CEO Overconfidence and Corporate Investment[*]

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Abstract

We explore behavioral explanations for sub-optimal corporate investment decisions. Focusing on the sensitivity of investment to cash flow, we argue that personal characteristics of chief executive officers, in particular overconfidence, can account for this widespread and persistent investment distortion. Overconfident CEOs overestimate the quality of their investment projects and view external finance as unduly costly. As a result, they invest more when they have internal funds at their disposal. We test the overconfidence hypothesis, using data on personal portfolio and corporate investment decisions of CEOs in Forbes 500 companies. We classify CEOs as overconfident if they repeatedly fail to exercise options that are highly in the money, or if they habitually acquire stock of their own company. The main result is that investment is significantly more responsive to cash flow if the CEO displays overconfidence. In addition, we identify personal characteristics other than overconfidence (education, employment background, cohort, military service, and status in the company) that strongly affect the correlation between investment and cash flow.

1 Introduction

The analysis of corporate investment decisions has been the focus of much of the finance literature of the last forty years.[1] Two main explanations for distortions in investment policies have emerged. Jensen and Meckling (1976) point to the misalignment of managerial incentives and shareholder interests. According to this view, managers overinvest to reap private benefits such as "perks," large empires, and entrenchment.[2] Myers and Majluf (1984), instead, propose asymmetric information between corporate insiders and the capital market as an explanation for investment distortions. Informational asymmetries cause good firms to be undervalued by the capital market, and bias managers towards debt financing and underinvestment.[3]

In contrast to the world of Modigliani and Miller (1958), both agency problems and asymmetric information imply that investment depends on capital structure. According to both theories the level of investment should be sensitive to the level of cash flow in the firm. Under the agency view, investment increases in internal funds because the external capital market limits the extent to which managers can pursue self-interested investment. Thus, an influx of cash flow induces the manager to invest more and increases investment distortions. Under asymmetric information, the managers themselves (who act in the interest of shareholders) restrict external financing in order to avoid diluting current shares. In this case, cash flow increases investment, but reduces the distortion.

A large volume of empirical literature, spawned by Fazzari, Hubbard and Petersen's 1988 paper (FHP), confirms the existence and robustness of investment-cash flow sensitivity after controlling for investment opportunities. Most of this literature relates investment-cash flow sensitivity to imperfections in the capital market.[4] In addition, the sensitivity of investment to cash flow appears to be more pronounced when managers have a large ownership stake in the firm–consistent with the asymmetric information story, but not the agency story (in its simplest form).[5] Kaplan and Zingales (1997, 2000), however, call this interpretation of investment-cash

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[1] Harris and Raviv (1991), Shleifer and Vishny (1997), Hubbard (1998), Zingales (2000), Stein (forthcoming) and Hart (forthcoming) provide excellent surveys.

[2] Berle and Means (1932), Baumol (1959), and Williamson (1964) were among the earliest to examine this conflict of interests. Jensen (1986) analyzes empire building, Shleifer and Vishny (1989) managerial entrenchment.

[3] Akerlof (1970) pioneered the adverse selection literature, showing the impact of informational asymmetry on quality. Other applications to equity and debt markets include Stiglitz and Weiss (1981); Greenwald, Stiglitz, and Weiss (1984); Myers (1984).

[4] Proxies for no or only minor financing constraints are, for example, high dividend payments (FHP; Hubbard, Kashyap, and Whited, 1995); participation in the public debt market (Gilchrist and Himmelberg, 1995); business group affiliation (Hoshi, Kashyap, Scharfstein, 1991; Cho, 1996; Shin and Park, 1999); or low surtax margins (Calomiris and Hubbard, 1995).

[5] See Hadlock (1998). The results of Morck, Shleifer, and Vishny (1988) suggest that the agency explanation

flow sensitivity into question. They construct more direct measures of financing constraints and show, using the same sample of firms as FHP, that financially constrained firms actually display a lower sensitivity of investment to cash flow than unconstrained firms.[6]

In this paper, we propose an alternative explanation for investment-cash flow sensitivity and non-optimal investment behavior. Rather than focusing on firm-level characteristics, we relate corporate investment decisions to personal characteristics of the top decision-maker inside the firm. We argue that one important explanation for the link between investment levels and cash flow levels is the tension between the overconfidence of the CEO and market valuation. An overconfident CEO systematically overestimates the return to his investment projects. If he has sufficient internal funds for investment and is not disciplined by the capital market or corporate governance mechanisms, he might not invest optimally, even in the absence of asymmetric information and agency problems. If he does not have sufficient internal funds, however, he will be reluctant to issue new equity because he perceivea the stock of his company to be undervalued by the market. As a result, overconfident managers curb their investment whenever they do not have sufficient internal funds at their disposal. Free cash flow provides an opportunity to invest closer to the desired level. Thus, the investment of overconfident managers responds to the amount of cash flow available inside the firm.

Heaton (2001) first showed that the assumption of overconfidence provides a unifying framework for managerial incentives to overinvest and (perceived) financing constraints. We expand on this insight in two ways. First, we model the impact of overconfidence on the sensitivity of the *level* of investment to capital structure. Then, we empirically test the predictions of the model. We show that the level of investment depends on the level of cash flow if managers display overconfidence about the quality of their investment projects.

We use a sample of 477 firms from Forbes 500 lists for the years 1980 to 1994 to test this prediction empirically.[7] The most important feature of this data set for our purpose is the time-series information it contains on the option and stock holdings of the CEOs. We use the data on the CEOs' personal portfolio decisions to construct several measures of overconfidence. By matching the CEO observations with firm-level data from CRSP and COMPUSTAT, we can relate the behavior of CEOs on their private accounts to decisions on their firms' corporate accounts and test whether overconfident CEOs exhibit higher investment cash flow sensitivity.

holds at low and at rather high levels of managerial ownership, but not for an intermediate range.

[6]Similarly, asymmetric information does not appear to be a plausible explanation for the "socialistic" allocation of internal funds from a cash wind fall within firms or the poor quality of projects financed with those funds (Lamont (1997) and Blanchard, López-de-Silanes, and Shleifer (1994)).

[7]The data was provided to us by Brian Hall and David Yermack. For details see Hall and Liebman (1998) and Yermack (1995).

Our measures of overconfidence build upon previous literature in corporate finance on the optimal timing of option exercises for underdiversified, risk-averse executives (Carpenter, 1998; Hall and Murphy, forthcoming).[8] Unlike outside investors, CEOs cannot trade their options or hedge the risk by short-selling stock of the company. In addition, their human capital and reputation are intimately linked to the firm's performance. Thus, a CEO is likely to be overexposed to his firm's idiosyncratic risk and, in most cases, should not hold options on company stock until expiration. Though the optimal schedule for early exercise depends on individual factors such as wealth, degree of risk-aversion and diversification, any risk-averse CEO should exercise his options early given a sufficiently high stock price.

The previous literature provides us with a benchmark for the minimum percentage in the money at which a CEO should exercise his options, for a given year after the vesting period. Our first measure of overconfidence compares the benchmark predictions to the actual exercise behavior of a CEO. If a CEO persistently exercises options later than suggested by the benchmark, we infer that this CEO is overconfident about his ability to keep the company's stock price rising and wants to profit from expected stock increases by holding the options. We find that among those CEOs who hold their options the average (and median) CEO does not make profit. This is consistent with the overconfidence hypothesis and in conflict with an alternative explanations of "late exercise" based on inside information.

In the second step of the analysis, we show that investment-cash flow sensitivity is significantly higher for "late exercisers" than for "rational exercisers." As predicted by the model, overconfident CEOs invest more whenever they have more cash at hand.

Other measures of overconfidence based on late option exercise and habitual stock purchases confirm these results. CEOs who, despite their underdiversification, do not reduce their exposure to company-specific risk display consistently higher investment-cash flow sensitivity.

We also provide complementary evidence that CEO characteristics other than overconfidence have explanatory power for corporate decision-making. Using additional data on the personal, educational and employment background of CEOs, which we collected from *Dun and Bradstreet* and *Who's Who in Finance and Industry*, we show that CEOs with an engineering or scientific background display higher investment-cash flow sensitivity while CEOs with a finance background exhibit lower sensitivity. Furthermore, the sensitivity is higher for CEOs born in the 1920s, CEOs with prior military service, and CEOs who tend to accumulate titles (president, chairman of the board). These findings confirm the view that not only firm-level, but also personal characteristics are important for a better understanding of investment-cash flow

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[8]Meulbroek (2001) provides a measure of the costs of equity-linked compensation, if executives are underdiversified.

sensitivity.[9]

One possible caveat to these results is the issue of endogeneity. Personal characteristics like employment background or birth cohort are directly observable by the board and may be a selection criterion for the choice of CEO. It is also conceivable that boards take overconfidence into account in choosing a CEO, even though overconfidence is much harder for the board to identify ex ante than the other personal characteristics, at least in our sample, since the majority of CEOs did not have prior experience as CEOs.

We are able to alleviate some endogeneity concerns with additional controls. We show that our results are not driven by industry effects or tangible firm characteristics like size and degree of financial constraint. Most importantly, endogeneity does not affect our main conclusion. If the board chooses a CEO because of his overconfidence, it should be aware of the "dark sides" of this personality feature (such as distorted investment behavior) and take steps to explicitly address them.

Traditional theories, which link investment-cash flow sensitivity to capital market imperfections or misaligned incentives, propose timely disclosure of corporate accounts or high-powered incentives as potential remedies. While these measures are undoubtedly crucial to overcome certain distortions in managerial decision-making, our findings suggest that they may not suffice to address managerial discretion. A manager whose incentives are perfectly aligned and who does not face any informational asymmetries may still invest suboptimally if he is overconfident. At the same time, his overconfidences leads him to believe that he is acting in the best interest of the shareholders. In this case, refined corporate governance structures, involving for instance a more active board of directors or constraints on capital structure and the use of internal funds, may be more appropriate for alleviating the deviation from first-best levels of investment.

Overall, our results suggest that measurable personal characteristics of chief executives are an important key to a better understanding of corporate decision-making. Overconfidence, in particular, seems to predict investment behavior in situations of managerial discretion. These findings have important implications for CEO selection and organizational design.

Related Literature

A large psychology literature suggests that people exhibit overconfidence in individual decision-making. One well-established stylized fact is the "better than average" effect: when people compare their skills to the skills of their peers, they tend to overstate their acumen relative to

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[9]See also Bertrand and Schoar (2001) on the impact of managerial style on firm policy.

the average (Larwood and Whittaker, 1977; Svenson, 1981; Alicke, 1985). Overconfidence, in the form of the "better than average effect," also affects the attribution of causality. Because individuals expect their behavior to produce success, they are more likely to attribute outcomes to their actions (and not to luck) when they suceed rather than when they fail.[10] The self-serving attribution of outcomes, in turn, reinforces individual overconfidence.

This upward bias in the assessment of future outcomes is sometimes referred to as "overoptimism" rather than "overconfidence." We follow the literature on self-serving attribution and choose the label "overconfidence" in order to distinguish the overestimation of one's own abilities (such as IQ or driving skill) and of outcomes relating to ones own personal situation from the general overestimation of exogenous outcomes.

CEOs are particularly likely to display overconfidence for three reasons. First, according to the psychology literature individuals are more overconfident about outcomes that they believe are under their control (Weinstein, 1980). A CEO who has selected an investment project is likely to feel the illusion of control over its outcome and to underestimate the likelihood of a bad outcome (March and Shapira 1987; Langer, 1975). Second, individuals are especially overconfident about outcomes to which they are highly committed (Weinstein, 1980). The typical compensation contract of a CEO ties his personal wealth to the company's stock price and, hence, to the outcomes of corporate investment decisions. This commitment is heightened since the CEO's reputational capital is also sensitive to his firm's performance. Third, overconfidence is likely to be strongest when the reference point is abstract (Alicke, Klotz, Breitenbecher, Yurak, et al., 1995). For a CEO who brings a portfolio of projects to the capital market, the relevant benchmark is the average portfolio of projects among all entities that seek outside financing–a quantity about which the CEO is unlikely to have concrete information. Indeed, psychologists have found that executives are particularly prone to display overconfidence, both in terms of the "better-than-average effect" and in terms of "narrow confidence intervals" (Larwood and Whittaker, 1977; Kid, 1970; Moore, 1977).

Given the psychological evidence, overconfidence has received surprisingly little attention in the corporate finance literature.[11] There are a few notable exceptions. Roll (1986) advanced the idea that in corporate takeovers the overconfidence of individual decision-makers often results in bidding firms paying too much for their targets. Goel and Thakor (2000), in contrast

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[10]Miller and Ross (1975) provide a critical review of the abundant psychology literature on self-serving biases. Babcock an Loewenstein (1997) relate the "above average" effect to the literature on self-serving biases and analyse the effects on bargaining. Gervais and Odean (2001) apply self-serving attribution to trading behavior.

[11]The asset pricing literature has instead been particularly receptive to the notion of overconfidence among private investors and traders. Examples include Odean (1998); Daniel, Hirshleifer, and Subrahmanyam (1998) and (2001); Barber and Odean (2000); Scheinkman and Xiong (2001).

to Roll and Heaton, point out that overconfidence can be value-increasing, when it takes the form of misperception of risk. Specifically, a risk averse manager who correctly perceives the risk of his projects is likely to invest too conservatively in the eyes of fully diversified shareholders, whereas an overconfident manager will be willing to assume greater risks.[12] The overconfident manager is also more likely to succeed when pitted against other managers in a CEO succession tournament (as in Lazear and Rosen, 1981) given his willingness to bear higher risks at any stage. Goel and Thakor's point, that overconfidence may not always be detrimental to firm performance, provides an important caution against equating overconfidence and value-reduction and further justification for focusing on investment decisions in the presence of free cash flow. Suppose, for instance, that an overconfident CEO, because of his strong conviction in the success of his projects, is quite adept at motivating the workers around him. His "cheerleading" may in fact be an asset to the corporation, as long as there is an effective board or a rational capital market to prevent him from financing negative net present value projects.[13] The negative effects of overconfidence, however, will manifest themselves when the CEO's actions are less constrained, such as determining the uses of free cash flow.

Empirical evidence for overconfidence in the economics literature is provided by Camerer and Lovallo (1999). They present an experiment in which players must choose whether to enter a competitive market where their winnings will be determined in part by performance on a short quiz. They find that subjects enter the market too often, given the self-selection of the competing subjects, and display overconfidence about their future performance. While Camerer and Lovallo find evidence of overconfidence in a controlled experiment, our paper is among the first to provide evidence of overconfidence in economic field data.

The paper is organized as follows. In Section 2 we present a simple model that generates the prediction that managerial overconfidence leads to positive investment-cash flow sensitivity. In Section 3 we introduce the data used in our analysis. Section 4 describes our empirical strategy, provides evidence that overconfidence can explain the sensitivity of investment to cash flow and discusses alternative explanations of our findings. Section 5 provides evidence that CEO overconfidence matters more in equity-dependent firms. In Section 6, we present broader evidence on the impact of personal characteristics on the sensitivity of investment to

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[12]Bernardo and Welch (2001) also develop a model in which managerial overconfidence persists in equilibrium. Overconfidence reduces the tendency to herd and facilitates the revelation of private information. Heifetz and Spiegel (2001) show under which conditions overconfident individuals end up outnumbering unbiased individuals in the evolutionary selection process. The idea that a biased objective function may confer advantages in the interaction with other (unbiased) agents goes back at least to Schelling (1960).

[13]Van den Steen (2001) models a setting in which the board of directors selects a CEO with "strong beliefs" for exactly this reason.

cash flow. Section 7 concludes and provides some broad directions for future research.

2   Theory

2.1   Setting

We propose a simple model that demonstrates the effect of managerial overconfidence on corporate investment in an efficient capital market. Our goal is to demonstrate the distortionary power of overconfidence apart from the informational asymmetries that lead to financing constraints, and hence sensitivity of investment to cash flow, in traditional models. Similarly, we rule out any agency problem between the owners and the management of the firm and assume that the manager maximizes shareholder value.[14] The only friction in our model comes from the manager's inflated perception of the firm's investment opportunities.

We analyze a simple three-period model. Consider a firm with existing assets A and s shares outstanding. At time 0, the return function $R(\cdot)$ is drawn from a distribution F, which is known to the CEO. If the CEO is overconfident, he may perceive the quality of his (potential) investment projects as "better than average" and bias $R(\cdot)$ upwards. At time 1, the level of cash flow C is realized and the CEO decides how much to invest. Investment I leads to returns $R(I)$ at time 2.[15] We make the usual assumptions on the slope and curvature of R, namely $R' > 0$ and $R'' < 0$, where R is defined on $[0, \infty)$. The interest rate is normalized to be zero.

We also assume that the firm has limited debt capacity.[16] Thus, a firm with low cash flow must eventually either issue equity or severely restrict its investment. We first consider the investment and financing decisions of CEOs who have exhausted their debt capacity and must choose between equity and internal funds to finance their investment. We will later consider the implications of untapped debt capacity.

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[14]A manager who is not self-interested does not necessarily act in the interest of current shareholders. Rather than maximizing shareholder value, efficient investment implies maximizing the total value of the firm (see Hart, 1993 and *forthcoming*). Conforming with the previous literature, we assume that the manager maximizes current shareholder value. Note, though, that in the case of overconfident managers it is not clear whether value maximization leads to more efficient outcomes than the maximization of current shareholder value. Indeed, the managers and shareholders will not agree on the value-maximizing course of action even without managerial self-interest .

[15]To allow for uncertainty about future returns, we can define $R(\cdot)$ to be stochastic rather than deterministic. Substituting $R(\cdot)$ with $\mathbb{E}R(\cdot)$ does not alter our results.

[16]Limited debt-capacity can be endogenized in a model with bankruptcy costs (such as difficulty in accessing future financing); cf. Bolton and Scharfstein, 1990.

2.2 Investment Decision of a Rational CEO

At time 1 the CEO chooses the level of investment $I \in [0, \infty)$ and a means of financing. Suppose the CEO has sufficient internal funds to finance all desired investment projects. Then, he maximizes $A + C + R(I) - I$ and invests at the first best level, where $R'(I) = 1$. This condition defines a unique, interior solution for the optimal level of investment I^* as long as $R'(I) > 1$ for some I.

Suppose, instead, that the CEO cannot finance all desired investment internally. Whenever the constraint of limited debt capacity is binding, the CEO must finance $I - C$ by issuing new equity s'. Since the capital market is frictionless, a CEO who correctly perceives $R(\cdot)$, is indifferent between financing investment out of C or issuing new shares and will not alter the investment level. Formally, we assume, w.l.o.g., that the CEO first expends the full amount of internal funds and raises the remaining financing for investment by issuing new equity. Then, the number of new shares s' that the CEO must issue satisfies the constraint $\frac{s'}{s+s'}(A + R(I)) = I - C$. That is, new shareholders demand an equity stake equal in value to the amount of capital they provide to the firm. The CEO maximizes shareholder value subject to the financing constraint, or

$$\max_{I} \quad \frac{A + R(I)}{s + s'}$$

$$\text{s.t.} \quad s'\frac{(A + R(I))}{s + s'} = I - C$$

This problem has the first-order condition $R'(I) = 1$.

Not surprisingly, the rational CEO invests at the first-best level, independent of the availability of internal funds. Since the CEO equates the marginal return on investment with the social marginal cost of additional investment, 1, the optimal level of investment is not sensitive to cash flow.

2.3 Investment Decision of an Overconfident CEO

An overconfident CEO, instead, perceives a wedge between external and internal finance. We consider the case of a CEO who overestimates the returns to his projects by percentage Δ. That is, for all levels of investment I he perceives the future return to be equal to $\widehat{R}(I) = R(I) \cdot (1 + \Delta)$.

We consider first the decision of a CEO with sufficiently high cash flow to finance all desired

investment. Here, the CEO maximizes $A + C + R(I) \cdot (1 + \Delta) - I$, so the desired level of investment, which we denote $\widehat{I}$, solves $R'(\widehat{I})(1+\Delta) = 1$. Note that $\widehat{I}$ exceeds the first best. So, given sufficient cash flow, an overconfident CEO will overinvest relative to the first best level.

Now, suppose that the CEO cannot finance all desired investment internally, i.e. $C < \widehat{I}$. As before, we assume that the market assesses the value of the firm's projects correctly. So, the overconfident CEO faces the same financing constraint as the rational CEO. To the overconfident CEO, however, the market is understating the present value of the returns to his investment projects.

As a consequence of this misperception, the CEO always invests all of C before issuing new equity. To find the optimal level of investment, he solves the following program:

$$\max_{I} \quad \frac{A + R(I)(1 + \Delta)}{s + s'}$$

$$\text{s.t. } s'\frac{A + R(I)}{s + s'} = I - C \tag{1}$$

The first order condition of this program is:

$$R'(I) = \frac{(A + R(I))(A + R(I) + \Delta R(I))}{(A + R(I))(A + R(I) + \Delta R(I)) + \Delta A(A + R(I) - (I - C))}$$

In order for the CEO to access the equity market at all, we must have $A + R(I) > (I - C)$. Thus, the right hand side of the first order condition is smaller than 1 and the overconfident CEO always overinvests relative to the first best[17]. The perceived cost of external finance curtails the investment of an overconfident CEO, but it cannot fully offset his inflated view of the firm's investment opportunities.

Since we cannot empirically identify the first best level of investment, however, our real concern is the direction of the dependence of investment on cash flow.

Proposition 1 *In a frictionless capital market, the level of investment I is sensitive to the amount of cash flow C, if and only if the CEO is overconfident ($\Delta > 0$). Further, investment is strictly increasing in C for $C \in [0, \widehat{I})$.*

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[17]The conclusion that the overconfident CEO always overinvests is special to this framework. As noted in the introduction, Heaton (1998) shows that overconfidence can lead to both underinvestment and overinvestment. If we assumed, for example, an additive form of overconfidence, i.e. the CEO perceives returns as $R(I) + \Delta$, then we would expect underinvestment relative to the first best for the cash-constrained overconfident CEO.

PROOF OF PROPOSITION 1. Suppose I^* solves (1). We showed in Section 2.2 that I^* does not depend on C if $\Delta = 0$. So, consider $\Delta > 0$. Suppose, in addition, that $\widehat{I} > C$. Then, (1) reduces to $\max_{I}(1 + \frac{R(I)}{A+R(I)}\Delta)(A + R(I) - I + C)$. Using the implicit-function theorem, we find

$$\frac{dI}{dC} = -\frac{\frac{AR'(I)}{(A+R(I))^2}}{\frac{-2A(R'(I))^2(A+R(I)+C-I)+(A+R(I))AR''(I)(C-I)}{(A+R(I))^3} + R''(I) + \frac{R''(I)}{\Delta}} \qquad (2)$$

The denominator of this expression is the second derivative of the objective function; thus, it is negative at an interior maximum. Then, $\frac{dI}{dC} > 0$. Suppose now that $\widehat{I} \leq C$; then $I^* = \widehat{I}$ and $\frac{dI}{dC} = 0$. Hence the optimal investment level I^* depends on C iff $c > 0$ and I^* strictly increases in C over $C \in [0, \widehat{I})$ for $\Delta > 0$. **Q.E.D.**

To summarize, whenever the overconfident CEO has to rely on equity financing, he reduces his level of investment. Cash flow allows him to mitigate the effect of perceived distortions in the capital market on his investment behavior and to raise investment closer to his desired level. Positive investment-cash flow sensitivity thus distinguishes an overconfident from a non-overconfident CEO.

It is noteworthy that the distinction between different degrees of overconfidence is less straightforward. Whether investment-cash flow sensitivity increases in overconfidence depends on the specification of the return function and, more generally, of the overconfidence model.[18] Therefore, it is preferable empirically to compare the investment behavior of "overconfident" versus "non-overconfident" CEOs, rather than attempting to construct a continuous measure of overconfidence. Even taking this approach, however, measurement error might weaken or hide the difference between investment-cash flow sensitivity in the overconfident and non-overconfident groups if the relationship is not monotonic. Therefore, the success of the empirical analysis depends on the precision of our measure of overconfidence. As long as $\frac{dI}{dC}$ is continuous in Δ, Proposition (1) implies that it will be increasing in some neighborhood around $\Delta = 0$. We must be sure that our criteria for overconfidence do not require such a high level of overconfidence that this entire neighborhood of Δ values is likely to fall into the non-overconfident category. To some extent, a positive and significant empirical relationship between our overconfidence measure and investment cash flow sensitivity might allay our concern about this possible theoretical ambiguity.

Thus far, investment-cash flow sensitivity is purely the result of perceived distortions in the equity market. When the firm has not exhausted its debt capacity, however, it will seek

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[18]See Kaplan-Zingales (1997) for a similarly posed theoretical problem.

outside financing not only on the equity market, but also on the debt market. Without formally modelling the debt market, we argue that debt-financing will often seem cheaper to the overconfident CEO than equity-financing. Unlike new shareholders, lenders do not participate in the (perceived) upside of the CEO's project. If the CEO perceives default risk to be negligible, he will be willing to accept debt even if it is – from his perspective – overpriced. Thus, a CEO with untapped debt capacity may be happy to finance all desired investment with debt, even if he is not willing to issue equity. As a result, he, like the CEO with unlimited cash, may fail to exhibit sensitivity of investment to cash flow.

Thus, we have two predictions about the relation between investment-cash flow sensitivity and overconfidence.

Prediction 1. The investment of overconfident CEOs is more sensitive to cash flow than the investment of CEOs who are not overconfident.

Prediction 2. The investment-cash flow sensitivity of overconfident CEOs is more pronounced in equity-dependent firms.

In the following Sections, we test these two predictions. The empirical analysis consists of two steps. The first step is the construction of an overconfidence measure. The second step is the analysis of the relationship between overconfidence and the sensitivity of investment to cash flow (Prediction 1) and the change in this relationship as equity-dependence increases (Prediction 2).

After we introduce our data set in Section 3, we propose (in Section 4) three measures of overconfidence. These measures use the theoretical prediction that an underdiversified, risk-averse executive should exercise stock options early if they are sufficiently in the money, and that he should not increase his equity holdings. At the end of the paper, we consider broader measures of personal characteristics, that do not necessarily capture overconfidence, and analyze their impact on investment-cash flow sensitivity as well.

3   Data

We analyze a sample of 477 large publicly-traded United States firms from the years 1980 to 1994. To be included in the sample, a firm must appear at least four times on one of the lists of largest US companies compiled by Forbes magazine in the period from 1984 to 1994.[19]

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[19]This criterion essentially excludes IPOs from our sample. Thus, the more stringent restrictions on insider trading associated with such firms, such as lockup periods, do not apply.

The core of the data set is described in detail in Hall and Liebman (1998). Here, we will simply highlight some of the more important features of the data for our purposes. The virtue of this data set is that it provides us with detailed information on the stock ownership and set of option packages – including exercise price, remaining duration, and number of underlying shares – for the CEO of each company in each year. From this data we obtain a fairly detailed picture of the CEO's portfolio rebalancing over his tenure. What we cannot deduce is the exact price at which the exercise of a particular option package occurred in a given year. As a result, we must make assumptions about the CEO's ability to time the market in the short run. We check the robustness of our results to three different assumptions on the exercise price: first, that exercise occurs at the maximum price during the fiscal year, second, that it occurs at the median price, and, third, that it occurs at the mean price. The results are typically similar across all three specifications.

In order to examine the relationship between a CEO's transactions on his personal account and his transactions on corporate accounts, we supplement Hall and Liebman's data set with various items from the COMPUSTAT database. Following Kaplan and Zingales (1997), we measure investment as capital expenditures (item 128), cash flow as earnings before extraordinary items (item 18) plus depreciation (item 14), and capital as property, plants and equipment (item 8). We normalize investment and cash flow with beginning of the year capital. Given that our sample is not limited to manufacturing firms (though it mainly consists of large, nonfinancial firms), we check the robustness of our results to normalization by assets (item 6). We measure Q as the ratio of market value of assets to book value of assets. Market value of assets is defined as total assets (item6) plus market equity minus book equity. Market equity is defined as common shares outstanding (item 25) times fiscal year closing price (item 199). Book equity is calculated as total assets (item 6) minus total liabilities (item 181) minus preferred stock (item 10) plus deferred taxes (item 35) plus convertible debt (item 79). When preferred stock is missing, we replace it with the redemption value of preferred stock. Book value of assets is total assets (item 6).[20]

In addition, we collect personal information about the CEOs in our sample. Specifically, we supplement the data set with the CEOs' employment history, educational background, and military service using *Dun and Bradstreet* and *Who's Who in Finance and Industry*. We broadly classify a CEO's background as technical, financial, and general management. Finally, we use CRSP to gather stock prices as well as 2 and 4 digit SIC codes for the companies in our sample.

Appendices A and B define the variables used in the regression analysis and Table 1 presents

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[20]Definitions as in Fama and French (2000).

the summary statistics of the data, divided into firm-specific and CEO-specific variables.

4   Test 1: Overconfidence and Investment

4.1   Empirical Specification

To test the model's prediction that the sensitivity of investment to cash flow increases in overconfidence, we use the following general regression specification:

$$I_{it} = \beta_1 + \beta_2 Q_{it} + \beta_3 C_{it} + X'_{it} B_4 + \beta_5 \Delta_{it} + \beta_6 C_{it} \cdot Q_{it} + C_{it} \cdot X'_{it} B_7 + \beta_8 C_{it} \cdot \Delta_{it} + \varepsilon_{it} \quad (3)$$

where C stands for cash flow, X is the set of controls used in the regression, and Δ is the overconfidence measure. X usually includes corporate governance, ownership, total number of vested options (normalized by total number of shares outstanding over 1000[21]) as well as year-, firm-, and (year)*(cash flow) fixed effects[22]. Where relevant, we also include interactions of industry dummies and cash-flow. The null hypothesis is that β_8, the coefficient on the interaction of cash flow and overconfidence, is equal to zero.

In order to account for serial correlation and heteroskedasticity, we estimate (3) in three different ways. First we run an OLS regression which facilitates comparison with the earlier investment to cash flow sensitivity literature. Then we recompute the standard errors by clustering the observations within each firm. This process treats the time series of observations within the firm as a single observation, effectively eliminating any serial correlation. Finally, we control for time series and panel effects by running a Prais-Winsten regression with panel-corrected standard errors, assuming panel-specific first order autoregressive error terms and heteroskedasticity between different panels.[23] We find that our results are robust to all three specifications.

We also take steps to insure that a small number of anomalous observations do not drive any of our results. Though we normalize cash flow by beginning of the year capital (or,

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[21]We follow the convention of the Hall-Liebman data set.

[22]Many papers in the literature use the lag of Q to proxy for investment opportunities. Our results are the same under this alternative specification.

[23]Assuming a common rather than panel-specific first-order autoregressive error term does not alter the results. We report this alternative specification for the first regressions (Measure 1). As a final alternative, we ran an OLS regression including a lag of investment as a control variable. The results are robust to this specification as well (though we do not report them).

alternatively, beginning of the year assets), we still have several severe outliers in the data. For example, the data set contains observations of capital normalized cash flow that are more than 50 standard deviations away from the mean (see Table 1). In all of our regressions but one (Measure 2), the results hold despite the presence of these anomalous observations. Our second measure of overconfidence, however, falls just below the cusp of statistical significance if we fail to take some action to limit the influence of the outliers with respect to cash flow. The approach we adopt throughout the paper is to take the natural logarithm of one plus each of our continuous variables. That is, I in (3) is the natural logarithm of one plus capital-normalized (or asset-normalized) investment, C is the natural logarithm of one plus capital- (or asset-) normalized cash flow and Q is the natural logarithm of one plus Tobin's Q^{24}. This transformation pulls the anomalous observations of cash flow closer to the mean and, since the mean is near zero (0.25), has little impact on the remaining observations. We checked the robustness of the results to alternative methods of dealing with the outliers. One alternative approach, with the same qualitative effect as taking logs, is to winsorize normalized cash flow at the 1% level, another is to truncate the distribution of normalized cash flow at the 1% level. It turns out that the results under these alternative approaches are even stronger than the results under winsorizing oder truncation. We choose the more conservative approach of taking logarithms and not to winsorize to avoid discarding information on the relative cash flows in different observations that can be retained by taking logs. We choose not to truncate the data since several of our regressions are on samples of approximately 1000 observations and we prefer not to further restrict the sample size. Also, the R squared values (both adjusted and unadjusted) are substantially higher in the log model than in the level model with winsorization or truncation. In addition, the R squared values of the log model do not differ substantially from the R squared values of the level model (without winsorization or truncation) and in the most relevant case (Measure 2), the log model has a higher R squared than the level model. For our first results, presented in Tables 3a-d, we present the level model, the log model and the level model with winsorization for comparison. The conclusions of the paper – that managerial overconfidence has a significant distortionary effect on corporate investment decisions – hold whether we address the presence of the outliers or not and regardless of which approach we choose in dealing with them. It is also reassuring to find that these anomalous observations are not responsible for any of the empirical results in the paper.

We construct several measures of overconfidence, or proxies for Δ, based on personal portfolio decisions of CEOs. We consider CEOs overconfident if they fail to exercise stock options that

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[24]We also apply this transformation to two of our control variables: the percentage stock ownership by the CEO and the number of vested options held by the CEO (normalized by total shares outstanding). Whether or not we transform these variables turns out to have little impact on the results.

are highly in the money or if they repeatedly buy stock of their own company. These measures utilize the trade-off between underdiversification and overconfidence for a risk averse CEO. CEOs of large corporations are typically underdiversified with respect to company risk and, as long as they are even slightly risk averse, should attempt to reduce their personal stake in the company whenever possible. In particular, underdiversified CEOs should exercise options after the vesting period if the options are sufficiently in the money, and they should reduce their position in company stock whenver possible. Overconfidence, however, may lead CEOs to postpone option exercise and to acquire additional stock. An overconfident CEO overestimates the quality and future returns of his investment projects. Therefore, he believes that the stock price of his company will continue to rise under his leadership more then he should objectively expect. As a result, his overconfidence induces him to postpone option exercise or to increase his holdings of company stock in order to benefit from the expected future gains.[25]

At the same time, if the CEO's expectations about the returns of potential investments are too optimistic and not shared by the external capital market, the volume of investment will be sensitive to the availability of internal funds. Thus, we would expect overconfident CEOs to display investment-cash flow sensitivity.

In the remainder of this section, we construct three proxies for Δ and present the respective results of the regression specified in Equation (3). We also perform supplementary tests to address alternative explanations for our estimates of β_8.

4.2 Measure 1: "Holding Options Too Long"

Our first measure uses the timing of option exercises to identify overconfidence. Previous literature in corporate finance finds that risk-averse, underdiversified executives typically should not hold their options until expiration (Carpenter, 1998; Hall and Murphy, forthcoming). Black and Scholes (1973) demonstrate that an investor who can hedge his position should value options as if he were risk-neutral and, therefore, never forgo option value by exercising an option early. Unlike outside investors, however, a CEO cannot trade his options or hedge the risk by short-selling stock of his company. CEO compensation contracts regularly contain large quantities of stock and option grants in lieu of cash compensation. To maximize the incentive effects of these holdings, the firm prohibits the CEO from perfectly hedging against the risk

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[25]Note that this is true for CEOs who are overconfident (as defined in this paper), but not necessarily for CEOs who display overoptimism about exogenous variables or overestimate the precision of their beliefs. Overoptimism may extend to the general economic environment and thus induce other types of personal investments than investment in the CEO's own company. Overcalibration reduces the expected volatility of the stock and thus the value of holding options. The key aspect of overconfidence for our results is self-attribution by the CEO.

by selling company stock short and limits the frequency and quantity of divestitures he may undertake in any given year. As a result, the CEO's portfolio is likely to include too much of his own company's idiosyncratic risk. In addition, the CEO's human capital is invested in the firm, so that a bad outcome in his firm will not only negatively impact his personal portfolio, but also reduce his outside options. So, again, a CEO is likely to be overexposed to his firm's idiosyncratic risk, and the Black-Scholes formula will not apply. A CEO instead must trade-off the option-value of holding his stock options against the costs of underdiversification. Though the optimal schedule for early exercise depends on his individual wealth, degree of risk-aversion and diversification, it is generally true, in the absence of signalling and inside information, that a risk-averse CEO should exercise his options early given a sufficiently high stock price.

Applying this result, we consider the subsample of CEOs for whom an option granted at the money five years prior would be substantially in the money. By looking five years beyond the grant date, we ensure that at least some portion of the package is beyond the vesting period. We then pose the following question: did the CEO exercise some portion of this package before or during the fifth year or is he still holding the package in its entirety? We classify CEOs who fall into the latter group as overconfident.

We use the Hall and Murphy (forthcoming) framework as a theoretical guide in choosing a reasonable threshold for the percentage in the money at or above which a CEO should exercise his stock options. Rather than calculating the percentage in the money at which a CEO should exercise for every executive in our sample, we calculate several thresholds, applicable for alternative assumptions on risk-aversion, diversification, and wealth, which we then apply to all of the CEOs in the sample.[26]

To begin, we take 67% in the money during the fifth year as our threshold. If an option is more than 67% in the money at some point in year five, a CEO should have exercised some portion of his option package either during or before the fifth year. This threshold correponds to a risk aversion of 3 in a CRRA utility specification and to a percentage of wealth in company equity equal to 66. We also repeat the exercise with a threshold of 100% ($\rho = 3$; 50% of wealth in stock). The Hall-Murphy framework assumes that the CEO must invest any proceeds from exercise at the riskless rate, i.e. the CEO's only exposure to market returns is through company stock and options. In order to minimize the effect of the resulting upward bias in the threshold

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[26]This simplification is defendable for two reasons. First, as we cannot observe each CEO's degree of risk aversion and wealth or the fraction of his total wealth invested in company equity, individual calibration would introduce a great deal of observation-specific noise into the estimation without clear benefits. Second, we employ several reasonable parameter values for risk-aversion, wealth, and diversification, which give us a range of percentages in the money. As our results appear to be robust to this range of calibrated threshold percentages, we are confident that our results are not driven by the specific parameter values employed.

percentage, the level of risk-aversion should be chosen on the higher rather than the lower end of reasonable parameter values.

We construct Measure 1 (for both 67% and 100% in the money during the fifth year) as follows. We consider the subsample of CEOs who at least twice during the sample period had options that were valued above the threshold during the fifth year (and therefore after the vesting period). We then identify the first instance at which the CEO failed to exercise such an option during or before the fifth year. From this point in time onward, we classify the CEO as overconfident as long as he subsequently exhibited the behavior at least one more time during his tenure as CEO. This last requirement lessens the probability that someone will be misclassified as overconfident when in fact they had an instance of inside information, they were pressured to hold a particular option by the board, they faced a particularly high tax burden from exercise, or they simply made a mistake. Indeed, as we are mainly interested in the "permanent" rather than "transitory" overconfidence level of a CEO, our measure targets CEOs who "habitually" exercise options late.

Note that our sample restriction guarantees that every CEO in the subsample at least had the opportunity to be classified as overconfident. Thus, it limits the degree of unobserved overconfidence in the group to which we compare our overconfident CEOs. It also guarantees that we are not overproportionally identifying CEOs as overconfident when the stock of their firm is doing well. Instead, only those CEOs whose company appreciated at least 67% (100%) in value over two different five year intervals remain in the sample. On the other hand, our restriction considerably limits the number of observations; it declines from 4437 to 1032. Table 2 presents summary statistics for the sample of CEOs who meet this selection criterion. It also provides summary statistics for the subsample of CEOs who are classified as overconfident under our measure. We still have 114 different CEOs in the sample. We also have a substantial subsample, 55, who display overconfidence in their personal portfolio decisions. In addition, we note that the distribution of firms across broad industry groups (defined more specifically in the appendix) is virtually identical in the overall sample and the overconfident subsample. Thus, our overconfidence measure appears orthogonal to firm characteristics, at least as measured at the industry level.

We run a set of three baseline regressions to demonstrate the effects of Q and cash flow on investment: first with no additional controls, then including firm fixed effects, and finally including firm fixed effects as well as controls for ownership, option holdings and corporate governance and their interactions with cash flow. The results are presented in Table 3a for the 67% threshold. The first two regressions confirm the stylized facts of the investment-cash flow sensitivity literature–namely that cash flow has a large amount of explanatory power beyond Q

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for investment. The third regression provides evidence that good corporate governance reduces the sensitivity of investment to cash flow. The effect of corporate governance is consistently negative and significant across our regression specifications. We also find that CEOs who own a higher percentage of their company display a significantly smaller investment to cash flow sensitivity. Thus, it may be that high ownership does indeed mitigate agency problems, especially among a subsample of successful firms [27]. High levels of option ownership, however, appear to be associated with higher investment cash flow sensitivities. It is possible that this variable is already a very noisy proxy for overconfidence, since exercising options reduces option holdings (ceteris paribus). However, the level of CEO option holdings is determined more by the board and the CEO's compensation contract than by the CEO himself. Any exercised option can be replaced by a new option at the board's discretion. So, we are reluctant to interpret level effects as evidence of overconfidence. Instead, the result may capture asymmetric information between corporate insiders and the capital market. That is, a CEO with high ownership (in the form of unexercised options) who acts in the interest of current shareholders is likely to worry more about diluting existing shares [28]. This effect may be more prevalent for option holdings than stock holdings because options must be exercised or forfeited within a given time horizion. Board pressure not to sell company equity, on the other hand, may make a decrease in its current value due to dilution irrelevant if the CEO believes that it will be offset by future increases from financing productive investment projects. Regardless of the interpretation, both the stock ownership and option holdings variables appear to be picking up some characterisitic of the firm since, unlike our overconfidence measures, both become largely insignificant when we control for factors like firm size or industry (see Tables 11 and 12 and Section 4.6).

Finally, we see that Q has more impact on investment for higher levels of cash flow. If current cash flow measures the success of past investment decisions, then it is not surprising that more successful companies are more responsive to investment opportunities in determining their current level of investment. The significance of this effect, however, appears to be particularly sensitive to our choice of normalization (see Table 10 and Section 4.6). Interestingly, the effect is also absent from the regressions involving our third overconfidence measure (see Table 9 and Section 4.6) [29].

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[27]It is interesting that in many of our other regressions this variable has the opposite effect. This inconsistency is in line, perhaps, with the observation of Morck, Shleifer, and Vishny (1988) that inside ownership seems to have a nonmonotonic effect on firm valuation.

[28]See Hadlock (1998). Note also that ownership through unexercised options does not appear to matter more in more equity-dependent firms, unlike our measures of overconfidence (see Tables 15 and 17). This is puzzling for either interpretation of the vested options variable.

[29]This effect, like the ownership effects, appears distinct from the overconfidence effect. If we exclude the interaction of Q and cash flow from our regressions, the results are similar and the significance of the overconfidence variables does not increase.

Then, given a baseline for comparison, we estimate Equation (3) using our benchmarked holder measure ("Holder 67") as a proxy for Δ. Table 3a also presents these regression results. The coefficient on the interaction of the holder indicator with cash flow is positive (0.2462 in the OLS specification with controls) and highly significant. Tables 3b and 3c show the winsorized and full sample results under the level specification of the regression model. Again, overconfidence has a strong postive effect on investment cash flow sensitivity. As predicted by our model, CEOs who demonstrate a higher level of overconfidence than their peers in their portfolio decisions also exhibit a higher sensitivity of investment to cash flow. Table 3d presents the regression results raising the threshold for rational exercise to 100% ("Holder 100"). The results are the same.

Alternative Explanations. While these results correspond exactly to the predictions of our model, we must address several alternative interpretations.

1. *Insider information.* Another reason a CEO may hold an option that is more than 67% (100%) in the money is insider information. Namely, the CEO may have private information about future stock prices that makes holding the option more attractive. Then, as this information has not been incorporated into the market price, the firm's stock is currently undervalued and investment may be sensitive to cash flow for the usual Myers-Majluf reasons. This sensitivity, however, should only persist until the information becomes public and not for the remainder of the CEO's tenure.

Nevertheless, we address this alternative interpretation of our findings more directly with some additional tests.

First, if holding options past the predicted exercise point were the result of inside information, we should see variation in exercising behavior across different instances when the same CEO faces the exercise or hold decision. That is, we would expect to observe a CEO holding his options when he has good information and exercising them when he does not. To test this null hypothesis, we ran a random effects probit regression of the probability that a CEO holds an option that is at least 67% in the money in the fifth year on the number of times that CEO has held such an option in the past[30]. The sample consists of the 746 observations in which a CEO had options beyond the 67% threshold in the fifth year after the grant date. The dependent variable is equal to 1 if the CEO did not exercise any portion of this option

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[30]We chose the random effects specification because the number of observations within each panel is small and the loss in degrees of freedom using fixed effects would be extreme. In addition, there is no implementable and consistent estimator of a fixed effects probit model. We checked the stability of the quadrature method of estimation and the robustness of the result to a logit, rather than probit, specification. Finally, the results are almost the same if we look only at the CEOs who had an option reach the 67% threshold at least twice.

package in or before the fifth year. Table 4a presents the regression results. In Column (1), the coefficient of "past late exercises" is positive (0.27) and highly significant ($z = 5.44$). Thus, we find that the probability that a CEO will hold an option past the 67% threshold increases with the number of times he has held such an option in the past. That is, some CEOs, rather than varying their exercise behavior over time, persistently hold their options beyond the 67% threshold. The results are robust to the inclusion of Q (Column 2), which we interpret here as a proxy for mispricing or the degree of possible inside information, and to the inclusion of the stock price at the end of the fiscal year (Column 3) as controls. A high value of Q appears to decrease the probability of late exercise (although it is not significant at even the 10% level) and stock price has no explanatory power. Thus, the number of times a CEO has held a 67%-in-the-money option in the past is considerably more important in determining the CEO's future exercise behavior than any information about current or future stock price performance. Table 4b shows the percentage of CEOs with hold an option that is 67% in the money divided into categories based on the number of past late exercises.

Second, if holding past the 67% (100%) threshold were a product of inside information, CEOs should make positive profits from holding their options rather than exercising them during the fifth year and investing the proceeds in a diversified portfolio. We, therefore, calculate the distribution of returns among all CEOs who had options beyond the threshold and who did not exercise. As we do not know the exact price at which a CEO exercised his options, we calculate the returns under three alternative assumptions. First, we assume that CEOs are able to perfectly time the market in the short run and exercise at the maximum price during the fiscal year of their actual and hypothetical exercise. We then compare the return the CEO obtained by holding the option to the return he would have received from exercising during the fifth year and investing the proceeds in the S&P 500. We then consider as alternatives exercise at the median price during the year and exercise at the mean, and recalculate returns. In all three cases, we assume the profits from actual exercise are invested in the S&P 500 index until the end of 1995 and, likewise, that the investment in the S&P 500 after the hypothetical exercise is held until the end of 1995.

Table 5 shows that, in fact, CEOs do not beat the market by holding options beyond the threshold. The return differential is not positive and statistically different from zero under *any* assumption about exercise behavior—not even under the extreme assumption that CEOs always exercise at the maximum stock price. In fact, under two of the three price assumptions, both the average and the median CEO earn a negative return by holding beyond the threshold. Under the assumption of perfect market timing (maximum exercise price) the median CEO still loses; the average CEO makes a small positive return. The size of the standard deviation, however, indicates in all three cases that we cannot support the hypothesis that CEOs who

hold their options past the 67% threshold are bearers of inside information. On average, they appear to match the market, as standard asset pricing models would suggest.

These results do not at all imply that CEO insider trading is negligible. Quite to the opposite, we observe that 45% of the return differentials are positive. If the overconfidence hypothesis is true, these insiders are likely to weaken our measure of overconfidence and to attenuate the impact of overconfidence on corporate investment. An alternative approach, therefore, and a third way to address the question of insider information, is to modify our measure of overconfidence so that it only includes "late exercisers" who make losses from holding their options. Even though we have shown that the average CEO classified as overconfident by our holder variable is not a bearer of inside information, some portion of the CEOs classified as overconfident may simply have good information. Here we try to eliminate those CEOs from the overconfident subsample. That is, we classify a CEO as overconfident only if he actually loses money (by our return measure) on at least one of the options he holds beyond the threshold. For these CEOs we are confident in saying ex post that they should have exercised when the option reached the threshold, given their demonstrated lack of favorable insider knowledge. Then, we repeat the regressions of Tables 3a-d with this modified overconfidence proxy. If the investment-cash flow sensitivity were driven by the small number of CEOs who held their options because of (highly persistent) inside information, then this additional restriction should weaken the coefficient on our proxy for Δ interacted with cash flow. Tables 6a and 6b show the estimates of Equation (3) with this modified overconfidence proxy for the 67% and for the 100% threshold. We find that the estimated coefficient on Δ interacted with cash flow is actually larger and more significant in all specifications than in the regressions with the original holder proxy.

Indeed, we can go one step further. In Tables 6c and 6d we reestimate the regressions including an indicator for the CEOs who always profit by holding their options past the threshold along with this modified overconfidence proxy. We find that the effect of being a "winner" is insignificant in all regression specifications. That is, the entire effect of our holder variables on investment cash flow sensitivity comes from the CEOs who sometimes lose by failing to exercise.

Finally, we provide additional evidence that the CEOs we eliminate by requiring losses are indeed the CEOs with inside information. In particular, we construct a modified proxy that allows us to contrast the permanence of the overconfidence effect with the transitory nature of the inside information effect. The CEOs classified as overconfident by the original holder variable that instead had inside information should only exhibit investment-cash flow sensitivity for the period in which they had the information. The overconfident CEOs, on the other hand,

should exhibit a permanent, personality-driven sensitivity of investment to cash flow. To see these effects empirically, we look at the investment-cash flow sensitivity of CEOs classified as overconfident by the original holder measure over their entire tenures instead of from the first instance of missing the threshold onward. We find that the effect of the holder variable on investment-cash flow sensitivity becomes insignificant. On the other hand, when we look at the CEOs who in addition made losses on one of the options they held beyond the threshold, i.e. when we eliminate the CEOs with inside information, the result is different. Here the sensitivity of investment to cash flow is positively related to membership in the subgroup even when we look at their entire tenure as CEO. Indeed, the estimates of the effect of the invariant modified holder variable on investment-cash flow sensitivity are slightly stronger than the estimates for the modified holder variables in Tables 6a and 6b. Then, the effect of membership in the modified holder subsample must be roughly the same after the first instance of missing the threshold as it is before. The results are presented in Tables 6e and 6f (for 67% and 100% respectively). The modified holder variable satisfies a comparative static unique to overconfidence, a prediction that is not satisfied when we allow even a small amount of inside information to contaminate our holding measures. Thus, we have identified the effect of personality-driven overconfidence on the sensitivity of investment to cash flow rather than another proxy for inside information.

This evidence will be bolstered by our additional measures of overconfidence, particularly Measure 3.

2. *Risk tolerance.* Alternatively, one might want to interpret our measure of overconfidence as a measure of risk aversion. A CEO holds his options beyond the threshold simply because he is less risk-averse and, therefore, less affected by underdiversification. It is hard, though, to imagine a compelling theoretical reason why a less risk averse CEO should display higher sensitivity of investment to cash flow. Thus, the strong and significant relationship between option holding behavior and sensitivity of investment to cash flow casts doubt on the risk tolerance story by itself. Also, while higher risk-tolerance induces option holders to exercise their options later, it does not imply that the CEO should habitually buy additional stock of his company – an alternative measure of overconfidence we construct in Section 4.4.

3. *Signalling.* Another interpretation of the CEO's decision to hold the option is that the decision to hold conveys a signal to the capital market. Specifically, CEOs may want to hold the options as a (potentially) costly signal that their firm's prospects are better than the prospects of other firms whose CEOs have options that are 67% in the money and five years old. Then, as long as signalling is not perfectly effective (which would require some theoretical justification), we might observe higher sensitivity of investment to cash flow among these firms.

The usefulness of option exercises as a signalling device, however, is doubtful. Financial services firms and the financial press generally discount the credibility of option exercises as signals of future stock prices. They refer to option exercises as "noise" and advise investors to concentrate on stock purchases and sales as indicators of the private information of corporate insiders.[31] A signalling theory also appears to be at odds with our finding that none of the correlation between investment-cash flow sensitivity and option holding comes from the subsample of CEOs whose firms subsequently outperform the S&P 500. This lack of correlation cannot be due to effective signalling since the CEOs whose firms subsequently underperformed sent exactly the same signal. But if holding is not useful as a signal, then, again, the risk averse CEO should exercise at the threshold. In addition, the time series behavior of the fraction of CEOs who hold options beyond the threshold does not fit the signalling interpretation. From Table 7 the fraction of CEOs who hold an option past the 67% threshold appears to be procyclical. It peaks in 1990 and declines during the recession years of 1991 and 1992 before climbing up again at the end of the period. While it is conceivable that overconfident CEOs are more likely to lose their positions in "bad times," signalling is no less valuable in a depressed economy. Signalling serves to differentiate a firm from similar firms with worse future prospects, which should be – if anything – more valuable in a bad economy, when finance is scarce. Finally, we point again to our later measures, particularly Measure 3, which will help to rule out signalling. (Measure 3 measures overconfidence and investment-cash flow sensitivity for two disjoint time periods.)

The same arguments address the hypothesis that CEOs are not actually signalling the higher quality of their firms, but instead use their insider trades opportunistically to try to raise the capital market valuation of their firms.

4. *Tax reasons.* Another consideration is taxation. An option holder may postpone the option exercise to postpone the payment of taxes on his profits. The most widely granted type of stock options, however, NQSOs and SARs, are taxed much less favorably at exercise than at sale of the stock. The CEO has to pay ordinary income tax of up to 39.6% on the profits from exercise (stock price minus exercise price) and only capital gains tax of 20% on the profits from sale (stock price at sale minus stock price at income taxation). Therefore, whenever a CEO

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[31]Financial advisory firms that track insider trades often report only the purchases and sales of stocks, not the exercise of options (see for instance the websites of Investar, Quicken; also EDGAR). Other websites make it explicit that option exercise should be understood as "noise" with respect to insider knowledge, see for instance

http://www.winninginvesting.com/insider.htm ("The employees consider the options part

of their salary..") or http://invest-faq.com/articles/trade-insider.html ("same-day exercise of a stock option and selling

the resulting stock ... rarely means very much.") Similarly, the weekly column "Insider Trading Spotlight" in the *Wall Street Journal*, the weekly coverage of insider-trading information in the *Financial Times*.

believes that the stock price will rise, he has an incentive to exercise his options early. But independent of any expectations of future stock prices, tax deferral, like risk aversion, would be unable to explain a persistent sensitivity of investment to cash flow in these CEO's firms. Tax deferral is only relevant to the CEO's personal account.

5. *Liquidity.* A final interpretation of the decision to hold an option is that the company's stock is illiquid and, as a result, the CEO would be unable to sell the shares he would obtain should he exercise. If the company's stock were illiquid, the CEO would also be unable or unwilling to conduct a seasoned equity offering since the price of the new shares would have to be unduly low to induce investors to purchase them. Then, investment might be sensitive to cash flow if the firm has exhausted its debt capacity, leaving cash as the sole means of financing additional investment.

One problem with this story is that the firms in our sample are among the largest US corporations and are, therefore, unlikely to have illiquid stocks. Another problem is that liquidity concerns should be more relevant when a stock is performing poorly than when it is consistently rising. In order to be included in any of the regressions to this point in our analysis, however, a firm had to experience at least two five year intervals between 1980 and 1994 over which its stock rose at least 67%. It is hard to imagine that the subsample of firms that consistently perform well would be the subsample which would face limited demand for its equity. Finally, a CEO in a firm with illiquid stock should not habitually purchase the company's stock. Our later measures, particularly Measure 3, address this point.

Further concerns, including the exact calibration of the threshold percentages for exercise, can be addressed with the following measures.

4.3   Measure 2: "Holding Options Forever"

So far we have considered the decision to exercise an option during the fifth year after the grant date. We have argued that CEOs who continue to hold, even though the option is sufficiently in the money, are overconfident. It is natural, then, to suppose that an underdiversified CEO who holds an option until expiration is overconfident as well.

So, we consider the full sample of CEO-years and classify a CEO as overconfident if he ever holds an option until the last year of its duration. Though we might want to require the CEO to hold an option until expiration multiple times before concluding that he is overconfident, the small number of CEOs who engage in this behavior prevents us from constructing this more "habitual" measure.

Instead, we make a "once and for all" classification of any CEO who ever during his tenure held an option until the last year as overconfident. Table 8 gives the results of estimating Equation (3) using this holder variable as our proxy for Δ. The results are quite similar to the results in Tables 3a and 3b. Specifically, the coefficient of the holder variable interacted with cash flow is positive and statistically significant. This measure is our only measure of overconfidence that is not robust to clustering the observations by firm. However, it is robust to our alternative method of controlling for serial correlation, the Prais-Winsten regression (Column 7), and to controlling for serial correlation by including lagged investment as an independent variable.

It is noteworthy that those options that were held until the last year before expiration were not simply out of the money for the majority of their duration. In our sample we find that over 85% of options that are held until their final year are in the money and the median percentage in the money for such options is 253%. Thus the CEO could have profitably exercised these options before their last year. In addition, the correlation between this holder measure (Measure 2) and the benchmarked holder measure (Measure 1) – on the subsample of Measure 1 – is positive and very high (0.30). Alternatively, the correlation with the "once and for all" loser variable is 0.28. The benchmarked measures and the holding forever measure appear to proxy for the same effect.

We still, however, need to address a potential objection to this measure. One explanation for holding an option until the end of its duration is that the CEO's decisions are "inertial." That is, the CEO procrastinates the decision to exercise his options until prompted by impending expiration, in the spirit of O'Donoghue and Rabin (2001). This inertia on his personal account may carry over to the firm's corporate account in a reluctance to conduct equity issues, or generally a preference for the "quiet life" (Bertrand and Mullainathan 1999). If, however, a CEO is actively carrying out other portfolio transactions – while not exercising his option – procrastination does not apply. We therefore consider the CEO's portfolio rebalancing in the two years prior to the year of exercise. We do not consider other transactions contemporaneous with the exercise of the option in question since the inertial CEO may bundle his transactions once he is prompted to make them. We find that roughly 68% of the CEOs either sell shares or exercise another option that is not in its final year of duration in the two years prior to the year in question. So, at least the majority of CEOs classified as overconfident under this holder measure appear to indeed be overconfident rather than procrastinators.

In addition, "inertia" is less pertinent for our benchmarked holder variables (Measure 1) since the vast majority of CEOs who held beyond the relevant benchmark in the fifth year nevertheless exercised before the option reached its final year. For example, 86% of the CEOs who held beyond the fifth year when the option reached 67% in the money during that year still

exercised before the option reached its final year. And, in any event, an inertial CEO would not habitually purchase company equity – the subject of our next section.

Again, we conclude that an overconfident CEO will alter investment more when cash flow changes than his less confident peers.

4.4   Measure 3: "Habitual Buyer of Stock"

Underdiversified CEOs, in order to divest themselves of idiosyncratic risk, should not only exercise their options before expiration, but also minimize their holdings of company stock to the extent that it is possible. Of course, the board of directors might prevent an executive from selling large blocks of equity. Also, an executive must be concerned about the negative signal stock sales convey to the market. There is no reason, however, why a CEO should habitually increase his equity position by acquiring new shares or accumulating new stock grants without selling any shares to compensate. An alternative way to measure overconfidence, then, is "habitual purchases" of stock.

As with the option measure, one might conjecture that a CEO who increases his equity holdings must have inside information about future stock prices. To address this concern, we consider equity purchases and investment decisions in two disjoint time periods. Specifically, we consider the subsample of CEOs who keep their position as CEO for at least 13 of the 15 years in our sample. We then identify the CEOs who were "net buyers" of company equity during their first five years in our sample [32]. We classify these CEOs as overconfident. We then skip a year and estimate equation (3) on the remainder of the CEOs' tenures. That is, we classify CEOs as overconfident based on their first five years in the sample, but exclude the first six years from the regression. The rationale is that any insider information with enough precision to affect corporate decisions is likely to realize either during the gap between the periods (and thus be irrelevant to investment decisions in the second period) or quite early on in the later subsample of CEO years. Thus, a strong relationship between net buying in the first five years and sensitivity of investment to cash flow over the seven or more years following the gap year is unlikely to be due to inside information. As shown in Table 9, we find that the coefficient on the interaction of the net buyer variable with cash flow is positive (0.5781 in the OLS specification) and highly significant ($t > 3.33$ in all specifications). We also reestimated the regression with a two year gap between the two sample periods to further weaken any

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[32]Here a net buyer is someone who bought stock on net at least one more year than he sold stock on net during his first five sample years.

possible information explanation of the findings [33]. The results are similar. Thus, we are comfortable interpreting the strong relationship between habitual increases in equity holdings and sensitivity of investment to cash flow as evidence of managerial overconfidence.

A second objection to the stock-based measure of overconfidence might be that the board of directors not only prevents the CEO from divesting stock, but also pressures him to increase his position in company equity. If this were the case, we might expect our measures of net buying behavior to be strongly positively correlated with the presence of an effective board of directors, assuming additional incentives are desirable. However, our Corporate Governance variable is negatively correlated with the net buyer variable, $\rho = -0.1456$. That is, the presence of a strong board of directors, rather than encouraging the acquisition of company shares, may actually discourage it.

Another alternative is that these CEOs do not sell shares because their firm is doing poorly and the stock price is low. However, the net buyer effects are strong in our regressions despite the fact that we control for the interaction of Q with cash flow.

We also note that the correlation between habitual stock acquisition and failing to exercise at the 67% threshold is positive. On the subsample of CEOs who appear in the data for at least 13 years and for whom a five year old option was at least 67% in the money at least twice (i.e. the intersection of the sample restrictions for the two proxies), the correlation between these two variables is 0.10. Alternatively, the correlation between the net buyer variable and the "invariant hold and lose" variable is 0.12. This relationship suggests that the habitual buyer variable, like the excessive option-holding variable, is indeed capturing overconfidence.

4.5   Summary

Thus far we have constructed three overconfidence measures using the CEOs' personal portfolio decisions and have shown that each measure is positively correlated with investment-cash flow sensitivity.

The first three proxies for overconfidence are based on the CEO's choice to hold a five-year-old option beyond the threshold for exercise predicted by the Hall-Murphy model. For two different calibrations of the model (yielding 67% and 100% in the money as thresholds for exercise), we show that CEOs who hold beyond the benchmark at least twice display significantly higher sensitivity of investment to cash flow than their peers after the point at which they reveal their overconfidence. We also show that those CEOs among this group who lose money at

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[33]The results are also similar we estimate the regression without a gap between the two time periods.

least once by holding such options (rather than exercising and investing the proceeds in the S&P 500) are responsible for the effect. Finally, we demonstrate the permanent nature of the overconfidence effect by providing evidence that its effect on investment-cash flow sensitivity is the same over the entire tenure of this latter group of CEOs. We provide evidence that CEOs are not, on average, holding these options to signal future prospects or because of inside information, higher risk tolerance, tax postponement, or stock illiquidity.

Second, we consider the group of CEOs who, at any point in their tenure, held an option until the year before expiration. We find that investment is significantly more sensitive to cash flow among this group of CEOs than among their peers. This measure complements the first proxies as it does not use calibrated parameter values in a theoretical model or rely on high performance of the company's equity in the market.

Finally, we construct a measure of overconfidence based on the CEOs' stock purchases. We classify CEOs as overconfident if they were a net buyer of company stock more years than they were a net seller during the first five years they appear in our sample. Then, we examine the investment behavior of all of our CEOs, excluding their first six years in the sample. CEOs we classify as overconfident, again, have higher investment-cash flow sensitivity in this subsample. This measure conflicts with an interpretation of our findings based on stock liquidity. In addition, by relating personal portfolio decisions to corporate investment decisions in disjoint time periods, it provides further evidence that signalling and inside information cannot explain our findings.

4.6   Robustness

Next, we check the robustness of these results to changes in the regression specifications. For the sake of brevity, we limit the tables in this section to a selection of the regressions presented in earlier tables. The results in these regressions are representative of the results in all of the specifications.

Normalization by Assets. We chose to normalize investment and cash flow by beginning of the year capital to stay within the context of existing literature; however, it is reasonable to suppose that this normalization may incorrectly weight the observations in our sample. Unlike the data samples of Fazzari, Hubbard, and Petersen or Kaplan and Zingales, our sample is not limited to manufacturing firms. To address this concern, we reran all of our regressions normalizing investment and cash flow by beginning of the year assets instead. The results are presented in Table 10. The alternative normalization has little effect on our estimates. Qualitatively, the regression results seem to point to the same explanation of investment-cash

flow sensitivity as the capital-normalized regressions.

Controlling for Industry Effects. To rule out industry-specific effects on the use of cash flow, we also include interactions of industry dummies and cash flow in the regressions. We employ two industry specifications.

First, we classify firms into six broad categories based on their two digit SIC codes. The details of the definitions of these categories are described in Appendix B. Given concerns about sample size, we use these variables when industry effects are required in later portions of our analysis. We also assign firms to 48 industries, following the definitions of Fama and French (1997).[34] While the industry definitions of Fama and French are targeted towards a complete coverage of all NYSE, AMEX, and NASDAQ stocks and are thus not ideally suited for our sample, they allow us to broadly cover all industries in an "exogenously" determined manner.

As shown in Tables 11a and 11b, our results are unaffected under either specification.

Controlling for Firm Size. To make sure that our regressions do not inadvertently pick up characteristics of investment behavior in large versus small firms, we include a measure of firm size, the log of beginning of the year assets, as well as its square in our regression analysis. An alternative interpretation of this additional control is that it proxies for financial constraints. Indeed, since large firms are more likely to pay dividends, firm size is likely to capture any interaction between our overconfidence measures and the empirical effects identified by Fazzari, Hubbard, and Petersen.

Table 12 contains the results of these regressions. None of our results are materially affected by the inclusion of firm size, its square, and their interactions with cash flow, as additional controls[35]. This result is not surprising because our corporate governance measure is negatively correlated with firm size and picks up any effects that otherwise might be attributed to firm size.

Controlling for Quintiles of the Kaplan-Zingales index. A more direct way of controlling for financial constraints is the inclusion of controls based on Kaplan and Zingales' measures of financing constraints. In particular, we construct the Kaplan-Zingales index of financial constraints, used by Lamont, Polk and Saá-Requejo (2001) and Baker, Stein, and Wurgler (2001), for our sample. Kaplan and Zingales use direct measures of financing constraints, including information from annual reports and information gleaned directly from the company's

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[34]For details, see Appendix A in Fama and French (1997).

[35]The results are similar if we exclude the square of firm size. They are also similar when we include higher powers of firm size.

executives, to classify their sample of firms as either constrained or unconstrained. They then estimate an ordered logit of this classification on five accounting ratios meant to quantify these financial constraints. Specifically, these variables are cash flow to total capital, Q, debt to total capital, dividends to total capital, and cash holdings to capital. Lamont, Polk and Saá-Requejo and Baker, Stein, and Wurgler use the estimates of this ordered logit regression to construct an index of financial constraints (or equity dependence) as follows:

$$
\begin{aligned}
KZ_{it} \quad = \quad & -1.001909 * \frac{CF_{it}}{K_{it-1}} + 0.2826389 * Q_{it} + 3.139193 * Leverage_{it} \\
& -39.3678 * \frac{Dividend_{it}}{K_{it-1}} - 1.314759 * \frac{C_{it}}{K_{it-1}}
\end{aligned}
$$

Higher values of the linear combination of the five ratios implies a higher degree of financial constraint[36].

We separate our sample into quintiles based on the lagged value of the Kaplan-Zingales index. Dummies for the five quintiles as well as the interaction of these dummies with the cash flow variable are included in the same set of regressions as above. Table 13 shows that our results are robust to the inclusion of this measure of financing constraints. It is interesting to note that the firms in the most constrained quintile do appear to have significantly higher sensitivities of investment to cash flow than the firms in the other four quintiles.

Our results, however, are subject to the same important caveat as the other papers employing the KZ index. Namely, our data sample is not the Kaplan and Zingales sample; our sample does not consist entirely of manufacturing firms nor of solely low dividend payers. Then, we cannot rule out an effect of financial constraints on our dependent variable beyond what is captured by the index. Nevertheless, our overconfidence measure passes the test of the two main specifications of financial constraints available in the literature.

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[36]For this robustness test, we use a different definition of Q than throughout the rest of the paper in order to conform to the definitions used by Kaplan and Zingales and to avoid rendering the weights meaningless. The ratios, in terms of COMPUSTAT data items are as follows: cash flow to capital = (item 18 + item 14) / item 8 ; Q = [item 6 + (item24 * item 25) - item 60 - item 74] / item 6 ; debt to capital (leverage) = (item 9 + item 34) / (item 9 + item 34 + item 216) ; dividends to capital = item21 + item 19) / item 8 ; cash to capital = item 1 / item 8. Item 8, capital, is always taken at the beginning of the year (lagged).

5   Test 2: Overconfidence and Financial Constraints

As developed in Section 2 and summarized in Prediction 2, a second implication of our model is that overconfidence should matter more for firms that are more financially constrained. If a firm has a sufficient stock of cash on hand to finance all of the CEO's desired investment projects, then cash flow will not affect the level of investment. Similarly, investment may not be sensitive to cash flow as long as the firm has untapped debt capacity. A CEO who overestimates his projects' returns may ex ante believe his project will be profitable even in the states of the world that ex post correspond to default. Then, even if he views debt as too expensive given his perception of his project's value, he may accept it rather than foregoing the project altogether. In other words, overconfidence should have a higher impact on the sensitivity of investment to cash flow among those firms that must access the equity market for additional finance.

To test this prediction, we again employ the Kaplan-Zingales index. The index, which includes cash stock, cash holdings and leverage, provides an objective and comprehensive measure of a firm's equity dependence. Prediction 2 would be confirmed if our measures of overconfidence are strongest for the subsample of firms which have the highest values of the Kaplan-Zingales index.

So, we divide our sample into quintiles of the Kaplan-Zingales index and estimate Equation (3) separately on each quintile. Since the sample restrictions necessary to use the benchmarked holder or stock purchase variables as proxies for Δ would severely limit the number of observations in each of the five subsamples, we use measures 2, holding options forever, as a proxy for overconfidence.

Using the "long holder" measure of overconfidence (Table 14), we find, as predicted, that the effect of overconfidence on the sensitivity of investment to cash flow is significant only for the top quintile of the Kaplan-Zingales index. This effect is highly significant in both the OLS and time series specifications ($t = 3.61$ and $t = 4.79$).

Thus, both predictions of our simple model of overconfidence are confirmed in the data.

6   Other Personal Characteristics

Though the thrust of our paper has been to show that overconfidence matters in corporate decision-making, the broader point is that personal characteristics of the leading executive rather than characteristics of the firm can explain deviations of corporate decisions from opti-

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mal levels. Thus, in this section we provide further evidence of the managerial fixed effect on the sensitivity of investment to cash flow. Though overconfidence is clearly part of this effect, it need not be the entire effect.

6.1   Education and Employment History

First, we examine the effect of the CEO's educational and personal employment background on his firm's sensitivity of investment to cash flow. Specifically, we classify CEOs into groups based on their field of study for their highest educational degree and their employment experience. We classify CEOs with MBAs or PhDs in economics or an undergraduate business degree as having a finance education. Similarly, we classify CEOs who previously worked in a financial institution or as a CFO or as treasurer or as an accountant or generally in a finance-related position as having a finance background. On the other hand, we classify CEOs with an engineering degree or a degree in the natural sciences as having a technical background. Likewise, we classify CEOs who are individual patent-holders or previously worked as an engineer, in the natural sciences, or generally in a technically-oriented position as having a technical background. Tables 15a through 15d present estimates of Equation (3) using dummies based on these classifications and interactions of those dummies with cash flow (in lieu of the over-confidence variables Δ and $C \cdot \Delta$). We also include industry dummies interacted with cash flow, alternatively employing the two different sets of industry dummies detailed in Section 4.6 and Appendix B. Controlling for industries in either of these two ways allows us to distinguish potential industry-specific investment patterns (i.e. the typical sensitivity of investment to cash-flow in a "technical firm") from the personal effect (i.e. the typical investment behavior of a person with a "technical background"). We also conduct the same robustness checks as in the previous section, shown in Tables 11, 13, and 14.

The effect of financial education and financial background on the sensitivity of investment to cash flow is striking. As Tables 15a and 15b show, the estimated coefficient on the interaction of financial education with cash flow is always roughly -0.2 and is significant at the 1% level in most specifications. CEOs with a finance background appear to invest differently than CEOs with a technical or general management background. In particular, they invest more, on average, and are less sensitive to cash flow in choosing the level of investment. The effects of finance background, shown in Tables 15c and 15d, are similar.

One plausible explanation of these results is that CEOs with a financial background have a better understanding of capital markets than their peers. It is also possible that the type of person who pursues a finance education or works in a financial field is less likely to be

overconfident than an engineer or scientist. While there may be many interpretations of the results, the important point is that a personal feature of the CEO proves again to have strong influence on corporate decision making.

6.2   Depression Baby

We also examine the effect of membership in the 1920s cohort on the sensitivity of investment to cash flow. Conventional wisdom suggests that living through the Great Depression may explain the reluctance of some CEOs to borrow. We find, in Table 16, that CEOs born in the 1920s do indeed exhibit higher sensitivities of investment to cash flow. Of course, even this effect is open to multiple interpretations. One might hypothesize, for example, that these CEOs are overconfident, since they experienced, as young men and often as soldiers, the victorious times at the end of World War II.

6.3   Military Service

Indeed, more than 25% of the CEOs in our sample for whom we have background information (120 out of 467 CEOs) served in the US armed forces. So, we consider, in addition, the effect a background of military service might have on investment decisions. This personal characteristic is particularly appealing because it seems completely exogenous to any characteristics of the firm. Yet, we find that CEOs with prior military service display a significantly higher sensitivity of investment to cash flow than their peers. The effect is also highly statistically significant ($t = 6.56$). In fact, the effect is nearly double in magnitude the effect of membership in the 1920s cohort. And, the effect remains significant even after we control for membership in the 1920s cohort (as does the 1920s cohort effect itself). So, the effect is not a result of high correlation between military service and being a young adult during World War II.

6.4   BOSS

Finally, we examine the effect of accumulation of titles on investment-cash flow sensitivity. In particular, we construct a variable similar to Morck, Shleifer, and Vishny's (1989) BOSS variable. This variable takes the value one if the CEO also holds the titles President and Chairman of the Board. One interpretation of this variable might be that an overconfident CEO, due to an inflated image of his own capabilities, is likely to pursue as much authority within the firm as possible. Therefore, the Titles variable may be another proxy for overconfidence. Alternatively, the Titles variable may simply be another proxy for corporate governance. The

more positions a CEO occupies, the less he is disciplined by the board and the more he can pursue his preferred investment policies.

The regression results for this variable are also presented in Table 16. Here, the effect on investment-cash flow sensitivity is positive and significant on its own and when we include 1920s cohort and military service. The effect appears to disappear, however, when we include industry effects.

6.5   What about Microsoft?

One consequence of our result that overconfidence matters more in equity dependent firms is that it becomes difficult to interpret firms like Microsoft through the lens of overconfidence. Kaplan and Zingales (2000) pose Microsoft as a counterexample to the equation of investment-cash flow sensitivities with financing constraints. Although it had a high estimated sensitivity of investment to cash flow from 1986-1997, Microsoft had almost no debt and an extraordinarily strong cash position in 1997. Thus, the standard asymmetric information story seems unable to account for this instance of investment-cash flow sensitivity. An empire-building explanation seems equally implausible given their cash position and the high levels of ownership of Microsoft's top management during this period. Though our overconfidence story also appears unable to account for this sensitivity (indeed we fail to classify Bill Gates as overconfident under any of our personal portfolio measures), our last results – specifically the effect of a technical education or background on investment – may motivate an explanation.

Though we do not formally model the "technical/financial background" effects, we can demonstrate empirically that they are fundamentally different from the overconfidence effect discussed in the majority of the paper. Specifically, we repeat the methodology of the last section, using technical education in lieu of a proxy for Δ. That is, we estimate the effect of technical education on investment-cash flow sensitivity in each of the Kaplan-Zingales quintiles. The results are presented in Table 17. The most striking result is that technical education has a significant positive effect on investment cash flow sensitivity only among the two least constrained quintiles of the index. If anything, the effect appears slightly negative among the most constrained firms. That is, any positive effect of a technical, as opposed to financial or general, education on investment-cash flow sensitivity, comes from the least financially constrained firms and not the most constrained firms. This result directly opposes our comparative static for overconfident

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firms [37].

Though overconfidence may be the key to understanding the sensitivity of investment to cash flow among equity dependent firms, a focus on broader personal characteristics might also shed light on cases that do not meet that criterion and have confounded the existing theories.

7   Conclusion

The main goal of this paper is to establish a relation between corporate decision-making and personal characteristics of the leading executive inside the corporation. We focus on the impact of managerial overconfidence on corporate investment decisions, and find that overconfidence has high explanatory power for the sensitivity of investment to cash flow. Our analysis consists of three main steps. First, we derive, in a simple model of the corporate investment decision, the prediction that the sensitivity of investment to cash flow is strongest in the presence of overconfidence. We then construct three measures of overconfidence, using data on personal portfolio decisions of the CEO: (1) Does the CEO hold his option too long? (2) Does the CEO hold his options even until the last year before expiration? (3) Did the CEO habitually buy stock of his company during the first five sample years? Whenever the answer to one of these questions is yes, we classify a CEO as overconfident. Additional tests on the persistence of such behavior and on the CEO's gains and losses from option exercise strengthen the interpretation of these measures as proxies for overconfidence.

We then regress investment on cash flow, the overconfidence measure and the interaction of overconfidence and cash flow. We find a strong positive relationship between the sensitivity of investment to cash flow and executive overconfidence. The coefficients of the interaction term of overconfidence and cash flow are highly statistically significant for all of our measures. We also find, consistent with the theory, that overconfidence matters more in firms that are equity dependent.

In addition to the overconfidence effects, we find that financial education or a financial employment background reduces the correlation between cash flow and investment while technical education or background, high status within the company (as measured by the accumulation of titles), membership in the 1920-1929 birth cohort, and military service strongly increase the sensitivity of investment to cash flow. These latter findings confirm that personal characteris-

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[37]It also reassures us that the result on overconfidence by Kaplan-Zingales quintile was not spurious. That is, we will not find that any variable with a positive correlation to investment cash flow sensitivity is strongest among the most constrained firms.

tics matter for corporate decision making and are identifiable empirically.

These results have important implications for contracting practices and organizational design. Specifically, standard incentives are unlikely to mitigate the detrimental effects of managerial overconfidence. As a result, the board of directors may need to play a more active role in project assessment and selection to counterbalance CEO overconfidence.

A   Variable Definitions

Variable Name	Definition
1. Dependent Variable	
Investment	Capital expenditures (Item 128)
2. Variables used for Normalization	
Capital (lagged)	Property, plants, and equipment (Item 8)
Assets (lagged)	Total assets (Item 6)
3. Control Variables	
Q	(Market value of assets / Book value of assets) = (Total assets (Item6) + Market value of equity - Book value of equity) / Total assets (Item 6)
Market value of equity	Common shares outstanding (Item 25) * Fiscal year closing price (Item 199)
Book value of equity	Total assets (Item 6) - Total liabilities (Item 181) - Preferred stock (Item 10) + Deferred taxes (Item 35) + Convertible debt (Item 79) [1]
Cash flow	Earnings before extraordinary items (Item 8) + Depreciation (Item 14)
CEO ownership	Percent of common stock owned by the CEO and his immediate family at the beginning of the fiscal year, even if the CEO disclaims beneficial ownership, unless the relative in question also works for the company. Does not include stock subject to options or conversion of other securities, restricted stock for which retrictions have not lapsed, or shares for which the CEO controls investment or voting rights without deriving economic benefit.
CEO vested options	(Total number of CEO stock options exercisable within 60 days as of some date reported near the beginning of the fiscal year) / (Total number of shares of stock outstanding at the beginning of the fiscal year)
Corporate Governance	Dummy variable equal to 1 if the number of directors, as listed in the proxy statement near the beginning of the fiscal year, is between 4 and 12.
Firm Size	ln[lag of {Total Assets (Item 6)}]
Industry effects	See Appendix B.
4. Overconfidence Measures	
Holder 67 (100)	Dummy variable equal to 1 for all CEO-years *after* the CEO holds a five-year-old option that is more than 67% (100%) in the money, provided that he subsequently does it again at least once.
Hold and Lose 67 (100)	Dummy variable equal to 1 for all CEO-years *after* the CEO holds a five-year-old option that is more than 67% (100%) in the money, provided that he subsequently does it again at least once and that he loses money by holding such an option (relative to exercising in the fifth year and investing the proceeds in the S&P 500) at least once.
Invariant Hold and Lose 67 (100)	Dummy variable equal to 1 *for all CEO-years* provided the CEO holds a five-year-old option that is more than 67% (100%) in the money at least twice during his tenure and that he loses money by holding such an option (relative to exercising in the fifth year and investing the proceeds in the S&P 500) at least once.
Longholder	Dummy variable equal to 1 *for all CEO-years* if the CEO ever held an option until the last year prior to expiration.
Habitual Stock Buyer	Dummy variable equal to 1 for all CEO years *after* the year in which a CEO was a net buyer of company stock four more years than he was a net seller in prior years.
Net Buyer in first five years	Dummy variable equal to 1 *for all CEO-years in the relevant subsample (i.e. excluding the first five sample years)* if the CEO was a net buyer of stock for more years than he was a net seller during his first five sample years.
5. Personal Characteristics	
Finance Background	Dummy variable equal to 1 *for all CEO-years* if the CEO had prior employment experience in a financial position. Financial positions include CFO, accountant, or employee of a financial institution.
Technical Background	Dummy variable equal to 1 *for all CEO-years* if the CEO had prior employment experience in a technical position. Technical positions include engineer, researcher, or natural scientist. Individual patent holders are also classified as having a technical background.
Titles	Dummy variable *for all CEO-years* equal to 1 if the CEO is also President and Chairman of the Board.
Military Service	Dummy variable *for all CEO-years* equal to 1 if the CEO served in the US Armed Forces.
"Depression Baby" (born before 1930)	Dummy variable *for all CEO-years* equal to 1 if the CEO was born between 1920 and 1929.

COMPUSTAT item numbers in parentheses.

[1] When preferred stock is missing, we replace it with the redemption value of preferred stock (Item 56).

B   Industry Dummies

We employ two specifications to control for industry effects. First, we group the 477 firms of our sample into six broad categories, as summarized in the table below.

Industry	SIC codes
1. Technical	1000-1799 (mining, construction);
	2800-2999 (chemicals, petroleum, coal);
	3300-3699 (metal, machinery);
	4900-4999 (electric, gas services);
	8711 (engineering services)
2. Financial	6000-6799 (financial, insurance, and real estate industries)
	8721 (accounting, auditing, and bookkeeping)
3. Manufacturing	2000-2799 (food, tobacco, textile, wood, printing);
	3000-3299 (plastics, leather, glass);
	3700-3999 (vehicles, miscellaneous)
4. Transportation	4100-4599, 4700-4799 (passenger & freight transportation);
	4600-4699, 4900-4999 (pipelines, energy distribution);
	4800-4899 (communications)
5. Trade	5000-5199 (wholesale trade);
	5200-5999 (retail trade)
6. Services	7000-8699 (hotels, repair, recreation, legal, educational, social);
	8712-8713 (architectural, surveying);
	8730-8999 (R&D, PR, miscellaneous)

Alternatively we follow the industry definitions of Fama and French (1997) and create 48 industry dummies. In both cases, we include firm fixed effects and the interaction of industry dummies and cash flow in the regressions. As the definitions of Fama and French (1997) are intended to cover comprehensively all NYSE, AMEX, and NASDAQ stocks for a sample period of more than thirty years, they are not ideally suited for our much smaller sample of 477 firms over a sample period of 15 years. For most of the analysis, we include industry-cash flow interactions, following the above definition of six broad industries. For the regressions where industry effects are potentially most relevant (professional background), we report the regression results under both specifications. For these and for all other regressions, the results are virtually the same under both specifications.

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Table 1a. Summary Statistics of Firm Data

All variables are defined in Appendices A and B. Number of firms = 333; total number of observations = 4437.

Variable	Observations	Mean	Median	Standard Deviations	Minimum	Maximum
Assets	4437	5,020.83	2,106.94	10,887.62	9.50	191,012.80
Capital	4433	2,082.80	840.62	3,658.84	0	46,777.30
Investment	4437	324.06	131.80	679.74	0	11,711.60
Investment normalized by lagged capital	4437	0.24	0.19	0.34	0	7.99
Investment normalized by lagged assets	4437	0.09	0.07	0.10	0	3.91
Cash Flow	4437	391.10	173.49	781.04	-1,577.48	11,713.10
Cash Flow normalized by lagged capital	4437	0.41	0.25	1.43	-0.97	82.83
Cash Flow normalized by lagged assets	4437	0.11	0.10	0.19	-0.41	9.60
Q	4437	1.41	1.13	0.87	0.51	11.22
Corporate Governance	3952	0.57	1	0.50	0	1
Technical Industry	4067	0.46	0	0.50	0	1
Manufacturing Industry	4067	0.25	0	0.43	0	1
Transportation Industry	4068	0.06	0	0.24	0	1
Trade Industry	4067	0.12	0	0.32	0	1
Financial Industry	4067	0.06	0	0.25	0	1
Service Industry	4067	0.05	0	0.21	0	1

Table 1b. Summary Statistics of CEO Data

All variables are defined in Appendices A and B. Number of firms = 333; total number of observations = 4437.

Variable	Observations	Mean	Median	Standard Deviations	Minimum	Maximum
Age	3962	57.50	58	6.74	32	84
Years as CEO	3929	8.48	6	7.40	1	45
Also President	3956	0.56	1	0.50	0	1
Also Chairman	3956	0.81	1	0.39	0	1
President and Chairman	3956	0.38	0	0.48	0	1
Founder	3346	0.17	0	0.37	0	1
Ownership (%)	3927	2.39	0.13	7.17	0	95.1
Vested Options (#) (adjusted to 1994)	3610	192,586.00	36,515.50	880,167.30	0	20,200,000.00
"Depression Baby" (born before 1930)	3962	0.53	1	0.50	0	1
Finance Backgorund	2257	0.24	0	0.42	0	1
Finance Education	1771	0.50	1	0.50	0	1
Technical Background	2257	0.16	0	0.37	0	1
Technical Education	1771	0.27	0	0.45	0	1
Military service	2762	0.22	0	0.42	0	1

Table 2. Summary Statistics of CEO Data: Subsamples

Subsample: CEOs with options more than 67% in the money in the fifth year at least 2 times

Al variables are defined in Appendices A and B. Number of CEOs = 114; total number of observations = 1032.

Variable	Observations	Mean	Median	Standard Deviation	Minimum	Maximum
Age	1032	57.73	58	6.49	34	82
Years as CEO	1010	10.69	9	7.36	1	40
Also President	1032	0.53	1	0.50	0	1
Also Chariman	1032	0.86	1	0.35	0	1
President and Chairman	1032	0.38	0	0.49	0	1
Founder	929	0.17	0	0.38	0	1
Ownership (%)	1032	1.60	2.10	4.41	0	38.49
Vested Options (#) (adjusted to 1994)	1022	280685.00	136,687.50	455601.00	0	4,080,000.00
"Depression Baby" (born before 1930)	1032	0.53	1	0.50	0	1
Finance Background	651	0.21	0	0.41	0	1
Finance Education	548	0.54	1	0.50	0	1
Technical Background	651	0.18	0	0.38	0	1
Technical Education	548	0.29	0	0.46	0	1
Military service	819	0.25	0	0.43	0	1
Technical Industry	1030	0.41	0	0.49	0	1
Manufacturing Industry	1030	0.29	0	0.46	0	1
Transportation Industry	1030	0.04	0	0.20	0	1
Trade Industry	1030	0.13	0	0.33	0	1
Financial Industry	1030	0.07	0	0.25	0	1
Service Industry	1030	0.05	0	0.22	0	1

Subsample: CEOs with options more than 67% in-the-money in the 5th year (at least twice) who hold such options beyond the 5th yr at least twice

All variables are defined in Appendices A and B. Number of CEOs = 55; total number of observations = 528.

Variable	Observations	Mean	Median	Standard Deviation	Minimum	Maximum
Age	528	58.72	59	6.55	40	82
Years as CEO	506	11.12	10	6.70	1	36
Also President	528	0.53	0	0.50	0	1
Also Chairman	528	0.84	1	0.36	0	1
President and Chairman	528	0.37	0	0.48	0	1
Founder	484	0.18	0	0.38	0	1
Ownership (%)	528	1.24	0.24	2.81	0	22.49
Vested Options (#) (adjusted to 1994)	519	281833.20	148,750.00	347039.60	0	2,000,000.00
"Depression Baby" (born before 1930)	528	0.63	1	0.48	0	1
Finance Background	296	0.21	0	0.41	0	1
Finance Education	276	0.58	1	0.49	0	1
Technical Background	296	0.14	0	0.35	0	1
Technical Education	276	0.31	0	0.46	0	1
Military service	379	0.28	0	0.45	0	1
Technical Industry	526	0.41	0	0.49	0	1
Manufacturing Industry	526	0.25	0	0.43	0	1
Transportation Industry	526	0.06	0	0.23	0	1
Trade Industry	526	0.13	0	0.34	0	1
Financial Industry	526	0.07	0	0.25	0	1
Service Industry	526	0.08	0	0.27	0	1

Table 3a. Regression of Investment on Cash Flow and Exercise Behavior (logs)

Sample: CEOs with options more than 67% in the money in the fifth year at least two times
Dependent Variable: Investment   **Normalization:** Beginning of year capital

	Baseline Regressions			Late Exercise of 67% in the money option (in year 5)				
	no fixed effects, no controls	fixed effects, no controls	fixed effects, controls		with controls	with clustered standard errors	panel corrected standard errors (psar1)	panel corrected standard errors (ar1)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash Flow	0.2348	0.3008	0.1952	0.0631	0.1560	0.1560	0.0948	0.0905
	(15.69)***	(6.16)***	(2.59)***	(0.95)	(2.07)**	(0.99)	(0.81)	(0.76)
Q	-0.0073	0.0882	-0.0368	-0.0540	-0.0498	-0.0498	-0.1170	-0.1026
	(0.46)	(3.64)***	(0.91)	(1.36)	(1.24)	(0.69)	(2.01)**	(1.72)*
(Q)*(Cash Flow)			0.2318	0.2641	0.2769	0.2769	0.3833	0.3408
			(4.12)***	(4.80)***	(4.88)***	(1.47)	(3.64)***	(3.16)***
CEO ownership [in %]			0.7874		0.5353	0.5353	0.8214	0.6664
			(2.54)**		(1.71)*	(1.50)	(2.67)***	(2.16)**
CEO vested options			-0.0200		-0.0176	-0.0176	-0.0207	-0.0192
			(2.60)***		(2.29)**	(1.64)	(2.72)***	(2.41)**
Corporate Governance			0.0408		0.0475	0.0475	0.0444	0.0435
			(2.54)**		(2.97)***	(2.74)***	(3.37)***	(2.98)***
(CEO ownership)*(Cash Flow)			-0.9073		-0.6620	-0.6620	-0.9872	-0.8805
			(3.72)***		(2.61)***	(1.19)	(3.24)***	(2.61)***
(CEO vested options)*(Cash Flow)			0.0695		0.0648	0.0648	0.0664	0.0732
			(4.25)***		(3.98)***	(1.71)*	(3.15)***	(3.43)***
(Corporate Governance)*(Cash Flow)			-0.0986		-0.1233	-0.1233	-0.1205	-0.1116
			(2.45)**		(3.05)***	(2.22)**	(3.03)***	(2.56)**
Holder 67				-0.0243	-0.0174	-0.0174	-0.0262	-0.0212
				(1.50)	(1.03)	(0.64)	(1.59)	(1.16)
(Holder 67)*(Cash Flow)				0.1616	0.1463	0.1463	0.1657	0.1657
				(4.22)***	(3.63)***	(1.85)*	(3.24)***	(2.93)***
Time Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Firm Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
(Time)*(Cash Flow) Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Observations	1032	1032	1032	1032	1032	1032	1032	1032
Adjusted R-squared	0.22	0.58	0.60	0.60	0.61	0.61	R^2=0.77	R^2=0.63

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.
Absolute value of t statistics in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3b. Regression of Investment on Cash Flow and Exercise Behavior (winsorized)

Sample: CEOs with options more than 67% in the money in the fifth year at least two times

Dependent Variable: Investment   **Normalization:** Beginning of year capital

	Baseline Regressions			Late Exercise of 67% in the money option (in year 5)				
	no fixed effects, no controls	fixed effects, no controls	fixed effects, controls		with controls	with clustered standard errors	panel corrected standard errors (psar1)	panel corrected standard errors (ar1)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash Flow	0.2929	0.5358	0.2760	0.2599	0.2525	0.2525	0.2642	0.2390
	(13.04)***	(6.05)***	(2.70)***	(2.94)***	(2.56)**	(1.67)*	(1.47)	(1.43)
Q	-0.0073	0.0180	-0.1272	-0.1596	-0.1503	-0.1503	-0.1687	-0.1613
	(0.76)	(1.30)	(4.89)***	(6.27)***	(5.97)***	(1.74)*	(4.22)***	(3.72)***
(Q)*(Cash Flow)			0.1529	0.1878	0.1947	0.1947	0.2365	0.2080
			(6.96)***	(8.72)***	(8.96)***	(1.65)	(5.12)***	(4.18)***
CEO ownership [in %]			1.527		0.8028	0.8028	1.1436	0.8752
			(2.34)**		(1.27)	(1.06)	(1.78)*	(1.28)
CEO vested options			-0.0091		-0.0077	-0.0077	-0.0109	-0.0090
			(4.92)***		(4.30)***	(1.48)	(3.90)***	(3.43)***
Corporate Governance			-0.0043		0.0227	0.0227	0.0039	0.0128
			(0.13)		(0.69)	(0.44)	(0.14)	(0.44)
(CEO ownership)*(Cash Flow)			-1.0682		-0.5795	-0.5795	-1.2306	-0.8213
			(2.72)***		(1.51)	(0.36)	(2.14)**	(1.28)
(CEO vested options)*(Cash Flow)			0.0153		0.0155	0.0155	0.0195	0.0171
			(6.66)***		(6.96)***	(1.79)*	(5.23)***	(4.61)***
(Corporate Governance)*(Cash Flow)			0.0593		-0.0282	-0.0282	0.0173	0.0039
			(0.94)		(0.46)	(0.18)	(0.23)	(0.05)
Holder 67				-0.1398	-0.1237	-0.1237	-0.1410	-0.1370
				(3.91)***	(3.47)***	(2.16)**	(4.19)***	(3.66)***
(Holder 67)*(Cash Flow)				0.5031	0.5035	0.5035	0.5613	0.5445
				(7.92)***	(7.82)***	(3.10)***	(5.87)***	(5.27)***
Time Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Firm Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
(Time)*(Cash Flow) Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Observations	1032	1032	1032	1032	1032	1032	1032	1032
Adjusted R-squared	0.16	0.45	0.50	0.51	0.54	0.54	$R^2=0.68$	$R^2=0.60$

Cash Flow winsorized at the 1% level. All variables are defined in the appendices.

Absolute value of t statistics in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3c. Regression of Investment on Cash Flow and Exercise Behavior

Sample: CEOs with options more than 67% in the money in the fifth year at least two times

Dependent Variable: Investment   **Normalization:** Beginning of year capital

	Baseline Regressions			Late Exercise of 67% in the money option (in year 5)				
	no fixed effects, no controls	fixed effects, no controls	fixed effects, controls		with controls	with clustered standard errors	panel corrected standard errors (psar1)	panel corrected standard errors (ar1)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash Flow	0.2124	0.3044	0.2417	0.0207	0.1843	0.1843	0.1985	0.1580
	(19.58)***	(5.66)***	(3.82)***	(0.48)	(2.97)***	(1.86)*	(1.94)*	(1.51)
Q	-0.0005	0.0529	-0.0120	-0.0291	-0.0442	-0.0442	-0.0463	-0.0572
	(0.06)	(4.44)***	(0.66)	(1.67)*	(2.45)**	(0.87)	(1.63)	(1.89)*
(Q)*(Cash Flow)			0.0749	0.0977	0.1217	0.1217	0.1407	0.1373
			(5.54)***	(7.22)***	(8.37)***	(1.44)	(4.04)***	(3.71)***
CEO ownership [in %]			1.5597		0.7294	0.7294	0.9631	0.6709
			(2.84)***		(1.34)	(1.06)	(1.44)	(1.04)
CEO vested options			-0.0038		-0.0007	-0.0007	-0.0008	-0.0002
			(2.73)***		(0.49)	(0.48)	(0.35)	(0.09)
Corporate Governance			0.0664		0.0893	0.0893	0.0827	0.079
			(2.22)**		(3.06)***	(2.21)**	(3.11)***	(2.97)***
(CEO ownership)*(Cash Flow)			-0.3528		0.2889	0.2889	0.0399	0.1376
			(1.38)		(1.09)	(0.27)	(0.09)	(0.28)
(CEO vested options)*(Cash Flow)			0.0074		0.0043	0.0043	0.0032	0.0026
			(4.84)***		(2.79)***	(1.82)*	(1.49)	(1.20)
(Corporate Governance)*(Cash Flow)			-0.1615		-0.2358	-0.2358	-0.2372	-0.2030
			(2.96)***		(4.38)***	(1.96)*	(3.33)***	(2.93)***
Holder 67				-0.0741	-0.0833	-0.0833	-0.1062	-0.0954
				(2.52)**	(2.67)***	(1.87)*	(2.98)***	(2.53)**
(Holder 67)*(Cash Flow)				0.3482	0.3753	0.3753	0.4291	0.4162
				(7.36)***	(7.05)***	(2.38)**	(4.60)***	(4.34)***
Time Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Firm Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
(Time)*(Cash Flow) Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Observations	1032	1032	1032	1032	1032	1032	1032	1032
Adjusted R-squared	0.29	0.58	0.60	0.61	0.62	0.62	R^2=0.74	R^2=0.67

All variables are defined in the appendices.

Absolute value of t statistics in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3d. Regression of Investment on Cash Flow and Exercise Behavior

Sample: CEOs with options more than 100% in the money in the fifth year at least two times
Dependent Variable: Investment   **Normalization:** Beginning of year capital

	Baseline Regressions			Late Exercise of 100% in the money option (in year 5)				
	no fixed effects, no controls	fixed effects, no controls	fixed effects, controls		with controls	with clustered standard errors	panel corrected standard errors (psar1)	panel corrected standard errors (ar1)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash Flow	0.2363	0.3005	0.2143	0.0674	0.1740	0.1740	0.0959	0.1057
	(15.54)***	(6.08)***	(2.81)***	(0.99)	(2.27)**	(1.08)	(0.80)	(0.87)
Q	-0.0079	0.0876	-0.0357	-0.0520	-0.0495	-0.0495	-0.1192	-0.1030
	(0.49)	(3.57)***	(0.86)	(1.28)	(1.20)	(0.66)	(1.95)*	(1.67)*
(Q)*(Cash Flow)			0.2272	0.2589	0.2729	0.2729	0.3886	0.3382
			(3.95)***	(4.60)***	(4.67)***	(1.40)	(3.51)***	(3.02)***
CEO ownership [in %]			0.8240		0.5831	0.5831	0.8382	0.7138
			(2.63)***		(1.85)*	(1.65)	(2.73)***	(2.29)**
CEO vested options			-0.0203		-0.0178	-0.0178	-0.0203	-0.0196
			(2.59)***		(2.26)**	(1.61)	(2.63)***	(2.39)**
Corporate Governance			0.0420		0.0487	0.0487	0.0428	0.0443
			(2.54)**		(2.95)***	(2.59)**	(3.17)***	(2.93)***
(CEO ownership)*(Cash Flow)			-0.9418		-0.7032	-0.7032	-1.0052	-0.9237
			(3.82)***		(2.71)***	(1.22)	(3.20)***	(2.65)***
(CEO vested options)*(Cash Flow)			0.0704		0.0656	0.0656	0.0674	0.0747
			(4.27)***		(3.98)***	(1.71)*	(3.15)***	(3.46)***
(Corporate Governance)*(Cash Flow)			-0.1141		-0.1375	-0.1375	-0.1276	-0.1241
			(2.76)***		(3.30)***	(2.37)**	(3.15)***	(2.76)***
Holder 100				-0.0233	-0.0157	-0.0157	-0.0272	-0.0195
				(1.40)	(0.91)	(0.56)	(1.56)	(1.01)
(Holder 100)*(Cash Flow)				0.1506	0.1334	0.1334	0.1573	0.1523
				(3.83)***	(3.21)***	(1.63)	(2.93)***	(2.56)**
Time Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Firm Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
(Time)*(Cash Flow) Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Observations	989	989	989	989	989	989	989	989
Adjusted R-squared	0.23	0.59	0.60	0.60	0.61	0.61	R^2=0.77	R^2=0.63

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4a. Persistence of Exercising Behavior
Random Effects Probit Regression

Sample: Observations with 67%-in-the-money options (in year five)
Dependent Variable: Late Exercise in current period

	(1)	(2)	(3)	(4)
Past late exercises	0.2684	0.223	0.2707	0.2193
	(5.44)***	(3.92)***	(5.44)***	(3.81)***
Q		-0.1153		-0.1281
		(1.49)		(1.57)
Stock Price (end of fiscal year)			-0.002	0.0025
			(0.53)	(0.54)
Observations	746	517	744	517
Number of CEOs	252	176	251	176

Absolute value of z statistics in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4b. Persistence of Exercising Behavior
Percent who Exercise Late partitioned by Number of Past Late Exercises

Sample: Observations with 67%-in-the-money options (in year five)

Past Late Exercises	% Who Exercise Late	Number of CEOs
0	0.29	527
1	0.57	138
2	0.70	70
3	0.77	39
4	0.85	27
5	0.70	20
6	0.78	9
7	0.00	6

Table 5. Profits and Losses of "Late Exercisers" (67%, 5th year)

Sample: CEOs (1) with option packages at least 67% in the money during the 5th year after the date of grant and (2) who have not exercised the options before the 5th year

Percentage in the money at exercise		Return (in %) relative to exercising during year 5 and investing in S&P500 until the end of 1995					
		Exercise at fiscal-year maximum price		Exercises at fiscal-year mean price		Exercises at fiscal-year median price	
percentile	% in the money	percentile	return	percentile	return	percentile	return
5th	109.71	5th	-43.04	5th	-49.50	5th	-44.88
10th	145.16	10th	-32.57	10th	-34.12	10th	-35.25
15th	192.35	15th	-28.95	15th	-26.26	15th	-27.41
20th	229.76	20th	-22.17	20th	-22.73	20th	-22.13
25th	253.58	25th	-19.04	25th	-19.33	25th	-17.36
30th	281.87	30th	-14.68	30th	-15.77	30th	-13.49
35th	317.18	35th	-11.45	35th	-11.60	35th	-10.66
40th	345.22	40th	-7.30	40th	-8.64	40th	-7.35
45th	384.20	45th	-3.68	45th	-6.14	45th	-4.69
50th	418.30	50th	-0.24	50th	-2.43	50th	-0.95
55th	520.93	55th	2.77	55th	1.86	55th	2.12
60th	561.99	60th	6.32	60th	5.11	60th	5.04
65th	708.25	65th	12.81	65th	8.59	65th	8.98
70th	839.53	70th	16.48	70th	12.47	70th	13.08
75th	1,028.75	75th	20.29	75th	16.09	75th	17.02
80th	1,195.19	80th	23.59	80th	19.22	80th	21.32
85th	1,620.58	85th	29.12	85th	26.12	85th	25.01
90th	2,063.16	90th	35.87	90th	34.97	90th	31.39
95th	4,146.08	95th	60.11	95th	53.73	95th	48.76
mean	1,137.52		1.97		-0.49		-0.23
standard deviation	2,525.81		31.40		29.88		28.62
Observations	187		187		187		187
CEOs	86		86		86		86

Table 6a. Regression of Investment on Cash Flow and Exercise Behavior

Sample: CEOs with options more than 67% in the money in the fifth year at least two times
Dependent Variable: Investment   **Normalization:** Beginning of year capital

	Baseline Regressions			Late Exercise of 67% in the money option (in year 5) with Losses				
	no fixed effects, no controls	fixed effects, no controls	fixed effects, controls		with controls	with clustered standared errors	panel corrected standard errors (ar1)	panel corrected standard errors (psar1)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash Flow	0.2348	0.3008	0.1952	0.0571	0.1655	0.1655	0.1036	0.0781
	(15.69)***	(6.16)***	(2.59)***	(0.89)	(2.28)**	(1.07)	(0.95)	(0.72)
Q	-0.0073	0.0882	-0.0368	-0.0591	-0.0611	-0.0611	-0.1158	-0.1259
	(0.46)	(3.64)***	(0.91)	(1.53)	(1.56)	(0.86)	(1.94)*	(2.22)**
(Q)*(Cash Flow)			0.2318	0.3113	0.3191	0.3191	0.3852	0.4355
			(4.12)***	(5.80)***	(5.79)***	(1.70)*	(3.61)***	(4.21)***
CEO ownership			0.7874		0.6156	0.6156	0.7319	0.8428
			(2.54)**		(2.06)**	(2.07)**	(2.56)**	(3.04)***
CEO vested options			-0.0200		-0.0093	-0.0093	-0.0093	-0.0129
			(2.60)***		(1.24)	(1.00)	(1.18)	(1.64)
Corporate Governance			0.0408		0.0450	0.045	0.0425	0.0462
			(2.54)**		(2.91)***	(2.77)***	(2.99)***	(3.50)***
(CEO ownership)*(Cash Flow)			-0.9073		-0.5936	-0.5936	-0.764	-0.7779
			(3.72)***		(2.50)**	(1.10)	(2.50)**	(2.74)***
(CEO vested options)*(Cash Flow)			0.0695		0.0410	0.041	0.0432	0.0422
			(4.25)***		(2.54)**	(1.23)	(1.99)**	(1.97)**
(Corporate Governance)*(Cash Flow)			-0.0986		-0.1251	-0.1251	-0.1172	-0.1349
			(2.45)**		(3.21)***	(2.63)***	(2.77)***	(3.46)***
Hold and Lose 67				-0.0951	-0.0859	-0.0859	-0.0936	-0.1037
				(5.12)***	(4.57)***	(2.55)**	(4.21)***	(4.79)***
(Hold and Lose 67)*(Cash Flow)				0.3901	0.3711	0.3711	0.3985	0.4030
				(8.83)***	(8.20)***	(3.31)***	(5.97)***	(6.46)***
Time Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Firm Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
(Time)*(Cash Flow) Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Observations	1032	1032	1032	1032	1032	1032	1032	1032
Adjusted R-squared	0.22	0.58	0.60	0.62	0.63	0.63	R^2=0.65	R^2=0.79

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6b. Regression of Investment on Cash Flow and Exercise Behavior

Sample: CEOs with options more than 100% in the money in the fifth year at least two times
Dependent Variable: Investment   **Normalization:** Beginning of year capital

	Baseline Regressions			Late Exercise of 100% in the money option (in year 5) with Losses				
	no fixed effects, no controls	fixed effects, no controls	fixed effects, controls		with controls	with clustered standard errors	panel corrected standard errors (ar1)	panel corrected standard errors (psar1)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash Flow	0.2363	0.3005	0.2143	0.0578	0.1788	0.1788	0.1150	0.0760
	(15.54)***	(6.08)***	(2.81)***	(0.89)	(2.43)**	(1.14)	(1.04)	(0.69)
Q	-0.0079	0.0876	-0.0357	-0.0587	-0.0637	-0.0637	-0.1178	-0.1320
	(0.49)	(3.57)***	(0.86)	(1.49)	(1.59)	(0.86)	(1.93)*	(2.25)**
(Q)*(Cash Flow)			0.2272	0.3092	0.3210	0.3210	0.3874	0.4467
			(3.95)***	(5.64)***	(5.67)***	(1.65)	(3.52)***	(4.15)***
CEO ownership			0.8240		0.6420	0.6420	0.7510	0.8375
			(2.63)***		(2.12)**	(2.18)**	(2.62)***	(3.04)***
CEO vested options			-0.0203		-0.0088	-0.0088	-0.0088	-0.0116
			(2.59)***		(1.15)	(0.93)	(1.10)	(1.46)
Corporate Governance			0.0420		0.0466	0.0466	0.0440	0.0442
			(2.54)**		(2.92)***	(2.65)***	(2.99)***	(3.25)***
(CEO ownership)*(Cash Flow)			-0.9418		-0.6110	-0.6110	-0.7740	-0.7758
			(3.82)***		(2.53)**	(1.10)	(2.47)**	(2.67)***
(CEO vested options)*(Cash Flow)			0.0704		0.0412	0.0412	0.0436	0.0413
			(4.27)***		(2.52)**	(1.22)	(1.99)**	(1.91)*
(Corporate Governance)*(Cash Flow)			-0.1141		-0.1419	-0.1419	-0.1328	-0.1430
			(2.76)***		(3.54)***	(2.86)***	(3.05)***	(3.59)***
Hold and Lose 100				-0.0947	-0.0854	-0.0854	-0.0937	-0.1079
				(5.01)***	(4.47)***	(2.38)**	(4.11)***	(4.87)***
(Hold and Lose 100)*(Cash Flow)				0.3836	0.3654	0.3654	0.3936	0.4064
				(8.53)***	(7.91)***	(3.13)***	(5.71)***	(6.31)***
Time Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Firm Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
(Time)*(Cash Flow) Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Observations	989	989	989	989	989	989	989	989
Adjusted R-squared	0.23	0.59	0.6	0.63	0.63	0.63	R^2=0.66	R^2=0.79

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6c. Regression of Investment on Cash Flow and Exercise Behavior

Sample: CEOs with options more than 67% in the money in the fifth year at least two times
Dependent Variable: Investment   **Normalization:** Beginning of year capital

	Baseline Regressions			Late Exercise of 67% in the money option (in year 5) with Losses				
	no fixed effects, no controls	fixed effects, no controls	fixed effects, controls		with controls	with clustered standared errors	panel corrected standard errors (ar1)	panel corrected standard errors (psar1)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash Flow	0.2348	0.3008	0.1952	0.0667	0.1809	0.1809	0.1179	0.0969
	(15.69)***	(6.16)***	(2.59)***	(1.03)	(2.47)**	(1.23)	(1.09)	(0.91)
Q	-0.0073	0.0882	-0.0368	-0.0614	-0.0591	-0.0591	-0.1143	-0.1234
	(0.46)	(3.64)***	(0.91)	(1.59)	(1.51)	(0.83)	(1.93)*	(2.21)**
(Q)*(Cash Flow)			0.2318	0.3144	0.3137	0.3137	0.3819	0.4307
			(4.12)***	(5.85)***	(5.66)***	(1.71)*	(3.59)***	(4.17)***
CEO ownership			0.7874		0.6252	0.6252	0.7296	0.8831
			(2.54)**		(2.06)**	(1.89)*	(2.45)**	(3.07)***
CEO vested options			-0.0200		-0.0103	-0.0103	-0.0102	-0.0133
			(2.60)***		(1.36)	(1.10)	(1.31)	(1.77)*
Corporate Governance			0.0408		0.0419	0.0419	0.0399	0.0422
			(2.54)**		(2.68)***	(2.92)***	(2.79)***	(3.21)***
(CEO ownership)*(Cash Flow)			-0.9073		-0.7092	-0.7092	-0.8652	-0.9047
			(3.72)***		(2.86)***	(1.55)	(2.89)***	(3.28)***
(CEO vested options)*(Cash Flow)			0.0695		0.0414	0.0414	0.0439	0.0428
			(4.25)***		(2.56)**	(1.24)	(2.04)**	(2.01)**
(Corporate Governance)*(Cash Flow)			-0.0986		-0.1145	-0.1145	-0.1086	-0.1236
			(2.45)**		(2.90)***	(2.82)***	(2.53)**	(3.13)***
Hold and Win 67				0.0356	0.0391	0.0391	0.0406	0.0496
				(1.79)*	(1.88)*	(1.05)	(1.86)*	(2.44)**
(Hold and Win 67)*(Cash Flow)				-0.0462	-0.0580	-0.0580	-0.0517	-0.0827
				(1.01)	(1.20)	(0.58)	(0.80)	(1.45)
Hold and Lose 67				-0.0853	-0.0746	-0.0746	-0.0823	-0.0905
				(4.40)***	(3.78)***	(2.31)**	(3.63)***	(4.15)***
(Hold and Lose 67)*(Cash Flow)				0.3749	0.3495	0.3495	0.3784	0.3762
				(8.10)***	(7.29)***	(3.22)***	(5.47)***	(5.77)***
Time Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Firm Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
(Time)*(Cash Flow) Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Observations	1032	1032	1032	1032	1032	1032	1032	1032
Adjusted R-squared	0.22	0.58	0.60	0.62	0.63	0.63	R^2=0.65	R^2=0.79

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6d. Regression of Investment on Cash Flow and Exercise Behavior

Sample: CEOs with options more than 100% in the money in the fifth year at least two times
Dependent Variable: Investment   **Normalization:** Beginning of year capital

	Baseline Regressions			Late Exercise of 100% in the money option (in year 5) with Losses				
	no fixed effects, no controls	fixed effects, no controls	fixed effects, controls		with controls	with clustered standard errors	panel corrected standard errors (ar1)	panel corrected standard errors (psar1)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash Flow	0.2363	0.3005	0.2143	0.0692	0.1974	0.1974	0.1313	0.0960
	(15.54)***	(6.08)***	(2.81)***	(1.05)	(2.64)***	(1.31)	(1.19)	(0.88)
Q	-0.0079	0.0876	-0.0357	-0.0601	-0.0601	-0.0601	-0.1159	-0.1274
	(0.49)	(3.57)***	(0.86)	(1.53)	(1.50)	(0.82)	(1.90)*	(2.19)**
(Q)*(Cash Flow)			0.2272	0.3106	0.3121	0.3121	0.3821	0.4393
			(3.95)***	(5.66)***	(5.48)***	(1.64)	(3.46)***	(4.07)***
CEO ownership			0.8240		0.6707	0.6707	0.7688	0.8927
			(2.63)***		(2.18)**	(2.02)**	(2.55)**	(3.11)***
CEO vested options			-0.0203		-0.0099	-0.0099	-0.0099	-0.0121
			(2.59)***		(1.29)	(1.05)	(1.24)	(1.56)
Corporate Governance			0.0420		0.0432	0.0432	0.0411	0.0403
			(2.54)**		(2.68)***	(2.78)***	(2.77)***	(2.99)***
(CEO ownership)*(Cash Flow)			-0.9418		-0.7392	-0.7392	-0.8900	-0.9036
			(3.82)***		(2.92)***	(1.56)	(2.86)***	(3.16)***
(CEO vested options)*(Cash Flow)			0.0704		0.0417	0.0417	0.0445	0.0423
			(4.27)***		(2.55)**	(1.24)	(2.04)**	(1.96)*
(Corporate Governance)*(Cash Flow)			-0.1141		-0.1301	-0.1301	-0.1231	-0.1321
			(2.76)***		(3.20)***	(3.12)***	(2.78)***	(3.27)***
Hold and Win 100				0.0351	0.0387	0.0387	0.0402	0.0475
				(1.74)*	(1.83)*	(1.05)	(1.81)*	(2.31)**
(Hold and Win 100)*(Cash Flow)				-0.0545	-0.0680	-0.0680	-0.0614	-0.0871
				(1.17)	(1.38)	(0.68)	(0.92)	(1.50)
Hold and Lose 100				-0.0843	-0.0734	-0.0734	-0.0817	-0.0942
				(4.25)***	(3.63)***	(2.11)**	(3.47)***	(4.15)***
(Hold and Lose 100)*(Cash Flow)				0.3650	0.3391	0.3391	0.3692	0.3763
				(7.71)***	(6.88)***	(2.98)***	(5.09)***	(5.50)***
Time Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Firm Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
(Time)*(Cash Flow) Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Observations	989	989	989	989	989	989	989	989
Adjusted R-squared	0.23	0.59	0.6	0.63	0.63	0.63	R^2=0.66	R^2=0.79

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6e. Regression of Investment on Cash Flow and Exercise Behavior

Sample: CEOs with options more than 67% in the money in the fifth year at least two times
Dependent Variable: Investment   **Normalization:** Beginning of year capital

	Baseline Regressions			Late Exercise of 67% in the money option (in year 5) with Losses				
	no fixed effects, no controls	fixed effects, no controls	fixed effects, controls		with controls	with clustered standard errors	panel corrected standard errors (ar1)	panel corrected standard errors (psar1)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash Flow	0.2348	0.3008	0.1952	-0.0214	0.0397	0.0397	-0.0401	-0.0640
	(15.69)***	(6.16)***	(2.59)***	(0.33)	(0.54)	(0.22)	(0.35)	(0.55)
Q	-0.0073	0.0882	-0.0368	-0.0779	-0.0818	-0.0818	-0.1430	-0.1558
	(0.46)	(3.64)***	(0.91)	(2.05)**	(2.09)**	(1.04)	(2.34)**	(2.62)***
(Q)*(Cash Flow)			0.2318	0.3414	0.3502	0.3502	0.4308	0.4936
			(4.12)***	(6.41)***	(6.32)***	(1.76)*	(3.89)***	(4.38)***
CEO ownership			0.7874		0.3747	0.3747	0.4977	0.6558
			(2.54)**		(1.25)	(1.33)	(1.69)*	(2.20)**
CEO vested options			-0.0200		-0.0050	-0.0050	-0.0051	-0.0086
			(2.60)***		(0.66)	(0.50)	(0.64)	(1.10)
Corporate Governance			0.0408		0.0370	0.0370	0.0334	0.0407
			(2.54)**		(2.41)**	(2.28)**	(2.41)**	(3.20)***
(CEO ownership)*(Cash Flow)			-0.9073		-0.2104	-0.2104	-0.3766	-0.3794
			(3.72)***		(0.86)	(0.38)	(1.17)	(1.24)
(CEO vested options)*(Cash Flow)			0.0695		0.0241	0.0241	0.0298	0.0307
			(4.25)***		(1.47)	(0.63)	(1.34)	(1.37)
(Corporate Governance)*(Cash Flow)			-0.0986		-0.0812	-0.0812	-0.0748	-0.0958
			(2.45)**		(2.10)**	(1.77)*	(1.84)*	(2.57)**
Invariant Hold and Lose 67				-1.0148	-1.0244	-1.0244	-0.5092	-0.4839
				(9.49)***	(9.19)***	(8.21)***	(7.42)***	(2.17)**
(Inv. Hold and Lose 67)*(Cash Flow)				0.4669	0.4410	0.4410	0.4667	0.4791
				(10.32)***	(9.10)***	(3.46)***	(6.61)***	(7.21)***
Time Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Firm Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
(Time)*(Cash Flow) Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Observations	1032	1032	1032	1032	1032	1032	1032	1032
Adjusted R-squared	0.22	0.58	0.6	0.63	0.63	0.63	R^2=0.65	R^2=0.78

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6f. Regression of Investment on Cash Flow and Exercise Behavior

Sample: CEOs with options more than 100% in the money in the fifth year at least two times
Dependent Variable: Investment   **Normalization:** Beginning of year capital

	Baseline Regressions			Late Exercise of 100% in the money option (in year 5) with Losses				
	no fixed effects, no controls	fixed effects, no controls	fixed effects, controls		with controls	with clustered standard errors	panel corrected standard errors (ar1)	panel corrected standard errors (psar1)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash Flow	0.2363	0.3005	0.2143	-0.0224	0.0513	0.0513	-0.0310	-0.0688
	(15.54)***	(6.08)***	(2.81)***	(0.34)	(0.68)	(0.28)	(0.27)	(0.57)
Q	-0.0079	0.0876	-0.0357	-0.0781	-0.0852	-0.0852	-0.1460	-0.1639
	(0.49)	(3.57)***	(0.86)	(2.01)**	(2.13)**	(1.05)	(2.33)**	(2.67)***
(Q)*(Cash Flow)			0.2272	0.3415	0.3541	0.3541	0.4352	0.5082
			(3.95)***	(6.28)***	(6.23)***	(1.72)*	(3.80)***	(4.34)***
CEO ownership			0.8240		0.3960	0.3960	0.5112	0.6439
			(2.63)***		(1.31)	(1.43)	(1.73)*	(2.17)**
CEO vested options			-0.0203		-0.0043	-0.0043	-0.0043	-0.0073
			(2.59)***		(0.56)	(0.42)	(0.53)	(0.91)
Corporate Governance			0.0420		0.0388	0.0388	0.0349	0.0397
			(2.54)**		(2.45)**	(2.24)**	(2.45)**	(3.06)***
(CEO ownership)*(Cash Flow)			-0.9418		-0.2205	-0.2205	-0.3785	-0.3660
			(3.82)***		(0.88)	(0.38)	(1.13)	(1.16)
(CEO vested options)*(Cash Flow)			0.0704		0.0240	0.0240	0.0298	0.0301
			(4.27)***		(1.45)	(0.62)	(1.32)	(1.33)
(Corporate Governance)*(Cash Flow)			-0.1141		-0.0981	-0.0981	-0.0901	-0.1060
			(2.76)***		(2.47)**	(2.11)**	(2.17)**	(2.80)***
Invariant Hold and Lose 100				-1.0234	-1.048	-1.048	-0.5080	-0.2548
				(9.48)***	(9.28)***	(8.12)***	(7.20)***	(3.21)***
(Inv. Hold and Lose 100)*(Cash Flow)				0.4653	0.4377	0.4377	0.4642	0.4821
				(10.12)***	(8.85)***	(3.33)***	(6.33)***	(6.99)***
Time Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Firm Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
(Time)*(Cash Flow) Fixed Effects	no	yes	yes	yes	yes	yes	yes	yes
Observations	989	989	989	989	989	989	989	989
Adjusted R-squared	0.23	0.59	0.6	0.64	0.64	0.64	R^2=0.66	R^2=0.78

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7. Time Series of the Fraction of CEOs that Hold Options 67% or 100% in the Money

Year	Fraction who Hold Despite Reaching 67% in Money	Observations	Fraction who Hold Despite Reaching 100% in Money	Observations
85	0.35	63	0.36	59
86	0.52	71	0.55	66
87	0.43	92	0.43	92
88	0.49	77	0.49	77
89	0.40	89	0.41	85
90	0.61	88	0.61	84
91	0.52	79	0.49	71
92	0.35	83	0.38	76
93	0.38	69	0.35	62
94	0.45	69	0.45	67

Fraction who Hold Despite Reaching 67% in Money

Fraction who Hold Despite Reaching 100% in Money
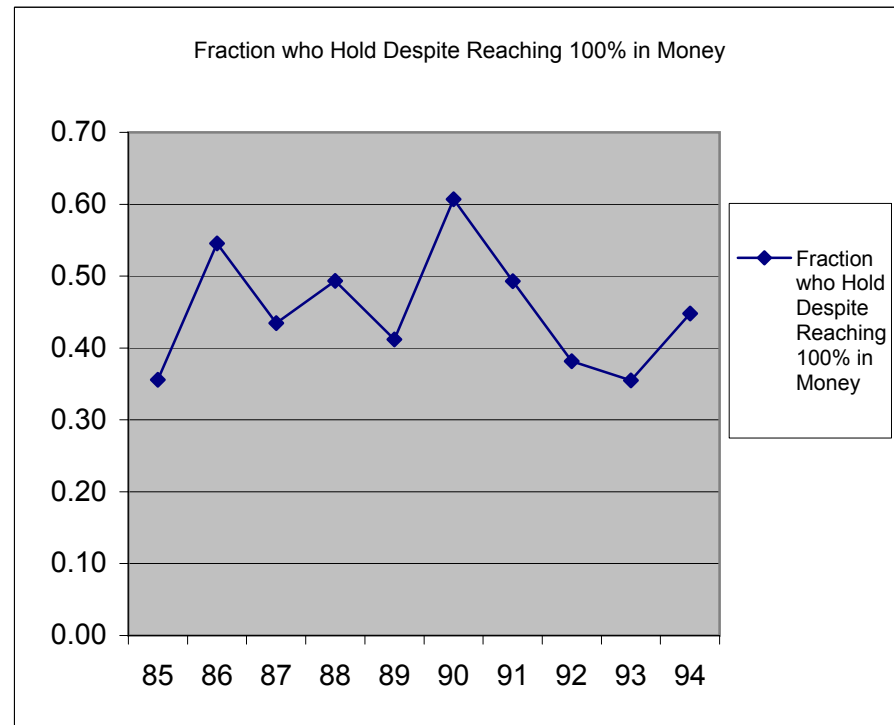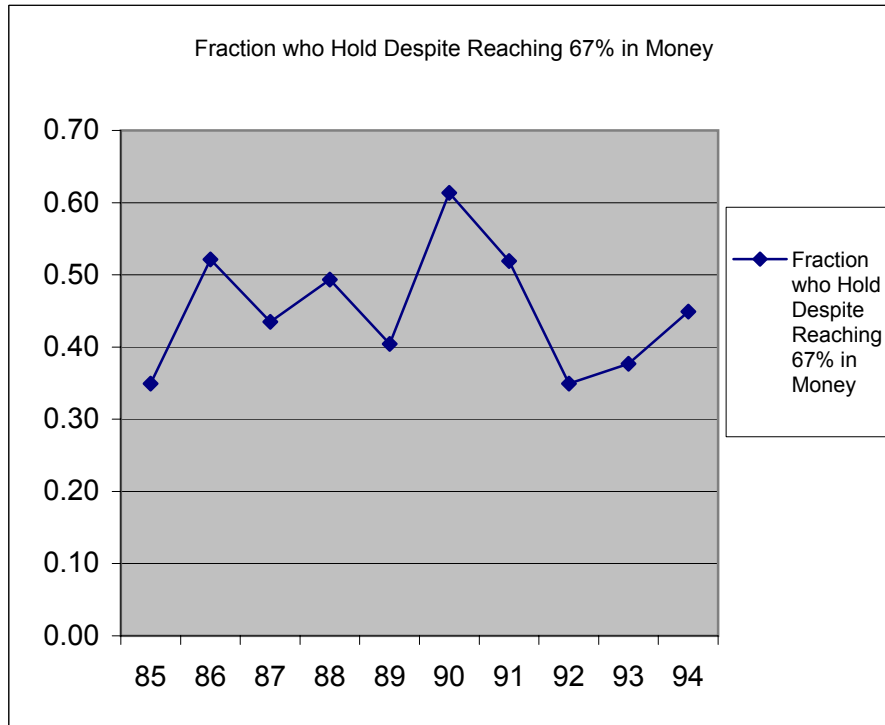
Table 8. Regression of Investment on Cash Flow and Holding Options "Forever"

Dependent Variable: Investment   **Normalization:** Beginning of year capital

	Baseline Regressions			Holding Options until the last year before expiration			
	no fixed effects, no controls	fixed effects, no controls	fixed effects, controls		with controls	with clustered standard errors	panel corrected standard errors (psar1)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cash Flow	0.2404	0.2993	0.1485	0.1135	0.1228	0.1228	-0.0047
	(26.48)***	(9.42)***	(3.59)***	(2.78)***	(2.94)***	(0.82)	(0.06)
Q	0.0584	0.0896	-0.0013	-0.0096	-0.0110	-0.0110	-0.0741
	(6.11)***	(5.82)***	(0.06)	(0.45)	(0.51)	(0.17)	(2.07)**
(Q)*(Cash Flow)			0.1981	0.2082	0.2156	0.2156	0.3706
			(6.26)***	(6.56)***	(6.77)***	(1.45)	(5.22)***
CEO ownership [in %]			0.0039		0.0314	0.0314	0.1428
			(0.07)		(0.52)	(0.18)	(1.42)
CEO vested options			0.0003		0.0020	0.0020	-0.0015
			(0.06)		(0.49)	(0.22)	(0.26)
Corporate Governance			0.0212		0.0210	0.0210	0.0250
			(2.84)***		(2.81)***	(1.86)*	(2.76)***
(CEO ownership)*(Cash Flow)			0.6763		0.6031	0.6031	0.4936
			(5.37)***		(4.72)***	(0.87)	(2.26)**
(CEO vested options)*(Cash Flow)			0.0162		0.0071	0.0071	0.0088
			(2.04)**		(0.86)	(0.20)	(0.56)
(Corporate Governance)*(Cash Flow)			-0.0677		-0.0635	-0.0635	-0.0782
			(3.37)***		(3.16)***	(1.63)	(2.61)***
ForeverHolder				-0.0253	-0.0194	-0.0194	-0.0283
				(2.42)**	(1.81)*	(0.74)	(1.88)*
(ForeverHolder)*(Cash Flow)				0.1017	0.0845	0.0845	0.1195
				(4.95)***	(3.90)***	(0.99)	(2.90)***
Time Fixed Effects	no	yes	yes	yes	yes	yes	yes
Firm Fixed Effects	no	yes	yes	yes	yes	yes	yes
(Time)*(Cash Flow) Fixed Effects	no	yes	yes	yes	yes	yes	yes
Observations	3354	3354	3354	3354	3354	3354	3354
Adjusted R-squared	0.24	0.57	0.58	0.58	0.58	0.58	R^2=0.73

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.
Absolute value of t statistics in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 9. Regression of Investment on Cash Flow and Buying behavior in first five years

Sample: CEOs who appear in the data for at least 13 years
Dependent Variable: Investment   **Normalization:** Beginning of the year capital

	Baseline Regressions			Buying Behavior in first five years			
	no fixed effects, no controls (1)	fixed effects, no controls (2)	fixed effects, controls (3)	OLS (4)	OLS (5)	with lagged investment (6)	panel corrected standard errors (psar1) (7)
Cash Flow	0.3495	0.3498	0.1213	0.4123	-0.0265	-0.0265	-0.1116
	(13.83)***	(3.96)***	(0.79)	(3.22)***	(0.18)	(0.18)	(0.74)
Q	-0.0531	-0.0582	-0.0985	-0.0140	-0.0139	-0.0139	-0.0892
	(1.78)*	(1.17)	(1.36)	(0.19)	(0.19)	(0.13)	(1.14)
Q*(Cash Flow)			0.1912	-0.2004	-0.0809	-0.0809	-0.0399
			(1.70)*	(1.64)	(0.67)	(0.53)	(0.31)
CEO ownership			-0.7236		-0.2189	-0.2189	-0.3295
			(2.55)**		(0.75)	(0.58)	(1.36)
CEO vested options			-0.0292		-0.0345	-0.0345	-0.0404
			(2.22)**		(2.70)***	(1.78)*	(2.98)***
Corporate Governance			0.1155		0.0416	0.0416	0.0274
			(3.96)***		(1.32)	(1.19)	(1.10)
(CEO ownership)*(Cash Flow)			3.3706		1.7151	1.7151	2.0473
			(6.01)***		(2.74)***	(1.69)*	(3.38)***
(CEO vested options)*(Cash Flow)			0.1986		0.2237	0.2237	0.2552
			(6.23)***		(7.17)***	(3.87)***	(7.60)***
(Corporate Governance)*(Cash Flow)			-0.4462		-0.0850	-0.0850	-0.0754
			(5.20)***		(0.79)	(0.55)	(0.67)
Net Buyer in first five years				-0.6442	-0.2486	-0.2486	0.2614
				(2.46)**	(0.70)	(0.67)	(1.31)
(Net Buyer)*(Cash Flow)				0.416	0.5781	0.5781	0.6422
				(5.83)***	(5.31)***	(3.33)***	(4.60)***
Time FE	no	yes	yes	yes	yes	yes	yes
Cash Flow-Time FE	no	yes	yes	yes	yes	yes	yes
Firm FE	no	yes	yes	yes	yes	yes	yes
Number of Observations	497	497	497	497	497	497	497
Adjusted R-squared	0.29	0.66	0.71	0.69	0.73	0.73	R^2=0.84

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.

Absolute value of t statistics in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%. Constant included.

Table 10. Normalization with Lagged Assets

Dependent Variable: Investment. **Normalization:** Lagged Assets

	OLS (1)	OLS (2)	OLS (3)	OLS (4)	clustered (5)	OLS (6)	pcse psar1 (7)	pcse psar1 (8)	pcse psar1 (9)
Cash Flow	0.512	0.2102	-0.2155	0.3127	0.3127	0.3548	0.2984	0.1431	0.2629
	(10.97)***	(3.19)***	(1.14)	(2.58)**	(1.46)	(2.98)***	(2.47)**	(0.62)	(1.11)
Q	0.024	0.0045	-0.0330	0.0186	0.0186	0.0148	-0.0081	-0.0296	-0.0322
	(4.49)***	(0.49)	(0.94)	(1.02)	(0.75)	(0.81)	(0.36)	(1.18)	(1.28)
CEO ownership		-0.1031	-0.2432	-0.0575	-0.0575	-0.0399	0.0326	0.0946	0.1057
		(4.17)***	(1.75)*	(0.39)	(0.36)	(0.27)	(0.34)	(1.31)	(1.47)
CEO vested options		-0.0002	-0.0078	-0.0124	-0.0124	-0.0110	-0.0138	-0.0058	-0.006
		(0.12)	(1.24)	(3.21)***	(2.24)**	(2.88)***	(3.37)***	(1.85)*	(1.92)*
Corporate Governance		0.0055	-0.0284	0.0161	0.0161	0.0179	0.0141	-0.0041	-0.0044
		(1.59)	(1.60)	(2.17)**	(1.32)	(2.42)**	(1.95)*	(0.94)	(0.99)
(Ownership)*(CF)		2.032	3.1905	1.5567	1.5567	1.4556	1.7912	1.0578	1.0018
		(12.69)***	(4.04)***	(1.81)*	(0.75)	(1.71)*	(2.03)**	(2.25)**	(2.11)**
(Vested options)*(CF)		0.0197	0.1676	0.0855	0.0855	0.0751	0.0930	0.0400	0.0421
		(1.72)*	(4.04)***	(3.24)***	(1.74)*	(2.86)***	(2.78)***	(1.37)	(1.44)
(Corp. Gov.)*(CF)		-0.0531	0.3336	-0.0821	-0.0821	-0.1031	-0.0878	0.0408	0.0428
		(1.87)*	(2.20)**	(1.56)	(0.82)	(1.95)*	(1.39)	(0.96)	(1.00)
(Q)*(CF)		0.0842	-0.0217	0.0858	0.0858	0.1168	0.2234	0.4762	0.4872
		(2.12)**	(0.17)	(1.19)	(0.51)	(1.62)	(2.15)**	(3.14)***	(3.11)***
Hold and Lose 67						-0.0332	-0.0373		
						(3.78)***	(3.41)***		
(Hold and Lose 67)*(CF)						0.3461	0.3888		
						(5.45)***	(4.18)***		
Invariant Hold and Lose 67				-0.0875	-0.0875				
				(2.05)**	(3.50)***				
(Inv. Hold and Lose 67)*(CF)				0.2756	0.2756				
				(4.24)***	(1.48)				
Longholder		-0.0112							
		(2.19)**							
(Longholder) * (CF)		0.0970							
		(2.89)***							
Net Stock Buyer in First Five Years			-0.0218						
			(0.33)						
(Net Buyer) * (CF)			0.2918						
			(2.10)**						
Finance Education									0.0226
									(3.09)***
(Finance Education) * (CF)									-0.1395
									(2.52)**
Technical Education									-0.0184
									(2.14)**
(Technical Education)*(CF)									0.0568
									(0.97)
Observations	4193	3372	497	1033	1033	1033	1033	1469	1469
Adjusted R-squared	0.66	0.70	0.81	0.67	0.67	0.67	R^2=0.77	R^2=0.88	R^2=0.88

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.
Absolute value of t statistics in parentheses. Year FE, Firm FE, Time*CF FE included except column (1). Columns (8) & (9) include Industry*CF FE where Industries are (roughly) grouped by 2 digit SIC code (see Appendix B). Constant included. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 11a. Regressions Controlling for Industry Effects

Dependent Variable: Investment **Normalization:** Beginning of year capital **Industries:** 2-digit SIC codes

	OLS (1)	OLS (2)	OLS (3)	clustered (4)	pcse (psar1) (5)	OLS (6)
Cash Flow	0.1982	0.0572	-0.0073	-0.0073	-0.0031	-0.4046
	(4.29)***	(0.79)	(0.10)	(0.04)	(0.03)	(2.45)**
Q	-0.0281	-0.1104	-0.1233	-0.1233	-0.1470	-0.1785
	(1.31)	(2.91)***	(3.24)***	(1.72)*	(2.76)***	(2.55)**
CEO ownership	-0.0947	0.2976	0.0375	0.0375	0.4714	-0.1969
	(1.58)	(0.98)	(0.12)	(0.13)	(1.80)*	(0.72)
CEO vested options	0.0024	-0.0108	-0.0084	-0.0084	-0.0121	-0.0102
	(0.57)	(1.51)	(1.16)	(0.90)	(1.66)*	(0.84)
Corporate Governance	0.0333	0.0429	0.0431	0.0431	0.0393	0.0089
	(4.46)***	(2.70)***	(2.72)***	(2.58)**	(2.84)***	(0.30)
(Ownership)*(CF)	1.1568	-0.3354	0.1725	0.1725	-0.4069	2.0615
	(8.47)***	(1.07)	(0.51)	(0.36)	(1.35)	(3.49)***
(Vested options)*(CF)	0.0197	0.0351	0.0271	0.0271	0.0278	0.1284
	(2.31)**	(2.22)**	(1.69)*	(0.73)	(1.29)	(4.12)***
(Corp. Gov.)*(CF)	-0.1118	-0.1095	-0.0989	-0.0989	-0.1187	0.0536
	(5.41)***	(2.57)**	(2.33)**	(1.83)*	(2.82)***	(0.52)
(Q)*(CF)	0.2224	0.3550	0.3761	0.3761	0.4349	0.1931
	(6.81)***	(6.64)***	(6.96)***	(2.32)**	(4.82)***	(1.63)
Hold and Lose 67		-0.0531			-0.0685	
		(2.86)***			(3.38)***	
(Hold and Lose 67)*(CF)		0.2610			0.3244	
		(5.61)***			(5.34)***	
Invariant Hold and Lose 67			-0.3276	-0.3276		
			(3.89)***	(2.56)**		
(Inv. Hold and Lose 67)*(CF)			0.3161	0.3161		
			(5.94)***	(2.43)**		
Longholder	-0.0379					
	(3.49)***					
(Longholder) * (CF)	0.1579					
	(6.58)***					
Net Buyer in first Five Years						-1.7052
						(3.66)***
(Net Buyer) * (CF)						0.4876
						(4.67)***
Observations	3345	1030	1030	1030	1030	497
Adjusted R-squared	0.60	0.66	0.66	0.66	R^2=0.81	0.77

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.
Absolute value of t statistics in parentheses. Year FE, Firm FE, Time*CF FE included. All regressions include Industry*CF FE where
industries are grouped by 2 digit SIC code (see Appendix B). Constant included. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 11b. Regressions Controlling for Industry Effects

Dependent Variable: Investment **Normalization:** Beginning of year capital **Industries:** Fama-French (1997) groups

	OLS (1)	OLS (2)	OLS (3)	clustered (4)	pcse (psar1) (5)	OLS (6)
Cash Flow	0.4241	2.1378	1.5724	1.5724	2.256	4.1708
	(0.57)	(3.04)***	(2.24)**	(5.91)***	(3.60)***	(2.37)**
Q	-0.0862	-0.3050	-0.3246	-0.3246	-0.3220	-0.1943
	(3.73)***	(6.98)***	(7.47)***	(4.00)***	(5.00)***	(2.62)***
CEO ownership	-0.0336	-0.1281	-0.5157	-0.5157	-0.1010	1.0308
	(0.49)	(0.31)	(1.22)	(0.96)	(0.23)	(2.10)**
CEO vested options	0.0010	-0.0148	-0.0105	-0.0105	-0.0160	-0.0085
	(0.23)	(2.00)**	(1.40)	(1.06)	(2.06)**	(0.65)
Corporate Governance	0.0304	0.0314	0.0293	0.0293	0.0318	-0.0121
	(4.02)***	(1.89)*	(1.77)*	(2.20)**	(2.21)**	(0.40)
(Ownership)*(CF)	0.8204	0.5622	1.3397	1.3397	0.7054	-1.5132
	(4.22)***	(0.86)	(1.96)*	(1.23)	(0.84)	(1.32)
(Vested options)*(CF)	0.0233	0.0490	0.0305	0.0305	0.0498	0.1085
	(2.45)**	(2.95)***	(1.75)*	(0.82)	(2.32)**	(2.83)***
(Corp. Gov.)*(CF)	-0.1003	-0.0758	-0.0589	-0.0589	-0.0995	0.0631
	(4.58)***	(1.57)	(1.23)	(1.13)	(2.21)**	(0.57)
(Q)*(CF)	0.3245	0.7782	0.8150	0.8150	0.7841	0.1961
	(8.35)***	(10.55)***	(11.04)***	(4.30)***	(5.98)***	(1.51)
Hold and Lose 67		-0.0698			-0.0796	
		(3.76)***			(3.88)***	
(Hold and Lose 67)*(CF)		0.2459			0.2921	
		(5.31)***			(4.95)***	
Invariant Hold and Lose 67			-0.5565	-0.5565		
			(4.85)***	(3.56)***		
(Inv. Hold and Lose 67)*(CF)			0.3573	0.3573		
			(5.75)***	(2.21)**		
Longholder	-0.0491					
	(4.41)***					
(Longholder) * (CF)	0.1635					
	(5.91)***					
Net Buyer in first Five Years						4.5235
						(1.02)
(Net Buyer) * (CF)						0.1280
						(0.71)
Observations	3345	1030	1030	1030	1030	497
Adjusted R-squared	0.64	0.7	0.7	0.7	R^2=0.83	0.81

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.
Absolute value of t statistics in parentheses. Year FE, Firm FE, Time*CF FE included. All regressions include Industry*CF FE where
industries are grouped as in Fama-French (1997). Constant included. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 12. Regressions Controlling for Firm Size

Dependent Variable: Investment. **Normalization:** Beginning of year capital

	OLS (1)	OLS (2)	OLS (3)	clustered (4)	pcse psar1 (5)	OLS (6)	pcse psar1 (7)	pcse psar1 (8)
Cash Flow	2.2957	1.9443	1.7007	1.7007	2.0493	2.527	2.9465	2.761
	(15.14)***	(6.37)***	(5.62)***	(2.18)**	(3.96)***	(2.68)***	(4.75)***	(4.47)***
Q	0.0115	-0.0420	-0.0494	-0.0494	-0.1042	0.0251	-0.0873	-0.0858
	(0.54)	(1.09)	(1.30)	(0.89)	(2.06)**	(0.35)	(1.32)	(1.30)
CEO ownership [%]	0.0296	-0.0102	-0.2516	-0.2516	-0.0086	-0.1262	0.3720	0.3694
	(0.53)	(0.03)	(0.87)	(0.82)	(0.03)	(0.40)	(2.26)**	(2.24)**
CEO vested options [#]	0.0003	-0.0035	0.0040	0.0040	-0.0018	-0.0179	-0.0042	-0.0047
	(0.09)	(0.49)	(0.54)	(0.49)	(0.24)	(1.37)	(0.70)	(0.79)
Corporate Governance	0.0346	0.0512	0.0538	0.0538	0.0474	0.0570	0.0066	0.0082
	(4.78)***	(3.31)***	(3.53)***	(3.97)***	(3.56)***	(1.85)*	(0.80)	(0.99)
(Ownership)*(CF)	0.1172	0.4475	0.8812	0.8812	0.4579	0.6891	-0.1434	-0.1331
	(0.97)	(1.77)*	(3.42)***	(1.57)	(1.37)	(0.86)	(0.51)	(0.48)
(Vested options)*(CF)	-0.0081	0.0090	-0.0171	-0.0171	-0.0070	0.1442	0.0106	0.0126
	(1.02)	(0.55)	(1.02)	(0.66)	(0.33)	(4.02)***	(0.60)	(0.71)
(Corp. Gov.)*(CF)	-0.1454	-0.1580	-0.1553	-0.1553	-0.1525	-0.2046	-0.0509	-0.0551
	(7.20)***	(3.93)***	(3.92)***	(3.79)***	(3.81)***	(1.90)*	(1.66)*	(1.80)*
(Q)*(CF)	0.0822	0.2257	0.2375	0.2375	0.3106	-0.1643	0.2126	0.2119
	(2.48)**	(4.04)***	(4.33)***	(2.00)**	(3.88)***	(1.33)	(1.73)*	(1.72)*
Hold and Lose 67		-0.0480			-0.0507			
		(2.60)***			(2.39)**			
(Hold and Lose 67)*(CF)		0.2166			0.1959			
		(4.63)***			(3.62)***			
Invariant Hold and Lose 67			-0.8720	-0.8720				
			(7.55)***	(6.75)***				
(Inv. Hold and Lose 67)*(CF)			0.3446	0.3446				
			(6.78)***	(3.73)***				
Longholder	-0.0272							
	(2.73)***							
(Longholder) * (CF)	0.1117							
	(5.55)***							
Net Buyer in first Five Years						0.1745		
						(0.49)		
(Net Buyer) * (CF)						0.4461		
						(3.86)***		
Finance Education							0.0479	
							(3.23)***	
(Finance Education) * (CF)							-0.1949	
							(4.04)***	
Technical Education								-0.0543
								(2.98)***
(Technical Education)*(CF)								0.1786
								(3.60)***
Firm Size	0.0526	0.1091	0.0857	0.0857	0.0761	0.1004	-0.0707	-0.0736
	(2.06)**	(2.06)**	(1.64)	(0.96)	(0.93)	(0.92)	(0.54)	(0.56)
(Firm Size) * (CF)	-0.5309	-0.4868	-0.4143	-0.4143	-0.5317	-0.5444	-0.6151	-0.6182
	(14.27)***	(5.64)***	(4.83)***	(1.74)*	(3.57)***	(2.17)**	(3.78)***	(3.78)***
Firm Size Squared	-0.0048	-0.0094	-0.0073	-0.0073	-0.0074	-0.0106		
	(2.89)***	(2.77)***	(2.14)**	(1.34)	(1.47)	(1.47)		
(Firm Size Squared) * (CF)	0.0308	0.0291	0.0226	0.0226	0.0313	0.0326	0.0347	0.0351
	(12.58)***	(4.90)***	(3.77)***	(1.42)	(3.18)***	(1.94)*	(3.47)***	(3.49)***
Observations	3354	1032	1032	1032	1032	497	1465	1465
Adjusted R-squared	0.64	0.67	0.68	0.68	R^2=0.81	0.75	R^2=0.85	R^2=0.85

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.
Absolute value of t statistics in parentheses. Year FE, Firm FE, Time*CF FE included. Columns (7) & (8) include Industry*CF FE where Industries are (roughly)
grouped by 2 digit SIC code (see Appendix B). Constant included. * significant at 10%; ** significant at 5%; *** significant at 1%. Lagged investment included where indicated.

Table 13. Kaplan-Zingales Index as a Control for Financing Constraints

Dependent Variable: Investment.　　**Normalization:** Beginning of year capital

	OLS (1)	OLS (2)	OLS (3)	clustered (4)	pcse psar1 (5)	OLS (6)	pcse psar1 (7)	pcse psar1 (8)
Cash Flow	0.1841	0.4985	0.3670	0.3670	0.3912	0.5129	0.4019	0.1874
	(4.16)***	(5.62)***	(4.09)***	(1.46)	(3.14)***	(2.74)***	(2.37)**	(1.13)
Q	-0.0343	-0.0970	-0.1144	-0.1144	-0.1330	-0.0526	-0.2258	-0.2292
	(1.63)	(2.42)**	(2.86)***	(1.51)	(2.34)**	(0.74)	(4.44)***	(4.54)***
1st Quintile of KZindex	0.0977	0.1953	0.1959	0.1959	0.1789	0.1936	0.0848	0.0910
	(7.92)***	(7.80)***	(7.90)***	(3.60)***	(6.81)***	(4.76)***	(3.85)***	(4.18)***
2nd Quintile of Kzindex	0.0739	0.1677	0.1720	0.1720	0.1456	0.0631	0.1220	0.1258
	(6.09)***	(6.74)***	(6.97)***	(4.82)***	(5.68)***	(1.15)	(7.46)***	(7.66)***
3rd Quintile of Kzindex	0.0322	0.1531	0.1650	0.1650	0.1409	0.0935	0.0691	0.0717
	(3.24)***	(7.05)***	(7.62)***	(4.13)***	(6.71)***	(2.65)***	(5.51)***	(5.78)***
4th Quintile of Kzindex	0.0272	0.0832	0.0875	0.0875	0.0796	0.0534	0.0516	0.0553
	(3.01)***	(4.05)***	(4.28)***	(2.69)***	(2.89)***	(1.64)	(4.44)***	(4.80)***
(KZindex1)*(CF)	-0.0895	-0.4115	-0.4065	-0.4065	-0.3699	-0.5898	-0.1811	-0.1944
	(3.43)***	(6.27)***	(6.24)***	(2.30)**	(4.11)***	(6.07)***	(2.73)***	(2.96)***
(KZindex2)*(CF)	-0.0922	-0.3858	-0.3951	-0.3951	-0.3271	-0.3194	-0.3331	-0.3445
	(2.58)***	(5.23)***	(5.41)***	(2.09)**	(3.27)***	(1.96)*	(5.05)***	(5.20)***
(KZindex3)*(CF)	-0.0013	-0.4994	-0.5122	-0.5122	-0.4887	-0.4451	-0.2790	-0.2798
	(0.04)	(6.57)***	(6.79)***	(2.48)**	(4.99)***	(3.97)***	(4.38)***	(4.42)***
(KZindex4)*(CF)	-0.0890	-0.3495	-0.3422	-0.3422	-0.3591	-0.4243	-0.3333	-0.3436
	(2.25)**	(4.19)***	(4.13)***	(1.90)*	(2.25)**	(3.29)***	(4.16)***	(4.29)***
Hold and Lose 67		-0.0967			-0.1180			
		(5.30)***			(5.88)***			
(Hold and Lose 67)*(CF)		0.3871			0.4190			
		(8.69)***			(7.21)***			
Invariant Hold and Lose 67			-0.5338	-0.5338				
			(7.24)***	(11.92)***				
(Inv. Hold and Lose 67)*(CF)			0.4611	0.4611				
			(9.53)***	(4.14)***				
Longholder	-0.0304							
	(2.85)***							
(Longholder) * (CF)	0.1152							
	(5.16)***							
Net Buyer in first Five Years						-1.4678		
						(5.31)***		
(Net Buyer)*(CF)						0.2021		
						(1.65)		
Finance Education							0.0478	
							(3.62)***	
(Finance Education) * (CF)							-0.2142	
							(4.72)***	
Technical Education								-0.0673
								(3.99)***
(Technical Education) * (CF)								0.2028
								(4.41)***
Observations	3291	1019	1019	1019	1019	490	1444	1444
Adjusted R-squared	0.61	0.66	0.66	0.66	R^2=0.82	0.76	R^2=0.87	R^2=0.87

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices

Absolute value of t statistics in parentheses. Year FE, Firm FE, Time*CF FE included. Constant included. * significant at 10%; ** significant at 5%; *** significant at 1%

Additional controls: Ownership, Vested Options, Corporate Governance, Ownership*CF, Governance*CF, Options*CF, and Q*CF.   Columns (8) and (9) include

industry * CF fixed effects where industries are classified according to 2-digit SIC codes (see Appendix B).

Table 14. Regression of Investment on Cash Flow and Overconfidence by Equity Dependence

Firms are classified according to quintiles of the Kaplan-Zingales index, where the most constrained subsample contains the highest quintile

Dependent Variable: Investment   **Normalization:** Beginning of year capital

	OLS with fixed effects					Panel Corrected Standard Errors (Panel Specific ar1)				
	Most Constrained	-->			Least Constrained	Most Constrained	-->			Least Constrained
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Cash Flow	-0.3948	-0.0852	0.0210	0.0742	0.4712	-0.2844	-0.2251	-0.1040	0.4151	0.3819
	(2.09)**	(0.59)	(0.16)	(0.57)	(4.87)***	(1.62)	(1.63)	(0.74)	(3.18)***	(2.98)***
Q	-0.0953	-0.0625	0.0609	-0.1006	0.1045	-0.1159	-0.1141	0.0249	-0.0534	-0.0046
	(1.70)*	(1.31)	(1.21)	(1.95)*	(1.72)*	(2.20)**	(2.54)**	(0.57)	(1.03)	(0.09)
CEO ownership	-0.5524	0.1956	0.1723	-0.1424	0.3921	-0.4627	0.0883	0.0729	-0.1195	0.4795
	(4.02)***	(1.15)	(0.93)	(1.29)	(1.61)	(2.42)**	(0.57)	(0.38)	(2.40)**	(2.77)***
CEO vested options	0.0173	0.0122	0.0218	-0.0013	-0.0241	0.0162	0.0079	0.0156	-0.0020	-0.0305
	(2.20)**	(1.28)	(2.32)**	(0.13)	(1.47)	(1.94)*	(0.77)	(1.53)	(0.28)	(2.02)**
Corporate Governance	0.0108	-0.0110	-0.0329	0.0128	0.0058	0.0208	-0.0114	-0.0272	0.0310	0.0142
	(0.75)	(1.06)	(2.56)**	(0.71)	(0.19)	(1.64)	(1.22)	(2.76)***	(1.97)**	(0.47)
(CEO ownership)*(Cash Flow)	1.0952	0.1642	-1.8177	-0.3904	-0.7232	0.7599	-0.0773	-1.4445	-0.0101	-0.7095
	(2.39)**	(0.26)	(2.43)**	(0.86)	(2.13)**	(1.93)*	(0.14)	(2.08)**	(0.05)	(2.36)**
(CEO vested options)*(Cash Flow)	-0.0252	-0.0694	-0.0503	0.0066	0.0532	-0.0266	-0.0670	-0.0321	0.0183	0.0701
	(0.81)	(1.68)*	(1.55)	(0.25)	(2.68)***	(0.84)	(1.56)	(0.92)	(0.89)	(3.03)***
(Corporate Governance)*(Cash Flow)	0.0084	0.0991	0.1890	-0.0892	-0.0117	-0.0476	0.1500	0.1572	-0.1224	-0.0191
	(0.11)	(1.72)*	(3.53)***	(1.76)*	(0.22)	(0.62)	(2.94)***	(3.36)***	(2.70)***	(0.32)
(Q)*(Cash Flow)	0.8803	0.6495	0.1259	0.3082	-0.0683	1.0104	0.7013	0.2977	0.0120	0.0607
	(7.24)***	(4.72)***	(0.89)	(2.65)***	(0.92)	(9.59)***	(5.51)***	(1.93)*	(0.10)	(0.76)
Long Holder	-0.0995	0.0113	0.0190	-0.0009	-0.0228	-0.0853	0.0385	0.0254	-0.0074	-0.0224
	(3.68)***	-0.56	(1.06)	(0.04)	(0.66)	(2.97)***	(1.92)*	(1.58)	(0.48)	(0.78)
(Long Holder)*(Cash Flow)	0.3453	0.0235	-0.0884	-0.0621	0.0508	0.4277	0.0302	-0.1021	-0.0404	0.0413
	(3.61)***	(0.28)	(1.52)	(0.98)	(0.98)	(4.79)***	(0.41)	(1.59)	(1.06)	(0.75)
Time Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
(Time)*(Cash Flow) Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	656	659	659	668	649	656	659	659	668	649
Adjusted R-squared	0.78	0.78	0.85	0.67	0.57	0.89	0.93	0.94	0.92	0.87

Investment, Cash flow, Q, CEO ownership and CEO vested options are the log of 1 plus the given variable.   R-squared values are unadjusted in the time series regressions.

All variables are defined in the appendices.

Absolute value of t statistics in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 15a. Regression of Investment on Cash Flow and Educational Background

Dependent Variable: Investment   **Normalization:** Beginning of year Capital   **Industries:** 2-digit SIC codes

	Baseline	Fixed Effects & Controls			Clustered standard errors (by firm)			panel corrected standard errors (psar1)		
	Background (1)	Technical (2)	Finance (3)	Both (4)	Technical (5)	Finance (6)	Both (7)	Technical (8)	Finance (9)	Both (10)
Cash Flow	0.1668	0.1137	0.3262	0.3117	0.1137	0.3262	0.3117	0.1008	0.3246	0.3077
	(1.48)	(1.02)	(2.84)***	(2.34)**	(0.56)	(1.55)	(1.32)	(0.51)	(1.60)	(1.49)
Q	-0.1472	-0.1585	-0.1573	-0.1570	-0.1585	-0.1573	-0.1570	-0.2019	-0.2018	-0.2014
	(3.76)***	(4.09)***	(4.05)***	(4.05)***	(1.92)*	(1.90)*	(1.91)*	(2.47)**	(2.47)**	(2.46)**
(Q)*(Cash Flow)	0.6595	0.6532	0.6533	0.6527	0.6532	0.6533	0.6527	0.7081	0.7093	0.7073
	(9.91)***	(9.92)***	(9.93)***	(9.92)***	(4.36)***	(4.35)***	(4.43)***	(4.87)***	(4.87)***	(4.87)***
Technical Education		-0.0736		-0.0391	-0.0736		-0.0391	-0.0781		-0.0307
		(4.27)***		(1.51)	(2.33)**		(1.14)	(4.17)***		(1.62)
(Technical)*(CF)		0.1979		0.0245	0.1979		0.0245	0.2256		0.0377
		(5.27)***		(0.33)	(2.30)**		(0.21)	(4.25)***		(0.63)
Finance Education			0.0543	0.0322		0.0543	0.0322		0.0600	0.0423
			(3.67)***	(1.45)		(2.15)**	(1.28)		(3.92)***	(3.28)***
(Finance)*(CF)			-0.2171	-0.2011		-0.2171	-0.2011		-0.2415	-0.2082
			(5.81)***	(2.69)***		(2.54)**	(1.77)*		(4.67)***	(3.96)***
Observations	1465	1465	1465	1465	1465	1465	1465	1465	1465	1465
Adjusted R-squared	0.67	0.68	0.68	0.68	0.68	0.68	0.68	R^2=0.80	R^2=0.80	R^2=0.80

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.

Absolute value of t statistics in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

Constant included. Controls for Corporate Governance, CEO Ownership, CEO Vested Options and interactions with Cash Flow included.

Fixed effects for Firm, Year, and (Year)*(CF) included. (Industry)*(CF) FE included, where industries are classified according to 2-digit SIC codes (see Appendix B).

Table 15b. Regression of Investment on Cash Flow and Educational Background

Dependent Variable: Investment   **Normalization:** Beginning of year Capital   **Industries:** Fama-French (1997) groups

	Baseline	Fixed Effects & Controls			Clustered standard errors (by firm)			panel corrected standard errors (psar1)		
	Background (1)	Technical (2)	Finance (3)	Both (4)	Technical (5)	Finance (6)	Both (7)	Technical (8)	Finance (9)	Both (10)
Cash Flow	0.1515	0.1145	0.2807	0.3042	0.1145	0.2807	0.3042	2.8582	2.9973	3.0754
	(0.13)	(0.10)	(0.25)	(0.27)	(0.59)	(1.51)	(1.36)	(2.69)***	(2.79)***	(2.86)***
Q	-0.1981	-0.2029	-0.2046	-0.2029	-0.2029	-0.2046	-0.2029	-0.2360	-0.2465	-0.2399
	(4.95)***	(5.08)***	(5.12)***	(5.07)***	(2.74)***	(2.76)***	(2.75)***	(2.57)**	(2.68)***	(2.60)***
(Q)*(Cash Flow)	0.8162	0.8258	0.8279	0.8247	0.8258	0.8279	0.8247	0.8452	0.8727	0.8492
	(10.98)***	(11.14)***	(11.17)***	(11.12)***	(7.50)***	(7.59)***	(7.56)***	(5.24)***	(5.31)***	(5.24)***
Technical Education		-0.0588		-0.0247	-0.0588		-0.0247	-0.0625		-0.0094
		(2.96)***		(0.89)	(1.88)*		(0.70)	(3.11)***		(0.45)
(Technical)*(CF)		0.1503		-0.0176	0.1503		-0.0176	0.1608		-0.0375
		(2.80)***		(0.19)	(2.12)**		(0.15)	(2.77)***		(0.49)
Finance Education			0.0483	0.0371		0.0483	0.0371		0.0609	0.0582
			(2.91)***	(1.58)		(1.96)*	(1.32)		(3.56)***	(3.96)***
(Finance)*(CF)			-0.1807	-0.2032		-0.1807	-0.2032		-0.1963	-0.2298
			(3.44)***	(2.24)**		(2.48)**	(1.65)		(3.74)***	(3.81)***
Observations	1465	1465	1465	1465	1465	1465	1465	1465	1465	1465
Adjusted R-squared	0.69	0.69	0.70	0.70	0.69	0.70	0.70	R^2=0.83	R^2=0.83	R^2=0.83

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.

Absolute value of t statistics in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

Constant included. Controls for Corporate Governance, CEO Ownership, CEO Vested Options and interactions with Cash Flow included.

Fixed effects for Firm, Year, and (Year)*(CF) included. (Industry)*(CF) FE included, where industries are classified according to the classification of Fama and French (1997).

Table 15c. Regression of Investment on Cash Flow and Employment Background

Dependent Variable: Investment   **Normalization:** Beginning of year Capital   **Industries:** 2-digit SIC codes

	Baseline	Fixed Effects & Controls			Clustered standard errors (by firm)			panel corrected standard errors (psar1)		
	Background (1)	Technical (2)	Finance (3)	Both (4)	Technical (5)	Finance (6)	Both (7)	Technical (8)	Finance (9)	Both (10)
Cash Flow	-0.3343	-0.3212	-0.3046	-0.2994	-0.3212	-0.3046	-0.2994	-0.3479	-0.3416	-0.3309
	(4.44)***	(4.23)***	(4.04)***	(3.95)***	(1.40)	(1.27)	(1.28)	(2.22)**	(2.13)**	(2.08)**
Q	-0.1701	-0.1690	-0.1523	-0.1527	-0.1690	-0.1523	-0.1527	-0.2154	-0.1999	-0.2005
	(4.65)***	(4.62)***	(4.15)***	(4.16)***	(1.93)*	(1.73)*	(1.74)*	(2.89)***	(2.57)**	(2.59)***
(Q)*(Cash Flow)	0.6237	0.6156	0.5871	0.5846	0.6156	0.5871	0.5846	0.6976	0.6709	0.6665
	(9.53)***	(9.36)***	(8.93)***	(8.85)***	(2.66)***	(2.42)**	(2.46)**	(4.39)***	(4.05)***	(4.06)***
Technical Background		-0.0306		-0.012	-0.0306		-0.012	-0.0290		-0.0146
		(1.68)*		(0.63)	(1.18)		(0.39)	(1.51)		(0.74)
(Technical)*(CF)		0.0746		0.0361	0.0746		0.0361	0.1031		0.0658
		(1.73)*		(0.82)	(0.87)		(0.36)	(1.63)		(1.00)
Finance Background			0.0394	0.0368		0.0394	0.0368		0.0283	0.0246
			(2.85)***	(2.54)**		(2.34)**	(1.81)*		(2.11)**	(1.73)*
(Finance)*(CF)			-0.1580	-0.1497		-0.1580	-0.1497		-0.1325	-0.1177
			(4.11)***	(3.76)***		(2.89)***	(2.28)**		(2.86)***	(2.42)**
Observations	1823	1823	1823	1823	1823	1823	1823	1823	1823	1823
Adjusted R-squared	0.65	0.65	0.65	0.65	0.65	0.65	0.65	R^2=0.78	R^2=0.78	R^2=0.78

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.

Absolute value of t statistics in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

Constant included. Controls for Corporate Governance, CEO Ownership, CEO Vested Options and interactions with Cash Flow included.

Fixed effects for Firm, Year, and (Year)*(CF) included. (Industry)*(CF) FE included, where industries are classified according to 2 digit SIC codes (see Appendix B).

Table 15d. Regression of Investment on Cash Flow and Employment Background

Dependent Variable: Investment   **Normalization:** Beginning of year Capital   **Industries:** Fama-French (1997) groups

	Baseline	Fixed Effects & Controls			Clustered standard errors (by firm)			panel corrected standard errors (psar1)		
	Background (1)	Technical (2)	Finance (3)	Both (4)	Technical (5)	Finance (6)	Both (7)	Technical (8)	Finance (9)	Both (10)
Cash Flow	0.1077	0.13	0.1094	0.118	0.13	0.1094	0.118	0.8983	0.1187	0.1168
	(0.08)	(0.10)	(0.09)	(0.09)	(0.50)	(0.41)	(0.45)	(3.05)***	(0.24)	(0.24)
Q	-0.1783	-0.1763	-0.172	-0.1714	-0.1763	-0.172	-0.1714	-0.2303	-0.2278	-0.2277
	(4.72)***	(4.66)***	(4.55)***	(4.53)***	(1.92)*	(1.87)*	(1.87)*	(2.88)***	(2.79)***	(2.79)***
(Q)*(Cash Flow)	0.6565	0.6467	0.6419	0.6383	0.6467	0.6419	0.6383	0.7368	0.7333	0.7325
	(8.96)***	(8.77)***	(8.73)***	(8.64)***	(2.64)***	(2.54)**	(2.56)**	(4.31)***	(4.21)***	(4.22)***
Technical Background		-0.0197		-0.0045	-0.0197		-0.0045	-0.012		-0.0043
		(0.98)		(0.21)	(0.65)		(0.13)	(0.55)		(0.19)
(Technical)*(CF)		0.0678		0.0302	0.0678		0.0302	0.0238		0.0055
		(1.16)		(0.49)	(0.58)		(0.23)	(0.28)		(0.06)
Finance Background			0.0324	0.0308		0.0324	0.0308		0.0161	0.0156
			(2.20)**	(1.96)*		(1.99)**	(1.43)		(1.02)	(0.94)
(Finance)*(CF)			-0.0823	-0.0771		-0.0823	-0.0771		-0.0451	-0.0437
			(1.81)*	(1.62)		(1.31)	(1.01)		(0.75)	(0.70)
Observations	1823	1823	1823	1823	1823	1823	1823	1823	1823	1823
Adjusted R-squared	0.66	0.66	0.66	0.66	0.66	0.66	0.66	R^2=0.79	R^2=0.79	R^2=0.79

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.

Absolute value of t statistics in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

Constant included. Controls for Corporate Governance, CEO Ownership, CEO Vested Options and interactions with Cash Flow included.

Fixed effects for Firm, Year, and (Year)*(CF) included. (Industry)*(CF) FE included, where industries are classified according to the classification of Fama and French (1997).

Table 16. Regression of Investment on Personal and Financial Characteristics

Dependent Variable: Investment   **Normalization:** Beginning of year capital

	OLS with fixed effects[1]					
	Titles	Cohort 1920s	Military Service	All Three	All Personal Characteristics	All Personal and Financial Characteristics
	(1)	(2)	(3)	(4)	(5)	(6)
Cash Flow	0.1888	0.1488	-0.2539	-0.3554	-0.2622	-0.2407
	(4.21)***	(3.12)***	(4.06)***	(5.33)***	(3.03)***	(2.82)***
Q	0.0211	0.0181	-0.1381	-0.1527	-0.1376	-0.1509
	-0.94	(0.80)	(4.57)***	(5.04)***	(3.54)***	(3.94)***
(Q)*(Cash Flow)	0.1362	0.1418	0.6727	0.7031	0.6102	0.6065
	(4.08)***	(4.24)***	(12.42)***	(12.70)***	(8.40)***	(8.45)***
Titles	-0.0148			-0.0081	0.0017	0.0034
	(2.19)**			(1.02)	(0.18)	(0.36)
(Titles)*(CF)	0.0789			0.0440	0.0107	0.0041
	(4.06)***			(1.91)*	(0.38)	(0.15)
CEO Tenure	-0.0006	0.0005	0.0002	0.0019	0.0011	0.0030
	(1.22)	(0.93)	(0.27)	(2.65)***	(1.00)	(2.73)***
(CEO Tenure)*(CF)	0.0020	-0.0003	0.0003	-0.0016	-0.0048	-0.0086
	(1.58)	(0.19)	(0.22)	(0.98)	(1.99)**	(3.51)***
Cohort 1920s		-0.0367		-0.0613	-0.0457	-0.0622
		(3.83)***		(4.58)***	(2.59)***	(3.51)***
(Cohort1920s)*(CF)		0.0808		0.1165	0.0987	0.1240
		(3.62)***		(3.89)***	(2.55)**	(3.21)***
Military Service			-0.0485	-0.0405	-0.0263	-0.0125
			(3.93)***	(3.23)***	(1.56)	(0.75)
(Military Service)*(CF)			0.2063	0.1849	0.1324	0.0679
			(6.56)***	(5.48)***	(3.03)***	(1.52)
Technical Background					-0.0066	-0.0100
					(0.29)	(0.45)
(Technical Background)*(CF)					0.0571	0.0772
					(1.02)	(1.40)
Finance Background					0.0103	0.0228
					(0.59)	(1.33)
(Finance Background)*(CF)					-0.0461	-0.1076
					(0.92)	(2.11)**
Long Holder						-0.1096
						(5.48)***
(Long Holder)*(CF)						0.2658
						(5.98)***
Observations	2825	2824	1920	1920	1546	1546
Adjusted R-squared	0.55	0.56	0.63	0.64	0.60	0.61

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable. All variables are defined in the appendices.

Absolute value of t statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

All regressions include Time, Firm and Time*CF fixed effects

[1]Controls for CEO ownership, CEO vested options, Corporate Governance, Founder and interactions of controls with CF included.

Columns (4) & (5) include industry*CF fixed effects where industries are classified by 2-digit SIC code (see appendix)

Table17. Regression of Investment on Cash Flow and Technical Education by Equity Dependence

Firms are classified according to quintiles of the Kaplan-Zingales index, where the most constrained subsample contains the highest quintile

| | OLS with fixed effects | | | | | Panel Corrected Standard Errors (Panel Specific ar1) | | | | |
| | Most Constrained | --> | | | Least Constrained | Most Constrained | --> | | | Least Constrained |
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Cash Flow	0.7503	-0.3695	2.9788	0.1945	0.0699	0.4512	-0.4949	5.5999	0.1842	0.5271
	(2.13)**	(0.63)	(0.26)	(0.50)	(0.24)	(1.63)	(1.20)	(1.48)	(0.47)	(1.87)*
Q	-0.0854	-0.1987	-0.0568	0.0062	-0.3788	-0.0447	-0.2386	-0.0496	-0.0044	-0.0773
	(1.19)	(2.06)**	(0.50)	(0.06)	(3.42)***	(0.67)	(2.98)***	(0.57)	(0.05)	(0.76)
CEO ownership [in %]	0.9342	-0.3684	-0.1548	-0.8388	0.4311	0.4083	-1.7976	-0.1828	-1.3252	0.4984
	(1.83)*	(0.23)	(0.61)	(0.71)	(0.79)	(0.99)	(1.04)	(0.64)	(0.99)	(1.20)
CEO vested options (number)	0.0129	-0.0003	0.0376	-0.0032	0.0015	0.0138	0.0133	0.0255	-0.0200	0.0067
	(1.13)	(0.02)	(2.72)***	(0.14)	(0.05)	(1.13)	(0.61)	(1.90)*	(1.19)	(0.36)
Corporate Governance	0.0165	-0.0479	0.0218	-0.0262	-0.0138	0.0204	-0.0426	0.0259	-0.0117	0.0269
	(0.92)	(2.74)***	(0.93)	(1.02)	(0.29)	(1.35)	(2.84)***	(1.44)	(0.59)	(0.67)
(CEO ownership)*(Cash Flow)	-0.0573	-0.4142	2.7754	0.9653	-0.8643	-0.0114	-0.7242	2.1072	1.7103	-0.0067
	(0.12)	(0.40)	(1.69)*	(0.48)	(1.05)	(0.04)	(0.71)	(1.32)	(0.70)	(0.01)
(CEO vested options)*(Cash Flow)	-0.0307	-0.0170	-0.1735	0.0175	-0.0247	-0.0852	-0.0355	-0.1194	0.0613	-0.0738
	(0.73)	(0.21)	(3.17)***	(0.29)	(0.43)	(1.69)*	(0.40)	(2.27)**	(1.29)	(1.71)*
(Corporate Governance)*(Cash Flow)	0.0408	0.2694	-0.1677	0.0115	0.0421	-0.0107	0.1828	-0.2271	-0.0226	-0.0265
	(0.38)	(2.40)**	(1.54)	(0.16)	(0.44)	(0.10)	(1.61)	(2.42)**	(0.44)	(0.29)
(Q)*(Cash Flow)	0.4220	1.486	0.7004	0.0652	0.6492	0.5173	1.3874	0.8405	0.0127	0.0814
	(2.62)***	(4.13)***	(2.48)**	(0.20)	(4.38)***	(3.10)***	(4.06)***	(3.22)***	(0.04)	(0.45)
Technical Education	-0.0543	0.0235	0.0334	-0.0998	-0.1411	0.0986	0.0334	0.0253	-0.1235	-0.1295
	(1.15)	(0.58)	(1.19)	(1.90)*	(1.81)*	(0.68)	(1.19)	(1.26)	(3.23)***	(2.11)**
(Technical Education)*(Cash Flow)	-0.1394	-0.1599	-0.1578	0.2258	0.2935	-0.0959	-0.2025	0.0075	0.2137	0.2902
	(1.13)	(1.13)	(1.11)	(2.01)**	(1.98)**	(0.75)	(1.41)	(0.06)	(2.09)**	(2.34)**
Time Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
(Time)*(Cash Flow) Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
(Industry)*(Cash Flow) Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	331	298	265	290	260	331	298	265	290	260
Adjusted R-squared^2	0.89	0.76	0.84	0.7	0.81	0.96	0.95	0.95	0.95	0.96

Investment, Cash flow, Q, CEO ownership, and CEO vested options are the log of 1 plus the given variable.   R-squared values are unadjusted in time series regressions.

All variables are defined in the appendices.

Absolute value of t statistics in parentheses

Industries are classified by 2-digit SIC code (see Appendix B)

* significant at 10%; ** significant at 5%; *** significant at 1%