Internet Appendix
for
Overconfidence and Early-life Experiences: The Effect of Managerial Traits on Corporate Financial Policies

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Abstract

This interent appendix provides a reduced form model of the capital structure decisions of overconfident managers relative to a rational benchmark which trades off the expected tax benefits of debt against bankruptcy costs. It also provides additional details on the construction of overconfidence measures for the 1992 to 2007 sample period using portfolio data from *Compustat's Execucomp* database and insider trading data from *Thomson Financial*.

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I. Model of Capital Structure with CEO Overconfidence

In this Section, we provide a simple theoretical framework to examine the capital structure predictions of one specific variation in managerial beliefs: CEO (over)confidence. The model formalizes the hypothesis development of the main paper and helps clarify the more subtle predictions such as the conditions under which the preference of overconfident CEOs for debt over equity are reversed.

We define overconfidence as the overestimation of mean future cash flows. The emphasis on the mean distinguishes our approach from previous theoretical literature on overconfidence. Hackbarth (2008) models the underestimation of variance to generate different capital structure implications. Heaton (2002) models an upward shift in the probability of the good (high cash flow) state, which does not disentangle theoretical results generated by the implied bias in means from those generated by the implied bias in variance. Relatedly, one theoretical contribution of our paper lies in showing that the overestimation of cash flows in nondefault states (i.e., overvaluation of the residual claim) generates a preference between risky debt and equity. The modeling approach of Heaton (shift in probabilities) does not allow for this mechanism.

We abstract from market frictions like agency costs and asymmetric information. However, such factors do not change our predictions as long as they affect managers uniformly and are not sufficient to create boundary solutions (e.g., full debt financing for a rational CEO). In our empirical work, we use a variety of controls and identification strategies to control for such imperfections and hence identify residual CEO-level variation that is unexplained by traditional theories.

We consider a manager's decision to undertake and finance a single nonscalable investment project with cost I and stochastic return $\tilde{R}$, given by R_G with probability $p \in (0;1)$ and R_B with probability $1-p$, where $R_G > I > R_B$. The investment cost and the return distribution are common knowledge. To fix the rational capital structure choice, we allow for two frictions, taxes and bankruptcy costs. The firm pays a marginal rate τ on the net return $\tilde{R}-I$ if $\tilde{R} > I$ and incurs a deadweight loss L in the case of bankruptcy. We assume perfectly competitive debt and equity markets and normalize the risk-free interest rate to zero. The firm has existing assets A and internal funds C. The CEO maximizes the perceived value of the company to existing shareholders. Note that a shareholder-value maximizing CEO never buys back shares since doing so is a zero-sum game from the perspective of shareholders: some current shareholders are helped at the expense of other current shareholders. We allow for the possibility that the CEO overestimates (after-tax) project returns $\tilde{R} - \tau 1_{\{R>I\}}(\tilde{R}-I)$: $\hat{E}[\cdot] > E[\cdot]$. He may also overestimate the value of assets in place A, $\widehat{A} > A$.

We proceed in two steps. We first consider the unconditional choice between internal and external financing. We then condition on accessing external financing and analyze the choice between risky debt and equity.

Starting from the unconditional choice between internal and external financing, we first compare using cash and riskless debt, denoted by $c \leq C$, to using equity. (Later, we consider the possibility that the CEO exhausts cash and riskless debt capacity, creating a choice between risky debt and equity.) We assume that the firm has $s > 0$ shares outstanding and denote by $s' \geq 0$ the number of new shares issued as part of the financing plan. We also assume that the bias in the CEO's expectation of project returns and in his valuation of existing assets does not depend on c.[1]

PROPOSITION 1: *Overconfident CEOs strictly prefer internal finance to equity and use weakly more internal financing than rational CEOs.*

Proof. The participation constraint of new shareholders to provide equity financing is

$$\frac{s'}{s+s'}\left(E[\tilde{R}-\tau\mathbf{1}_{\{R>I\}}(\tilde{R}-I)]+A+C-c\right)=I-c.$$

Thus, the manager's perception of the value of current shareholders' claims after equity financing is

$$\begin{aligned} G &= \left(1-\frac{s'}{s+s'}\right)\left(\widehat{E}[\tilde{R}-\tau\mathbf{1}_{\{R>I\}}(\tilde{R}-I)]+\widehat{A}+C-c\right) \\ &= \frac{\widehat{E}[\tilde{R}-\tau\mathbf{1}_{\{R>I\}}(\tilde{R}-I)]+\widehat{A}+C-c}{E[\tilde{R}-\tau\mathbf{1}_{\{R>I\}}(\tilde{R}-I)]+A+C-c}\left(E[\tilde{R}-\tau\mathbf{1}_{\{R>I\}}(\tilde{R}-I)]+A+C-I\right). \end{aligned}$$

Differentiating with respect to c,

$$\begin{aligned} \frac{\partial G}{\partial c} &= \frac{\left(\widehat{E}[\tilde{R}-\tau\mathbf{1}_{\{R>I\}}(\tilde{R}-I)]-E[\tilde{R}-\tau\mathbf{1}_{\{R>I\}}(\tilde{R}-I)]\right)+\left(\widehat{A}-A\right)}{\left(E[\tilde{R}-\tau\mathbf{1}_{\{R>I\}}(\tilde{R}-I)]+A+C-c\right)^2}\cdot \\ &\quad \left(E[\tilde{R}-\tau\mathbf{1}_{\{R>I\}}(\tilde{R}-I)]+A+C-I\right). \end{aligned}$$

Notice that the numerator of the above fraction is zero if the CEO is rational ($\hat{E}[\cdot]=E[\cdot]$ and $\widehat{A}=A$), and that it is positive for overconfident CEOs by the definition of overconfidence. Hence, $\frac{\partial G}{\partial c}=0$ for unbiased CEOs and $\frac{\partial G}{\partial c}>0$ for overconfident CEOs if and only if $E[\tilde{R}-\tau 1_{\{R>I\}}(\tilde{R}-I)]+A+C-I>0$. That is, as long as firm value is positive, an overconfident CEO maximizes the perceived value on $c\in[0,I]$ by setting internal financing c as high as possible. A rational CEO, in contrast, is indifferent among all financing plans and hence uses weakly less internal funding than overconfident CEOs. **QED**

The intuition for Proposition 1 is that overconfident CEOs perceive the price that investors are willing to pay for new issues s' to be too low, since they believe that markets underestimate future returns. This logic immediately extends to the CEO's preference between internal finance (if available) and risky debt if the CEO overestimates cash flows in the default state (R_B): since he overestimates cash flows going to creditors, he perceives interest payments on debt to be too high. Thus, overconfident CEOs have a strict preference for internal financing over any form of external finance and exhaust cash reserves and riskless debt capacity before issuing risky securities.

Next, we analyze the choice between the two types of risky external financing – risky debt and equity – conditional on accessing external capital markets. From Proposition 1, overconfident CEOs will exhaust all cash and riskless debt capacity before raising risky capital. Thus, for simplicity, we set cash and existing assets (which can be collateralized) equal to zero, that is, $\widehat{A} = A = C = 0$. Conditional on implementing the project, the resulting maximization problem is

$$\max_{\text{d,s}} \quad \frac{s}{s+s'}\hat{E}[(\tilde{R} - \tau \mathbf{1}_{\{R>I\}}(\tilde{R} - I - [w-d]) - w)^+] \tag{IA.1}$$

$$\text{s.t.} \quad \frac{s'}{s+s'}E[(\tilde{R} - \tau \mathbf{1}_{\{R>I\}}(\tilde{R} - I - [w-d]) - w)^+] = I - d \tag{IA.2}$$

$$E[\min\{w, \tilde{R} - L\}] = d \tag{IA.3}$$

$$R_B \leq d \leq I \tag{IA.4}$$

where w is the face value of debt, d is the market value of debt, and L is the deadweight loss from bankruptcy. Interest payments $w - d$ are tax deductible. The CEO maximizes the perceived expected returns accruing to current shareholders after subtracting taxes and repaying debt. Constraints (IA.2) and (IA.3) are the participation constraints for new shareholders and lenders, respectively. Note that the compensation required for equity and debt financing depends on investors' unbiased beliefs rather than managerial perception. Condition (IA.4) reflects that we are considering the case of risky debt, that is, the choice between debt and equity after exhausting all riskless debt capacity created by the project.

The following proposition characterizes the financing choice of rational CEOs ($\hat{E}[\cdot] = E[\cdot]$):

PROPOSITION 2: *Rational CEOs finance the risky portion of investment, $I - R_B$, using only risky debt if the tax benefits are high relative to bankruptcy costs, $\frac{\tau(I-R_B)}{1-\tau} > L$. They use only equity if the tax benefits are low relative to bankruptcy costs, $\frac{\tau(I-R_B)}{1-\tau} < L$. They are indifferent if $\frac{\tau(I-R_B)}{1-\tau} = L$.*

Proof. For notational simplicity, define $Q \equiv E[(\tilde{R} - \tau 1_{\{R>I\}}(\tilde{R} - I - [w-d]) - w)^+]$. Using the participation constraint for shareholders (IA.2) and the fact that $E[\cdot] = \hat{E}[\cdot]$ for rational CEOs, we can rewrite the maximand as $Q - (I - d)$. We consider separately the case in which the CEO uses at least some risky debt ($w > d > R_B$) and the case in which the CEO uses no risky debt ($w = d = R_B$). The latter case is the lower boundary of (IA.4).

In the first case, that is, if $w > R_B$, the firm defaults in the bad state and, hence Q becomes

$$\begin{aligned} Q &= (1-\tau)pR_G + p\tau I - (1-\tau)pw - p\tau d \quad \text{(IA.5)} \\ \Longleftrightarrow Q - (I-d) &= (1-\tau)pR_G - (1-p\tau)I - (1-\tau)pw + (1-p\tau)d. \end{aligned}$$

Using (IA.3) to substitute for w, the maximand $Q - (I - d)$ becomes

$$Q - (I - d) = (1 - \tau)pR_G - (1 - p\tau)I + (1 - \tau)(1 - p)(R_B - L) + \tau(1 - p)d. \qquad \text{(IA.6)}$$

Since d enters positively, value is maximized by setting d as high as possible. Thus, given boundary (IA.4), the optimal level of debt is $d^* = I$. Substituting back into the maximand yields

$$Q - (I - d^*) = (1 - \tau)[pR_G + (1 - p)(R_B - L) - I].$$

In the second case, that is, $w = R_B$, the firm uses only riskless debt and equity. Thus, there is no default, and we have

$$Q = (1 - \tau)pR_G + p\tau I + (1 - p)R_B - d \qquad \text{(IA.7)}$$

$$\Longleftrightarrow Q - (I - d) = (1 - \tau)pR_G - (1 - p\tau)I + (1 - p)R_B. \qquad \text{(IA.8)}$$

Comparing the value function at the two boundaries, we find that the manager will choose full debt financing if

$$(1 - \tau)[pR_G + (1 - p)(R_B - L) - I] > (1 - \tau)pR_G - (1 - p\tau)I + (1 - p)R_B, \qquad \text{(IA.9)}$$

which simplifies to $\frac{\tau(I - R_B)}{1 - \tau} > L$. For the reverse inequality, the manager will choose full equity financing, and he is indifferent in the case of equality. **QED**

If a CEO chooses to raise debt, it is optimal to set the debt level as high as possible since tax benefits are increasing in the amount of debt while bankruptcy costs are fixed. If the

CEO chooses full equity financing, he avoids bankruptcy costs, but gives up the tax benefits of debt. The optimum, then, is either full debt or full equity financing, depending on whether the expected tax benefits, $\tau p(w-d)$, outweigh expected bankruptcy costs, $(1-p)L$. Note that in the simple two-state setup, the optimal capital structure never includes both risky debt and equity. However, interior leverage choices become optimal if we add an intermediate state in which the firm may or may not default depending on the level of debt chosen.

Now consider a CEO who overestimates the returns to investment, $\hat{E}[\cdot] > E[\cdot]$. Specifically, assume that the CEO overestimates returns by a fixed amount Δ in the good state, $\hat{R}_G = R_G + \Delta$, but correctly perceives returns in the bad state, $\hat{R}_B = R_B$. This assumption allows us to isolate the mechanism that generates a preference for risky debt: overvaluation of the residual claim on cash flows in the good state.

PROPOSITION 3: *For the risky portion of investment, overconfident CEOs choose full debt financing (rather than equity financing) more often than rational CEOs.*

Proof. Let $Q \equiv E[(\tilde{R} - \tau \mathbf{1}_{\{R>I\}}(\tilde{R} - I - [w-d]) - w)^+]$. Denote by $\widehat{Q}$ an overconfident manager's perception of Q. Then, $\widehat{Q} = Q + p(1-\tau)\Delta$. Using (IA.2), we can write the objective function of the overconfident CEO's maximization problem as $[Q-(I-d)]\frac{\widehat{Q}}{Q}$.

Consider first the case in which the CEO uses at least some risky debt ($w > d > R_B$). Then, using equations (IA.5) and (IA.6) and constraint (IA.3), the maximand becomes

$$\begin{aligned}
[Q-(I-d)]\frac{\widehat{Q}}{Q} &= [Q-(I-d)]\left[1+\frac{p(1-\tau)\Delta}{Q}\right] \\
&= [(1-\tau)pR_G - (1-p\tau)I + (1-\tau)(1-p)(R_B-L) + \tau(1-p)d] \cdot \\
&\quad \left[1+\frac{p(1-\tau)\Delta}{(1-\tau)pR_G + p\tau I - (1-\tau)[d-(1-p)(R_B-L)] - p\tau d}\right].
\end{aligned}$$

Differentiating with respect to d yields

$$\frac{\partial}{\partial d}\left[\frac{Q-(I-d)}{Q}\widehat{Q}\right] = \tau(1-p) + \frac{\tau(1-p)p(1-\tau)\Delta}{Q} + \frac{p(1-\tau)\Delta\left[(1-\tau)+p\tau\right]}{Q^2}\left[Q-(I-d)\right].$$

The derivative is strictly positive if $Q > 0$ and hence $s/(s+s')Q = Q-(I-d) > 0$. We know that $Q \geq 0$ since it is defined as the expectation over values truncated at zero ($Q \equiv E[(\tilde{R} - \tau 1_{\{R>I\}}(\tilde{R} - I - [w-d]) - w)^+]$). Since $Q = p[(1-\tau)(R_G - w) + \tau(I-d)]$ in the case of risky debt by (IA.5), and $R_G - w \geq 0$ (since $w > R_G$ would yield lower payoffs to bondholders and stockholders than $w = R_G$ due to default costs in both states), and since $I - d \geq 0$ by (IA.4), $Q = 0$ if and only if $R_G - w = 0$ and $I - d = 0$. Thus, we have either $Q > 0$, in which case the derivative is strictly positive and the manager sets d as high as possible, $d^* = I$, or we have $Q = 0$, which also occurs for $d = I$. In both cases, the maximand becomes

$$[Q-(I-d)]\frac{\widehat{Q}}{Q} = \widehat{Q} = (1-\tau)[pR_G + (1-p)(R_B - L) - I] + p(1-\tau)\Delta.$$

Now consider the case in which $w = d = R_B$. Then, the firm finances I using only riskless debt and equity. There is no default and, using (IA.7) and (IA.8), the maximand becomes

$$\begin{aligned}[Q-(I-d)]\frac{\widehat{Q}}{Q} &= [Q-(I-d)]\left[1+\frac{p(1-\tau)\Delta}{Q}\right] \\ &= [(1-\tau)pR_G - (1-p\tau)I + (1-p)R_B]\cdot \\ &\quad \left[1+\frac{p(1-\tau)\Delta}{(1-\tau)pR_G + (1-p)R_B - R_B + p\tau I}\right].\end{aligned}$$

Comparing the values of the objective function using the optimal amount of risky debt and all equity, we find that the manager chooses risky debt financing if and only if

$$\begin{aligned}&(1-\tau)[pR_G+(1-p)(R_B-L)-I]+p(1-\tau)\Delta\\>\ &\left[1+\frac{p(1-\tau)\Delta}{(1-\tau)pR_G+(1-p)R_B-R_B+p\tau I}\right][(1-\tau)pR_G-(1-p\tau)I+(1-p)R_B],\end{aligned}$$

or alternatively,

$$\tau(1-p)(I-R_B)+\left\{p(1-\tau)\Delta\left[1-\frac{(1-\tau)pR_G+(1-p)R_B-I+p\tau I}{(1-\tau)pR_G+(1-p)R_B-R_B+p\tau I}\right]\right\}>(1-\tau)(1-p)L.$$

Comparing this condition to condition (IA.9) in Proposition 1, we see that the overconfident CEO will be more likely to use debt if and only if the term in { } is positive. Since $I > R_B$ by assumption, the term in [ ] is positive, yielding the result. **QED**

An overconfident CEO is more likely to choose full debt financing than a rational CEO for two reasons. First, the CEO overestimates the tax benefits of debt since he overestimates future returns (i.e., overestimates cash flow R_G by Δ). Second, he perceives equity financing to be more costly since new shareholders obtain a partial claim on Δ without paying for it. In our simple setup, the CEO agrees with the market about the fair interest rate on risky debt since there is no disagreement about the probability of default or the cash flow in default states.

In our simple setting, overconfidence does not affect the decision to implement a project, conditional on external financing. Since capital markets do not finance negative net present value projects, overconfident CEOs destroy value 'only' by using risky debt in some cases in which equity would be cheaper. If we re-introduce A or C, overconfident CEOs may overinvest since they overvalue returns from investment and can finance negative net present value projects by diluting A or spending out of C. Likewise, if we allow for CEOs to perceive $\widehat{A} > A$, overconfident CEOs might underinvest due to concerns over diluting claims on existing assets.[2]

Since we used $\hat{R}_B > R_B$ to argue that overconfident CEOs prefer internal finance to risky debt, we briefly consider the choice between risky debt and equity in the same setting, that is, for a CEO who overestimates not only R_G but also R_B, for example, $\hat{R}_B = R_B + \Delta$. In most cases, the conclusions of Proposition 3 go through. Only if $\hat{R}_B \geq w \geq R_B$, that is, if the CEO mistakenly believes that risky debt is riskless, *is it* possible (for a specific range of parameters) that the overconfident CEO prefers equity over risky debt. This case requires the probability of the bad state to be very large and Δ to be sufficiently small (and an appropriate choice of the other parameters). The first parameter restriction, a high probability of the bad state, is needed so that the terms offered for debt financing seem particularly costly. The CEO believes that the required interest is unduly high (since creditors perceive cash flows to be lower by Δ in the bad state) and that he will have to pay the overly high interest not only in the (low probability) good state, but also in the (high probability) bad state. Under equity financing, the CEO instead believes that he will maintain a fraction of Δ in all states. The second parameter restriction, a small Δ, is needed since the cost of equity but not the cost of debt depends on Δ. The perceived cost of equity increases in Δ since new equity holders receive a fractional claim on all firm cash flows, whereas the perceived cost of debt does not depend on Δ since both the interest charged by creditors and the cost the CEO misperceives to be appropriate, zero, are independent of Δ. Thus, the perceived cost of debt relative to equity can dominate the perceived benefit – namely, the value of retaining the residual claim on Δ in the good state (and the extra tax benefit on the high interest) – only if Δ is sufficiently small.

In summary, the reversed preference for equity over debt applies only for a small portion of the parameter space and, due to the required large probability of default, is unlikely to apply to our sample of *Forbes 400* firms.

Overall, our analysis demonstrates that overconfidence can generate a preference for risky debt over equity, conditional on accessing external capital markets. This preference arises because overconfident CEOs prefer being the residual claimant on the full cash flow in non-default states to giving up a fraction of cash flows in all states. In addition, overconfident CEOs may exhibit debt conservatism. They raise little external financing of any kind, in particular less risky debt than rational CEOs. In other words, the absolute amount of debt used by overconfident CEOs can be smaller even if leverage is higher (due to less frequent equity issuance).

II. Overconfidence Measures on Extended Sample

Below we provide details on the construction of our alternative measures of overconfidence on the 1992 to 2007 sample of *Execucomp* and *Thomson Financial* data. We also discuss their limitations relative to our original measures:

Longholder_Exec. Our core measure of overconfidence exploits package-level information about strike prices and remaining duration to identify late option exercise. *Execucomp* contains such information for all CEO option packages outstanding at the end of each fiscal year, beginning in 2006. Using these data, we exactly replicate the *Longholder* measure. The drawback of this measure is its limited availability. In particular, the short time series includes very few CEO changes in a given firm, precluding fixed effects analyses, and shows the exercise decisions of newly hired CEOs for at most two years.

Longholder_ CJRS. For years prior to 2006, *Execucomp* contains fewer details about new options granted (total number and value) and only aggregated information on the number and value of exercised as well as outstanding options. Package-level strike prices and remaining duration are not available.[3] Thus, the data does not allow us to determine whether a CEO held an option to expiration as required by the *Longholder* measure and how much it was in-the-money. The closest approximation feasible with the older *Execucomp* data is the approach proposed by Campbell et al. (2009) and Hirshleifer, Teoh, and Low (2010): they use the aggregate data to calculate average strike prices and therefore the average moneyness of the options, assuming the options are not underwater. A CEO is then classified as overconfident for all sample years after he first holds exercisable options that are, on average, at least 67% in the money at the end of a fiscal year, mirroring our *Holder 67* measure. In addition, the CEO must fail to exercise such options at least one additional time during the sample period. Under this approach, it is not possible to impose a restriction on remaining option duration (though such a restriction is theoretically required) since the data do not allow inferences about remaining duration, even on average.

Longholder_ Thomson (_Fill). Thomson Financial contains transaction-level data, including the expiration date and strike price of each exercised CEO option, from 1996 to the present. Thus, it should be possible to replicate the original *Longholder* measure constructed from annual snapshots of CEO option holdings. To do so, we follow a procedure similar to Otto (2009) and classify a CEO as overconfident if the CEO exercises an option in the final year of its duration and the option is at least 40% in-the-money one year prior to its expiration date. However, we find that the insider filings, particularly for derivative transactions, are noisy. We must drop more than 25% of CEO option exercises due to cleanse codes that indicate poor data quality, absence of required data items (strike prices or expiration dates), and obvious reporting mistakes (e.g., transaction date after the expiration date). These issues also raise doubts about how to classify CEOs for whom we do not observe (usable) exercise information, particularly since we know from the *Execucomp* snapshots that most of these CEOs have options. We consider two possibilities: (1) we include only CEOs for whom we observe at least one *Thomson* option exercise (*Longholder_ Thomson*) and (2) we include all *Execucomp* CEOs (*Longholder_ Thomson_ Fill*). The two variables differ only in the comparison group; the set of CEOs classified as overconfident is identical.

The exact steps we follow to identify overconfidence under the *Longholder_ Thomson* measures are as follows:

To begin, we download all Table 2 transactions for firms in our *Execucomp* sample, requiring the role code to equal "CEO." We then apply the following filters:

1. We keep only observations for which *Thomson* cleanse codes indicate a reasonable degree of data accuracy ("R," "H," "C," "L," or "I").

2. We drop observations that are amendments of prior records to avoid double-counting transactions (*amend* = "A").

3. We require the acquisition/disposition flag to indicate that the record represents disposal of securities (*acqdisp* = "D").

4. We keep only derivative codes that indicate the securities in question are call options ("OPTNS," "ISO," "CALL," "NONQ," "EMPO," "DIRO," "DIREO," "EMPLO," "NON Q," "NONQU," "SAR," "OPTIO," "EMP.", or "EMPL").

5. We drop observations with missing strike prices or exercise dates.

6. We drop observations with implausible values of the strike price (*xprice* < 0.1 or *xprice* > 2000).

7. We keep only records with transaction codes indicating option exercises (*trancode* = "M," "X," "H," or "F").

Next, we merge the resulting data with monthly stock price data from *CRSP*. We identify all option exercises that meet two "*Longholder*" criteria: (1) the exercise occurs within 365 calendar days of option expiration and (2) the option was at least 40% in-the-money 12 months prior to the month of expiration (using the *CRSP* end-of-the-month stock price). We then merge the *Thomson* data with our *Execucomp* sample, retaining an option exercise observation only if the insider name in the *Thomson* data matches the CEO name in *Execucomp*. Finally, we set the variable *Longholder_ Thomson* or *Longholder_ Thomson_ Fill* equal to one if we observe at least one option exercise meeting the two *Longholder* criteria during the CEO's tenure in our *Execucomp* panel. The two measures differ only in the control groups (i.e., the CEO-years for which the variable is set to zero). For *Longholder_ Thomson*, we include a CEO in the control group only if we observe at least one option exercise by the CEO in the *Thomson* data, but never an exercise that meets the two *Longholder* criteria. For *Longholder_ Thomson_ Fill*, we include all *Execucomp* CEOs for whom we never observe an option exercise meeting the two *Longholder* criteria.

In Table IA.I, we present summary statistics of the extended sample of firm-years (Panel A). In columns (II), (III), and (IV), we present summary statistics of overconfident CEO-years under each of the overconfidence measures described above. The most pronounced differences are in firm size: *Longholder_Exec* CEOs operate firms with more assets, though the difference also reflects the later sample years. They also have the highest kinks (Panel B).

In Table IA.II, we provide additional information on the four overconfidence measures, including the pairwise correlations between the measures and with lags of firm performance. This table supplements the discussion in Section VI of the main text.

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Notes

[1]Formally, we assume $\frac{\partial}{\partial c}\hat{E}[\tilde{R} - \tau 1_{\{R>I\}}(\tilde{R} - I)] = 0$ and $\frac{\partial}{\partial c}\widehat{A} = 0$.

[2]Propositions 1 and 2 of Malmendier and Tate (2004) derive these results formally in a parallel setup for external investment projects (mergers).

[3]In principle, the data allow one to track new grants over time and attempt to match changes in aggregate option holdings back to their original annual grant "package" using, for example, a first-in first-out allocation rule. This approach is noisy and reduces the usable sample period to a few years. Instead, we construct an alternative measure using *Thomson* transaction-level data that contain explicit information on the expiration dates and strike prices of exercised (and expiring) options.

Table IA.I

Summary Statistics (Execucomp Sample)

In Panel A, Net Financing Deficit is cash dividends plus net investment plus change in working capital minus cash flow after interest and taxes. Net Investment is capital expenditures plus increase in investments plus acquisitions plus other uses of funds minus sale of PPE minus sale of investment. Change in Working Capital is change in operating working capital plus change in cash and cash equivalents plus change in current debt. Cash Flow after Interest and Taxes is income before extraordinary items plus depreciation and amortization plus extraordinary items and discontinued operations plus deferred taxes plus equity in net loss (earnings) plus other funds from operations plus gain (loss) from sales of PPE and other investments. Net Debt Issues are long-term debt issuance minus long-term debt reduction. Net Equity Issues are sales of common stock minus stock repurchases. Profitability is operating income before depreciation, normalized by assets at the beginning of the year. Tangibility is PPE, normalized by assets at the beginning of the year. Q is market value of assets over book value of assets, where market value of assets is book value of assets plus market equity minus book equity. Δ denotes one-year changes. The Fama-French Industry Groups are defined on French's website (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). In Panel B, Kink is the amount of interest at the point where the marginal benefit function becomes downward-sloping, as a proportion of actual interest expense. ECOST is the standard deviation of the first difference in taxable earnings divided by assets, the quotient times the sum of advertising and R&D expenses divided by sales. CYCLICAL is the standard deviation of operating earnings divided by mean assets first calculated for each firm, then averaged across firms within two-digit SIC codes. Return on Assets is income before extraordinary items plus interest expense plus depreciation, divided by assets. Z-score is 3.3 times the difference of operating income before depreciation and depreciation plus sales plus 1.4 times retained earnings plus 1.2 times working capital (balance sheet), the quantity divided by assets. Quick Ratio is the sum of cash and short-term investments and total receivables divided by total current liabilities. Current Ratio is total current assets divided by total current liabilities. Q-ratio is preferred stock plus market value of common equity plus net short-term liabilities, the quantity divided by assets. R&D-to-sales and Advertising-to-sales are set to zero when the numerator is missing. Computer Industry is all firms with SIC code 357, Semiconductor Industry is all firms with SIC code 367, Chemicals and Allied Products comprises SIC codes 280-289, Aircraft and Guided Space Vehicles is SIC codes 372 and 376, and Other Sensitive Industries is SIC codes 340-400, excluding 357, 367, 372, and 376. Vested options (as a % of shares outstanding) are multiplied by 10 so that the means of vested options and stock ownership are the same order of magnitude. In Panel C, CEO Vested Options are the CEO's holdings of options that are exercisable within six months of the beginning of the year (as a percentage of shares outstanding), multiplied by 10 so that the means of vested options and CEO Stock Ownership are the same order of magnitude. Depression Baby is an indicator variable for CEOs born in the 1920s. Military Experience indicates CEOs with prior military service.

Panel A. Financing Deficit Variables

	Full Sample (I)			Longholder_Exec Sample (II)			Longholder_CJRS Sample (III)			Longholder_Thomson(_Fill) Sample (IV)		
	Number of Firms = 2,166 Num. Firm-Years = 13,948 (w/ Net Equity Issues) = 13,556			Number of Firms = 270 Num. Firm-Years = 377 (w/ Net Equity Issues) = 367			Number of Firms = 1,359 Num. Firm-Years = 7,151 (w/ Net Equity Issues) = 6,952			Number of Firms = 763 Num. Firm-Years = 5,097 (w/ Net Equity Issues) = 4,932		
Variable	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Assets ($m)	5507.56	1112.16	22779.22	12870.27	2053.48	57899.51	4665.88	1108.21	15685.05	6879	1516.50	28433.19
Net Financing Deficit ($m)	8.44	0.01	1260.86	109.20	0.55	3162.61	4.69	1.72	945.82	7	-0.24	1591.74
Cash Dividends ($m)	93.40	2.11	527.63	237.92	6.68	1042.14	77.03	0.00	414.01	120	5.80	514.52
Net Investment ($m)	431.65	78.00	2038.34	1224.21	142.70	5352.03	428.15	93.47	1551.85	564	114.21	2370.11
Change in Working Capital ($m)	59.76	12.71	869.69	6.50	22.39	1092.09	54.89	15.90	757.65	75	16.36	758.64
Cash Flow after Interest and Taxes ($m)	576.36	119.00	1951.71	1359.42	258.14	4002.86	555.39	128.86	1806.95	753	177.20	2201.42
Net Financing Deficit/Assets$_{t-1}$	0.04	0.00	0.27	0.03	0.00	0.25	0.06	0.00	0.32	0.03	0.00	0.22
Net Debt Issues/Assets$_{t-1}$	0.03	0.00	0.18	0.06	0.00	0.21	0.04	0.00	0.20	0.04	0.00	0.18
Net Equity Issues/Assets$_{t-1}$	0.01	0.00	0.19	-0.03	-0.01	0.12	0.01	0.00	0.24	0.00	0.00	0.12
Profitability	0.16	0.16	0.15	0.17	0.17	0.12	0.18	0.18	0.16	0.18	0.17	0.12
Δ Profitability	-0.01	0.00	0.15	-0.01	0.00	0.07	-0.01	0.00	0.13	0.00	0.00	0.12
Tangibility	0.34	0.27	0.27	0.29	0.18	0.29	0.34	0.25	0.29	0.35	0.27	0.28
Δ Tangibility	-0.01	0.00	0.16	0.00	0.00	0.13	-0.01	0.00	0.18	-0.01	0.00	0.16
Q	2.12	1.61	1.90	2.17	1.88	1.21	2.43	1.85	2.24	2.20	1.73	1.57
Δ Q	-0.12	-0.01	2.16	-0.03	-0.03	0.64	-0.11	0.00	2.27	-0.06	0.00	1.37
ln(Sales)	7.12	7.05	1.63	7.71	7.50	1.64	7.08	7.02	1.59	7.44	7.36	1.57
Δ ln(Sales)	0.10	0.09	0.27	0.10	0.11	0.23	0.14	0.12	0.27	0.12	0.10	0.22

Distribution across Fama French 12 Industry Groups

	(I)	(II)	(III)	(IV)		(I)	(II)	(III)	(IV)
Consumer Nondurables	0.09	0.06	0.07	0.09	Telecommunication	0.03	0.02	0.03	0.02
Consumer Durables	0.04	0.02	0.03	0.04	Utilities	n.a.	n.a.	n.a.	n.a.
Manufacturing	0.13	0.07	0.10	0.12	Shops	0.15	0.16	0.14	0.16
Energy	0.05	0.09	0.06	0.07	Health	0.10	0.14	0.13	0.11
Chemicals and Allied Products	0.05	0.02	0.03	0.05	Money	n.a.	n.a.	n.a.	n.a.
Business Equipment	0.20	0.20	0.24	0.17	Other	0.17	0.21	0.17	0.17

Table IA.I (cont.)

Panel B. Kink Variables

	(I)			(II)			(III)			(IV)		
	Number of Firms = 1,485			Number of Firms = 194			Number of Firms = 914			Number of Firms = 613		
	Num. Firm-Years = 8,730			Num. Firm-Years = 278			Num. Firm-Years = 4,413			Num. Firm-Years = 3,599		
Variable	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Kink	4.23	3	3.44	5.28	5	3.55	4.56	4	3.43	4.48	4	3.35
I(No dividend)	0.37	0	0.48	0.44	0	0.50	0.45	0	0.50	0.34	0	0.47
I(Negative owners' equity)	0.02	0	0.15	0.01	0	0.08	0.02	0	0.13	0.01	0	0.08
I(NOL carryforward)	0.33	0	0.47	0.47	0	0.50	0.32	0	0.47	0.31	0	0.46
ECOST	3.58	0.45	10.15	3.97	0.35	10.65	4.33	0.59	11.18	3.22	0.44	9.07
CYCLICAL	0.09	0.10	0.03	0.10	0.10	0.03	0.09	0.10	0.02	0.09	0.10	0.03
Return on assets	0.11	0.12	0.10	0.12	0.12	0.08	0.12	0.13	0.09	0.12	0.12	0.07
ln(sales)	7.39	7.32	1.50	7.77	7.55	1.53	7.36	7.30	1.48	7.66	7.56	1.44
Z-score	2.09	2.13	1.39	2.14	2.09	1.19	2.15	2.21	1.37	2.27	2.22	1.14
Quick ratio	1.44	1.04	1.44	1.48	1.07	1.42	1.56	1.12	1.59	1.42	1.03	1.46
Current ratio	2.22	1.80	1.62	2.22	1.70	1.61	2.31	1.87	1.73	2.18	1.78	1.64
PPE-to-assets	0.32	0.27	0.21	0.26	0.19	0.23	0.30	0.24	0.21	0.31	0.26	0.21
Q-ratio	1.46	1.12	1.24	1.64	1.34	1.10	1.72	1.31	1.37	1.62	1.24	1.28
R&D-to-sales	0.04	0	0.12	0.06	0	0.15	0.05	0.00	0.13	0.04	0	0.10
Advertising-to-sales	0.01	0	0.03	0.01	0	0.03	0.01	0	0.02	0.01	0	0.02
Computer Industry	0.02	0	0.15	0.01	0	0.12	0.03	0	0.16	0.02	0	0.13
Semiconductor Industry	0.04	0	0.20	0.06	0	0.23	0.06	0	0.24	0.05	0	0.21
Chemicals and Allied Products Industry	0.10	0	0.30	0.09	0	0.29	0.10	0	0.30	0.12	0	0.32
Aircraft and Guided Space Vehicles Industry	0.01	0	0.11	0.01	0	0.10	0.01	0	0.11	0.01	0	0.11
Other Sensitive Industries	0.22	0	0.41	0.21	0	0.40	0.23	0	0.42	0.21	0	0.41

Panel C. CEO Variables

	(I)			(II)			(III)			(IV)		
	Number of CEOs = 3,466			Number of CEOs = 270			Number of CEOs = 1,579			Number of CEOs = 869		
Variable	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Age	56.12	56	7.63	56.75	56	6.73	56.03	56	7.40	55.92	56	6.93
Tenure	9.13	7	7.81	11.28	9	7.95	10.27	8	7.84	10.05	8	7.63
CEO Stock Ownership	0.03	0.00	0.07	0.02	0.00	0.06	0.03	0.01	0.06	0.02	0.00	0.05
CEO Vested Options	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Depression Baby	0.10	0	0.30	n.a.	n.a.	n.a.	0.09	0	0.29	0.09	0	0.29
Military Experience	0.04	0	0.18	0.01	0	0.09	0.03	0	0.17	0.02	0	0.14

Table IA.II
Alternative Longholder Measures (Execucomp Sample)

The sample consists of S&P 1500 companies covered by *Compustat's Execucomp* database between 1992 and 2007, excluding financial companies (SIC 6000-6999) and regulated utilities (SIC 4900-4999). Longholder_Exec is is a binary variable where one signifies that the CEO at some point during his tenure held an option package until the last year before expiration, provided that the package was at least 40% in-the-money entering its last year. Longholder_Thomson is a binary indicator defined as Longholder_Exec, but using *Thomson Financial* data to identify option exercises that occur in the final year of the option's duration. Longholder_Thomson is zero for CEOs for whom we observe at least one option exercise in the *Thomson* database during the sample period. Longholder_Thomson_Fill is defined as Longholder_Thomson, but includes all CEOs who do not satisfy the Longholder criteria in the control group. Longholder_CJRS is a binary indicator set to one if the CEO at least twice during his tenure in the sample was holding options with average moneyness greater than 67% at the end of a fiscal year, starting in the first year the CEO displays the behavior. $Returns_x$ are the natural logarithm of one plus stock returns (excluding dividends) from year x-1 to x. p-values and number of observations are in parentheses.

Panel A. Summary Statistics

	N	% Overconfident	% Not Overconfident
Longholder_Exec	3,566	22.18	77.82
Longholder_CJRS	19,108	49.45	50.55
Longholder_Thomson	12,970	53.56	46.44
Longholder_Thomson_Fill	21,549	32.24	67.76

Panel B. Pairwise Correlations

	Longholder_Exec	Longholder_CJRS	Longholder_Thomson	Longholder_Thomson_Fill	$Returns_{t-1}$	$Returns_{t-2}$	$Returns_{t-3}$	$Returns_{t-4}$	$Returns_{t-5}$
Longholder_Exec	1								
Longholder_CJRS	0.2208	1							
	(0.00; 3314)	(- ; 19108)							
Longholder_Thomson	0.4375	0.1671	1						
	(0.00; 2290)	(0.00; 12398)	(- ; 12970)						
Longholder_Thomson_Fill	0.4840	0.2678	1	1					
	(0.00; 3566)	(0.00; 19108)	(- ; 12970)	(- ; 21549)					
$Returns_{t-1}$	0.0498	0.1517	0.0314	0.0723	1				
	(0.00; 3526)	(0.00; 18980)	(0.00; 12870)	(0.00; 21298)	(- ; 28944)				
$Returns_{t-2}$	0.0202	0.1684	0.0167	0.0581	-0.0227	1			
	(0.23; 3495)	(0.00; 18706)	(0.06; 12719)	(0.00; 20939)	(0.00; 27801)	(- ; 27848)			
$Returns_{t-3}$	0.0379	0.1629	0.0169	0.0523	-0.0538	-0.0498	1		
	(0.03; 3454)	(0.00; 18285)	(0.06; 12484)	(0.00; 20429)	(0.00; 26644)	(0.00; 26691)	(- ; 26470)		
$Returns_{t-4}$	0.0145	0.1303	0.021	0.0508	-0.0613	-0.0622	-0.0488	1	
	(0.40; 3420)	(0.00; 17760)	(0.02; 12175)	(0.00; 19809)	(0.00; 25484)	(0.00; 25520)	(0.00; 25568)	(- ; 25624)	
$Returns_{t-5}$	0.0103	0.0897	0.0345	0.0518	0.004	-0.0744	-0.0716	-0.0561	1
	(0.55; 3385)	(0.00; 17172)	(0.00; 11799)	(0.00; 19129)	(0.54; 24305)	(0.00; 24326)	(0.00; 24360)	(0.00; 24413)	(- ; 24478)