21), Divdu = 1; otherwise, Divdu = 0	Capital market accessibility (−)
Acq	Acquisitions divided by total assets; #129/#6	Cash outflows (−)
Indusig	Industry sigma (also named industry cash flow risk) is computed in two stages, the first calculating each firm's standard deviation of cash flow to total assets over 10 years and the second grouping firms by two-digit SIC codes and calculating each group's mean of standard deviations obtained	Precautionary savings (+)
Own	CEO ownership percentage is defined as shares owned by the executive, excluding options that are exercisable or will become exercisable within 60 days, divided by the number of common shares outstanding as reported by the company; SHROWN_EXCL_OPTS/SHRSOUT (from the *ExecuComp* "ANNCOMP" database)	Managerial risk aversion (+)
Own2	The square of *Own*	The cost of holding more cash (−)
NI	Debt issuance plus equity sales minus debt retirement and minus equity repurchases, divided by total assets; (#111 + #108 − #114 − #115)/#6	Cash inflows (+)

Table 9 continued

Variables	Definition, computation with *Compustat* item number (#)	Proxy (correlation with cash)
D	Optimistic CEO-year dummy (i.e., D = 1 when the CEO holds an average percentage of exercised option moneyness of more than 100 %, otherwise D = 0). Data for measuring optimism are from the *ExecuComp* and *Compustat* databases	
Kink	The ratio of the amount of interest required to make the tax rate function slope downward, divided by the actual interest expense (*Kink* data kindly provided by John Graham)	Debt conservatism (+)
BHR	Buy-and-hold *CRSP* NYSE/AMEX/NASDAQ/Arca value-weighted monthly market index returns over 1 year prior to the corresponding firm's fiscal year	
lagBHR	One-year-lagged buy-and-hold market index returns	
Stdev	The standard deviation of *CRSP* NYSE/AMEX/NASDAQ/Arca value-weighted monthly market index returns over 1 year prior to the corresponding firm's fiscal year	
lagStdev	One-year-lagged standard deviation	

A set of proxies is given in the last column, as well as the predicted relation with cash holdings

Appendix 2

See Table 10.

Table 10 Cash holdings by high/low Q and high/low R&D

Variable: cash	Mean Low Q	SD	Obs.	Mean High Q	SD	Obs.	*t* test
Panel A							
Optimistic group	0.094	0.121	595	0.205	0.175	595	−0.11***
Non-optimistic group	0.094	0.132	2766	0.148	0.158	2766	−0.05***
	Low R&D			High R&D			
Panel B							
Optimistic group	0.1	0.115	595	0.198	0.182	595	−0.10***
Non-optimistic group	0.092	0.125	2924	0.154	0.164	2608	−0.06***

This table summarizes a set of descriptive statistics on the variable Cash by partitioning each optimistic and non-optimistic group's sample by Q and R&D respectively. The sample includes *CRSP*/*Compustat* firm-year observations from 1992 to 2010. We define CEOs as optimistic (non-optimistic) if they hold exercisable options that have more (less) than 100 % moneyness. Data for measuring optimism are from the *ExecuComp* and *Compustat* databases. The variable *Cash* is the cash-to-assets ratio; *Q* is the market-to-book ratio; *R&D* is R&D expenditures divided by sales. All variable definitions are given in the Appendix 1. The last column reports the *t* values of the tests of differences between the mean cash holdings of the high and low Q groups and also between the high and low R&D groups

*** Statistical significance at the 1 % level

Appendix 3

See Table 11.

Table 11 Regressions of cash holdings on CEO optimism: debt conservatism effect test

Model CEO optimism cutoff	1 100 % cutoff	2 67 % cutoff
Kink	0.034***	0.037***
	(0.008)	(0.008)
D × Kink	0.017	0.002
	(0.019)	(0.017)
D × Q × Kink	0.012	0.005
	(0.008)	(0.008)
D × Size × Kink	−0.001	0.006
	(0.009)	(0.008)
D × Cashflow × Kink	−0.351**	0.038
	(0.171)	(0.191)
D × NWC × Kink	−0.190***	−0.103
	(0.065)	(0.069)
D × Capex × Kink	−0.140	−0.171
	(0.165)	(0.163)
D × Laglev × Kink	−0.129**	−0.144**
	(0.055)	(0.060)
D × R&D × Kink	−0.373**	−0.254
	(0.176)	(0.173)
D × Divdu × Kink	0.000	−0.004
	(0.020)	(0.019)
D × Acq × Kink	−0.379***	−0.288**
	(0.126)	(0.117)
D × Indusig × Kink	−0.256	−0.178
	(0.283)	(0.259)
D × Own × Kink	0.146	0.187
	(0.510)	(0.427)
D × Own2 × Kink	−2.087	−0.917
	(2.706)	(2.091)
D × NI × Kink	0.117	0.167*
	(0.079)	(0.086)
Optimistic/total obs.	870/4827	1373/4827

Table 11 continued

Model	1	2
CEO optimism cutoff	100 % cutoff	67 % cutoff
Chi^2	3439.1***	3173.7***

The dependent variable in all regressions is the cash-to-assets ratio. The independent variables include *D* (CEO optimism dummy), *Q* (the market-to-book ratio), *Size* (the logarithm of total assets), *Cashflow* (cash flow, divided by total assets), *NWC* (working capital from balance sheet minus cash and short-term investments, divided by assets), *Capex* (capital expenditures scaled by total assets), *Laglev* (the 1-year lagged value of total long-term debt plus debt in current liabilities, divided by total assets), *R&D* (R&D expenditures divided by sales), *Divdu* (dividend dummy equal to 1 if a firm pays dividends, otherwise zero), *Acq* (acquisitions divided by total assets), *Indusig* (industry cash flow risk), *Own* (CEO ownership percentage), *Own2* (the square of *Own*), *NI* (debt issuance plus equity sales minus debt retirement and minus equity repurchases, divided by total assets), the interaction terms (defined as *D* interacted with each independent variable), *Kink* (debt conservatism). All variable definitions are given in the Appendix 1. The standard errors adjusted for clustering by firm are reported in parentheses. All regressions include cash holdings controls, D*cash holdings controls, and year and industry fixed effects. This table only displays the results for *Kink*, the interaction of this variable with *D*, and the three-way interaction variables linking *Kink*, *D*, and the cash holding control variables. The full results are available upon request

*, **, and *** Significance at the 10, 5, and 1 % levels, respectively

References

Acharya V, Almeida H, Campello M (2007) Is cash negative debt? A hedging perspective on corporate financial policies. J Financ Intermed 16(4):515–554

Almeida H, Campello M, Weisbach M (2004) The cash flow sensitivity of cash. J Financ 59(4):1777–1804

Bates T, Kahle K, Stulz R (2009) Why do US firms hold so much more cash than they used to? J Financ 64(5):1985–2021

Berggren N, Daunfeldt SO, Hellström J (2014) Social trust and central-bank independence. Eur J Polit Econ 34:425–439

Billett MT, Qian Y (2008) Are overconfident CEOs born or made? Evidence of self-attribution bias from frequent acquirers. Manag Sci 54(6):1037–1051

Brown J, Peterson B (2011) Cash holdings and R&D smoothing. J Corp Financ 17(3):694–709

Campbell TC, Gallmeyer M, Johnson S, Rutherford J, Stanley B (2011) CEO optimism and forced turnover. J Financ Econ 101(3):695–712

Cordeiro L (2009) Managerial overconfidence and dividend policy. Working paper. London Business School. doi:10.2139/ssrn.1343805

Cunado J, Gil-Alana L, Perez de Gracia F (2008) Stock market volatility in US bull and bear markets. J Money Invest Bank 1(1):24–32

Deshmukh S, Goel AM, Howe KM (2010) CEO overconfidence and dividend policy. J Financ Intermed 22(3):440–463

Dittmar A, Duchin R (2014) Looking in the rear view mirror: the effect of managers' professional experience on corporate financial policy. Ross School of Business Paper No. 1221. doi:10.2139/ssrn.2142465

Dittmar A, Mahrt-Smith J (2007) Corporate governance and the value of cash holdings. J Financ Econ 83(3):599–634

Drobetz W, Grüninger M (2007) Corporate cash holdings: evidence from Switzerland. Financ Mark Portf Manag 21(3):293–324

Englmaier F (2010) Managerial optimism and investment choice. Manag Decis Econ 31(4):303–310

Faulkender M, Wang R (2006) Corporate financial policy and the value of cash. J Financ 61(4):1957–1990

Ferreira M, Vilela A (2004) Why do firms hold cash? Evidence from EMU countries. Eur Financ Manag 10(2):295–319

Ferris SP, Jayaraman N, Sabherwal S (2013) CEO overconfidence and international merger and acquisition activity. J Financ Quant Anal 48(1):137–164

Gervais S, Heaton J, Odean T (2011) Overconfidence, compensation contracts, and capital budgeting. J Financ 66(5):1735–1777
Goel A, Thakor A (2008) Overconfidence, CEO selection, and corporate governance. J Financ 63(6):2737–2784
Graham J (2000) How big are the tax benefits of debt? J Financ 55(5):1901–1942
Hackbarth D (2008) Managerial traits and capital structure decisions. J Financ Quant Anal 43(4):843–881
Hall BJ, Liebman JB (1998) Are CEOs really paid like bureaucrats? Q J Econ 113(3):653–691
Hall BJ, Murphy KJ (2002) Stock options for undiversified executives. J Account Econ 33(1):3–42
Han S, Qiu J (2007) Corporate precautionary cash holdings. J Corp Financ 13(1):43–57
Harford J, Mansi SA, Maxwell WF (2008) Corporate governance and firm cash holdings in the US. J Financ Econ 87(3):535–555
Heaton J (2002) Managerial optimism and corporate finance. Financ Manag 31(2):33–45
Hill M, Fuller K, Kelly G, Washam J (2014) Corporate cash holdings and political connections. Rev Quant Financ Account 42(1):123–142
Hirshleifer D, Low A, Teoh SH (2012) Are overconfident CEOs better innovators? J Financ 67(4):1457–1498
Iskandar-Datta M, Jia Y (2014) Investor protection and corporate cash holdings around the world: new evidence. Rev Quant Financ Account 43(2):245–273
Jensen MC (1986) Agency costs of free cash flow, corporate finance, and takeovers. Am Econ Rev 76(2):323–329
Keynes JM (1936) The general theory of employment, interest and money. McMillan, London
Kieschnick R, McCullough BD (2003) Regression analysis of variates observed on (0, 1): percentages, proportions and fractions. Stat Model 3(3):193–213
Kim C, Mauer D, Sherman A (1998) The determinants of corporate liquidity: theory and evidence. J Financ Quant Anal 33(3):335–359
Lee KW, Lee CF (2009) Cash holdings, corporate governance structure and firm valuation. Rev Pac Basin Financ Mark Polic 12(3):475–508
Lins KV, Servaes H, Tufano P (2010) What drives corporate liquidity? An international survey of cash holdings and lines of credit. J Financ Econ 98(1):160–176
Liu Y, Taffler R (2008) CEO overconfidence in M&A decision making and its impact on firm performance. Working paper. University of Edinburgh
Luo Q, Hachiya T (2005) Corporate governance, cash holdings, and firm value: evidence from Japan. Rev Pac Basin Financ Mark Polic 8(4):613–636
Malmendier U, Tate G (2005a) CEO overconfidence and corporate investment. J Financ 60(6):2661–2700
Malmendier U, Tate G (2005b) Does overconfidence affect corporate investment? CEO overconfidence measures revisited. Eur Financ Manag 11(5):649–659
Malmendier U, Tate G (2008) Who makes acquisitions? CEO overconfidence and the market's reaction. J Financ Econ 89(1):20–43
Malmendier U, Tate G, Yan J (2011) Overconfidence and early-life experiences: the effect of managerial traits on corporate financial policies. J Financ 66(5):1687–1733
Opler T, Pinkowitz L, Stulz R, Williamson R (1999) The determinants and implications of corporate cash holdings. J Financ Econ 52(1):3–46
Ozkan A, Ozkan N (2004) Corporate cash holdings: an empirical investigation of UK companies. J Bank Financ 28(9):2103–2134
Pinkowitz L, Williamson R (2001) Bank power and cash holdings: evidence from Japan. Rev Financ Stud 14(4):1059–1082
Pinkowitz L, Stulz R, Williamson R (2006) Does the contribution of corporate cash holdings and dividends to firm value depend on governance? A cross-country analysis. J Financ 61(6):2725–2751
Puri M, Robinson DT (2007) Optimism and economic choice. J Financ Econ 86(1):71–99
Riddick L, Whited T (2009) The corporate propensity to save. J Financ 64(4):1729–1766
Wagner J (2001) A note on the firm size–export relationship. Small Bus Econ 17(4):229–237
Yermack D (1995) Do corporations award CEO stock options effectively. J Financ Econ 39(2):237–269
Yu HC, Sopranzetti BJ, Lee CF (2015) The impact of banking relationships, managerial incentives, and board monitoring on corporate cash holdings: an emerging market perspective. Rev Quant Financ Account 44(2):353–378