CEO Overconfidence and Corporate Investment

Ulrike Malmendier Geoffrey Tate

Abstract

We argue that managerial overconfidence can account for corporate investment distortions. Overconfident managers overestimate the returns to their investment projects and view external funds as unduly costly. Thus, they overinvest when they have abundant internal funds, but curtail investment when they require external financing. We test the overconfidence hypothesis, using panel data on personal portfolio and corporate investment decisions of Forbes 500 CEOs. We classify CEOs as overconfident if they persistently fail to reduce their personal exposure to company-specific risk. We find that investment of overconfident CEOs is significantly more responsive to cash flow, particularly in equity-dependent firms.

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In this paper, we argue that personal characteristics of CEOs in large corporations lead to distortions in corporate investment policies. In particular, we study the investment decisions of CEOs who overestimate the future returns of their companies, measured by a failure to divest company-specific risk on their personal accounts. We find that overconfident CEOs have a heightened sensitivity of corporate investment to cash flow, particularly among equity-dependent firms.

The two traditional explanations for investment distortions are the misalignment of managerial and shareholders interests (Jensen and Meckling (1976); Jensen (1986)) and asymmetric information between corporate insiders and the capital market (Myers and Majluf (1984)). Both cause investment to be sensitive to the amount of cash in the firm. Under the agency view, managers overinvest to reap private benefits such as "perks," large empires, and entrenchment. Since the external capital market limits the extent to which managers can pursue self-interested investment, an influx of cash flow enables 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 the (undervalued) shares of their company. In this case, cash flow increases investment, but reduces the distortion. The empirical literature, starting with Fazzari, Hubbard, and Petersen (1988), confirms the existence and robustness of investment-cash flow sensitivity after controlling for investment opportunities. While most of the literature relates investment-cash flow sensitivity to imperfections in the capital market, this interpretation remains controversial (Kaplan and

Zingales (1997), (2000); Fazzari, Hubbard, and Petersen, (2000)).

We propose an alternative explanation for investment-cash flow sensitivity and suboptimal 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. Building on Roll (1986) and Heaton (2002), we argue that one important link between investment levels and cash flow is the tension between the beliefs of the CEO and the market about the value of the firm. Overconfident CEOs systematically overestimate the return to their investment projects. If they have su cient internal funds for investment and are not disciplined by the capital market or corporate governance mechanisms, they overinvest relative to the first-best. If they do not have su cient internal funds, however, they are reluctant to issue new equity because they perceive the stock of their company to be undervalued by the market. As a result, they curb their investment. Additional cash flow provides an opportunity to invest closer to their desired level.

Our overconfidence story builds upon a prominent stylized fact from the social psychology literature, the "better-than-average" e ect. When individuals assess their relative skill, they tend to overstate their acumen relative to the average (Larwood and Whittaker (1977); Svenson (1981); Alicke (1985)). This e ect extends to economic decision-making in experiments (Camerer and Lovallo (1999)). It also a ects the attribution of causality. Because individuals expect their behavior to produce success, they are more likely to attribute good outcomes to their actions, but bad outcomes to (bad) luck (Miller and Ross (1975)). Executives appear to be particularly prone to display overconfidence, both in terms of the better-than-average e ect and in terms of "narrow confidence intervals" (Larwood and Whittaker (1977); Kidd

(1970); Moore (1977)).[1] This finding is attributed to three main factors, each of which trigger overconfidence: the illusion of control, a high degree of commitment to good outcomes, and abstract reference points that make it hard to compare performance across individuals (Weinstein (1980); Alicke et al. (1995)). All three factors are pertinent in the context of corporate investment. A CEO who hand-picks an investment project is likely to believe he can control its outcome and to underestimate the likelihood of failure (March and Shapira (1987); Langer (1975)). The typical CEO is also highly committed to good company performance since his personal wealth and the value of his human capital fluctuate with the company's stock price. Finally, assessing relative managerial skill or, specifically, the ability to pick profitable investment projects is difficult – even ex post – due to other factors that influence overall firm performance.

Heaton (2002) first showed that common distortions in corporate investment may be the result of managers overestimating the returns to their investment. We expand on Heaton's insight in two ways. First, we model how the pre-existing capital structure affects the role of overconfidence. Second, we empirically test the predictions of the model.

To construct measures of overconfidence, we exploit the overexposure of typical CEOs to the idiosyncratic risk of their firms. CEOs receive large grants of stock and options as compensation. They cannot trade their options or hedge the risk by short-selling company stock, and the value of their human capital is intimately linked to the firm's performance. Because of this under-diversification, risk-averse CEOs should exercise their options early given a sufficiently high stock price (Lambert, Larcker, and Verrecchia (1991); Meulbroek (2001); Hall and Murphy (2000), (2002)). We take two main approaches to translate this logic into overconfidence

measures. First, we identify a benchmark for the minimum percentage in-the-money at which CEOs should exercise their options for a given year immediately following the vesting period. If a CEO persistently exercises options later than suggested by the benchmark, we infer that he is overconfident in his ability to keep the company's stock price rising and that he wants to profit from expected price increases by holding the options. Second, we look at the end of the option's duration. If a CEO is optimistic enough about his firm's future performance that he holds options all the way to expiration (typically ten years), we classify him as overconfident. Finally, since underdiversified CEOs should also avoid acquiring additional equity, we classify CEOs who habitually increase their holdings of company stock as overconfident.

We apply these measures to a panel data set on the options and stock holdings of CEOs of 477 large U.S. companies between 1980 and 1994. As a first test of the classifications, we find that CEOs who excessively hold company stock options do not earn significant abnormal returns over the S&P 500 on average. This result helps to rule out alternative explanations of "late exercise" based on inside information. We also explicitly address other potential explanations of our overconfidence measures. In the second step of the analysis, we show that investment-cash flow sensitivity is significantly higher for "late exercisers" or "stock purchasers" than for their peers. As predicted by the model, overconfident CEOs invest more when they have more cash at hand. Further, the sensitivity of investment to cash flow is strongest for CEOs of equity-dependent firms, for whom perceived financing constraints are most binding.

We provide complementary evidence that CEO characteristics other than overconfidence have explanatory power for corporate decision-making. CEOs with an engineering (or scientific) education or employment background display higher investment-cash flow sensitivity,

while CEOs with a financial education or employment background exhibit lower sensitivity. Furthermore, the sensitivity is higher for "depression babies" born in the 1930s and CEOs who assume multiple positions in their company (president, chairman of the board). These findings lend further support to the view that not only firm-level, but also personal characteristics are important for a better understanding of corporate decision-making.[2] However, overconfidence matters for investment-cash flow sensitivity beyond the effects of these observable CEO characteristics.

One caveat to our results is the issue of endogeneity. Observable personal characteristics such as employment background or birth cohort could be selection criteria for the CEO. Boards may even take overconfidence into account in choosing a CEO – though this seems harder to identify ex ante. We are able to alleviate some endogeneity concerns with additional controls. We show that our results are not driven by industry effects, firm effects (where possible), or tangible firm characteristics like size and degree of financial constraint. Most importantly, however, 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.

The overconfidence-based explanation for investment distortions has a number of novel policy implications. 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. Our findings suggest that these provisions 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. He believes that he is acting in the best interest of shareholders. Thus, refined corporate governance structures, involving a more active board of directors or constraints on the use of internal funds, may be necessary to achieve first-best investment levels.

The remainder of the paper is organized as follows. In Section I we present a simple model that develops the prediction that managerial overconfidence leads to positive investment-cash flow sensitivity. In Section II we introduce the data used in our analysis. Section III describes the construction of our overconfidence measures and discusses alternative explanations. Section IV provides evidence that overconfidence increases the sensitivity of investment to cash flow. Section V provides evidence that CEO overconfidence matters more in equity-dependent firms. Section VI assesses the robustness of the overconfidence e ect to the inclusion of other observable CEO characteristics. Section VII concludes.

I. Model

We propose a simple two-period model that demonstrates the e ect of managerial overconfidence on corporate investment in an e cient capital market. Since our goal is to demonstrate the distortionary power of overconfidence, we abstract from informational asymmetries and agency problems and assume that the manager maximizes current shareholder value.[3] The only friction in the model comes from the manager's inflated perception of the firm's investment opportunities.

Consider a firm with existing assets A and s shares outstanding. At time 1, cash flow C is realized. The CEO chooses the level of investment I [0, ∞) and a means of financing. The

investment generates a (weakly positive) stochastic future return, realized at time 2. We denote the expected return to investment I as R(I), with $R' > 0$ and $R'' < 0$ for all I. To guarantee interior solutions, we also assume that $R'(I) > 1$ for some I. The interest rate is normalized to zero. An overconfident CEO overestimates future returns by percentage Δ. Hence, for all levels of investment I, the CEO perceives the expected return to be $R(I) \cdot (1 + \Delta)$, with $\Delta = 0$ in the benchmark case of a rational CEO.

To finance I, the CEO can either use internal funds or raise external finance (debt or equity). We consider the choice among cash, risk-free debt, and equity. In this setting, equity is the only financial instrument for which the CEO's overestimation of future returns results in disagreement about the appropriate price.[4] We assume that the firm has an exogenous capacity for riskless debt D, capacity which is determined by the collateral value of the existing assets and, thus, is strictly smaller than the going-concern value (A > D). This condition ensures repayment in all states of the world and arises endogenously if there is a positive probability of investment failure (i.e., zero returns) for all I. The maximization problem of the CEO is thus

$$\max_{I, s^e, c, d} \frac{s}{s + s^e} [A + C + R(I)(1 + \Delta) - c - d] \tag{1}$$

$$\text{s.t. } \frac{s^e}{s + s^e} (A + C + R(I) - c - d) = I - c - d \tag{2}$$

$$c \le C, \quad d \le D, \quad c + d \le I \tag{3}$$

$$c \ge 0, \quad d \ge 0, \quad I \ge 0, \tag{4}$$

where c is the amount of cash financing, d is the amount of debt financing, and s^e is the number

Table I

Summary Statistics

The sample with "Holder67 Sample Restriction" contains all CEO-years of CEOs who had options more than 67% in-the-money in the fifth year at least two times during their sample tenure. The "Holder67 Sample" contains all CEO-years after the CEO fails to exercise a five-year-old option that is at least 67% in-the-money, provided that he subsequently does it again at least once.

Panel A. Firm Data Summary Statistics

	Full Sample						Holder67 Sample Restriction						Holder67 Sample					
	Number of Firms = 337						Number of Firms = 113						Number of Firms = 58					
Variable	Obs.	Mean	Median	SD	Min.	Max.	Obs.	Mean	Median	SD	Min.	Max.	Obs.	Mean	Median	SD	Min.	Max.
Assets ($M)	3742	5,652	2,286	12,759	14	198,599	1058	5,584	2,161	12,978	20.3	180,237	305	6,802	2,532	18,782	197	180,237
Capital ($M)	3740	2,448	989	5,599	4	128,063	1058	1,831	846	3,616	4	42,027	305	2,306	924	5,049	48.6	42,027
Investment ($M)	3742	382	151	949	0	17,810	1058	370	159	878	0	11,712	305	477	182	1,190	0	11,712
Investment normalized by lagged capital	3742	0.23	0.18	0.25	0	5.72	1058	0.25	0.21	0.23	0	5.72	305	0.23	0.21	0.12	0	0.94
Investment normalized by lagged assets	3742	0.09	0.07	0.08	0	1.64	1058	0.10	0.08	0.07	0	0.07	305	0.09	0.08	0.06	0	0.42
Cash flow ($M)	3742	453	191	985	-618	15,726	1058	490	203	1,005	-117	11,713	305	616	249	1,317	-60	11,713
Cash flow normalized by lagged capital	3742	0.35	0.25	0.35	-0.24	2.55	1058	0.42	0.32	0.35	-0.11	2.46	305	0.40	0.31	0.33	-0.09	2.46
Cash flow normalized by lagged assets	3742	0.11	0.10	0.07	-0.16	0.65	1058	0.13	0.12	0.07	-0.06	0.59	305	0.12	0.12	0.07	-0.06	0.49
Q (beginning of the fiscal year)	3742	1.44	1.14	0.92	0.51	12.26	1058	1.58	1.31	0.90	0.66	10.71	305	1.62	1.39	0.75	0.83	6.49
Earnings/Price Ratio	3648	0.05	0.06	0.15	-7	1	1030	0.06	0.06	0.06	-0.94	0.35	304	0.05	0.05	0.04	-0.22	0.15
ROA	3742	0.06	0.05	0.06	-0.21	0.55	1058	0.08	0.07	0.07	-0.19	0.55	305	0.07	0.06	0.06	-0.19	0.32
Corporate governance (Outside CEOs)	3742	1.77	1	1.59	0	9	1058	1.74	1	1.58	0	8	305	1.85	1	1.73	0	8

Distribution across Fama French 12 Industry Groups (3728 observations)				*(1056 observations)*				*(305 observations)*			
Consumer Nondurables	0.11	Telecommunication	0.04	Cons. ND	0.14	Telecomm.	0.02	Cons. ND	0.10	Telecomm.	0.02
Consumer Durables	0.04	Utilities	0.17	Cons. D	0.05	Utilities	0.03	Cons. D	0.05	Utilities	0.00
Manufacturing	0.13	Shops	0.11	Manuf.	0.11	Shops	0.12	Manuf.	0.10	Shops	0.12
Energy	0.03	Health	0.05	Energy	0.01	Health	0.09	Energy	0.02	Health	0.10
Chemicals and Allied Products	0.06	Money	0.06	Chemicals	0.12	Money	0.05	Chemicals	0.15	Money	0.05
Business Equipment	0.07	Other	0.26	Bus. Equip.	0.12	Other	0.26	Bus. Equip.	0.16	Other	0.25

(http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html).

Panel B. CEO Data Summary Statistics

	Full Sample						Holder 67 Sample Restriction						Holder 67 Sample					
	Number of CEOs = 697						Number of CEOs = 113						Number of CEOs = 58					
Variable	Obs.	Mean	Median	SD	Min.	Max.	Obs.	Mean	Median	SD	Min.	Max.	Obs.	Mean	Median	SD	Min.	Max.
Age	3741	57.57	58	6.77	33	84	1058	58.02	58	6.12	41	82	305	60.78	61	5.88	44	82
Years as CEO	3716	8.53	6	7.44	1	45	1058	10.81	9	7.24	1	39	297	13.72	12	5.91	6	35
CEO & President & Chairman (dummy)	3742	0.38	0	0.49	0	1	1058	0.37	0	0.48	0	1	305	0.40	0	0.49	0	1
Founder (dummy)	3186	0.17	0	0.37	0	1	944	0.17	0	0.38	0	1	279	0.17	0	0.38	0	1
Stock ownership (%)	3742	0.023	0.0012	0.07	0	0.951	1058	0.017	0.002	0.05	0	0.38	305	0.009	0.003	0.02	0	0.22
Vested options (% of shares outst.)	3742	0.002	0.0005	0.01	0	0.463	1058	0.004	0.001	0.01	0	0.11	305	0.005	0.002	0.01	0	0.07
"Depression baby" (born in 1930s) (dummy)	3741	0.37	0	0.48	0	1	1058	0.42	0	0.49	0	1	305	0.37	0	0.48	0	1
Finance career (dummy)	2014	0.23	0	0.42	0	1	693	0.21	0	0.41	0	1	187	0.15	0	0.36	0	1
Technical career (dummy)	2014	0.19	0	0.39	0	1	693	0.18	0	0.38	0	1	187	0.17	0	0.38	0	1
Finance education (dummy)	2218	0.33	0	0.47	0	1	786	0.38	0	0.49	0	1	215	0.45	0	0.50	0	1
MBA (dummy)	2218	0.27	0	0.44	0	1	786	0.33	0	0.47	0	1	215	0.36	0	0.48	0	1
Technical education (dummy)	2218	0.56	1	0.50	0	1	786	0.52	1	0.50	0	1	215	0.48	0	0.50	0	1

Table II

Correlations

Sample A: CEOs with options more than 67% in-the-money in the fifth year at least two times.
Sample B: CEOs with at least 10 years in the data and no more than one missing observation of ownership in the first five years. Data from the first five years of each CEO's tenure excluded.
Sample C: CEOs with options more than 67% in-the-money in the fifth year at least two times and with at least 10 years in the data and no more than one missing observation of ownership in the first five years. Data from the first five years of each CEO's tenure excluded.

Overconfidence and Firm Characteristics

	Holder 67			Longholder			Net Buyer			Size			Q			CF/k			Stock Ownersh.			Vested Options			Corp. Gov.		
	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.
Holder 67	1.00	n/a	1.00																								
Longholder	***0.25***	n/a	n/a	1.00	1.00	n/a																					
Net Buyer	n/a	n/a	**0.06**	n/a	**0.01**	n/a	n/a	1.00	1.00																		
Size	*0.15*	n/a	0.06	*-0.17*	*-0.11*	n/a	n/a	*0.25*	*0.32*	1.00	1.00	1.00															
Q	0.03	n/a	-0.04	*0.10*	*0.11*	n/a	n/a	*-0.11*	*-0.10*	*-0.25*	*-0.34*	*-0.28*	1.00	1.00	1.00												
CF/k	-0.03	n/a	-0.04	*0.11*	*0.15*	n/a	n/a	*-0.16*	*-0.08*	*-0.20*	*-0.10*	*-0.12*	*0.44*	*0.40*	*0.44*	1.00	1.00	1.00									
Stock ownership	*-0.10*	n/a	*-0.18*	*-0.07*	*-0.19*	n/a	n/a	*-0.20*	*-0.18*	*-0.20*	*-0.12*	*-0.13*	-0.01	-0.01	*-0.09*	*0.06*	*0.11*	0.00	1.00	1.00	1.00						
Vested options	*0.10*	n/a	0.06	*0.17*	*0.30*	n/a	n/a	*-0.11*	*-0.15*	*-0.31*	*-0.26*	*-0.37*	*0.18*	*0.18*	*0.20*	*0.25*	*0.27*	*0.34*	*0.10*	*-0.07*	0.01	1.00	1.00	1.00			
Corporate governance	0.04	n/a	0.02	0.02	0.04	n/a	n/a	*0.06*	0.01	*0.33*	*0.29*	*0.35*	*-0.08*	*-0.15*	*-0.09*	*-0.08*	*-0.09*	-0.01	*-0.14*	*-0.23*	*-0.15*	*-0.16*	*-0.14*	*-0.18*	1.00	1.00	1.00

Overconfidence and CEO Characteristics

	Holder 67			Longholder			Net Buyer			Depression Baby			CEO/Pres/Chm.			Finance Career			Techn. Career			Tenure		
	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.
"Depression baby"	*-0.06*	n/a	*-0.15*	-0.03	*-0.07*	n/a	n/a	0.04	0.04	1.00	1.00	1.00												
CEO & President & Chairman	0.04	n/a	0.05	-0.04	*-0.06*	n/a	n/a	*0.13*	0.07	-0.01	-0.02	*-0.10*	1.00	1.00	1.00									
Finance career	*-0.09*	n/a	*-0.16*	*-0.10*	*-0.13*	n/a	n/a	*0.08*	*0.29*	-0.05	0.06	-0.03	*-0.14*	*-0.12*	*-0.19*	1.00	1.00	1.00						
Technical career	-0.01	n/a	0.02	*-0.12*	-0.05	n/a	n/a	*-0.25*	*-0.26*	*0.10*	0.07	*0.15*	*0.07*	0.01	0.04	*-0.15*	*-0.15*	-0.07	1.00	1.00	1.00			
Tenure	*0.25*	n/a	-0.05	0.02	*-0.06*	n/a	n/a	*-0.21*	*-0.18*	*-0.18*	*-0.35*	*-0.28*	0.01	-0.01	-0.03	*-0.14*	*-0.12*	*-0.13*	*0.14*	0.07	*0.22*	1.00	1.00	1.00

Coefficients in italics are significant at 10%.

Table III
Persistence of Exercising Behavior

In Panel A, the dependent variable is a dummy variable taking the value one if the CEO fails to exercise a five-year-old option that reaches at least 67% in-the-money in the current period. Past late exercises is the number of times that the CEO has exercised such options late in the past. Q is the market value of assets over the book value of assets at the beginning of the year. Earnings/Price ratio is the minimal earnings to price ratio during the fiscal year. Panel B presents statistics on late exercises of stock options partitioned by the number of past late exercises by the CEO in question.

Panel A. Random Effects Probit Regression

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

	(1)	(2)	(3)	(4)
Past late exercises	0.2493	0.2569	0.2571	0.266
	(4.40)***	(4.57)***	(4.61)***	(4.80)***
Q		-0.1519		-0.1514
		(1.79)*		(1.81)*
Earnings/price ratio			-0.709	-0.8128
			(0.77)	(0.89)
Observations	759	742	731	728
Number of CEOs	278	273	272	271

Absolute value of z statistics in parentheses.

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

Panel B. Percent of "Late Exercisers" 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	0.32	487
1	0.64	128
2	0.73	67
3	0.94	32
4	0.79	28
> 4	0.74	23

Table IV

Distribution of Returns of "Late Exercisers" (67%, fifth year)

The table presents data on the returns of late exercising CEOs (Holders 67) by percentiles. The first column presents the percentage in-the-money at the maximum price during the fifth fiscal year from grant date for each option package that is held beyond the 67% threshold. The second, third, and fourth columns present the returns (in %) relative to exercising the options during year five and investing instead in the S&P500, assuming exercise at the maximum, mean, and median stock prices during the fiscal year, respectively. We also present the last percentile for which the return is negative under each price assumption. All returns are annualized.

Sample: CEOs who have option packages at least 67% in-the-money in the fifth year after the option grant and who have not exercised the options before the fifth year.

Percentage in-the-money in year 5		Return (in %) relative to exercising during year 5 and investing in S&P500					
		Exercise at fiscal-year maximum price		Exercise at fiscal-year mean price		Exercise at fiscal-year median price	
Percentile	% in the money	Percentile	Return	Percentile	Return	Percentile	Return
10th	161.89	10th	-16.56	10th	-16.48	10th	-16.45
20th	213.71	20th	-10.32	20th	-10.51	20th	-11.65
30th	280.97	30th	-6.40	30th	-5.89	30th	-7.39
40th	366.88	40th	-2.79	40th	-2.50	40th	-2.56
		46th	-0.66	46th	-0.38	49th	-0.05
50th	435.88	50th	1.02	50th	1.64	50th	0.30
60th	616.83	60th	5.72	60th	6.94	60th	5.59
70th	905.43	70th	10.86	70th	10.96	70th	11.62
80th	1,395.22	80th	19.16	80th	17.32	80th	16.05
90th	2,326.39	90th	28.27	90th	25.27	90th	25.07
Mean	1,275.90		3.60		4.85		3.57
Standard Deviation	3,336.66		20.23		20.96		21.15
Observations	182		182		182		182
CEOs	86		86		86		86

Table V

Regression of Investment on Cash Flow and Exercise Behavior

The dependent variable in the regressions is Investment, defined as firm capital expenditures and normalized by capital at the beginning of the year. Cash flow is earnings before extraordinary items plus depreciation and is normalized by capital at the beginning of the year. Q is the market value of assets over the book value of assets at the beginning of the year. Stock ownership is the fraction of company stock owned by the CEO and his immediate family at the beginning of the year. Vested options are the CEO's holdings of options that are exercisable within six months of the beginning of the year, as a fraction of common shares outstanding. Vested options are multiplied by 10 so that the mean is comparable to stock ownership. Size is the natural logarithm of assets at the beginning of the year. Corporate governance is the number of outside directors who currently serve as CEOs of other companies.

Holder 67 is a dummy variable equal to one for all CEO-years after the CEO holds a five-year-old option that is more than 67% in-the-money, provided that he subsequently does it again at least once. Industries are defined as the twelve Fama-French industry groups. In Columns 6 and 7, standard errors are robust to heteroskedasticity and arbitrary within-firm serial correlation.

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

	Baseline Regressions			Late Exercise of 67%,-in-the-money Options (in year 5)			
	no fixed effects, no controls	fixed effects, no controls	fixed effects, controls	over-confidence with fixed effects, no controls	over-confidence with fixed effects, controls	standard errors clustered by firm	industry - CF interactions, clustered by firm
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cash flow	0.2052	0.6419	1.6579	0.6729	1.7044	1.7044	1.2911
	(9.73)***	(7.19)***	(9.85)***	(7.56)***	(10.20)***	(2.99)***	(3.22)***
Q	0.0250	0.0635	-0.0049	0.0656	-0.0088	-0.0088	-0.0112
	(3.04)***	(6.54)***	(0.24)	(6.79)***	(0.44)	(0.18)	(0.35)
Stock ownership (%)			-0.1077		-0.1834	-0.1834	0.1892
			(0.19)		(0.33)	(0.26)	(0.34)
Vested options			0.1946		0.1398	0.1398	0.1989
			(1.61)		(1.17)	(1.04)	(1.55)
Size			0.0466		0.0543	0.0543	0.0429
			(2.45)**		(2.88)***	(1.47)	(1.44)
Corporate governance			-0.0042		-0.0071	-0.0071	-0.0131
			(0.54)		(0.92)	(0.75)	(1.40)
(Q)*(Cash flow)			0.0521		0.0648	0.0648	0.0645
			(2.64)***		(3.28)***	(0.83)	(1.28)
(Stock ownership)*(Cash flow)			-0.5749		-0.6897	-0.6897	-1.1138
			(1.38)		(1.67)*	(0.45)	(0.97)
(Vested options)*(Cash flow)			-0.4612		-0.2981	-0.2981	-0.5015
			(4.15)***		(2.62)***	(1.32)	(2.62)***
(Size)*(Cash flow)			-0.1713		-0.1754	-0.1754	-0.1433
			(8.47)***		(8.77)***	(2.31)**	(2.64)***
(Corporate governance)*(Cash flow)			0.0363		0.0441	0.0441	0.0597
			(2.16)**		(2.65)***	(1.69)*	(2.61)**
Holder 67				-0.0351	-0.0495	-0.0495	-0.0362
				(1.35)	(1.96)*	(1.67)*	(1.27)
(Holder 67)*(Cash flow)				0.1648	0.2339	0.2339	0.1718
				(3.39)***	(4.70)***	(2.59)**	(2.20)**
Year fixed effects	no	yes	yes	yes	yes	yes	yes
Firm fixed effects	no	yes	yes	yes	yes	yes	yes
(Year fixed effects)*(Cash flow)	no	yes	yes	yes	yes	yes	yes
(Industry fixed effects)*(Cash flow)	no	no	no	no	no	no	yes
Observations	1058	1058	1058	1058	1058	1058	1056
Adjusted R-squared	0.13	0.56	0.61	0.56	0.62	0.62	0.67

Constant included. Absolute value of t statistics in parentheses.

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

Figure 1

Holder Regression for Different % in the Money

Figure 1 presents the results of reestimating the regression specified in Column 6 of Table V using different percentages in-the-money as thresholds for rational exercise in the classification of CEOs as overconfident. More specifically, *Holder 67* is replaced in the regression by Holder "x", where Holder "x" is a dummy variable equal to one for all CEO-years after the CEO holds a five-year-old option that is more than "x"% in-the-money, provided that he subsequently does it again at least once. In addition, the sample is restricted in each regression to the subsample of CEOs who at least twice had options that reached at least "x"% in the money after five years. The number of CEOs meeting this restriction for each "x" is presented below along with the subset of those CEOs who are classified as overconfident using the Holder "x" measure. Coefficients on Holder "x" interacted with cash flow are significant at the 5% level for all x except x = 50, 80, and 85, which are significant at 1%, where standard errors are robust to heteroskedasticity and arbitrary within-firm serial correlation.

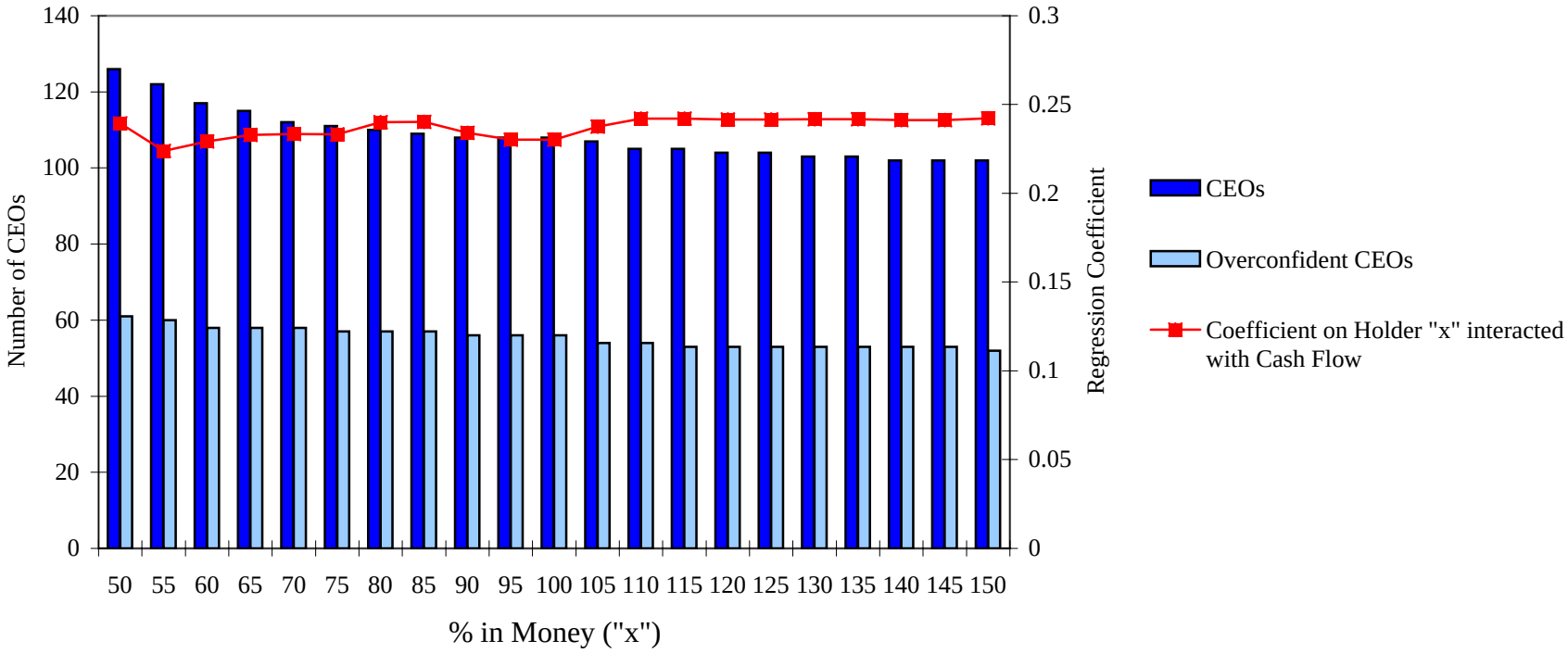

Table VI

Regression of Investment on Cash Flow and Exercise Behavior

The dependent variable in the regressions is Investment, defined as firm capital expenditures and normalized by capital at the beginning of the fiscal year. Cash flow is earnings before extraordinary items plus depreciation and is normalized by capital at the beginning of the year. Q is the market value of assets over the book value of assets at the beginning of the year. Stock ownership is the fraction of company stock owned by the CEO and his immediate family at the beginning of the year. Vested options are the CEO's holdings of options that are exercisable within 6 months of the beginning of the year, as a fraction of common shares outstanding. Vested options are multiplied by 10 so that the mean is comparable to stock ownership. Size is the natural logarithm of assets at the beginning of the fiscal year. Corporate governance is the number of outside directors who currently serve as CEOs of other companies.

Hold and Win 67 is a dummy variable equal to one for all CEO-years after the CEO holds a five-year-old option that is more than 67% in-the-money, provided that he subsequently does it again at least once and that he earns excess returns by holding the options (relative to exercising in the fifth year and investing the proceeds in the S&P 500) each time. Hold and Lose 67 is a dummy variable equal to one for all CEO-years after the CEO holds a five-year-old option that is more than 67% 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. Returns are calculated using the maximum stock price during the fiscal year. Industries are defined as the twelve Fama-French industry groups. In Columns 6 and 7, standard errors are robust to heteroskedasticity and arbitrary within-firm serial correlation.

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

	Baseline Regressions			Late Exercise of 67%,-in-the-Money Options (in year 5) with Losses			
	no fixed effects, no controls	fixed effects, no controls	fixed effects, controls	over-confidence with fixed effects, no controls	over-confidence with fixed effects, controls	standard errors clustered by firm	industry - CF interactions, clustered by firm
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cash flow	0.2096	0.6576	1.7235	0.681	1.7368	1.7368	1.3526
	(9.58)***	(7.14)***	(9.83)***	(7.42)***	(9.95)***	(2.90)***	(3.21)***
Q	0.0271	0.0668	-0.0057	0.0716	-0.007	-0.007	-0.0055
	(3.14)***	(6.29)***	(0.26)	(6.74)***	(0.32)	(0.14)	(0.16)
Stock ownership (%)			-0.2164		-0.2233	-0.2233	-0.09
			(0.31)		(0.33)	(0.33)	(0.14)
Vested options			0.1802		0.1311	0.1311	0.2108
			(1.46)		(1.07)	(0.94)	(1.54)
Size			0.0535		0.0587	0.0587	0.0504
			(2.71)***		(2.99)***	(1.52)	(1.63)
Corporate governance			-0.0042		-0.0072	-0.0072	-0.0124
			(0.52)		(0.90)	(0.75)	(1.36)
(Q)*(Cash flow)			0.0527		0.0647	0.0647	0.072
			(2.53)**		(3.10)***	(0.82)	(1.41)
(Stock ownership)*(Cash flow)			-0.7401		-0.8257	-0.8257	-1.196
			(1.71)*		(1.92)*	(0.55)	(1.09)
(Vested options)*(Cash flow)			-0.4438		-0.2907	-0.2907	-0.5406
			(3.87)***		(2.46)**	(1.25)	(2.57)**
(Size)*(Cash flow)			-0.1761		-0.1768	-0.1768	-0.1575
			(8.42)***		(8.46)***	(2.27)**	(2.72)***
(Corporate governance)*(Cash flow)			0.0383		0.0467	0.0467	0.0561
			(2.18)**		(2.67)***	(1.72)*	(2.64)***
Hold and Win 67				-0.1359	-0.0679	-0.0679	-0.0621
				(2.49)**	(1.31)	(0.81)	(0.64)
(Hold and Win 67)*(Cash flow)				0.3254	0.2869	0.2869	0.1855
				(3.82)***	(3.45)***	(1.96)*	(1.24)
Hold and Lose 67				-0.0289	-0.0622	-0.0622	-0.0498
				(0.94)	(2.09)**	(1.76)*	(1.61)
(Hold and Lose 67)*(Cash flow)				0.1417	0.2366	0.2366	0.1699
				(2.22)**	(3.71)***	(2.33)**	(1.91)*
Year fixed effects	no	yes	yes	yes	yes	yes	yes
Firm fixed effects	no	yes	yes	yes	yes	yes	yes
(Year fixed effects)*(Cash flow)	no	yes	yes	yes	yes	yes	yes
(Industry fixed effects)*(Cash flow)	no	no	no	no	no	no	yes
Observations	1016	1016	1016	1016	1016	1016	1014
Adjusted R-squared	0.13	0.55	0.61	0.56	0.62	0.62	0.68

Constant included. Absolute value of t statistics in parentheses.

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

Table VII

Regression of Investment on Cash Flow and Longholder or Net Buyer

The dependent variable in the regressions is Investment, defined as firm capital expenditures and normalized by capital at the beginning of the year. Cash flow is earnings before extraordinary items plus depreciation and is normalized by capital at the beginning of the year. Q is the market value of assets over the book value of assets at the beginning of the year. Stock ownership is the fraction of company stock owned by the CEO and his immediate family at the beginning of the year. Vested options are the CEO's holdings of options that are exercisable within 6 months of the beginning of the year, as a fraction of common shares outstanding. Vested options are multiplied by 10 so that the mean is comparable to stock ownership. Size is the natural logarithm of assets at the beginning of the year. Corporate governance is the number of outside directors who currently serve as CEOs of other companies.

Longholder is a dummy variable equal to one if the CEO ever held an option until the last year prior to expiration. Net Buyer is a dummy variable equal to one if the CEO was a net buyer of stock more years than he was a net seller in his first five years in the sample. Columns 5 - 8 includes only CEOs with at least 10 years in the sample and excludes their first five years. Industries are defined as the twelve Fama-French industry groups. Standard errors in columns 3, 4, 7, and 8 are robust to heteroskedasticity and arbitrary within-firm serial correlation.

	Longholder Regressions				Net Buyer Regressions			
	fixed effects, controls	over-confidence with fixed effects, controls	standard errors clustered by firm	firm - CF interactions, clustered by firm	fixed effects, controls	over-confidence with fixed effects, controls	standard errors clustered by firm	industry - CF interactions, clustered by firm
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash flow	0.7249	0.656	0.656	1.1063	1.6262	1.555	1.555	1.382
	(8.33)***	(7.50)***	(2.53)**	(2.59)**	(7.24)***	(6.99)***	(4.19)***	(2.46)**
Q	0.0814	0.0851	0.0851	0.1009	0.0752	0.0770	0.0770	0.0677
	(7.53)***	(7.89)***	(1.99)**	(1.45)	(3.45)***	(3.57)***	(3.23)***	(2.96)***
Stock ownership (%)	0.1936	0.196	0.196	0.1138	0.3543	-0.0964	-0.0964	-0.1138
	(2.37)**	(2.41)**	(1.01)	(0.54)	(0.91)	(0.24)	(0.24)	(0.27)
Vested options	-0.0231	0.003	0.003	0.0098	0.1104	0.0639	0.0639	0.0934
	(0.24)	(0.03)	(0.01)	(0.07)	(0.72)	(0.42)	(0.43)	(0.64)
Size	-0.0465	-0.0494	-0.0494	-0.0213	-0.0860	-0.0790	-0.0790	-0.0827
	(4.81)***	(5.12)***	(2.34)**	(0.53)	(3.36)***	(3.12)***	(1.48)	(1.53)
Corporate governance	0.0012	0.0023	0.0023	0.0058	0.0025	0.0071	0.0071	-0.0025
	(0.31)	(0.59)	(0.43)	(1.22)	(0.26)	(0.74)	(0.42)	(0.16)
(Q)*(Cash flow)	-0.0062	-0.0099	-0.0099	-0.0234	-0.0555	-0.0721	-0.0721	-0.0502
	(0.63)	(1.02)	(0.23)	(0.04)	(2.44)**	(3.17)***	(1.80)*	(1.53)
(Stock ownership)*(Cash flow)	0.0186	0.002	0.002	0.2694	-0.8325	0.3991	0.3991	0.5724
	(0.12)	(0.01)	(0.00)	(1.91)*	(1.25)	(0.56)	(0.34)	(0.44)
(Vested options)*(Cash flow)	0.3198	0.2847	0.2847	-0.0427	-0.1131	-0.0012	-0.0012	0.0221
	(4.46)***	(3.97)***	(1.19)	(0.61)	(0.85)	(0.01)	(0.01)	(0.11)
(Size)*(Cash flow)	-0.0595	-0.053	-0.053	-0.0202	-0.1517	-0.1653	-0.1653	-0.1123
	(5.67)***	(5.04)***	(1.55)	(1.18)	(5.49)***	(6.02)***	(3.43)***	(2.31)**
(Corporate governance)*(Cash flow)	-0.0074	-0.0096	-0.0096	-0.0242	0.022	0.0006	0.0006	0.0337
	(0.82)	(1.07)	(0.49)	(0.34)	(0.92)	(0.03)	(0.01)	(0.55)
Longholder		-0.0504	-0.0504	-0.0306				
		(2.65)***	(1.00)	(1.05)				
(Longholder)*(Cash flow)		0.1778	0.1778	0.1126				
		(5.51)***	(1.33)	(1.32)				
Net Buyer						1.0615	1.0615	0.1053
						(2.83)***	(1.84)*	(0.11)
(Net Buyer)*(Cash flow)						0.4226	0.4226	0.449
						(4.33)***	(1.57)	(1.92)*
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
(Year fixed effects)*(Cash flow)	yes	yes	yes	yes	yes	yes	yes	yes
(Industry fixed effects)*(Cash flow)	no	no	no	no	no	no	no	yes
(Firm fixed effects)*(Cash flow)	no	no	no	yes	no	no	no	no
Observations	3742	3742	3742	3742	842	842	842	842
Adjusted R-squared	0.54	0.54	0.54	0.63	0.53	0.54	0.54	0.56

Constant Included. Absolute value of t statistics in parentheses.

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

Table VIII

Regression of Investment on Cash Flow and Overconfidence by Equity Dependence

The dependent variable in the regressions is Investment, defined as firm capital expenditures and normalized by capital at the beginning of the year. Cash flow is earnings before extraordinary items plus depreciation and is normalized by capital at the beginning of the year. Q is the market value of assets over the book value of assets and is taken at the beginning of the year. Stock ownership is the fraction of company stock owned by the CEO and his immediate family at the beginning of the year. Vested options are the CEO's holdings of options that are exercisable within 6 months of the beginning of the year, as a fraction of common shares outstanding. Vested options are multiplied by 10 so that the mean is comparable to stock ownership. Size is the natural logarithm of assets at the beginning of the year. Corporate governance is the number of outside directors who currently serve as CEOs of other companies. Longholder is a dummy variable equal to one if the CEO ever held an option until the last year prior to expiration.

Firms are classified according to quintiles of the Kaplan-Zingales index, where the highest quintile contains the most constrained subsample. All standard errors are robust to heteroskedasticity and arbitrary within-firm serial correlation.

	OLS with Fixed Effects				
	Most Constrained	---------->			Least Constrained
	(1)	(2)	(3)	(4)	(5)
Cash flow	1.1538	0.1763	0.8952	0.5259	0.6969
	(2.21)**	(0.34)	(2.08)**	(1.01)	(2.50)**
Q	0.1844	0.0598	0.0700	0.0124	-0.0346
	(4.48)***	(1.41)	(1.99)**	(0.43)	(0.41)
Stock ownership (%)	-0.4103	0.5790	0.0266	-0.1723	0.3433
	(1.60)	(2.02)**	(0.15)	(1.16)	(0.79)
Vested options	0.1414	-0.3270	0.2748	0.2150	0.7829
	(0.59)	(1.02)	(1.43)	(0.53)	(1.09)
Size	-0.0428	-0.0175	-0.0223	-0.0664	-0.0425
	(1.04)	(0.73)	(0.94)	(1.54)	(0.81)
Corporate governance	0.0022	-0.0044	0.0034	-0.0073	0.0122
	(0.21)	(0.64)	(0.57)	(0.51)	(0.52)
(Q)*(Cash flow)	-0.1685	0.0364	-0.0420	0.0371	0.0420
	(2.12)**	(0.30)	(0.53)	(1.00)	(0.64)
(Stock ownership)*(Cash flow)	-0.3707	-1.2622	-1.0177	0.5432	0.0685
	(0.69)	(1.48)	(1.32)	(0.92)	(0.10)
(Vested options)*(Cash flow)	-0.4152	1.3804	0.0486	-0.1765	-0.6750
	(1.18)	(2.31)**	(0.08)	(0.55)	(1.22)
(Size)*(Cash flow)	-0.0446	-0.0144	-0.0482	0.0258	-0.0413
	(0.69)	(0.23)	(1.05)	(0.47)	(0.98)
(Corporate governance)*(Cash flow)	-0.0439	0.0954	-0.0318	0.0237	-0.0273
	(0.91)	(2.26)**	(1.24)	(0.57)	(0.80)
Longholder	-0.0832	0.0831	-0.0196	-0.0219	-0.1404
	(1.72)*	(1.74)*	(0.68)	(0.43)	(1.10)
(Longholder)*(Cash flow)	0.4990	-0.1449	0.0680	0.0025	0.2453
	(3.52)***	(1.10)	(0.67)	(0.02)	(1.28)
Year fixed effects	yes	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes	yes
(Year fixed effects)*(Cash flow)	yes	yes	yes	yes	yes
Observations	728	728	729	728	728
Adjusted R-squared	0.75	0.82	0.91	0.78	0.56

Constant included. Absolute value of t statistics in parentheses.

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

Table IX

Regression of Investment on Personal Characteristics and Longholder

The dependent variable in the regressions is Investment, defined as firm capital expenditures and normalized by capital at the beginning of the year. Cash flow (CF) is earnings before extraordinary items plus depreciation and is normalized by capital at the beginning of the year. Q is the market value of assets over the book value of assets at the beginning of the year. Titles is a dummy variable equal to one for all CEO-years if the CEO is also president and chairman of the board. Tenure is the number of years the CEO has held that position. "Depression baby" is a dummy variable equal to one if the CEO was born in the 1930s. Finance Education is a dummy variable equal to one if the CEO had "financial education." Financial education includes undergraduate and graduate degrees in accounting, finance, business (incl. MBA), and economics. Technical Education is a dummy variable equal to one if the CEO had "technical education." Technical education includes undergraduate and graduate degrees in engineering, physics, operations research, chemistry, mathematics, biology, pharmacy, and other applied sciences.

Longholder is a dummy variable equal to one if the CEO ever held an option until the last year prior to expiration. Industries are defined as the twelve Fama-French industry groups. All standard errors are robust to heteroskedasticity and arbitrary within-firm serial correlation.

	OLS with Fixed Effects				
	Titles	Cohort 1930s	Employment Background	All Personal Characteristics	All Personal Characteristics and Longholder
	(1)	(2)	(3)	(4)	(5)
Cash Flow	0.9414	1.0181	0.9946	0.8087	0.7106
	(3.08)***	(2.78)***	(2.87)***	(2.94)***	(2.63)***
Q	0.0751	0.078	0.0868	0.0769	0.0819
	(1.04)	(1.08)	(1.25)	(1.05)	(1.13)
Titles	-0.0239			-0.0208	-0.0199
	(0.97)			(0.86)	(0.83)
(Titles)*(CF)	0.1342			0.1234	0.1222
	(1.38)			(1.30)	(1.30)
Tenure	-0.0013	-0.0021		-0.0018	-0.0013
	(0.88)	(1.20)		(1.18)	(0.93)
(Tenure)*(CF)	0.0032	0.0044		0.0043	0.0026
	(0.70)	(0.89)		(0.92)	(0.60)
"Depression baby"		-0.0415		-0.0527	-0.0432
		(1.33)		(1.88)*	(1.69)*
("Depression baby")*(CF)		0.1138		0.1427	0.1255
		(1.32)		(2.00)**	(1.85)*
Finance Education			0.04	0.051	0.0513
			(1.62)	(2.26)**	(2.32)**
(Finance Education)*(CF)			-0.123	-0.1458	-0.1482
			(1.80)*	(2.34)**	(2.40)**
Technical Education			-0.0475	-0.0486	-0.0503
			(1.78)*	(1.96)*	(2.07)**
(Technical Education)*(CF)			0.0894	0.1022	0.1117
			(1.21)	(1.44)	(1.59)
Longholder					-0.0642
					(1.65)
(Longholder)*(CF)					0.2196
					(1.97)*
Observations	2201	2201	2201	2201	2201
Adjusted R-squared	0.56	0.55	0.55	0.56	0.56

Constant included. Absolute value of t statistics in parentheses.

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

Controls for Corporate governance, Stock ownership, Vested options, Size and interactions of these variables and of Q with Cash Flow are included. Fixed effects for Year and Firm and the interactions of (Year)*(CF) and (Industry)*(CF) are also included.