Do CEO Beliefs Affect Corporate Cash Holdings?

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Abstract

We examine the effect of CEO optimism on corporate cash holdings by developing an expanded trade-off model of cash holdings that incorporates CEO beliefs. The optimistic CEO views external financing as excessively costly but expects this cost to decline over time, thus delaying external financing and maintaining a lower cash balance than rational CEOs. Our results indicate that CEO optimism, on average, is associated with a 24 percent decline in the firm's cash balance. We also document that relative to rational CEOs, optimistic CEOs exhibit a lower change in the cash balance over time, save less cash out of their current cash flow, hold lower cash to fund the firm's growth opportunities, and rely more on cash to finance acquisitions. We confirm our central findings with two different samples of firms and two alternative measures of optimism.

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I. Introduction

The current literature identifies several firm characteristics that impact corporate cash holdings (Opler, Pinkowitz, Stulz, and Williamson, 1999, and Bates, Kahle, and Stulz, 2009). However, not much is known about how cash holdings are affected by managerial characteristics, which have been shown to affect various corporate policies. For example, Bertrand and Schoar (2003) document that top executives vary considerably in their management "styles" based on their evidence that manager fixed effects account for some of the unexplained variation for a wide range of corporate policies. Cronqvist, Makhija, and Yonker (2012) find that corporate leverage choices mirror the personal leverage choices of CEOs. Graham, Harvey, and Puri (2013) use psychometric tests to identify behavioral traits of CEOs and provide evidence that these traits are related to corporate financial policies.

We examine the effect of managerial traits on corporate cash holdings. Specifically, we focus on CEO overconfidence or optimism. The finding that people are overconfident is one of the most robust in the psychology of judgment (De Bondt and Thaler, 1995, Kahneman, Paul, and Tversky, 1982, and Russo and Schoemaker, 1990). Overconfidence is defined either as an upward bias in expectations of future outcomes, also known as optimism, or as overestimation of the precision of one's information leading to underestimation of risk. Much of the work in behavioral finance has focused on the first interpretation and has used the terms optimism and overconfidence interchangeably.[1] The literature on behavioral corporate finance has shown that CEO overconfidence (or optimism) impacts investment, merger, dividend, and financing decisions (Malmendier and Tate, 2005, 2008, Malmendier, Tate, and Yan, 2011, and Deshmukh, Goel, and Howe, 2013). An important insight from

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[1]The overestimation of future cash flows (optimism) is discussed in Hackbarth (2008), Heaton (2002), Hirshleifer (2001), and Malmendier and Tate (2005). The overestimation of the precision of one's information is discussed in Barberis and Thaler (2003), Ben-David, Graham, and Harvey (2013), Bernardo and Welch (2001), Gervais, Heaton, and Odean (2011), Hackbarth (2008), Hirshleifer (2001), and Malmendier and Tate (2005). The former is a bias about the first moment of the outcome whereas the latter is a bias about the second moment of the outcome. As Hirshleifer (2001) points out, an overestimation of the precision of one's information may lead to optimism.

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this evidence is that optimistic CEOs behave as if they are financially constrained given their beliefs about the cost of external financing.

The effect of CEO optimism on various corporate policies implies a potential relation between managerial optimism and corporate cash holdings, which remains largely unexplored in the literature. We draw on the idea that optimistic CEOs behave as if they are financially constrained to explore the effect of CEO optimism on cash holdings. The implications of an optimistic CEO's perceived financial constraints for cash holdings, however, are not obvious. On the one hand, optimistic CEOs may hold more cash than rational CEOs to finance future investments with internal cash rather than with future external financing that they expect to be unduly costly. On the other hand, optimistic CEOs may view current external financing as unduly costly and finance current investments with internal cash, resulting in a lower cash balance. Thus, the effect of CEO optimism on cash holdings depends on the CEO's beliefs about the relative costs of current and future external financing.

We exploit the tension between the perceived costs of current and future external financing and develop a model of corporate cash holdings. When the CEO and the investors in the market have identical beliefs, the optimal cash balance is determined based on a trade-off of the benefits and costs of holding cash. However, when the CEO and the investors differ in their beliefs, the CEO's preferred cash balance also depends on his/her perception about the cost of external financing. An optimistic CEO believes that the firm's equity is currently underpriced. Moreover, the CEO thinks that this underpricing will get mitigated over time as investors learn about the profitability of the firm's investments. Consequently, an optimistic CEO expects the cost of external financing to decline and delays raising external financing. Until this anticipated decline occurs, the optimistic CEO finances the firm's investments by relying more on internal cash, causing him/her to maintain a lower cash balance than rational CEOs. The main prediction of the model is that a firm managed by an optimistic CEO maintains a lower cash balance than that managed by a rational CEO.

We test the model's main prediction using a sample drawn from the Execucomp database over the period 1992-2012. As in Malmendier and Tate (2005, 2008) and Malmendier et al. (2011), we classify managers as optimistic if they overinvest personal funds in their company. For this classification, we follow Campbell, Gallmeyer, Johnson, Rutherford, and Stanley (2011) and use the data on option compensation. We classify a CEO as optimistic if he/she

held an option that was more than 100% in the money at least once during his/her tenure and zero otherwise. Campbell et al. (2011) and Malmendier et al. (2011) show that comparable measures appear to capture optimism in managerial beliefs.

We find that CEO optimism, on average, is associated with a 24 percent reduction in the firm's cash balance. In addition, optimistic CEOs exhibit a lower change in the cash balance from one year to the next than do rational CEOs. We also find that firms managed by optimistic CEOs save less cash out of their current cash flow than those managed by rational CEOs. These results are consistent with the main prediction of our theoretical model. We verify our main results using an alternative measure of optimism and an alternative sample of large firms used in Malmendier and Tate (2005, 2008) and in Malmendier et al. (2011).

We also examine the interactive effect of CEO optimism on the relation between cash holdings and each of the following: growth opportunities, cash flow, investment spending, and acquisitions spending. The existing literature documents a positive relation between cash holdings and growth opportunities. We confirm this result but find that the difference in cash holdings between higher-growth firms and lower-growth firms is smaller in firms led by optimistic CEOs than in firms led by rational CEOs. One explanation is that higher-growth firms led by rational CEOs hold more cash than lower-growth firms to finance higher future investments. An optimistic CEO, however, prefers to finance future investments by raising external financing in the future rather than by saving and hoarding cash because he/she expects the terms of financing to improve over time. We also find that the reduction in cash holdings associated with CEO optimism is more pronounced in firms that spend more on acquisitions. This finding is consistent with the existing empirical evidence that optimistic CEOs rely more heavily on cash in financing acquisitions than do rational CEOs.

There is a substantial body of research on corporate cash holdings. The early work by Keynes (1936) focuses on the costs and benefits of cash reserves. Kim, Mauer, and Sherman (1998) develop a trade-off model and find empirical support for many of its predictions. Opler et al. (1999) also examine the determinants of cash holdings and find support for a trade-off model of cash holdings. Recent research analyzes specific aspects of the determinants of cash holdings. For example, Harford (1999) examines the relation between cash holdings and acquisitions; Dittmar, Mahrt-Smith, and Servaes (2003) and Harford, Mansi, and Maxwell (2008) examine the role of corporate governance; Acharya, Davydenko, and Strebulaev (2012)

and Harford, Klasa, and Maxwell (2014) examine the interactions between credit risk and cash holdings; Bates et al. (2009) provide a summary of the different motives for firms to hold cash and explore the intertemporal growth in aggregate cash holdings; Duchin (2010) examines the relation between cash holdings and corporate diversification; and Fresard (2010) studies the strategic effect of corporate cash policy. Dittmar and Duchin (2014) find that firms led by CEOs who experienced firm distress early in their career save more cash.

We contribute to the cash holdings literature by showing that managerial beliefs affect corporate cash holdings. We develop a new theoretical framework by modeling the trade-offs faced by an optimistic CEO in simultaneously determining cash holdings and choosing investment and financing levels, both of which have been shown to be affected by CEO beliefs. Our empirical results provide strong evidence that optimistic CEOs hold less cash than rational CEOs. We test additional predictions and the findings strengthen the optimism-based interpretation of our results.

Our paper also contributes to the growing literature on behavioral corporate finance. Baker, Ruback, and Wurgler (2007) survey the literature that examines the relation between corporate policies and behavioral characteristics of corporate managers and investors. Hackbarth (2008) shows theoretically that overconfident managers tend to choose higher debt levels. Bernardo and Welch (2001), Gervais et al. (2011), and Goel and Thakor (2008) endogenize CEO overconfidence and consider the impact of CEO overconfidence on shareholders. Heaton (2002) examines how managerial optimism affects corporate policies, de Meza and Southey (1996) and Landier and Thesmar (2009) examine financial contracting with optimistic managers, and Bergman and Jenter (2007) link stock option compensation to employee optimism.

Our study is more closely related to the literature that explores the effect of CEO overconfidence or CEO optimism on corporate policies. Malmendier and Tate (2005) document that firms managed by overconfident CEOs exhibit a greater sensitivity of investment spending to internal cash flow. Malmendier and Tate (2008) show that overconfident CEOs are more likely to engage in acquisitions that are value-destroying. Malmendier et al. (2011) argue that overconfident managers perceive their firms to be undervalued and are reluctant to raise funds through costly external sources. They document that the reluctance of overconfident CEOs to raise funds through external sources leads to both a pecking order of financing and

debt conservatism. Deshmukh et al. (2013) show that firms managed by overconfident CEOs pay lower dividends. Our results are consistent with the central thesis of this literature that behavioral characteristics of CEOs affect corporate policies.

We document qualitatively similar findings for both the Campbell et al. (2011) measure based on the Execucomp sample and the Malmendier and Tate (2005, 2008) measure of CEO optimism based on a sample of large firms compiled by *Forbes* magazine. Campbell et al. (2011) draw on Malmendier and Tate (2005, 2008) to develop their measure of CEO optimism. Our overall results for the two measures of optimism based on two different samples suggest that the optimism measure developed by Campbell et al. (2011) serves as a reasonable alternative to the optimism measures developed by Malmendier and Tate (2005, 2008). The Execucomp dataset, with more recent coverage and many more firms, should provide researchers with an opportunity to explore many new issues in behavioral corporate finance.

The paper proceeds as follows. In Section II, we develop a model of cash holdings and CEO optimism. Section III describes the data and the variables. Section IV presents the empirical results. Section V summarizes our findings and discusses the implications of the study.

II. Model

In this section, we present a model in which cash holdings are based on a comparison of the costs of current and future external financing. We begin with a numerical example to illustrate the intuition underlying the model.

A. **An Example.** Consider a firm that is waiting to see how its current product performs in the market. The firm will invest in follow-on products, Product A and Product B. Each of these products will be a "hit" with probability p and a "miss" with probability $1 - p$. A hit product will return \$2 if \$1 is invested and \$3.50 if \$2 is invested. A miss product returns 0. The probability p that either of these products is a hit depends on how the current product fares. If it is successful, then $p = 0.85$, otherwise $p = 0.6$. The firm will invest in Product A before observing the performance of its current product and in Product B after observing the performance of its current product.

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Assume that the interest rate is zero. If the current product is successful, then the firm should invest $2 in Product B because its NPV of $3.5 \times 0.85 - \$2 = \$0.975$ is higher than the NPV of $2 \times 0.85 - \$1 = \$0.70$ from an investment of $1. If the current product is not successful, then the firm should invest $1 in Product B because its NPV of $2 \times 0.6 - \$1 = \$0.20$ is higher than the NPV of $3.50 \times 0.6 - \$2 = \$0.10$ from an investment of $2. The firm will invest optimally in Product B, either using existing cash or through cash raised from investors who will share the same beliefs as the management based on the performance of the current product.

The investment in Product A, however, is made before observing the performance of the current product and depends on beliefs about the probability that the current product will be successful. Suppose the CEO believes that this probability is 0.6. Based on these beliefs, the probability that Product A will be a hit is $0.6 \times 0.85 + 0.4 \times 0.6 = 0.75$. The CEO prefers investing $2 in Product A (NPV of $0.625) to investing $1 (NPV of $0.50) in the absence of any financing constraints. Suppose that investors consider the CEO's beliefs to be optimistic and estimate the probability of success of the current product to be only 0.1. They infer that Product A will be a hit with probability $0.1 \times 0.85 + 0.9 \times 0.6 = 0.625$ and based on these beliefs, they consider an investment of $1 in Product A (NPV of $0.25) to be more value-enhancing than an investment of $2 (NPV of $0.1875). In the absence of external financing requirements, the CEO will invest $2 in Product A despite the disagreement with the investors.

However, investors' beliefs can influence the CEO's actions when investors determine the terms of financing available to the firm. One impact is the reduction in investment. Suppose the firm raises debt financing and debtholders are repaid only if Product A is a hit. Investors believe that this will occur with probability 0.625 so for each $1 they invest, they demand repayment of $1/0.625 = \$1.60$, resulting in an expected repayment of $1. The CEO believes that for each $1 that debt investors provide, they will get back $1.60 with probability 0.75 resulting in an expected repayment of $1.20, and therefore, considers debt financing to be too costly. As a result, despite optimistic beliefs, the CEO will only invest $1 because the shareholders' payoff net of debtholders' repayment equals $2 - \$1.6 = \$0.40$, which is higher than the payoff of $3.50 - \$3.20 = \$0.30$ with an investment of $2.

The other impact of the CEO's optimism is on cash policy. In addition to its investment needs for Product A, the firm holds excess cash for other uses of cash, e.g., transactions and precautionary needs. The amount of this excess cash depends on the benefits and costs of keeping excess cash. We assume that the net cost of keeping excess cash C is $(C - 0.50)^2$. This cost is minimized at excess cash of $0.50. The optimistic CEO trades off this cost with the cost of raising, what he/she perceives to be, costly external financing. Assuming that the firm has no initial cash, the firm raises $1 for investment in Product A and an additional C for maintaining excess cash. The CEO believes that shareholders' expected payoff, net of the cost of maintaining excess cash and the debt repayment, is $C - (C - 0.50)^2 - 0.75 \times 1.6 \times (1 + C)$ which is maximized at $C = \$0.40$.

Thus, the key takeaway is that the CEO will hold less excess cash than the level which minimizes the costs of holding excess cash. The reason is that the CEO considers external financing to be too costly. Note that even though the CEO considers external financing to be too costly, he does not hoard cash for investing in Product B. The reason is that the CEO expects the temporary underpricing of debt securities to vanish before investing in Product B because, by then, the market would have learned about the performance of the current product. We now present the full model.

B. **Timeline.** Consider a firm that is managed by a CEO who acts in the interest of original shareholders. All agents are risk neutral and the discount rate is zero. The firm starts with assets in place (existing projects) at time $t = 0$ that result in cash flow at time $t = M$, where $0 < M < 1$ indicates the maturity of the assets in place. The firm also pays out cash and/or raises external financing at time $t = 0$ and at time $t = M$, invests continuously in a new project between $t = 0$ and $t = 1$, and gets liquidated after realizing its final cash flow at time $t = 2$. Figure 1 shows the timeline of events.

C. **Investment Payoffs.** The assets in place have a maturity M. So the payoff from the assets in place, X_0, is realized at $t = M$, after investment in the new project has started ($M > 0$) and before the investment in the new project is completed ($M < 1$). The investment in the new project is made continuously over time with each instantaneous investment contributing to the aggregate payoff from the project at $t = 2$. Each instantaneous investment can be viewed either as a stage of a single lumpy investment or as one of a series of multiple identical

$t = 0$	$t = M$	$t = 2$
Firm starts with cash C_0	Excess cash increases firm value by $h(C)$	Cash flow from new project is realized
CEO determines amount of external financing raised (F) or dividend paid ($-F$)	Cash flow from assets in place, X_0 is observed	Investors who provided external financing at $t=0$ or $t=M$ are repaid subject to cash availability
CEO invests in new project at rate I between $t=0$ and $t=M$	Beliefs about payoffs from the new project are updated	Any remaining cash is distributed to original shareholders
Resulting excess cash is $C = C_0 + F - MI$	CEO determines amount of external financing raised or dividend paid.	
	CEO invests in new project at rate J between $t=M$ and $t=1$	

FIGURE 1. **Timeline**

atomic investments available to the firm at different points in time. Viewing investment as a continuous process allows us to distinguish investment decisions made before the realization of cash flow at $t = M$ from investment decisions made after $t = M$. An investment at the rate of I_t in an infinitesimal time interval $\mathrm{d}t$ at time t contributes $X_t \mathrm{d}t$ to the cash flow at $t = 2$ where

$$X_t = \begin{cases} 0 & \text{with probability } \pi_l \\ f(I_t) & \text{with probability } \pi_m \\ af(I_t) & \text{with probability } \pi_h \end{cases} \tag{1}$$

where f is an increasing and concave function, $a \geq 1$ is a constant, and π_l, π_m, and π_h are probabilities of low, medium, and high project payoffs, respectively. These probabilities are unknown and are determined by an unobserved quality of the firm. This quality also impacts the payoff from assets in place such that a higher value of X_0 indicates a higher quality and hence a higher value of X_t. Specifically, $\pi_l(X_0)$ is decreasing in X_0 (or equivalently $\pi_h(X_0) + \pi_m(X_0)$ is increasing in X_0) and $\pi_h(X_0)/\pi_m(X_0)$ is increasing in X_0. Since new information is revealed only at $t = M$, the rate of investment chosen by the firm will not change between the interval $t = 0$ to $t = M$ or between the interval $t = M$ to $t = 1$. Let the rate of investment be I per unit time before $t = M$ and J per unit time after $t = M$.

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D. **Preferred Cash Balance.** The firm starts with a cash balance of C_0 at $t = 0$. Let F be the net amount raised by the firm between dates $t = 0$ and $t = M$. For simplicity, we assume that the financing or payout decisions are taken at $t = 0$ and then at $t = M$ as no new information is revealed between these two points in time. If F is positive, the firm raises F though external financing and if F is negative, the firm pays out $-F$ to investors. A part of the resulting cash balance is used to invest an amount $M \times I$ before $t = M$. The cash balance that is in excess of the investment needs between $t = 0$ and $t = M$ is

$$C = C_0 + F - MI. \tag{2}$$

We call this cash balance excess cash, which is not used to meet investment needs before $t = M$. It can, however, be used to partly finance investment made after $t = M$, with the rest supplied by any additional capital that the firm raises at $t = M$. The firm's choice of the excess cash balance is also affected by other factors such as transactional motives and precautionary cash needs. Without explicitly modeling such factors, we assume that there is an optimal cash balance and any deviation of excess cash balance from this optimum is costly. Specifically, we assume that the excess cash balance of C results in expected incremental firm value of $h(C)$ at $t = M$ where $h(C^*) = C^*, h'(C^*) = 1, h'' < 0$, and C^* is the optimal cash balance.

E. **Investment and Financing Decisions After $t=M$.** At $t = M$, both the CEO and the investors observe the realized cash flow (X_0) and update their beliefs about the probability distribution of new investment $(\pi_l, \pi_m,$ and $\pi_h)$. Since the CEO and the investors share the same beliefs, external financing is fairly priced and the investment decision after $t = M$ is independent of the financing policy. That is, the CEO chooses the NPV-maximizing investment rate J such that:

$$(\pi_m + a\pi_h) f(J) - J \geq (\pi_m + a\pi_h) f(J') - J' \quad \forall J'.$$

F. **CEO Optimism.** We now consider the possibility that the investors and the CEO disagree about the quality of the firm's projects before $t = M$. The CEO believes that the probability distribution of the payoff from assets in place (X_0) is $g(X_0, p)$ where p is the CEO's degree of optimism. A value of $p = 0$ indicates beliefs that coincide with those of the investors and a higher value indicates greater optimism while negative values indicate

pessimism. We assume $p > 0$. Investors believe that the probability distribution of X_0 is $g(X_0, 0)$. A higher value of p in the probability distribution $g(X_0, p)$ makes higher outcomes more likely. Specifically, we assume that g follows monotone-likelihood-ratio-property with respect to p so the ratio $g(x_2, p)/g(x_1, p)$ is increasing in p for $x_2 > x_1$.

G. **Financing Terms Before $t=M$.** The terms of financing are chosen so that new investors expect to earn zero NPV on their investment in the firm. Since an optimistic CEO's beliefs diverge from those of the investors, the CEO may consider the financing decision to have a nonzero NPV. This difference of opinion can impact both the level and the form of financing. In general, agents take positions which promise higher payoffs in states that they consider more likely than do other agents. This phenomenon has been used to explain portfolio choices of investors (DeTemple and Murthy, 1994), the capital structure choice (Yang, 2013), and the existence of financial intermediaries (Coval and Thakor, 2005). Since the CEO is more optimistic about the prospects of the firm than are the investors, the CEO may prefer debt financing to equity financing, consistent with the finding in Malmendier et al. (2011).[2] The new investors (debtholders) provide financing F and set the face value of debt to $F/E_0[\pi_m + \pi_h]$ because they consider the probability of repayment to be $E_0[\pi_m + \pi_h]$. The subscript in the expectation operator indicates the degree of optimism in the beliefs used to calculate the expectation. Here, the subscript 0 indicates that the expectation is based on investors' beliefs that exhibit zero optimism: $E_0[.] \equiv E[. \mid g(X_0, 0)]$.

H. **CEO's Objective.** The CEO disagrees with the investors and believes that new investors will be repaid with probability $E_p[\pi_m + \pi_h]$ where the expectation is computed based on the beliefs of the CEO whose degree of optimism is p: $E_p[.] \equiv E[. \mid g(X_0, p)]$. The CEO uses these beliefs in computing the impact of new financing on the value of the firm to original shareholders. The CEO's objective is to maximize

$$Z(I, C, p) \equiv h(C) + X_0 + ME_p[\pi_m + a\pi_h]f(I) - (C + MI - C_0)\frac{E_p[\pi_m + \pi_h]}{E_0[\pi_m + \pi_h]}$$
$$+ (1 - M)E_p\left[\max_J \{(\pi_m + a\pi_h)f(J) - J\}\right]. \tag{3}$$

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[2]Our analysis goes through with equity financing too. Note that there is no distinction between equity and debt financing in the model if we choose $a = 1$.

The first term in the objective is the value of the excess cash balance, the second term is the cash flow from assets in place, the third term is the expected cash flow from the investment made before $t = M$, the fourth term is the expected repayment to new investors, and the last term is the expected NPV of the investment to be made after $t = M$. The CEO chooses the investment rate I and the excess cash balance C to maximize this objective. The cash balance of the firm equals $C + MI$, the sum of the excess cash balance and the cash kept to meet investment needs before $t = M$.

I. **Investment Policy.** The investment rate I that maximizes the CEO's objective (3) is given by the following first order condition:

$$E_p\left[\pi_m + a\pi_h\right] f'(I) = \frac{E_p\left[\pi_m + \pi_h\right]}{E_0\left[\pi_m + \pi_h\right]}. \tag{4}$$

A rational CEO chooses the NPV-maximizing investment rate I^* that is obtained from the above equation by substituting $p = 0$:

$$f'(I^*) = \frac{1}{E_0\left[\pi_m + a\pi_h\right]}. \tag{5}$$

If the CEO's beliefs differ from those of investors, the investment rate I is increasing in the CEO's degree of optimism. To see this, we rewrite (4) as

$$f'(I) = \frac{1}{E_0\left[\pi_m + \pi_h\right]} \left(1 - \frac{a - 1}{a + E_p[\pi_m]/E_p[\pi_h]}.\right) \tag{6}$$

The ratio $E_p[\pi_m]/E_p[\pi_h]$ is decreasing in p because a higher p makes a higher X_0 more likely and a higher X_0 increases the ratio π_h/π_m.[3] An increase in p lowers the ratio $E_p[\pi_m]/E_p[\pi_h]$, which lowers the right side of (6), and to maintain equality, the left side of (6) must be lowered by increasing I.

The intuition for this result is that as CEO optimism increases, it has three effects on the CEO's choice of investment. First, a more optimistic CEO estimates a higher value of the probability $\pi_m + \pi_h$ that the project will have a positive payoff. This increases the CEO's estimate of the NPV of the project. Second, a more optimistic CEO estimates a higher value of the probability $\pi_m + \pi_h$ of repayment to debt investors. However, as debt is priced using investors' lower estimation of the probability of repayment, the CEO perceives debt to be

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[3]Formally, $\frac{E_p[\pi_m]}{E_p[\pi_h]} = \frac{\int \pi_m(x)g(x,p)\mathrm{d}x}{\int \pi_m(x)\{\pi_h(x)/\pi_m(x)\}g(x,p)\mathrm{d}x}$. Since $\pi_h(x)/\pi_m(x)$ is increasing in x and g follows monotone-likelihood-ratio-property, $\frac{E_p[\pi_m]}{E_p[\pi_h]}$ is decreasing in p by Chebyshev's inequality.

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underpriced. In the special case of $a = 1$, high and medium payoffs coincide and the only difference in beliefs is about the probability of repayment. The overestimation of project NPV is exactly offset by the overestimation of the cost of external financing because both are caused by an overestimation of $\pi_m + \pi_h$, so an optimistic CEO invests the same amount as the rational CEO. However, if $a > 1$, there is a third effect. The CEO also overestimates the probability of high payoff (π_h) relative to the probability of medium payoff (π_m), which further increases the NPV of the investment without affecting the perceived underpricing of debt. So if $a > 1$, a more optimistic CEO invests more, even though the CEO believes that the external financing is too costly.

J. **Cash Policy.** The excess cash balance C that maximizes the CEO's objective (3) is given by the following first-order condition:

$$h'(C) = \frac{E_p \left[\pi_m + \pi_h\right]}{E_0 \left[\pi_m + \pi_h\right]}. \tag{7}$$

For a rational CEO, the above condition is satisfied at the preferred cash balance C^*. However, if the CEO's beliefs differ from those of investors, the excess cash balance C is decreasing in the CEO's degree of optimism. To see this, consider a value for optimism p and a value for excess cash C that satisfy (7). For a more optimistic CEO, a higher value of p increases the right side of (7). To restore equality in (7), the left side must be increased by lowering C.

The intuition for this result is that as CEO optimism increases, the CEO perceives financing to be more overpriced. The benefit of holding an excess cash balance (beyond investment needs before $t = M$) does not depend on optimism because the CEO expects the firm to raise financing at a zero NPV at $t = M$. Thus, the CEO's perceived cost of maintaining an excess cash balance increases while the benefit does not and, as a result, the CEO chooses to hold lower excess cash.

The total cash balance of the firm consists of cash kept for investment before $t = M$ and excess cash. We have shown that the former is increasing in CEO optimism while the latter is decreasing in CEO optimism. The total cash can be increasing or decreasing in CEO optimism depending on the relative size of cash kept for meeting investment needs and the excess cash retained for other reasons. Note that an optimistic CEO does not maintain any cash to meet investment needs after $t = M$. The reason is that investment needs after

$t = M$ can be met by either raising external financing earlier and maintaining a higher cash balance until $t = M$ or by keeping a lower cash balance until $t = M$ and then raising external financing. An optimistic CEO prefers the latter policy because he considers external financing to be too costly before $t = M$. Moreover, the CEO believes that the payoff from assets in place will be high at $t = M$ and after observing that high payoff, investors will revise upwards their perception of the firm's projects' quality and offer financing on more advantageous terms.

Thus, the firm maintains a cash balance only to meet investment needs before $t = M$. The total cash held by the firm is $C + MI$ where the investment rate I, determined by (6), is (weakly) increasing in CEO optimism, and the excess cash C, determined by (7), is decreasing in CEO optimism. If assets in place have a longer maturity (M is larger), then investment needs form a bigger fraction of the cash balance compared to excess cash and greater optimism results in a smaller decline in the total cash balance.[4] That is, optimistic CEOs hold a smaller cash balance when they expect cash flows from assets in place to be realized relatively early. However, if the CEO expects the difference of opinion to persist over a long period because assets in place are long-lived, then the reduction in holding of excess cash is offset by the higher cash that the CEO raises to meet investment needs.

K. **Hypotheses.** Our model predicts the following two hypotheses:

Hypothesis 1. *Firms led by optimistic CEOs hold less cash than firms led by rational CEOs. This follows from Section J.*

Hypothesis 2. *The difference between the total cash held by a rational CEO and the total cash held by an optimistic CEO is smaller in a firm with longer maturity of assets (M). This follows from Section J.*

For our empirical analysis, we test Hypothesis 1 in this paper.

III. Data and Variables

Our initial sample of firms is drawn from Standard and Poor's Execucomp database over the period 1992-2012. From this initial sample of firm-year observations, we eliminate observations for financial firms (SIC 6000-6999), utilities (SIC 4900-4999), and regulated telephone

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[4]$\partial^2(C + MI)/\partial p \partial M = \partial I/\partial p > 0.$

companies (SIC 4813). These data filters result in 19,328 firm-year observations for 2,172 firms for our main empirical analysis. We supplement the option-compensation data from Execucomp with various items from the COMPUSTAT database to construct our control variables.

We use the data on option compensation from the Execucomp database to construct our CEO optimism measures. Options typically represent a large component of CEO compensation packages. CEOs also have their human capital invested in the firm. Taken together, these effects cause CEOs to be underdiversified and thus highly exposed to company-specific risk. The options issued to CEOs are non-tradeable and the CEOs are prohibited from hedging their exposure by short selling their company stock. Underdiversified CEOs should thus rationally exercise their options early if they are sufficiently deep in-the-money (Hall and Murphy, 2002). An optimistic CEO, however, overestimates the expected value of the firm's future payoff and perceives the firm's stock to be undervalued. So, despite being underdiversified, an optimistic CEO is less likely to exercise stock options and hold the options longer than his/her rational counterparts. Malmendier and Tate (2005, 2008) use this rationale to derive portfolio-based CEO overconfidence measures based on the option-exercise behavior of CEOs. This rationale also underlies our measures of CEO optimism, *Optimism* and *Post-Optimism*. We now describe these two measures along with the various control variables we use in our empirical analysis.

Optimism. We draw on Malmendier and Tate (2005) and Campbell et al. (2011) to construct this measure. For example, Malmendier and Tate (2005) classify CEOs as overconfident if they held options that were fully vested five years before expiration and were at least 67% in the money. We adopt a threshold of 100% moneyness and set *Optimism* equal to one over all the CEO-years if the CEO held an option that was more than 100% in the money at least once during his/her tenure and zero otherwise. The *Optimism* variable thus represents a fixed effect over all of a CEO's years. Since the Execucomp database does not provide detailed data on the option holdings of a CEO or the exercise price associated with each option grant, we follow Campbell et al. (2011) to calculate the average moneyness of a CEO's option holdings for each year in our sample period. First, we compute the realizable value per option as the ratio of the total realizable value of exercisable options to the number of exercisable options. Next, we subtract the realizable value per option from the fiscal-year-end

stock price to obtain an estimate of the average exercise price of options. Last, to determine the average percentage moneyness of the options, we divide the realizable value per option by the estimated average exercise price.

In constructing *Optimism*, we face a trade-off between statistical power and effective identification of optimistic CEOs. We adopt a more conservative threshold of 100% moneyness, relative to the 67% cutoff in Malmendier and Tate (2005), to identify optimistic CEOs more effectively. However, this higher threshold also increases the likelihood that some optimistic CEOs get classified as non-optimistic. In this sense, the *Optimism* variable represents a noisy measure of optimism and CEOs not classified as optimistic may represent a mix of both rational and optimistic CEOs. For ease of exposition, we refer to the CEOs in this group as rational CEOs. The goal underlying our classification of CEOs is to ensure that the "Optimistic" group is more likely to contain optimistic CEOs while the "rational" group is more likely to contain non-optimistic CEOs. Any noise in the *Optimism* variable likely introduces a bias against finding support for the hypothesized negative relation between cash holdings and CEO optimism.

Post-Optimism. This measure, also based on the CEO's option-exercise behavior, allows for time variation over the sample period and eliminates forward-looking information in the classification of a CEO. *Post-Optimism* equals one in all CEO-years following (and including) the first year in which the CEO holds an option that is more than 100% in the money, and zero otherwise.[5]

Control Variables. The extant empirical literature indicates that cash holdings are influenced by many factors. In our empirical analysis, we control for all the relevant factors shown to affect corporate cash holdings. These control variables are based on the evidence in Opler et al. (1999), Harford et al. (2008), and in Bates et al. (2009). Specifically, we include growth opportunities, cash flow, firm size, leverage, net working capital, R&D expenditures, capital spending, acquisitions, bond rating, cash flow volatility, and CEO stock ownership. We also include CEO option ownership given that the variable *Optimism* is based on the CEO's ownership of options. In addition, we control for the CEO's stock ownership and option

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[5]This measure is motivated by the *Post-Longholder* measure in Malmendier and Tate (2005, 2008).

ownership because they may affect the agency problem between the shareholders and the CEO.

We calculate *Growth Opportunities* as the ratio of the market value of assets to book value of *net* assets, where the market value of assets equals the market value of equity plus the book value of total liabilities and net assets equals total assets minus cash & short-term investments; *Cash Flow* as the ratio of operating income before depreciation *less* interest expense *less* income taxes *less* common and preferred dividends *to* net assets; *NWC to Assets* as the ratio of net working capital (net of cash and short-term investments) to net assets; *RD to Assets* as the ratio of R&D expenditures to net assets (and set equal to zero if R&D is missing); *Capex to Assets* as the ratio of capital expenditures to net assets; *Acquisitions to Assets* as the ratio of acquisitions to net assets; and *Cash Flow Volatility* as the standard deviation of the firm's cash flow over the prior ten-year period. *Bond Rating* is an indicator variable that equals one if the firm has a long-term debt rating and zero otherwise. We use the natural logarithm of sales, termed as *Log of Sales,* as a proxy for firm size. For robustness, we also use the natural logarithm of the book value of net assets. The CEO's stock ownership, termed as *Stock Ownership*, equals the fraction of the company stock (excluding options) owned by the CEO as a fraction of common shares outstanding. The CEO's option ownership, termed as *Vested Options*, equals the ratio of the CEO's holdings of exercisable options as a fraction of common shares outstanding.

Measures of the Dependent Variable. We use two measures. We follow Opler et al. (1999) and use *Cash Holdings*, which equals the ratio of cash and short-term investments to net assets. As Opler et al. (1999) note, a firm's ability to generate future profits should depend on its non-cash assets. However, Bates et al. (2009) argue that this measure of cash holdings can generate large outliers if firms hold most of their assets in cash. To reduce the potential problem of large outliers, we follow Foley, Hartzell, Titman, and Twite (2007) and use an alternative measure, *Log of Cash Holdings*, which equals the natural logarithm of one plus *Cash Holdings.* Bates et al. (2009) produce their results using cash to assets as their main measure. For robustness, we also estimate our main models with *Cash to Assets* as the dependent variable, which equals the ratio of cash and short-term investments to the book value of total assets.

Our treatment of data outliers is as follows. We trim the cash flow variable at 0.5% to ensure that our results are not affected by outliers (Malmendier and Tate, 2005, 2008). We also trim the growth and cash flow volatility variables at the 99.5% level, owing to the extremely large outliers. In addition, we remove about 1% of the observations for which the value of the leverage variable exceeds one. While all tabulated results reflect this treatment of the data, our main result regarding the negative relation between cash holdings and measures of CEO optimism is robust to including all the observations after winsorizing these four variables (at the respective levels at which we trim the observations).

IV. EMPIRICAL RESULTS

We begin our empirical analysis with univariate comparisons between subsamples of firms with Optimism = 1 (optimistic CEOs) and Optimism = 0 (rational CEOs). Next, we perform a multivariate analysis by estimating a regression model of cash holdings as a function of CEO optimism and the control variables discussed in the previous section. Even though the univariate comparisons provide a general idea of the differences between firms managed by optimistic and rational CEOs, they do not account for the interaction among the various firm attributes in determining cash holdings. In contrast, the multivariate analysis that we perform allows us to investigate the marginal impact of CEO optimism on corporate cash holdings while controlling for other relevant factors. In all of the regression models, we control for both firm and year fixed effects and cluster standard errors by firm. We estimate the models using those observations for which data are available on all variables.

The summary statistics in Table 1 show that optimistic-CEO observations represent about 56% of the total firm-year observations. The mean and median values of cash holdings, our main variable of interest, is slightly higher for firms with optimistic CEOs. In addition, firms with optimistic CEOs have a relatively higher CEO option ownership (as measured by vested options), higher growth opportunities, higher cash flow, higher R&D, higher capital expenditures, and higher CEO Tenure (tenure of the CEO with the firm in years).

[Table 1 here]

A. **Optimism and the Cash Level.** We estimate a regression model of cash holdings on the panel data for our sample firms. The independent variable of interest is *Optimism.* We also include the various control variables. The results from Model 1 in Table 2 indicate that

the level of cash holdings is negatively related to Optimism and the coefficient is statistically significant at the 1% level. The results also indicate that the level of cash holdings is positively related to Growth Opportunities, Cash Flow, Leverage, and RD to Assets and negatively related to Log of Sales, NWC to Assets, Capex to Assets, Acquisitions to Assets, and Stock Ownership. The coefficients on all of these control variables are statistically significant at the 5% level or better and the results are generally consistent with the previous literature (Opler et al. (1999), Harford et al. (2008), and Bates et al. (2009)). Finally, the coefficient on Bond Rating, Cash Flow Volatility, and Vested Options are not statistically significant at conventional levels.

[Table 2 here]

The negative coefficient on Optimism indicates that the level of cash holdings is negatively related to the level of CEO optimism and is consistent with our main testable prediction (Hypothesis 1). The magnitude of the coefficient on Optimism, which represents the incremental effect of CEO optimism on cash holdings, is 0.0208. This value is about 24% of the median level of cash holdings (of about 8.5%) for the overall sample. As an illustration of the economic significance of this coefficient, consider the median cash holdings of 6.99% for the sub-sample of non-optimistic CEOs. The cash holdings of a similar firm managed by an optimistic CEO will be about 30% lower, on average, at 4.91%.

In Model 2, we use Post-Optimism in place of the Optimism variable. The overall results are qualitatively similar to those in Model 1. The coefficient on Post-Optimism is of a similar magnitude to that on Optimism. The coefficient on Post-Optimism is also economically significant - its magnitude is roughly 24% of the median level of cash holdings (of about 8.5%) for the overall sample. In Models 3 and 4, we use Log of Cash Holdings as the dependent variable. In Model 3, we estimate the model with Optimism and in Model 4, we replace Optimism with Post-Optimism. The coefficients on both Optimism and Post-Optimism, respectively, continue to be negative and statistically significant at the 1% level. The coefficient on Vested Options is now negative and statistically significant at the 10% level or better. The rest of the results are qualitatively similar to those in Models 1 and 2, respectively.

Robustness Checks. We perform several robustness checks. For these tests, we estimate both Model 1 and Model 3 (i.e., with the two measures of the dependent variable). Our main result with respect to the negative relation between cash holdings and optimism continues to hold qualitatively in multiple robustness checks which consist of replacing the natural logarithm of sales with the natural logarithm of the book value of net assets, clustering standard errors by CEO instead of by firm, using industry fixed effects (at the two-digit SIC level) instead of firm fixed effects, and using *Cash to Assets* as the dependent variable.

The summary statistics in Table 1 indicate that optimistic CEOs have higher CEO tenure. A positive association between *optimism* and CEO tenure is likely to arise mechanically given the way we construct *Optimism.* While there is no theoretical rationale for a relation between cash holdings and CEO Tenure, we perform a robustness check to examine if the relation between cash holdings and optimism simply represents a relation between cash holdings and CEO tenure. We estimate our main models after including CEO Tenure and find that the relation between cash holdings and optimism remains negative and statistically significant.

Malmendier et al. (2011) show that a measure of optimism, based on Execucomp data and calculated the way we do, seems to reflect CEO optimism when the regression specification controls for past stock return performance. We estimate both Model 1 and Model 3 after including five lags of annual stock return and find that the negative relation between cash holdings and optimism is robust to the inclusion of past stock return performance.

Many studies such as Opler et al. (1999) and Bates et al. (2009) include a dividend dummy variable as an explanatory variable. This variable is used to proxy ease of access to external capital markets and is hypothesized to have a negative effect on cash holdings. Other studies such as Harford et al. (2008) use both a dividend dummy and a bond rating dummy. In our empirical analysis, we use a bond rating dummy (or indicator) variable. We do not use the dividend dummy due to endogeneity concerns arising from the negative effect of CEO overconfidence on firm's dividend payout documented in Deshmukh et al. (2013). As a check, we estimate both Model 1 and Model 3 after including both the bond rating dummy variable and a dividend dummy variable, which equals one if the firm pays dividends and zero otherwise. Our untabulated results indicate that the negative relation between cash holdings and optimism remains significant.

B. **Optimism and Changes in the Cash Level.** We now examine the relation between the change in cash holdings and optimism. We do so for two reasons. The first reason represents a simple follow-up question based on the results in Table 2. We ask: Given that optimistic CEOs hold a lower cash balance than rational CEOs, do they also accumulate cash at a lower level? In other words, are the changes in cash holdings lower in firms managed by optimistic CEOs? The second reason is that exploring the relation between the change in cash holdings and optimism allows us to address potential endogeneity concerns if cash holdings have an effect on CEO optimism even though there is no prior theory or evidence to suggest that this might be the case. Nonetheless, we follow Harford et al. (2008) and estimate a regression model with the Change in Cash Holdings (over the fiscal year) as the dependent variable after including the lagged level of cash holdings as an explanatory variable. The rest of the explanatory variables are the same as in Table 2. Estimating this regression model allows us to explore whether CEO optimism can predict future cash holdings of the firm after controlling for the lagged value of cash holdings.

The results from Model 1 in Table 3 indicate that the Change in Cash Holdings is negatively related to Optimism and the coefficient is statistically significant at the 1% level. Similarly, the results from Model 2 in Table 3 indicate that the Change in Cash Holdings is negatively related to Post-Optimism and the coefficient is also statistically significant at the 1% level. The rest of the results are qualitatively similar to those in Table 2. In Models 3 and 4, we use the Change in Log of Cash Holdings as the dependent variable. In Model 3, we estimate the model with Optimism and in Model 4, we replace Optimism with Post-Optimism. The results are qualitatively similar to those in Models 1 and 2, respectively. For robustness, we also estimate the model with the Change in Cash to Assets as the dependent variable. Again, the results remain qualitatively the same.

The results in Table 3 should allay any endogeneity concerns arising from reverse causality. If firms with low cash holdings attract optimistic CEOs, then this effect should remain cross-sectional and we should not observe the negative relation between optimism and the change in cash holdings that we document in Table 3. We perform another test to rule out potential reverse causality. Harford et al. (2008) use the lagged value of their main explanatory variable when estimating their regression model of the change in cash holdings. In our case, we cannot do so because Optimism represents a CEO fixed effect. However, the

Post-Optimism variable exhibits variation over time for a CEO when it switches from zero to one when CEOs are identified as "optimistic" and we exploit this variation by using its lagged value. The negative relation between Change in Cash Holdings and Post-Optimism remains statistically significant and suggests that Change in Cash Holdings is lower in years in which CEOs are identified as optimistic.

[Table 3 here]

C. **Optimism, Cash Holdings, and Change in Cash Holdings: Alternative Optimism Measure and Sample.** We examine the implications of our model and the ensuing testable hypothesis using both an alternative sample and an alternative measure of optimism. The sample we use is identical to that in Malmendier and Tate (2005, 2008) and is based on the sample of 477 firms in Yermack (1995) and in Hall and Liebman (1998). This sample consists of those firms that appear at least four times in one of the lists of the largest U.S. companies compiled by *Forbes* magazine over the period 1984-1994. This data set provides detailed information on CEO stock and stock option holdings. Malmendier and Tate (2008) use the data on option holdings to derive their various portfolio-based optimism/overconfidence measures. In our tests below, we use *Longholder*, their main measure of CEO overconfidence.[6] To be consistent with our analysis thus far, we eliminate observations for financial firms (SIC 6000-6999), utilities (SIC 4900-4999), and regulated telephone companies (SIC 4813) from the panel data on the original sample of 477 firms. The data cover the period 1980-1994 and we supplement the above data on CEO overconfidence with various items from the COMPUSTAT database to construct our control variables. These data filters result in 2324 firm-year observations for 237 firms for our empirical analysis.

We estimate a regression model of cash holdings with *Longholder* as the independent variable of interest. The various control variables we include are the same as in Table 2. The results from Model 1 in Table 4 indicate that the level of Cash Holdings is negatively related to Longholder and the coefficient is statistically significant at the 5% level. The negative coefficient on Longholder indicates that the level of cash holdings is negatively related to the level of CEO optimism and is consistent with our main testable prediction (Hypothesis 1)

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[6]Longholder is an indicator variable that identifies CEOs who hold an option until the year of expiration at least once during their tenure even though the option is at least 40% in the money. This variable (akin to our Optimism variable) represents a fixed effect over all of a CEO's years.

and with our findings in Table 2. The magnitude of the coefficient on Longholder is roughly of a similar magnitude to that on Optimism in Table 2. This similarity in the magnitude of the two coefficients further validates the implications of the model. The results also indicate that the level of cash holdings is positively related to Growth Opportunities, Cash Flow Volatility, and Vested Options and negatively related to Capex to Assets and Acquisitions to Assets. The coefficients on all of these control variables, with the exception of Vested Options, are statistically significant at the 5% level or better and these results are generally consistent with the previous literature. Finally, the coefficient on Bond Rating, Log of Sales, NWC to Assets, Cash Flow, Leverage, and RD to Assets, and Stock Ownership are not statistically significant at conventional levels.

[Table 4 here]

The magnitude of the coefficient on Longholder, which represents the incremental effect of CEO optimism on cash holdings, is 0.0265. This value is about 55% of the median level of cash holdings (of about 4.8%) for the overall sample. As an illustration of the economic significance of this coefficient, consider the median cash holdings of 4.7% for the sub-sample of non-optimistic CEOs. The cash holdings of a similar firm led by an optimistic CEO, on average, will be about 56% lower at 2.05%. In Model 2, we use Log of Cash Holdings as the dependent variable. The results indicate that the coefficient on Longholder is negative and statistically significant at the 10% level. The rest of the results are qualitatively similar to those in Model 1.

Next, we examine the relation between the change in cash holdings and Longholder in Model 3 of Table 4. As in Table 3, we include the lagged level of cash holdings as an explanatory variable. The rest of the explanatory variables are the same as in Model 1 of Table 4. The results from Model 3 indicate that the Change in Cash Holdings is negatively related to Longholder and the coefficient is statistically significant at the 5% level. The rest of the results are qualitatively similar to those in Model 1. In Model 4, we use the Change in Log of Cash Holdings as the dependent variable. Again, the change in cash holdings is negatively related to Longholder and the coefficient is statistically significant at the 5% level.

The qualitatively similar findings that we document for the two alternative measures of optimism indicate that the optimism measure based on Execucomp data captures the notion of CEO optimism reflected in the measure developed by Malmendier and Tate (2005, 2008).

Since the Execucomp dataset covers a recent time period and many more firms, it should provide researchers with an opportunity to explore many new issues in behavioral corporate finance.

D. **Interaction Effects.** The previous literature on cash holdings documents that growth opportunities, cash flow, investment spending (capital expenditures and R&D), and acquisitions are important determinants of cash holdings. We confirm these findings in Table 2. In addition, these four determinants of cash holdings are also related to CEO optimism. For example, Malmendier and Tate (2005) show that overconfident CEOs finance their investment spending predominantly with internal funds or cash flow. Malmendier and Tate (2008) show that overconfident CEOs are more likely to engage in acquisitions. Growth opportunities affect future investment needs of a firm and optimistic CEOs are likely to consider this effect when determining their cash holdings. In light of these arguments and evidence, we examine how the relations between cash holdings and each of growth, cash flow, investment spending, and acquisitions are affected by CEO optimism. We use the Optimism measure and the Execucomp sample to examine the various interactive effects.

Growth. We estimate the regression model of Cash Holdings in Model 1, Table 2 by including the interaction between Optimism and Growth. The results in Model 1, Table 5 indicate that the coefficient on Growth is positive while the coefficient on the interaction between Growth and Optimism is negative. Both of these coefficients are significantly different from zero at the 1% level. These results indicate that regardless of whether the CEOs are rational or optimistic, a CEO in a higher-growth firm holds more cash than a similar CEO in a lower-growth firm. However, the negative coefficient on the interaction term shows that the increase in cash holdings resulting from higher growth opportunities is lower in firms managed by optimistic CEOs. One explanation is that optimistic CEOs in higher-growth firms prefer to finance the greater future investment needs through external financing in the future rather than through internal cash accumulated by raising external financing earlier because they expect the terms of financing to improve over time.[7]

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[7]For example, both lower-growth and higher-growth firms may hold $50 for transaction purposes but higher-growth firms may hold an additional $100 for future investment needs. In contrast, optimistic CEOs of higher-growth firms may choose to hold $50 for transaction purposes and only an additional $50 of the

Cash Flow. In Table 2, we document a positive relation between cash holdings and cash flow, which is consistent with prior evidence (Harford et al. (2008)). We now examine whether there is any difference in the magnitude of this relation between firms managed by optimistic CEOs and those managed by rational CEOs. The rationale for exploring this differential effect is that following an increase in current cash flow, an optimistic CEO might anticipate higher future cash flow and thus perceive a lower cash requirement. We estimate the regression model of Cash Holdings in Model 1, Table 2 by including the interaction between Optimism and Cash Flow. Our results from Model 2, Table 5 indicate that the positive relation between cash holdings and cash flow continues to hold. However, the coefficient on the interaction of Optimism and Cash Flow, though negative, is nonsignificant. This finding suggests that, in our sample, there is no difference in the relation between cash flow and the level of cash holdings across firms managed by optimistic and rational CEOs.

Investment Spending. Malmendier and Tate (2005) find that overconfident CEOs tend to rely more on internal funds (i.e., cash flow) in financing their investment spending. Cash holdings can be viewed as a source of internal funds. Do optimistic CEOs rely more (or less) on cash holdings, in addition to cash flow, in financing their investment spending? To answer this question, we examine the effect of CEO Optimism on the relation between cash holdings and investment spending. We create a new variable, Investment Spending to Assets, by adding Capex to Assets and RD to Assets. We include this variable, along with its interaction with Optimism, and estimate the regression model of Cash Holdings in Model 1, Table 2. The results in Model 3, Table 5 indicate a positive and significant coefficient on Investment Spending, which suggests that firms with higher investment needs hold a higher cash balance. However, the coefficient on the interaction term, though negative, is nonsignificant.

Acquisition Spending. Malmendier and Tate (2008) document that overconfident CEOs are more likely to engage in acquisitions. Given the reluctance of optimistic CEOs to raise external funds, we investigate whether CEO Optimism affects the negative relation between spending on acquisitions and cash holdings that we document in Table 2. We estimate the

total $100 needed for future investment needs. Consequently, the difference between cash holdings of higher-growth and lower-growth firms will be $100 ($150 minus $50) in firms led by rational CEOs but only $50 ($100 minus $50) in firms led by optimistic CEOs.

regression model of Cash Holdings in Model 1, Table 2 by including the interaction between Optimism and Acquisitions to Assets. The results in Model 4, Table 5 indicate that the coefficient on Acquisitions to Assets is negative and significant (at the 1% level) and the coefficient on the interaction term is negative and significant at the 10% level. This result suggests that for a given level of acquisitions spending, the firm managed by an optimistic CEO holds less cash. This finding is consistent with Malmendier and Tate (2008), who show that overconfident CEOs are more likely to finance their acquisitions with cash as opposed to stock.

[Table 5 here]

E. **Optimism and the Cash-Flow Sensitivity of Cash.** Almeida, Campello, and Weisbach (2004) draw on Keynes (1936) and develop a model of liquidity to explain the relation between financial constraints and cash policy. They document that changes in cash holdings are positively related to cash flow for financially constrained firms. In contrast, no such relation exists among financially unconstrained firms. Given that optimistic CEOs behave as if they are financially constrained, a natural question that arises is: Is the cash-flow sensitivity of cash different for firms managed by optimistic CEOs? Our model predicts a negative relation between optimism and the level of cash holdings and our overall results indicate a negative relation between optimism and both the level of cash holdings and the change in the level of cash holdings. Therefore, in light of our model prediction and the evidence thus far, we predict the cash flow sensitivity of cash to be lower in firms managed by optimistic CEOs.

We follow Almeida et al. (2004) and estimate a model with the change in cash holdings as the dependent variable. The explanatory variables are optimism, cash flow, cash flow interacted with optimism, growth opportunities, and the logarithm of the book value of net assets as a proxy for firm size. As in Almeida et al. (2004), we use an instrumental variables (IV) approach to control for the potential endogeneity of investment and financial decisions and follow them in choosing the set of instruments: two lags of the level of fixed capital (net PPE to net assets), lagged acquisitions to net assets, lagged net working capital to net assets, lagged short-term debt to net assets, twice lagged sales growth, and two-digit SIC indicators. We estimate a fixed effects IV model, controlling for year effects. The

standard errors are based on the conventionally-derived variance estimator for generalized least-squares regression.

The results from Model 1 in Table 6 indicate that the firms in our sample exhibit a positive cash-flow sensitivity of cash indicating the presence of financial constraints for our sample. In other words, firms in our sample, on average, increase their cash holdings when they experience an extra dollar of cash flow. The coefficient on the interaction of optimism and cash flow is negative and statistically significant at the 1% level. This negative sign suggests that firms managed by optimistic CEOs save less cash out of an extra dollar of cash flow than firms managed by rational CEOs. For example, the coefficient of about 0.60 on cash flow suggests that when cash flow increases by $1, rational CEOs save about 60 cents. In contrast, the coefficient on the interactive term (of Cash Flow and Optimism) of -0.30 suggests that when cash flow increases by $1, optimistic CEOs save only about 30 cents. We obtain qualitatively the same result (in Model 2) when we use Post-Optimism in place of Optimism. We also estimate this model on the alternative sample and the Longholder measure. The results, presented in Model 3, indicate that the main results are both quantitatively and qualitatively similar to those in Model 1. Specifically, the magnitude of the coefficient on cash flow is similar across both Model 1 and Model 3. In addition, the magnitude of the coefficient on the interactive term *Cash Flow * Longholder* is similar to that on *Cash Flow * Optimism.*

We now estimate Model 1, Table 6 separately for financially constrained and unconstrained firms. Since optimistic CEOs behave as if they are financially constrained, we want to rule out the possibility that Optimism might serve as a proxy for financial constraints. We use two of the variables in Almeida et al. (2004) to identify constrained and unconstrained firms: the bond rating dummy and the dividend dummy. A value of zero for both of these variables identifies constrained firms while a value of one identifies unconstrained firms. In total, we estimate four models: two for constrained firms (i.e., bond rating dummy = 0 and dividend dummy = 0) and two for unconstrained firms (i.e., bond rating dummy = 1 and dividend dummy = 1). Our untabulated results indicate that the coefficient on cash flow is positive and significant at the 1% level in all the four cases while the coefficient on the interaction of Cash Flow and Optimism is negative and significant at the 1% level in three cases. In the fourth case (bond rating dummy = 1), the coefficient on the interaction of Cash Flow

and Optimism is negative but nonsignificant ($p = 0.139$). These findings suggest that given financial constraints, optimism has a negative effect on the relation between cash holdings and cash flow.

[Table 6 here]

V. Conclusion

The key message of the paper is that CEO beliefs, specifically those characterized as optimism, play a significant role in corporate cash policy. Contrary to the intuitive predictions based on extant research, we find that optimistic CEOs hold less cash than their rational counterparts. This reduction in cash holdings resulting from CEO optimism is both statistically and economically significant. For example, our empirical results show that firms managed by optimistic CEOs hold cash balances that are, on average, 25 percent lower than those in firms managed by rational CEOs.

The central hypothesis of a negative relation between CEO optimism and cash holdings derives from an expanded tradeoff model of corporate cash holdings. Specifically, the model adds managerial beliefs (i.e., optimism) to the traditional trade-off model of costs and benefits of holding cash. The intuition is that an optimistic CEO believes external financing to be excessively costly but expects this cost to decrease over time as investors learn about the profitability of existing investments. As a result, the CEO delays raising external financing while funding current investments with internal cash, resulting in a lower cash balance.

We confirm our main results using two different datasets and two different measures of optimism, one based on Campbell et al. (2011) and the other on Malmendier and Tate (2005, 2008). In addition to maintaining a lower cash balance, firms managed by optimistic CEOs exhibit a lower change in their cash balance over time and save less cash out of their current cash flow than firms managed by rational CEOs. We also find that CEO optimism weakens the positive relation between cash holdings and a firm's growth opportunities, and strengthens the negative relation between cash holdings and spending on acquisitions. The former finding suggests that firms led by optimistic CEOs prefer to finance future investments by raising external financing in the future because they expect to raise funds on more attractive terms. The latter finding is consistent with existing evidence that optimistic CEOs rely more on cash than rational CEOs when financing acquisitions.

References

Acharya, Viral, Sergei A. Davydenko, and Ilya A. Strebulaev, 2012, Cash holdings and credit risk, *Review of Financial Studies*, 25, 3572–3609.

Almeida, Heitor, Murillo Campello, and Michael S. Weisbach, 2004, The cash flow sensitivity of cash, *Journal of Finance*, 59, 1777–1804.

Baker, Malcolm, Richard Ruback, and Jeffrey Wurgler, 2007, Behavioral corporate finance: A survey, in Espen Eckbo, ed., *The Handbook of Corporate Finance: Empirical Corporate Finance* (Elsevier/North-Holland), chapter 4, 145–186.

Barberis, Nicholas C., and Richard H. Thaler, 2003, A survey of behavioral finance, in George. M. Constantinides, Milton M. Harris, and Rene M. Stultz, eds., *Handbook of the Economics of Finance* (Elsevier/North-Holland), volume 1B, chapter 18, 1053–1128.

Bates, Thomas W., Kathleen M. Kahle, and René M. Stulz, 2009, Why do U.S. firms hold so much more cash than they used to?, *Journal of Finance*, 64, 1985–2021.

Ben-David, Itzhak, John R. Graham, and Campbell R. Harvey, 2013, Managerial miscalibration, *Quarterly Journal of Economics*, 128, 1547–1584.

Bergman, Nittai K., and Dirk Jenter, 2007, Employee sentiment and stock option compensation, *Journal of Financial Economics*, 84, 667–712.

Bernardo, Antonio E., and Ivo Welch, 2001, On the evolution of overconfidence and entreprenuers, *Journal of Economics & Management Strategy*, 10, 301–330.

Bertrand, Marianne, and Antoinette Schoar, 2003, Managing with style: The effect of managers on firm policies, *Quarterly Journal of Economics*, 118, 1169–1208.

Campbell, T. Colin, Michael Gallmeyer, Shane A. Johnson, Jessica Rutherford, and Brooke W. Stanley, 2011, CEO optimism and forced turnover, *Journal of Financial Economics*, 101, 695–712.

Coval, Joshua D., and Anjan V. Thakor, 2005, Financial intermediation as a beliefs-bridge between optimists and pessimists, *Journal of Financial Economics*, 75, 535–569.

Cronqvist, Henrik, Anil K. Makhija, and Scott E. Yonker, 2012, Behavioral consistency in corporate finance: CEO personal and corporate leverage, *Journal of Financial Economics*, 103, 20–40.

De Bondt, Werner F. M., and Richard H. Thaler, 1995, Financial decision-making in markets and firms: A behavioral perspective, in R. A. Jarrow, V. Maksimovic, and W. T. Ziemba,

eds., *Handbooks in Operations Research and Management Science* (North-Holland, Amsterdam), volume 9, chapter 13, 385–410.

de Meza, David, and Clive Southey, 1996, The borrower's curse: Optimism, finance and entrepreneurship, *The Economic Journal*, 106, 375–386.

Deshmukh, Sanjay, Anand M. Goel, and Keith M. Howe, 2013, CEO overconfidence and dividend policy, *Journal of Financial Intermediation*, 22, 440–463.

DeTemple, Jerome, and Shashidhar Murthy, 1994, Intertemporal asset pricing with heterogeneous beliefs, *Journal of Economic Theory*, 62, 294–320.

Dittmar, Amy, Jan Mahrt-Smith, and Henri Servaes, 2003, International corporate governance and corporate cash holdings, *Journal of Financial and Quantitative Analysis*, 38, 111–133.

Dittmar, Amy K., and Ran Duchin, 2014, Looking in the rear view mirror: The effect of managers professional experience on corporate financial policy, University of Michigan and University of Washington, Working paper.

Duchin, Ran, 2010, Cash holdings and corporate diversification, *Journal of Finance*, 65, 955–992.

Foley, C. Fritz, Jay C. Hartzell, Sheridan Titman, and Garry Twite, 2007, Why do firms hold so much cash? a tax-based explanation, *Journal of Financial Economics*, 86, 579–607.

Fresard, Laurent, 2010, Financial strength and product market behavior: The real effects of corporate cash holdings, *Journal of Finance*, 65, 1097–1122.

Gervais, Simon, J. B. Heaton, and Terrance Odean, 2011, Overconfidence, compensation contracts, and capital budgeting, *J. Finance*, 66, 1735–1777.

Goel, Anand M., and Anjan V. Thakor, 2008, Overconfidence, CEO selection, and corporate governance, *Journal of Finance*, 63, 2737–2784.

Graham, John R., Campbell R. Harvey, and Manju Puri, 2013, Managerial attitudes and corporate actions, *Journal of Financial Economics*, 109, 103–121.

Hackbarth, Dirk, 2008, Managerial traits and capital structure decisions, *Journal of Financial and Quantitative Analysis*, 43, 843–881.

Hall, Brian J., and Jeffrey B. Liebman, 1998, Are CEOs really paid like bureaucrats?, *Quarterly Journal of Economics*, 113, 653–691.

Hall, Brian J., and Kevin J. Murphy, 2002, Stock options for undiversified executives, *J. Account. Econ.*, 33, 3–42.

Harford, Jarrad, 1999, Corporate cash reserves and acquisitions, *Journal of Finance*, 54, 1969–1997.

Harford, Jarrad, Sandy Klasa, and William F. Maxwell, 2014, Refinancing risk and cash holdings, *Journal of Finance*, 69, 975–1012.

Harford, Jarrad, Sattar A. Mansi, and William F. Maxwell, 2008, Corporate governance and firm cash holdings in the US, *Journal of Financial Economics*, 87, 535–555.

Heaton, J. B., 2002, Managerial optimism and corporate finance, *Financial Management*, 31, 33–45.

Hirshleifer, David, 2001, Investor psychology and asset pricing, *Journal of Finance*, 56, 1533–1597.

Kahneman, Daniel, Slovic Paul, and Amos Tversky, eds., 1982, *Judgement under Uncertainty: Heuristics and Biases* (Cambridge University Press).

Keynes, John Maynard, 1936, *The General Theory of Employment, Interest and Money* (McMillan, London).

Kim, Chang-Soo, David C. Mauer, and Ann E. Sherman, 1998, The determinants of corporate liquidity: Theory and evidence, *Journal of Financial and Quantitative Analysis*, 3, 335–359.

Landier, Augustin, and David Thesmar, 2009, Financial contracting with optimistic entrepreneurs, *Rev. Finan. Stud.*, 22, 117–150.

Malmendier, Ulrike, and Geoffrey Tate, 2005, CEO overconfidence and corporate investment, *Journal of Finance*, 60, 2661–2700.

Malmendier, Ulrike, and Geoffrey Tate, 2008, Who makes acquisitions? CEO overconfidence and the market's reaction, *Journal of Financial Economics*, 89, 20–43.

Malmendier, Ulrike, Geoffrey Tate, and Jon Yan, 2011, Overconfidence and early-life experiences: The effect of managerial traits on corporate financial policies, *J. Finance*, 66, 1687–1733.

Opler, Tim, Lee Pinkowitz, René Stulz, and Rohan Williamson, 1999, The determinants and implications of corporate cash holdings, *Journal of Financial Economics*, 52, 3–46.

Russo, J. Edward, and Paul J. H. Schoemaker, 1990, *Decision Traps: The Ten Steps to Brilliant Decision-Making and How to Overcome Them* (Simon & Schuster).

Yang, Baozhong, 2013, Dynamic capital structure with heterogeneous beliefs and market timing, *Journal of Corporate Finance*, 22, 254–277.

Yermack, David, 1995, Do corporations award CEO stock options effectively?, *Journal of Financial Economics*, 39, 237–269.

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Table 1
Summary Statistics: Optimistic CEO Firms vs. Non-Optimistic CEO Firms

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Cash Holdings equals the ratio of cash and short-term investments to net assets. *Log of Cash Holdings* equals the natural logarithm of one plus *Cash Holdings*. *Growth Opportunities* equals the ratio of the market value of assets to book value of *net* assets, where the market value of assets equals the market value of equity plus the book value of total liabilities. Net assets equals the difference between total assets and cash & short-term investments. *Cash Flow* equals the ratio of operating income before depreciation *less* interest expense *less* income taxes *less* common and preferred dividends *to* book value of net assets. *Leverage* equals the ratio of the sum of long-term debt and debt in current liabilities to net assets. *NWC to Assets* equals the ratio of net working capital (net of cash and short-term investments) to net assets. *RD to Assets* equals the ratio of R&D expenditures to net assets. *Capex to Assets* equals the ratio of capital expenditures to net assets; *Acquisitions to Assets* equals the ratio of acquisitions to net assets. *Cash Flow Volatility* equals the standard deviation of the firm's cash flow over the prior ten-year period. *Bond Rating* is an indicator variable that equals one if the firm has a long-term debt rating and zero otherwise. *Stock Ownership* equals the fraction of the company stock owned by the CEO (excluding options) as a fraction of common shares outstanding. *Vested Options* equals the ratio of the CEO's holdings of exercisable options as a fraction of common shares outstanding. *CEO Tenure* is the tenure of the CEO with the firm (in years).

Variable	Optimistic CEOs			Non-Optimistic CEOs			Optimistic vs. Non-Optimistic CEOs	
	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation	*p*-value for Difference (in Means)	*p*-value **for** Difference (in Medians)
Cash Holdings	0.2386	0.0859	0.42	0.1852	0.0699	0.36	0.00	0.00
Growth Opportunities	2.7889	1.9530	2.46	1.9703	1.5631	1.45	0.00	0.00
Cash Flow	0.1161	0.1076	0.12	0.0842	0.0842	0.11	0.00	0.00
Book Value of Assets (in $ millions)	4464.89	1113.53	13240.58	5763.63	1368.40	15750.75	0.00	0.00
Net Sales (in $ millions)	4523.66	1160.25	16381.23	5541.12	1464.64	14480.21	0.00	0.00
Leverage	0.2331	0.2191	0.18	0.2549	0.2471	0.18	0.00	0.00
NWC to Assets	0.0934	0.0884	0.18	0.0961	0.0901	0.19	0.31	0.28
RD to Assets	0.0517	0.0021	0.11	0.0412	0.0031	0.10	0.00	0.00
Capex to Assets	0.0756	0.0551	0.07	0.0596	0.0443	0.05	0.00	0.00
Acquisitions to Assets	0.0386	0.0018	0.08	0.0313	0.0005	0.07	0.00	0.00
Bond Rating	0.5031	1.0000	0.50	0.5614	1.0000	0.50	0.00	0.00
Cash Flow Volatility	0.0840	0.0372	0.17	0.0667	0.0321	0.12	0.00	0.00
Stock Ownership	0.0264	0.0052	0.06	0.0143	0.0022	0.04	0.00	0.00
Vested Options	0.0099	0.0060	0.01	0.0067	0.0038	0.01	0.00	0.00
CEO Tenure (years)	8.4441	7.0000	7.90	5.0183	3.0000	5.94	0.00	0.00
Observations		11257			8701			

Table 2
CEO Optimism and Cash Holdings

This table provides estimates from a regression model, which is estimated on the pooled data over the period 1992-2012. *Cash Holdings* equals the ratio of cash and short-term investments to net assets. *Log of Cash Holdings* equals the natural logarithm of one plus *Cash Holdings*. *Optimism* equals one over all the CEO-years if the CEO held an option that was more than 100% in the money at least once during his/her tenure, and zero otherwise. *Post-Optimism* equals one in all CEO-years following (and including) the first year in which the CEO holds an option that is more than 100% in the money, and zero otherwise. *Growth* equals the ratio of the market value of assets to book value of *net* assets, where the market value of assets equals the market value of equity plus the book value of total liabilities. Net assets equals the difference between total assets and cash & short-term investments. *Cash Flow* equals the ratio of operating income before depreciation *less* interest expense *less* income taxes *less* common and preferred dividends *to* book value of net assets. *Log of Sales* equals the natural logarithm of net sales. *Leverage* equals the ratio of the sum of long-term debt and debt in current liabilities to net assets. *NWC to Assets* equals the ratio of net working capital (net of cash and short-term investments) to net assets. *RD to Assets* equals the ratio of R&D expenditures to net assets. *Capex to Assets* equals the ratio of capital expenditures to net assets. *Acquisitions to Assets* equals the ratio of acquisitions to net assets. *Cash Flow Volatility* equals the standard deviation of the firm's cash flow over the prior ten-year period. *Bond Rating* is an indicator variable that equals one if the firm has a long-term debt rating and zero otherwise. *Stock Ownership* equals the fraction of the company stock owned by the CEO (excluding options) as a fraction of common shares outstanding. *Vested Options* equals the ratio of the CEO's holdings of exercisable options as a fraction of common shares outstanding. All models include firm and year fixed effects and the standard errors are clustered by firm.

	Dependent Variable			
	Cash Holdings (Model 1)	Cash Holdings (Model 2)	Log of Cash Holdings (Model 3)	Log of Cash Holdings (Model 4)
Optimism	-0.0208***		-0.0104***	
	(-3.32)		(-2.92)	
Post-Optimism		-0.0203***		-0.0088***
		(-3.53)		(-2.81)
Growth	0.0609***	0.0618***	0.0325***	0.0328***
	(11.39)	(11.03)	(15.88)	(15.45)
Cash Flow	0.2343***	0.2363***	0.1623***	0.1606***
	(3.17)	(3.00)	(5.71)	(5.35)
Log of Sales	-0.0522***	-0.0493***	-0.0353***	-0.0345***
	(-6.02)	(-5.64)	(-7.42)	(-7.17)
Leverage	0.0774**	0.0826**	0.0443***	0.0475***
	(2.48)	(2.55)	(2.69)	(2.80)
NWC to Assets	-0.2979***	-0.2811***	-0.1471***	-0.1417***
	(-3.75)	(-3.50)	(-4.92)	(-4.67)
RD to Assets	1.5121***	1.5095***	0.6021***	0.6128***
	(7.38)	(7.09)	(8.13)	(7.72)
Capex to Assets	-0.1693**	-0.1639**	-0.0638*	-0.0634*
	(-2.55)	(-2.40)	(-1.92)	(-1.85)
Acquisitions to Assets	-0.2205***	-0.2035***	-0.1527***	-0.1479***
	(-7.56)	(-6.94)	(-11.11)	(-10.61)
Bond Rating	0.0062	0.0043	-0.0005	-0.0016
	(0.63)	(0.43)	(-0.08)	(-0.28)
Cash Flow Volatility	0.0575	0.0608	0.0324	0.0305
	(1.01)	(1.03)	(1.16)	(1.06)
Stock Ownership	-0.1417**	-0.1382**	-0.0796**	-0.0746**
	(-2.29)	(-2.25)	(-2.17)	(-2.01)
Vested Options	-0.1980	-0.0911	-0.3932**	-0.3588*
	(-0.41)	(-0.18)	(-2.16)	(-1.85)
Firm-Year Observations	19877	18808	19877	18808
Adjusted R^2	0.7774	0.7826	0.8265	0.8296

*** Significant at the 0.01 level; ** Significant at the 0.05 level; * Significant at the 0.10 level.

Table 3
CEO Optimism and Change in Cash Holdings

This table provides estimates from a regression model, which is estimated on the pooled data over the period 1992-2012. *Cash Holdings* equals the ratio of cash and short-term investments to net assets. *Log of Cash Holdings* equals the natural logarithm of one plus *Cash Holdings*. *Optimism* equals one over all the CEO-years if the CEO held an option that was more than 100% in the money at least once during his/her tenure, and zero otherwise. *Post-Optimism* equals one in all CEO-years following (and including) the first year in which the CEO holds an option that is more than 100% in the money, and zero otherwise. *Growth* equals the ratio of the market value of assets to book value of *net* assets, where the market value of assets equals the market value of equity plus the book value of total liabilities. Net assets equals the difference between total assets and cash & short-term investments. *Cash Flow* equals the ratio of operating income before depreciation *less* interest expense *less* income taxes *less* common and preferred dividends *to* book value of net assets. *Log of Sales* equals the natural logarithm of net sales. *Leverage* equals the ratio of the sum of long-term debt and debt in current liabilities to net assets. *NWC to Assets* equals the ratio of net working capital (net of cash and short-term investments) to net assets. *RD to Assets* equals the ratio of R&D expenditures to net assets. *Capex to Assets* equals the ratio of capital expenditures to net assets. *Acquisitions to Assets* equals the ratio of acquisitions to net assets. *Cash Flow Volatility* equals the standard deviation of the firm's cash flow over the prior ten-year period. *Bond Rating* is an indicator variable that equals one if the firm has a long-term debt rating and zero otherwise. *Stock Ownership* equals the fraction of the company stock owned by the CEO (excluding options) as a fraction of common shares outstanding. *Vested Options* equals the ratio of the CEO's holdings of exercisable options as a fraction of common shares outstanding. All models include firm and year fixed effects and the standard errors are clustered by firm.

| | Dependent Variable | | | |
	Change in Cash Holdings (Model 1)	Change in Cash Holdings (Model 2)	Change in Log of Cash Holdings (Model 3)	Change in Log of Cash Holdings (Model 4)
Optimism	-0.0204***		-0.0077***	
	(-3.31)		(-2.99)	
Post-Optimism		-0.0202***		-0.0075***
		(-3.56)		(-3.17)
Lagged Cash Holdings	-0.9842***	-0.9857***		
	(-61.90)	(-68.26)		
Lagged Log of Cash Holdings			-0.6596***	-0.6695***
			(-19.50)	(-19.36)
Growth	0.0604***	0.0614***	0.0260***	0.0266***
	(11.35)	(11.01)	(14.08)	(13.74)
Cash Flow	0.2310***	0.2330***	0.1453***	0.1450***
	(3.15)	(2.98)	(6.11)	(5.73)
Log of Sales	-0.0488***	-0.0460***	-0.0200***	-0.0196***
	(-5.86)	(-5.47)	(-5.36)	(-5.11)
Leverage	0.0797***	0.0847***	0.0673***	0.0698***
	(2.57)	(2.64)	(5.12)	(5.08)
NWC to Assets	-0.2978***	-0.2814***	-0.1376***	-0.1349***
	(-3.76)	(-3.51)	(-5.46)	(-5.21)
RD to Assets	1.5015***	1.4991***	0.4922***	0.4983***
	(7.34)	(7.06)	(7.02)	(6.68)
Capex to Assets	-0.1804***	-0.1742**	-0.1779***	-0.1743***
	(-2.70)	(-2.54)	(-5.75)	(-5.47)
Acquisitions to Assets	-0.2449***	-0.2261***	-0.2957***	-0.2870***
	(-8.05)	(-7.53)	(-17.67)	(-17.34)
Bond Rating	0.0070	0.0051	0.0019	0.0009
	(0.71)	(0.51)	(0.45)	(0.21)
Cash Flow Volatility	0.0529	0.0569	-0.0107	-0.0083
	(0.94)	(0.97)	(-0.46)	(-0.34)
Stock Ownership	-0.1408**	-0.1373**	-0.0688**	-0.0628**
	(-2.31)	(-2.27)	(-2.43)	(-2.23)
Vested Options	-0.1784	-0.0709	-0.2626*	-0.2223
	(-0.37)	(-0.14)	(-1.80)	(-1.44)
Firm-Year Observations	19872	18803	19872	18803
Adjusted R^2	0.9688	0.9716	0.5569	0.5687

*** Significant at the 0.01 level; ** Significant at the 0.05 level; * Significant at the 0.10 level.

Table 4
CEO Optimism, Cash Holdings, and Change in Cash Holdings: Alternative Sample and Optimism Measure

This table provides estimates from a regression model, which is estimated on the pooled data over the period 1980-1994. *Cash Holdings* equals the ratio of cash and short-term investments to net assets. *Log of Cash Holdings* equals the natural logarithm of one plus *Cash Holdings*. *Longholder* is a binary variable that equals 1 if the CEO held an option package until the last year before expiration at least once during his/her tenure *and* the option package held was at least 40% in the money entering its final year. *Growth* equals the ratio of the market value of assets to book value of *net* assets, where the market value of assets equals the market value of equity plus the book value of total liabilities. Net assets equals the difference between total assets and cash & short-term investments. *Cash Flow* equals the ratio of operating income before depreciation *less* interest expense *less* income taxes *less* common and preferred dividends *to* book value of net assets. *Log of Sales* equals the natural logarithm of net sales. *Leverage* equals the ratio of the sum of long-term debt and debt in current liabilities to net assets. *NWC to Assets* equals the ratio of net working capital (net of cash and short-term investments) to net assets. *RD to Assets* equals the ratio of R&D expenditures to net assets. *Capex to Assets* equals the ratio of capital expenditures to net assets. *Acquisitions to Assets* equals the ratio of acquisitions to net assets. *Cash Flow Volatility* equals the standard deviation of the firm's cash flow over the prior ten-year period. *Bond Rating* is an indicator variable that equals one if the firm has a long-term debt rating and zero otherwise. *Stock Ownership* equals the fraction of the company stock owned by the CEO (excluding options) as a fraction of common shares outstanding. *Vested Options* equals the ratio of the CEO's holdings of exercisable options as a fraction of common shares outstanding. All models include firm and year fixed effects and the standard errors are clustered by firm.

	Dependent Variable			
	Cash Holdings (Model 1)	Log of Cash Holdings (Model 2)	Change in Cash Holdings (Model 3)	Change in Log of Cash Holdings (Model 4)
Longholder	-0.0265**	-0.0210*	-0.0213**	-0.0156**
	(-2.03)	(-1.92)	(-2.11)	(-1.97)
Lagged Cash Holdings			-0.6337***	
			(-11.06)	
Lagged Log of Cash Holdings				-0.5758***
				(-13.41)
Growth	0.0658***	0.0492***	0.0534***	0.0377***
	(5.34)	(5.62)	(4.65)	(4.83)
Cash Flow	0.0940	0.0940	0.2161	0.1807*
	(0.55)	(0.80)	(1.44)	(1.82)
Log of Sales	-0.0165	-0.0145	-0.0124	-0.0112*
	(-1.31)	(-1.50)	(-1.29)	(-1.66)
Leverage	0.0275	0.0068	0.0794	0.0527
	(0.54)	(0.18)	(1.63)	(1.52)
NWC to Assets	-0.0631	-0.0647*	-0.0158	-0.0543*
	(-1.26)	(-1.65)	(-1.20)	(-1.69)
RD to Assets	0.4562	0.3557	0.4278	0.3136
	(1.03)	(1.08)	(1.12)	(1.12)
Capex to Assets	-0.1631**	-0.1385***	-0.2728***	-0.2412***
	(-2.57)	(-2.61)	(-4.29)	(-4.80)
Acquisitions to Assets	-0.1094***	-0.0860***	-0.2091***	-0.1741***
	(-3.39)	(-3.52)	(-5.06)	(-5.35)
Bond Rating	0.0122	0.0111	0.0119	0.0100*
	(1.04)	(1.29)	(1.40)	(1.66)
Cash Flow Volatility	0.9172**	0.5199***	1.091**	0.5192**
	(2.58)	(2.74)	(2.06)	(2.02)
Stock Ownership	-0.1425	-0.1117	-0.1042	-0.0797
	(-1.23)	(-1.20)	(-1.26)	(-1.25)
Vested Options	0.0416*	0.0329*	0.0354*	0.0229*
	(1.82)	(1.93)	(1.79)	(1.73)
Firm-Year Observations	2324	2324	2324	2324
Adjusted R^2	0.6873	0.6801	0.4869	0.4175

*** Significant at the 0.01 level; ** Significant at the 0.05 level; * Significant at the 0.10 level.

Table 5
CEO Optimism and Cash Holdings: Interactive Effects

This table provides estimates from a regression model, which is estimated on the pooled data over the period 1992-2012. *Cash Holdings* equals the ratio of cash and short-term investments to net assets. *Optimism* equals one over all the CEO-years if the CEO held an option that was more than 100% in the money at least once during his/her tenure, and zero otherwise. *Post-Optimism* equals one in all CEO-years following (and including) the first year in which the CEO holds an option that is more than 100% in the money, and zero otherwise. *Growth* equals the ratio of the market value of assets to book value of *net* assets, where the market value of assets equals the market value of equity plus the book value of total liabilities. Net assets equals the difference between total assets and cash & short-term investments. *Cash Flow* equals the ratio of operating income before depreciation *less* interest expense *less* income taxes *less* common and preferred dividends *to* book value of net assets. *Log of Sales* equals the natural logarithm of net sales. *Leverage* equals the ratio of the sum of long-term debt and debt in current liabilities to net assets. *NWC to Assets* equals the ratio of net working capital (net of cash and short-term investments) to net assets. *RD to Assets* equals the ratio of R&D expenditures to net assets. *Capex to Assets* equals the ratio of capital expenditures to net assets. *Investment Spending* is the sum of *RD to Assets* and *Capex to Assets*. *Acquisitions to Assets* equals the ratio of acquisitions to net assets. *Cash Flow Volatility* equals the standard deviation of the firm's cash flow over the prior ten-year period. *Bond Rating* is an indicator variable that equals one if the firm has a long-term debt rating and zero otherwise. *Stock Ownership* equals the fraction of the company stock owned by the CEO (excluding options) as a fraction of common shares outstanding. *Vested Options* equals the ratio of the CEO's holdings of exercisable options as a fraction of common shares outstanding. All models include firm and year fixed effects and the standard errors are clustered by firm.

	Dependent Variable			
	Cash Holdings (Model 1)	Cash Holdings (Model 2)	Cash Holdings (Model 3)	Cash Holdings (Model 4)
Optimism	0.0407*	-0.0046	-0.0177	-0.0174***
	(1.94)	(-0.40)	(-1.26)	(-2.72)
Optimism * Growth	-0.0299***			
	(-2.79)			
Optimism * Cash Flow		-0.1709		
		(-1.56)		
Optimism * Investment Spending			-0.0742	
			(-0.52)	
Optimism * Acquisitions				-0.1074*
				(-1.90)
Growth	0.0873***	0.0616***	0.0649***	0.0608***
	(7.83)	(11.16)	(11.76)	(11.39)
Cash Flow	0.2198***	0.3319***	0.1268*	0.2346***
	(3.02)	(3.91)	(1.84)	(3.18)
Log of Sales	-0.0526***	-0.0524***	-0.0567***	-0.0522***
	(-6.12)	(-6.03)	(-6.34)	(-6.02)
Leverage	0.0803***	0.0756**	0.0862***	0.0774**
	(2.59)	(2.43)	(2.72)	(2.48)
NWC to Assets	-0.2763***	-0.3006***	-0.3165***	-0.2985***
	(-3.38)	(-3.82)	(-3.93)	(-3.77)
RD to Assets	1.4800***	1.5056***		1.5141***
	(7.33)	(7.33)		(7.38)
Capex to Assets	-0.1697**	-0.1667**		-0.1706***
	(-2.56)	(-2.50)		(-2.57)
Investment Spending			0.8147***	
			(6.16)	
Acquisitions to Assets	-0.2184***	-0.2213***	-0.1813***	-0.1532***
	(-7.56)	(-7.60)	(-6.45)	(-3.09)
Bond Rating	0.0078	0.0061	0.0003	0.0063
	(0.79)	(0.62)	(0.03)	(0.63)
Cash Flow Volatility	0.0525	0.0531	0.0585	0.0569
	(0.93)	(0.92)	(1.02)	(1.00)
Stock Ownership	-0.1501**	-0.1398**	-0.1846***	-0.1410**
	(-2.45)	(-2.29)	(-2.71)	(-2.28)
Vested Options	-0.1400	-0.2113	0.0049	-0.1854
	(-0.29)	(-0.44)	(0.01)	(-0.38)
Firm-Year Observations	19877	19877	19877	19877
Adjusted R^2	0.7794	0.7778	0.7632	0.7775

*** Significant at the 0.01 level; ** Significant at the 0.05 level; * Significant at the 0.10 level.

Table 6
Effect of CEO Optimism on the Cash-Flow Sensitivity of Cash

This table provides estimates from a (firm) fixed-effect IV estimation of the regression model of the cash-flow sensitivity of cash, which is estimated on the pooled data over the period 1992-2012 for the main sample and over 1980-1994 for the alternative sample. *Cash Holdings* equals the ratio of cash and short-term investments to net assets. *Optimism* equals one over all the CEO-years if the CEO held an option that was more than 100% in the money at least once during his/her tenure, and zero otherwise. *Post-Optimism* equals one in all CEO-years following (and including) the first year in which the CEO holds an option that is more than 100% in the money, and zero otherwise. *Longholder* is a binary variable that equals 1 if the CEO held an option package until the last year before expiration at least once during his/her tenure *and* the option package held was at least 40% in the money entering its final year. *Growth Opportunities* equals the ratio of the market value of assets to book value of *net* assets, where the market value of assets equals the market value of equity plus the book value of total liabilities. Net assets equals the difference between total assets and cash & short-term investments. *Cash Flow* equals the ratio of operating income before depreciation *less* interest expense *less* income taxes *less* common and preferred dividends *to* book value of net assets. *Capex to Assets* equals the ratio of capital expenditures to net assets. *Acquisitions to Assets* equals the ratio of acquisitions to net assets. *Change in NWC* equals the change in net working capital (net of cash and short-term investments) over the fiscal year divided by net assets. *Change in Short-Term Debt* equals the change in debt in current liabilities over the fiscal year divided by net assets. All models include year fixed effects and the standard errors are based on the conventionally-derived variance estimator for generalized least-squares regression.

	Dependent Variable		
	Change in Cash Holdings (Model 1)	Change in Cash Holdings (Model 2)	Change in Cash Holdings (Model 3)
Optimism	0.0266***		
	(2.56)		
Post-Optimism		0.0249***	
		(3.04)	
Longholder			0.0146
			(0.74)
Cash Flow	0.6029***	0.5415***	0.5663***
	(11.56)	(13.90)	(6.26)
*Cash Flow * Optimism*	-0.3009***		
	(-5.10)		
*Cash Flow * Post-Optimism*		-0.2085***	
		(-4.65)	
*Cash Flow * Longholder*			-0.3241**
			(-2.05)
Growth Opportunities	0.0325***	0.0284***	0.0428***
	(8.92)	(9.53)	(6.14)
Size	0.0594***	0.0142	-0.0269***
	(3.74)	(1.24)	(-2.56)
Capex to Assets	-1.2014	-1.6480***	-0.8165*
	(-1.53)	(-2.56)	(-1.84)
Acquisitions to Assets	-1.6989***	-1.9354***	0.0525
	(-4.28)	(-6.33)	(0.13)
Change in NWC	-1.5241***	-1.5093***	-0.8787***
	(-12.17)	(-13.82)	(-5.52)
Change in Short-Term Debt	-0.9826***	-0.9240***	-0.8593***
	(-6.61)	(-7.40)	(-5.22)
Firm-Year Observations	19106	18077	2253
χ^2	732.20***	1141.74***	225.53***

*** Significant at the 0.01 level; ** Significant at the 0.05 level; * Significant at the 0.10 level.