Managerial Duties and Managerial Biases*

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ABSTRACT

The analysis of managerial overconfidence often focuses on one decision-maker, typically the CEO. We construct a measure of CFO overconfidence and show that the interplay and assortative matching of managers significantly affect the magnitude and attribution of the bias in financing decisions. In a simple model, we illustrate the direct role of CFO overconfidence and the indirect role of CEO overconfidence in financing. Empirically, both CEO and CFO overconfidence are correlated with a preference for debt, but the CFO's type dominates. CEO overconfidence lowers the cost of debt and triggers a multiplier effect via the hiring of overconfident CFOs.

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A growing literature in corporate finance points to the central role of managers' individual characteristics and biases in explaining corporate decision-making. While the idea that personal traits matter for organizational outcomes dates back at least to Hambrick and Mason (1984), recent work has been able to establish convincing empirical evidence for important corporate outcomes such as investment, mergers, or financing decisions (see, e.g., the overview in Baker and Wurgler (2012)). The spectrum of managerial traits ranges from their risk aversion, education, childhood experiences, and gender to behavioral biases such as overconfidence, loss aversion, or escalation of commitment.[1] These traits and biases appear to have a first-order impact on corporate performance, as the factor analysis of Kaplan, Klebanov and Sorensen (2012) indicates.

Much of the literature focuses on one type of manager, most often the chief executive officer (CEO). This emphasis reflects the CEO's role as the top decision maker in the firm, and also data availability. Fewer papers investigate the role of the chief financial officer (CFO) or of other top-five managers.[2] Even less attention has been paid to the question of multiplier or other interaction effects between managers: Are managerial biases ameliorated or exacerbated when overconfident managers interact with other (top) managers in the firm? In fact, might corporate outcomes be misattributed to CEO overconfidence when the analysis does not account for the traits of other managers and for managers' assortative matching? These questions are important not only to researchers, who aim to assess the magnitude of biases and their effects; it is also relevant and oft-asked in practice: When trying to devise corporate-governance responses to biased managerial behavior, how should boards compose the C-suite? Should one personality counterbalance the other, or is it better if managers have compatible beliefs and styles? Do the CEO's traits dominate in all decisions, or can we detect the imprint of other managers' traits in their respective domains?

In this paper, we take a first step towards addressing these questions. We focus on financing

[1] See Graham, Harvey and Puri (2013), Bertrand and Schoar (2003), Malmendier and Tate (2005 and 2008), Malmendier, Tate, and Yan (2011), Chevalier and Ellison (1999), Jiekun and Kisgen (2013), Faccio, Marchica, and Mura (2015), Yim (2013), Camerer and Malmendier (2007), Bazerman and Neale (1992), and Staw and Ross (1993), among others.

[2] Notable examples of CFO studies include Ben-David, Graham, and Harvey (2007, 2013), Jiang, Petroni and Wang (2010), and Chava and Purnanandam (2010). Studies that analyze several of the C-suite managers include Aggarwal and Samwick (1999), Datta, Iskandar-Datta and Raman (2001), and Selody (2010).

choices and analyze the respective influence of CEO and CFO overconfidence.[3] We consider CEO overconfidence, defined as the CEO's overoptimistic beliefs in the value she can create in her firm; and we consider CFO overconfidence, which we define as the CFO's overoptimistic beliefs about the value the CEO can create in the firm.[4] We show that optimistic beliefs of both managers leave a measureable impact on debt issuance and leverage decisions. The CFO's beliefs, however, dominate those of the CEO, especially when we consider both jointly. At the same time, the persona of CEO is most important when predicting financing conditions (the interest rate paid on loans). We also show that overconfident CEOs tend to select like-minded CFOs when given the opportunity.

Our analysis starts from a simple model of CEO and CFO decision-making. Our theoretical framework differs from previous theoretical work on the role of CEO overconfidence such as Malmendier and Tate (2005) and (2008) in two important dimensions. First, we allow both CEOs and CFOs to exhibit overconfidence. Second, we consider how the CEO's optimistic beliefs might affect her effort. As outlined above, overconfident beliefs stem from overestimating the CEO's ability and, hence, the returns to her efforts. As a result, the CEO might exert more effort if she is overconfident and the CFO, in turn, will account for such behavior in his financing choice.

Our model generates three main testable predictions. A first, direct prediction is that, conditioning on the CEO's type, an overconfident CFO exhibits a preference for debt when accessing external finance. Intuitively, to the extent that they consider their firm to be undervalued, CFOs find equity too costly relative to debt, since equity prices are more sensitive to differences in opinions about future cash flows. This argument is similar to the prediction for CEOs in Malmendier, Tate and Yan (2011), with the important difference that, arguably more realistically, the CFO chooses the means of financing. While we will also analyze, empirically, the role of the CEO in

[3] Our approach can be applied to other C-suite managers, e.g., the COO and operating decisions. However, the intersection of ExecuComp and Thompson data is currently too small to perform such an analysis. (See Section II.A for details about the construction of the dataset.)

[4] We note that the nature of CEO and CFO overconfidence under these definitions are to some extent different. While the former characterizes a belief in own abilities, the latter reflects an overoptimistic belief in another person (the CEO) or in the firm. Hence, it might be appropriate to choose different labels. Here, we stick to a common label, not only to simplify, but also because both biases link directly to the same empirical measure, late exercise of executive stock options.

determining the type of financing directly, we focus the theoretical analysis on the case where the capital structure decisions are delegated to the CFO.

A second and more subtle prediction pertains to the indirect influence of the CEO's overconfidence on financing. We show that CEO bias may lower the cost of financing, especially for firms in intermediate ranges of profit variability. The reason is that overconfident CEO overestimate returns to effort, and these optimistic beliefs induce higher effort.[5] The key model ingredient here is that we allow for a shock to the profitability of the investment that occurs after the financing decision is made. Anticipating that, following a negative shock, a CEO may be less willing to work hard, debtholders will require a higher premium on debt. An overconfident CEO, however, might be optimistic enough to work towards the good outcome regardless, and hence obtain better financing terms. Moreover, the model predicts that the association between CEO overconfidence and cost of debt varies non-monotonically with profit variability: A severe shock will invariably diminish incentives to work for any type of CEO. A mild shock will not matter much for any type of CEO and will not be priced. After shocks in an intermediate range, however, a rational CEO might anticipate the project to be out of the money and not exert effort, while an overconfident CEO overestimates the returns to effort and might work hard. In this case, overconfidence helps solving the incentive problem. Overconfident CEOs obtain better financing conditions for corporate debt as issuers anticipate such behavior. This "non-monotonicity" is specific to models of biased beliefs and helps ruling out alternative explanations under which CEO overconfidence is proxying for some omitted firm characteristic.

Third, the model can be employed to illustrate another indirect channel through which the CEO overconfidence affects financing, namely hiring. We show that an overconfident CEO who is in the position to select a new CFO is more likely to choose another overconfident manager. The intuition is straightforward: To the extent that the CEO delegates capital-structure decisions to the CFO, she prefers to hire a CFO who shares her views regarding the firm's profitability. As CEOs have a significant say in selection of board members (Shivdasani and Yermack (1999), Cai et al. (2009),

[5] Cf. similar mechanisms in Pikulina, Renneboog, Tobler (2014) and Gervais, Heaton, Odean (2011).

Fischer et al. (2009)), who are in turn in charge of the CFO choice, this prediction implies a potential multiplier effect of overconfident managers.

All predictions find strong support in the data. To measure overconfidence, we follow the option-based approach proposed in Malmendier, Tate and Yan (2011). Their "Longholder_Thomson" measure uses the timing of option exercise as a proxy for managerial overconfidence, relative to a benchmark model of optimal option exercise for managers. We replicate their CEO measure, and we generate a parallel CFO measure. We also construct a continuous version of our Longholder proxy following recent work by Otto (2014).

First, we analyze simultaneously the roles of the CEO and the CFO in the choice between debt and equity, conditional on accessing public markets. Using various measures of net debt issuance from Compustat and SDC, as well as traditional financing-deficit models, we find that that overconfident executives are reluctant to issue equity. We also find a positive association between overconfidence and leverage choices. However, CFO overconfidence is statistically and quantitatively more important than CEO overconfidence and, if analyzed jointly with CEO overconfidence, dominates in all specifications. That is, the predictive power of CEO overconfidence disappears when the empirical model includes a proxy for CFO overconfidence. The manager whose beliefs matter for capital budgeting decisions *directly* appears to be the CFO, not the CEO. At the same time, effort and hiring point to an important *indirect* channel.

To test the second prediction of our model, we merge DealScan data on syndicated loans with our dataset, which allows us to analyze the terms of financing. We show that, conditional on several known determinants of the cost of debt financing, overconfident CEOs pay significantly lower interest rates. The effect is non-monotonic in the manner predicted by our model: We estimate a significant effect only for companies with intermediate profit variability. This holds regardless of whether we use earnings volatility, analysts' coverage, or analysts' forecasts variability as proxies, and robustly so for a broad range of cutoff points to determine the intermediate range.

Finally, we also find that companies with overconfident CEOs are more likely to appoint like-minded CFOs. The statistical and economic magnitudes of this effect are large.

Overall, our findings confirm the importance of managerial traits in corporate finance, but they

also caution against the focus on one single manager in much of the literature. We confirm the thrust of the existing literature by providing evidence that focuses on the role of the CFO and showing that his beliefs significantly affect outcomes in the CFO domain. As such, we help to complete the literature on managerial overconfidence, which has been heavily focused on the CEO or, if considering the CFO, did not aim to analyze the interplay of CEO and CFO. Differently from prior studies on managerial overconfidence, we consider CEO and CFO jointly and show that the CFO matters most for financing choices, while the CEO affects financing outcomes indirectly, by influencing the financing conditions and by hand-selecting CFOs that reflect her views. The domain-specific relevance of managerial overconfidence also corroborates the empirical importance and interpretation of the widely used Longholder measure of overconfidence. At the same time, our results caution that in considering only one manager, empirical analyses might misattribute outcomes and fail to recognize multiplier effects. Our results suggest that previously identified effects of CEO overconfidence on the choice of external financing might reflect biases of the CFO – though we would like to emphasize that our newer data does not suggest strong CEO effects in capital structure decisions to begin with and is therefore not entirely comparable. Moreover, the impact of CEO biases may increase rapidly whenever the CEO has the opportunity to select other top managers. Fixed effect regressions help address the concern about confounds by accounting for time-invariant firm characteristics, albeit only imperfectly if there are CFO switches, assortative matching, and multiplier effects. Our research suggests that the managerial traits analysis might need to move towards more complete firm data sets, where it is possible for all agents to influence firm outcomes.

Literature Review. In addition to the literature on managerial traits cited above, our analysis builds on previous work on the role of CFOs and their biases in determining corporate outcomes, including, among others, Ben-David, Graham, and Harvey (2007, 2013), Jiang, Petroni and Wang (2010), and Chava and Purnanandam (2010). Using a methodology similar to Bertrand and Schoar (2003), Ge, Matsumoto and Zhang (2011) find that CFO "style" is related to a number of accounting choices. Huang and Kisgen (2011) establish a link between the gender of CEOs and CFOs and the

returns to acquisitions (where male executives are likely to be more overconfident). Outside the behavioral realm, Jiang, Petroni and Wang (2010) and Kim, Li and Zhang (2011) find that CFOs' equity incentives have much larger explanatory power than CEOs' incentives for earnings management and stock crashes. In this paper, we confirm that the traits of CFOs have larger explanatory power than those of CEOs for certain financial decisions, but are the first to bring this comparison to the realm of overconfidence and to jointly consider different managers as well as the indirect channels through which the beliefs of CEOs still matter.

Our paper also extends the literature that links overconfidence to capital structure decisions. Graham and Harvey (2001) present survey evidence suggesting that CFOs' reluctance to issue equity may be due to overconfidence. From a theoretical perspective, the capital structure model of Hackbarth (2009) predicts higher debt ratios for managers who overestimate earnings growth. Landier and Thesmar (2009) and Graham, Harvey, and Puri (2013) confirm empirically that overconfidence is associated with higher leverage and, in particular, a preference for short-term debt. Consistent with this prior work, our model connects overconfidence with higher debt ratios, but we also find that it is overconfidence at the CFO level that matters most in this context.

Our paper also contributes to the literature emphasizing the "bright side" of overconfidence. Ever since the influential paper by Roll (1986) on the link between managerial "hubris" and poor returns to acquirers, it has been a puzzle why boards keep appointing overconfident managers, also in light of the evidence in the subsequent literature on overconfident managers' poor decision making in a large number of contexts (see the overview in Malmendier and Tate (2015)). More recent papers, however, point out that overconfident managers may increase firm value (Goel and Thakor (2008)), engage in more innovative activities (Hirshleifer, Low and Teoh (2012)), and tend to require lower levels of incentive compensation for a given amount of effort (Otto (2014)). Others argue that (mild) overconfidence can prevent underinvestment (Campbell, Gallmeyer, Johnson, Rutherford and Stanley (2011)), reduce conflicts between bondholders and shareholders such as the debt overhang problem (Hackbarth (2009)), or be advantageous in oligopolistic market settings with strategic interaction between firms (Englmaier (2010, 2011). Our theoretical model further illustrates that overconfident CEOs may exert more effort and thereby – abstracting from potential

negative influences of overconfidence on corporate investment – may create more value to shareholders than rational CEOs, consistent with the work of Gervais and Goldstein (2007) and Hilary, Hsu, Segal and Wang (2014). By showing that overconfident CEOs pay lower interest rates on corporate loans, we provide a new angle on the "bright side" of overconfidence. Moreover, the non-monotonicity result, that identifies companies with profit variability as most relevant, is helpful in sorting out which firms may benefit most from hiring an overconfident manager.

Our model also relates to recent studies of dissent between managers in organizations (Landier, Sraer and Thesmar (2009); Landier, Savaugnat, Sraer and Thesmar (2012)), which suggest that CEOs are more likely to hire like-minded executives. Our empirical results support this hypothesis in the context of on an easily measurable, widely studied and relevant personal bias. Also related is recent empirical work analyzing when and where managers are more likely to delegate their decisions (such as Graham, Harvey, and Puri (2015), Acemoglu, Aghion, Lelarge, Van Reenen, and Zilibotti (2007), and Bloom, Sadun, and Van Reenen (2012)). Finally, Goel and Thakor (2008) show that overconfident managers are more likely to be appointed as CEOs. Here, we ask who is likely to be chosen as CFO conditional on the overconfidence of the CEO. We expect the commonality of personal traits to play an important role. For example, Graham, Harvey and Puri (2015) report that 48.2% of the CEOs they survey claim that "gut feel" is an important element in their decision to delegate corporate investment decisions to lower level executives.

In the remainder of the paper we first introduce our theoretical framework and generate the three main predictions about the impact of CEO and CFO overconfidence on firm outcomes (Section I). We then introduce our data and measures of CEO and CFO overconfidence (Section II). We relate these measures to the choice of financing (Section III) and to the terms of financing (Section IV). Finally, in Section V, we study the CFO hiring decisions, revealing the endogeneity of the relation between CEO and CFO overconfidence. Section VI concludes.

I. Theoretical Framework

A. Setting of the Model

We consider a simple model of investment and financing that allows us to capture the effect of distorted beliefs of CEOs and CFOs on corporate decision making. The role of the CEO ("she") is to make an investment decision, whereas the CFO ("he") chooses the financing of the investment project. The project costs I and generates an uncertain gross return $\tilde{R}$, which equals either $I + \sigma$ or $I - \sigma$, each with probability $1/2$, where $I \geq \sigma > 0$ is a measure of the "return variability." If the CEO exerts effort, she improves the expected value of the project to $\tilde{R} + \Delta$. Effort is costly, which is modeled as giving up a private benefit B, similar to the approach in Dewatripont and Tirole (1994) and Holmstrom and Tirole (1997 and 1998).[6]

The firm has no internal funds but the CFO can obtain external financing for the firm, either by issuing debt, which has a face value D, or by issuing shares for a fraction γ of the firm to new shareholders. (For tractability, we do not consider issuing debt and equity simultaneously.) External investors are risk neutral and must break even in equilibrium. There are no other assets or payoffs and, for simplicity, we assume no discounting. As in previous models of overconfidence (Malmendier and Tate, 2005, 2008), we abstract from the problem of finding the optimal compensation contract. We simply assume that the CEO and the CFO own a fraction α and β of the firm, respectively, where $\alpha, \beta > 0$ and $\alpha + \beta \leq 1$.[7]

We allow both the CEO and the CFO to deviate from rational belief formation. An overconfident CEO overestimates the return to her effort by an amount ω. That is, she believes that, by exerting high effort, she can increase the return of the project by an amount $\Delta + \omega$. An overconfident CFO also overestimates the returns to the CEO's efforts. For simplicity, his bias is also ω. That is, an overconfident CFO believes that whenever the CEO exerts high effort, the return of the project

[6] See also Tirole (2005), Pagano and Volpin (2005), and Matsa (2011), among others. In these papers, B is interpreted as the benefit from working on other projects (which reduces the expected revenue of the main project), as the benefit of a "softer" management style toward workers, or simply as opportunity costs from managing the project diligently.

[7] This simplification is common, for example, in the literature on managerial myopia and ensures that managers "care" about the market value of the firm (see for example Stein (1989) and Edmans (2009)).

increases by $\Delta + \omega$. Importantly, both managers are aware of each other's beliefs. For example, if the CEO is overconfident, the CFO knows that the CEO believes the return to her effort to be $\Delta + \omega$, regardless of whether the CFO himself is rational or overconfident. If the CFO is overconfident himself, he simply shares the CEO's (incorrect) beliefs regarding her ability. We will focus the analysis on the case $\Delta > B/\alpha \geq \omega$. The first inequality guarantees that the CEO's effort is not only socially valuable ($\Delta > B$), but also valuable to the rational CEO ($\alpha\Delta > B$), given the compensation arrangement. The second inequality implies that the additional return to effort an overconfident CEO expects to obtain due to her erroneous beliefs ($\alpha\omega$) is bounded above by the private benefit from shirking B. These restrictions limit the number of cases to be considered to those where moral hazard affects both overconfident and rational CEOs, but not always.[8] In these cases, the firm can always obtain financing, but its cost will vary based on the parameter conditions and managerial beliefs.

The CEO maximizes her expected utility, given by a fraction α of the expected net return plus (if applicable) the private benefit. She forms expectations using her personal beliefs. The CFO also maximizes his expected payoff, given by a fraction β of the expected net return.[9] His beliefs may differ from those of the CEO.

Investors anticipate correctly the true expected payoffs of the investment project. This modelling choice embeds two assumptions. First, as in previous literature (see Malmendier and Tate, 2005, 2008), investors do not share managers' overly optimistic views. Second, investors anticipate

[8] These assumptions are useful in streamlining the theoretical discussion. The main insight of this theoretical framework, namely, that overconfidence can ameliorate conditional financing terms as it helps overcome the moral hazard problem, however, is robust to relaxing them (i.e., considering parameter ranges $\Delta \leq B/\alpha$ and $B/\alpha < \omega$). Broadly speaking, if the first part of the double-inequality does not hold, i.e., $\Delta \leq B/\alpha$, the rational CEO never exerts high effort (except in the knife-edge case where $\Delta = B/\alpha$). If the second part does not hold, i.e., $B/\alpha > \omega$, the optimal debt contract becomes significantly more complicated, but without generating new insights. This assumption does, however, affect the CFO's funding choice. We discuss these variations and the robustness of our results in more detail in Online Appendix A1.e.

[9] Note in particular that the CFO's decisions is the same if we assume the CFO cares about firm value or about existing shareholders' surplus. This is because his optimization problem is equivalent up to a multiplication factor when we model him as partial owner of the firm (share β). There are many plausible alternative specifications of the objective functions; for example, the CFO may give some weight to the CEO's well-being. We have solved a version of the model where the CFO is "fully committed" to the CEO, i.e., maximizes her expected utility, including B, rather than his own equity stake. This variation also delivers the exact same insights.

the effort a CEO will put into the project. For example, they might recognize managerial overconfidence and anticipate how it will affect managerial behavior. This assumption is supported by the evidence in Otto (2014), who shows that shareholders recognize managerial optimism and adjust incentives contracts accordingly. It is also consistent with the evidence in Malmendier and Tate (2008) and Hirshleifer et al (2012), who show that measures of overconfidence based on option exercises are correlated with press portraits, suggesting that outsiders are able to identify overconfident managers.

The timing is as follows. At $t = 0$, the CEO announces the planned investment project, and the CFO chooses between debt and equity financing. If funding is obtained, then at $t = 1$ the actual profitability of the investment is revealed, i.e., whether the return equals $I + \sigma$ or $I - \sigma$. At $t = 2$, after having observed the realization of $\tilde{R}$, the CEO decides whether to exert high or low effort. At $t = 3$, cash flow is realized and investors are repaid. The full timeline is illustrated in Figure 1. The dotted line on the left indicates an extended model, considered in Section I.E, where we analyze whether the pairing of CEO and CFO overconfidence may be endogenous. There, we will allow for a pre-period $t = -1$, in which the CEO selects the (new) CFO.

B. CEO Overconfidence and Moral Hazard

Solving backward, we first analyze the effort decision of the CEO at $t = 2$, given the capital structure choice of the CFO at $t = 0$; we will then turn to the CFO's problem. We denote the return that the CEO expects to obtain from exerting high effort as $\Delta + \widehat{\omega}_{CEO}$ with $\widehat{\omega}_{CEO} = \omega$ if she is overconfident and $\widehat{\omega}_{CEO} = 0$ if she is rational. As standard in this type of models, we assume that, whenever indifferent, the manager exerts high effort rather than shirking.

At $t = 2$, the CEO knows the state of the world and the CFO's financing choice. We have four Incentive Compatibility (IC) constraints to consider to induce high effort, one for each state of the world and each financing choice. For debt financing in the good state of the world, we have:

$$(\text{IC}_{\text{D,Good}}) \qquad \alpha \cdot \max\{0, I + \sigma + \Delta + \widehat{\omega}_{CEO} - D\} \geq \alpha \cdot \max\{0, I + \sigma - D\} + B \qquad (1)$$

Intuitively, if the CEO believes the return of the project to be larger than D, she expects to reap the

difference between the revenue of the project and the face value of debt. If the perceived return is lower than D, the CEO defaults and is left with 0. Based on similar arguments, the IC for debt financing in the bad state of the world is:

$$(\text{IC}_{\text{D,Bad}}) \qquad \alpha \cdot \max\{0, I - \sigma + \Delta + \hat{\omega}_{CEO} - D\} \geq \alpha \cdot \max\{0, I - \sigma - D\} + B \tag{2}$$

In the case of equity financing, the CEO only obtains a fraction $\alpha(1-\gamma)$ of the project payoff, plus, possibly, the private benefit. In this case, both the IC for the good state of the world, $\alpha(1-\gamma)(I + \sigma + \Delta + \hat{\omega}_{CEO}) \geq \alpha(1-\gamma)(I + \sigma) + B$, and the IC for the bad state of the world, $\alpha(1-\gamma)(I - \sigma + \Delta + \hat{\omega}_{CEO}) \geq \alpha(1-\gamma)(I - \sigma) + B$, simplify to:

$$(\text{IC}_{\text{E}}) \qquad \alpha(1-\gamma)(\Delta + \hat{\omega}_{CEO}) \geq B. \tag{3}$$

C. CEO Overconfidence and the Cost of Debt

Given CEO behavior at $t = 2$, the CFO chooses between debt and equity at $t = 0$. The optimal contract allocates the full residual surplus of the project to the incumbent shareholders, conditioning on investors breaking even. Biased beliefs may affect contract design and financing choice but, because of competition, outsiders will not be able to earn any rents. We first derive the optimal debt contract, conditional on the choice of debt, and then analyze how CEO overconfidence affects the cost of debt financing. In Online Appendix A1, we solve for the optimal equity contract, which is a necessary step for deriving the CFO's choice between debt and equity at $t = 0$.

We denote the return to the project in state $S \in \{\text{Good, Bad}\}$ and after effort $e \in \{\text{High, Low}\}$ as $\pi(S, e)$; for example, $\pi(\text{Good, High}) = I + \sigma + \Delta$. Similarly, we denote the return the CEO and the CFO expect to be reaped given their beliefs with $\hat{\pi}_{CEO}(S, e)$ and $\hat{\pi}_{CFO}(S, e)$, respectively.

Given his beliefs, the CFO solves the following program to identify the (second-best) optimal debt contract:

$$\max_{D} \beta E[\max\{0, \hat{\pi}_{CFO}(S, e_s) - D\}] \tag{4a}$$

$$u_{CEO}(S, D, e_s) \geq u_{CEO}(S, D, e_s') \;\; \forall S \text{ and } e_s \neq e_s' \tag{4b}$$

$$E[\min\{D, \pi(S, e_s)\}] \geq I \tag{4c}$$

where $u_{CEO}(S, D, e_s)$ denotes the CEO's utility in state *S* under a debt contract with face value *D* if she exerts effort e_s, where e_s is the effort choice the CEO makes under a debt contract with face value *D* in state *S*. Note that, as the CFO's compensation is a linear function of the value of the firm (owned by incumbent shareholders), the CFO maximizes the shareholder value of the firm, albeit *as perceived by him*. In what follows, "perceived firm value" is a short-hand for "expected payoff to incumbent shareholders conditioning on CFO's beliefs." In other words, the maximization program reflects that the CFO may have distorted beliefs regarding CEO's skills.

The participation constraint in equation (4c) reflects that the payoff to debtholders in each state of the world and for effort level e_s is $\min\{D, \pi(S, e_s)\}$: If the return of the project is larger than D, debtholders are paid the face value of debt and incumbent shareholders enjoy the residual revenue of the project. If the return is lower than D, the CEO defaults, debtholders obtain all of the return, and shareholders are left with 0.

We denote as $D^*_{\widehat{\omega}}$ the face value of debt that solves this maximization problem given CEO beliefs $\widehat{\omega}_{CEO}$. (We will see below that the optimal contract does not depend on CFO's beliefs.)

We can now establish our first result.[10]

Proposition 1 (Cost of Debt)

The cost of debt under the equilibrium debt contract is lower for firms with an overconfident CEO, and is independent of the CFO's beliefs: The face value offered to firms with overconfident and rational CEOs is the same only for sufficiently low or high return variability: $D_0^* = D_\omega^* = I$ *if* $\sigma \leq \Delta - B/\alpha$ *and* $D_0^* = D_\omega^* = I + \sigma$ *if* $\sigma > \Delta - B/\alpha + \omega$. *It is strictly lower for the overconfident CEO in intermediate ranges of return variability:* $D_\omega^* = I$ *for the overconfident CEO and* $D_0^* = I + \sigma$ *for the rational CEO if* $\Delta - B/\alpha + \omega \geq \sigma > \Delta - B/\alpha$.

Proof*: See Online-Appendix A1*.

Intuitively, for small levels of ex ante variability in the return of the investment, both types of

[10] We obtain the same results if we reduce the role of the CFO to picking debt or equity, but assign the CEO the power to reject or accept the debt contract proposed by investors, i.e., if the contract is chosen to maximize the CEO's rather than the CFO's utility.

CEOs exert high effort in both states of the world. For very high levels of variability, both types of CEOs shirk in both states of the world and debtholders will seek compensation in the good state of the world by imposing a higher face value of debt.[11] For moderate levels of variability, however, the low payoffs in the bad state deter a rational CEO from working hard, but not an overconfident CEO, who overestimates the value she can generate. Hence, we obtain the prediction that the positive influence of overoptimistic beliefs should be driven by firms whose returns are subject to a medium range of volatility, holding constant their profitability.[12] What exactly is considered a 'medium range of volatility' of course depends on the parametrization of our model, including unknown traits of the CEO, (B, ω). In our empirical analysis, we split the sample into terciles of volatility as a starting point and then explore a wide range of alternative sample splits to test the existence and robustness of the predicted non-monotonicity.

Note that we can also explore how the cost of equity financing (conditional on obtaining equity financing) responds to overconfidence, using the optimal equity contract derived in Online Appendix A1. However, the theoretical prediction here varies with parameters which are hard to identify empirically (B, Δ and I) and is less robust to allowing for strategic reasons for equity issuance (such as signaling or market timing). We will thus focus the empirical analysis on the effect of overconfidence on the cost of debt.

D. CFO Overconfidence and the Choice between Debt and Equity

In order to evaluate the CFO's decision between debt and equity, we need to compute his *perceived* expected utility (which, for overconfident CFOs, may be biased) in four cases: both managers are rational; both managers are overconfident; the CFO is overconfident and the CEO rational; the CFO

[11] Because σ is bounded above by I (the gross return of the investment in the bad state of the world can never be negative), it is possible that σ cannot be larger than $\Delta - B/\alpha + \omega$, namely if either Δ or ω are very large. (If $\Delta - B/\alpha \geq I$, the rational CEO will always exert effort under the optimal debt contract. Similarly, if $\Delta - B/\alpha + \omega \geq I$, the overconfident CEO will always exert effort. In other words, a sufficiently high value of ω will mechanically solve any incentive problem.) These cases also corroborate the main finding of the theoretical model, namely, that overconfidence helps to overcome the moral hazard problem. Here, we focus on the more interesting case $\Delta - B/\alpha + \omega < I$ (and hence $\Delta - B/\alpha < I$).

[12] In a more general model where managers also choose the investment level, this insight still holds to the extent that the resulting (potential) overinvestment problem is not "too severe" relative to the moral hazard problem.

is rational and the CEO overconfident. However, both a rational and an overconfident CFO correctly take the CEO's possible bias into account. Thus, even a rational CFO's choice will be affected by the CEO being overconfident because CEO overconfidence affects the cost of debt and equity as established above (and in Online Appendix A1). Proposition 2 summarizes the results:

Proposition 2. Choice between Debt and Equity

An overconfident CFO uses more debt and less equity than a rational CFO, both under an overconfident and under a rational CEO.

Proof: *See Online Appendix A1*.

As made more precise in the proof, there are parameter ranges such that both types of CFOs behave similarly in strictly preferring debt over equity; however, an overconfident CFO strictly prefers debt financing over equity financing whenever a rational CFO is indifferent between the two. The intuition is similar to the one in Malmendier, Tate and Yan (2011), albeit applied to the CFO's beliefs about the ability of the CEO to create value: Biased CFOs overestimate the return to the CEO's effort. For this reason, they perceive external financing to be too costly. However, while this difference in opinion matters for all the states of the world in the case of equity financing, it matters only for the default states in case of debt financing.

E. CEO Overconfidence and CFO Hiring

We now analyze the influence of CEO beliefs on the *selection* of a CFO. In our simplified setting, the CEO has sole discretion in replacing a CFO. In practice, the recruiting of the CFO is a prerogative of the board of directors. However, a large empirical literature documents the overwhelming influence of the CEO on the selection of board members (Shivdasani and Yermack (1999), Cai et al. (2009), Fischer et al. (2009)), and moreover CEOs tend to be heavily involved in the selection of other members of the C-suite, whether or not those member sit on the board themselves. For this part of the analysis, we add a period $t = -1$ in which the CEO chooses the CFO.

Proposition 3: CEO's Hiring Decision

An overconfident CEO (weakly) prefers to hire an overconfident CFO.

Proof: *See Online Appendix A1.*

Proposition 3 is not necessarily obvious, because even when the two executives share the same degree of bias, they maximize different objective functions. The intuitive reason for the assortative matching result of Proposition 3 is that there is no disagreement regarding CEO's moral hazard problem. Therefore, for the financing choice made by the CFO all that matters is the commonality or discrepancy of beliefs with the CEO.

We summarize our findings in the format of three key testable predictions:

Prediction 1. *Overconfident CFOs are more likely to issue debt relative to equity when accessing external financing, conditioning on CEO's type.*

Prediction 2. *CEO overconfidence is associated, on average, with a lower cost of debt. This effect is driven by firms belonging to an intermediate range of profit volatility.*

Prediction 3. *A firm run by an overconfident CEO is more likely to hire an overconfident CFO.*

II. Data

A. Overconfidence Measure

Measuring managerial overconfidence is a challenge to empirical researchers. The existing methodologies fall into four categories: the option-based approach, the earnings-forecast-based approach, the survey-based approach, and the press-based approach. The option-based approach infers managerial beliefs about their own companies from managers' personal investments in their companies. Examples include the "Longholder" and the "Holder 67" measures of Malmendier and Tate (2005, 2008), which are derived from the timing of option exercise by the CEO. Galasso and Simcoe (2011), Malmendier, Tate and Yan (2011), Otto (2014) and Hirshleifer, Low and Teoh (2012) also adopt this measurement approach. Another example is Sen and Tumarkin (2009), in which the overconfidence measure is derived from the share retention rate of stocks obtained from an option exercise. The earnings-forecast-based approach, proposed by Otto (2012), infers overconfidence

from overstated earnings forecasts. As an example of the survey-based approach, Ben-David, Graham, and Harvey (2007, 2013) construct CFO overconfidence proxies based on miscalibrated stock-market forecasts by CFOs who participated in the Duke/CFO Business Outlook survey.[13] For the media-based approach, Malmendier and Tate (2008) and Hirshleifer, Low and Teoh (2012) construct CEO overconfidence measures based on the characterization of CEOs reported in the press. Overall, the option-based measures are by far the most widely-used approach, likely since the identification relies on individual choices and the implied "revealed beliefs."

We follow the option-based approach and replicate the "Longholder_Thomson" measure in Malmendier, Tate and Yan (2011), which uses the timing of option exercise as a proxy for managerial overconfidence. We also replicate our results using the continuous variant proposed by Otto (2014). It is helpful to highlight the underlying idea and major features of the "Longholder_Thomson" measure. The measure is based on a benchmark model of option exercise for managers (Hall and Murphy (2002)), where the optimal schedule for option exercise depends on individual wealth, degree of risk aversion, and diversification. Given that stock options granted to managers are not tradable and short-selling of company stock is prohibited, managers holding stock and option grants are highly exposed to the idiosyncratic risk of their companies. Under the rational benchmark, risk-averse managers address their under-diversification exercising options early. However, overconfident managers, who overestimate mean future cash flows of their firms, postpone exercising in-the-money options in order to tap expected future gains.

Based on this underlying theoretical model, Malmendier and Tate (2005) define a binary variable called "Longholder" as a proxy for managerial overconfidence, where 1 signifies the overconfident manager at some point of his tenure held an option until the last year before expiration, given the option was at least 40% in-the-money. Empirically, Malmendier and Tate (2005) use CEO option-package-level data from a sample of 477 large publicly traded U.S. firms from 1980 to 1994 to identify CEO option exercise.

[13] This behavioral bias is related to the underestimation of the variance but is sometimes also called overconfidence. This bias, however, does not have clear predictions regarding the timing of option exercise. See Malmendier, Tate and Yan (2011, fn. 1) for a brief discussion.

An accurate replication of the original Longholder measure for longer and more recent time periods and a broader set of managers and firms requires complete option-package-level data for firm managers. We use the Thomson insider filing dataset to construct overconfidence measures for both the CEO and the CFO. We reconstruct the Longholder_Thomson measure in Malmendier, Tate and Yan (2011) for the years 1992 to 2013, which has the same definition as the original Longholder measure, but uses the Thomson insider filing dataset to identify the option exercise by managers in public U.S. firms. We extend the measure to CFOs. The control group consists of managers who are also in the Thomson database but who do not meet the criteria of overconfidence.

We use the same data to construct a continuous version of the Longholder measure following Otto (2014), which weights each 'overconfident transaction' by the number of shares exercised. (Details of the construction are in Online Appendix A3.) While we report the estimation results using the Longholder dummy in the tables in the main body of the paper, we also discuss the results using the continuous measure in the main text, and we include the replication of all results under the continuous measure in Online Appendix A3. As we will see, the estimation results are similar under both measures for our main specifications. They differ only when we work with relatively small and selected samples. This may reflect that the dummy approach gives us more variation than a continuous measure,[14] or that the linearity implicit in the continuous measure is an imperfect representation of the variation in the *degree* of overconfidence. We also note a somewhat subtle point which might suggest favoring the dummy approach for our sample, especially when including the more limited data on CFOs: A necessary condition for a manager to be classified as Longholder is that she experiences at least one instance in which options are deeply in the money. In order to "score high" in terms of overconfidence under the continuous measure, the manager needs to experience many of these instances, a much more demanding condition (in our sample) than the mere threshold and likely to be met only for particularly successful companies. At the same time, we acknowledge the appeal of a continuous measure and its finer distinction, and replicate all regressions in Online Appendix A3.

[14] For example, the standard deviation of the Longholder CEO and Longholder CFO dummies are .46 and .49, respectively, in our largest sample, but only .29 and .23 for the continuous measure.

The Thomson insider filing dataset includes forms 3, 4 and 5 reported by insiders to the SEC. It provides option exercise data in its Table 2 ("Insider Filings. Derivative Transactions"), which illustrates reports from form 4. These transactions data are available starting from 1996. However, since our measure of overconfidence is a managerial permanent characteristic, we can include in our sample also the years 1992-1995, as long the companies in this time period had managers for which we can obtain transactions data in form 4. We keep only those records with a very high degree of confidence in the data accuracy and reasonableness (Thomson cleanse indicators R, H and C) or a reasonably high degree of confidence (Thomson cleanse indicators L and I). We drop those records which are an amendment to previous records. We further drop records with obvious errors, such as an indicated maturity date that is earlier than the exercise date and options with missing exercise date (because the days remaining until maturity cannot be calculated). To reduce the effect of extreme outliers, we keep only those records for which the exercise price of the option is within the range of $0.1 to $1000. To calculate the in-the-money percentage for each option, we obtain stock price data from CRSP. We use the Execucomp database to obtain tenure as well as stock and option holdings of the CEOs and CFOs in the Thomson database. The last step limits our firm sample to the intersection of the Execucomp database and the Thomson database, a subset of S&P 1500 U.S. firms including small, medium and large cap firms from 1992 to 2013. Thomson provides the CUSIP of the companies in its dataset, therefore the merge with Compustat is straight-forward. However, we also employ a conservative fuzzy algorithm in order to link the names of the executives in the two datasets, verify manually the accuracy of each match, and discard all the transactions in which the names do not coincide.

As already mentioned, an empirical issue with the CFO data is the significantly lower number of transactions that can be used to construct the overconfidence measure. The reason is that CFOs typically receive smaller option grants than CEOs and are covered in Execucomp to a lesser extent. This could introduce measurement error as we might code a CFO as non-overconfident simply because we are able to observe only a handful of transactions. In order to address this problem, we keep only managers for which we can observe at least 10 transactions. This restriction reduces our

sample size, but allows us to be confident that our Longholder measure is capturing a systematic behavior adopted by the executives we include in our sample.

Finally, in a few cases the same firm has more than one executive listed as either CEO or CFO in Execucomp. In these instances, we manually checked on the form 10-K available on the SEC website[15] which executive held the relevant position at the end of the fiscal year. SEC's "Edgar" database collects 10-K forms starting from 1994, so in some cases this information could not be recovered and we excluded these observations.

B. Alternative Interpretations

Before turning to the remaining data sources and steps in the data construction, we address potential alternative interpretations of the Longholder_Thomson measure and their implications for the results of this paper.

Procrastination. The Longholder_Thomson overconfidence measure captures a persistent tendency of managers to delay option exercise. Hence, one might argue managers hold exercisable options until expiration due to their "inertia" or "procrastination." We find, however, that 74% of overconfident CEOs and 69% of overconfident CFOs conduct portfolio transactions one year prior to the year when options expire. Meanwhile, if "inertia" is a personality feature, an "inertial" manager should not actively borrow more debt when the financing deficit is high. We will find, however, that the higher the financing deficit, the more debt is issued by overconfident CEOs and, especially, CFOs.

Insider Information. Managers may choose to hold exercisable options because they have positive insider information about future stock prices. One issue with this explanation is that positive insider information should be transitory, rather than persistent. However, managers who are classified as overconfident persistently hold exercisable options for about five years or longer.

The key distinction between overconfidence and information is whether or not the overconfident mangers earn positive abnormal returns from holding options until expiration. We calculate the actual returns of overconfident CEOs and CFOs from holding options until their expiration,

[15] http://www.sec.gov/edgar.shtml

given that these options were at least 40% in-the-money ("Longheld" transactions). Then we calculate hypothetical returns from exercising these options 1, 2, 3 or 4 years earlier and investing in the S&P 500 Index until these options were actually exercised. We find that, depending on the horizon chosen, approximately 45%-48% of the "Longheld" transactions do not earn positive abnormal returns. Reestimating our results with this subset of managers classified as overconfident confirms or strengthens the results, whenever the sample is large enough to separately estimate separate "winner" and a "loser" Longholder variables.

Signaling. One might argue that managers' persistent holding of exercisable options serves to signal to the capital market indicating their firms have better prospects than other similar firms do. Here, a similar informal argument applies as in the discussion of insider trading: A firm may be temporarily overvalued, but our measure captures a permanent managerial behavior. Moreover, in our regressions, we include the number of vested options held by the manager (standardized by total number of shares outstanding of the firm) to control for this possibility.

Risk Tolerance. The Longholder_Thomson overconfidence measure captures a habitual tendency of managers to hold company risk. One might claim that risk-tolerant or risk-seeking managers prefer to hold exercisable options longer and therefore appear to be overconfident under the Longholder_Thomson measure. However, risk tolerance does not predict aversion to equity financing. Moreover, if overconfident managers undertake riskier projects, the cost of debt should be higher for their firms, but in our analysis we find the opposite.

Agency Problems. A final alternative interpretation is that, being more incentivized, overconfident managers are more willing to act in the interest of (existing) shareholders. However, by increasing leverage, overconfident managers may be reducing the cash flow available to shareholders, if this behavior increases default probability and there are non-negligible bankruptcy costs. Also, as mentioned above, in our regressions we control for both the shares and the vested options owned by managers.

Hence, while the option-based overconfidence measure must be subjected to additional scrutiny as it is not the result of randomized controlled variation, the leading alternative interpretations

appear to be easily addressed with the construction of the measure or the empirical results.

C. Other variables

Our empirical analysis requires a broad array of firm-level financial variables as well as other firm and industry characteristics. We retrieve these variables from Compustat, excluding financial firms and regulated utilities (SIC codes 6000 - 6999 and 4900 - 4999) for the usual concern about lack of comparability of accounting data. Below, we describe briefly our main variables of interest and leave additional details to Online Appendix A2.

The key variables for our analysis of financial policies are Net Debt Issues and Net Financing Deficit. Using the same definitions as Malmendier, Tate and Yan (2011), Net Debt Issues is long-term debt issues (item 111) minus long-term debt reductions (item 114). Net Financing Deficit is cash dividends plus investment plus the change in working capital minus cash flow after interest and taxes. Net Debt Issues and Net Financing Deficit are normalized by assets at the beginning of the year.

We also construct standard firm-level control variables including Q, profitability, tangibility, size, book leverage and annual changes in these variables. Q is given by assets (item 6) plus market value of equity (item 199 x item 25) minus common equity (item 60) and balance sheet deferred taxes and investment tax credit (item 35), all divided by assets (item 6).

Profitability is operating income before depreciation (item 13) normalized by assets (item 6) at the beginning of the year. Tangibility is property, plants and equipment (item 8) normalized by assets (item 6) at the beginning of the year. Size is the natural logarithm of sales (item 12). Book leverage is the sum of debt in current liabilities (item 34) and long term debt (item 9) divided by the sum of debt in current liabilities (item 34), long term debt (item 9) and common equity (item 60).

We combine firm-level variables with manager-level variables to form the whole sample, a panel of 636 S&P 1500 firms from 1992 to 2013. Table I reports summary statistics for firms (Panel A) and CEOs and CFOs (Panel B), separately for each type of analysis and the corresponding sample. Not surprisingly, the typical company in our dataset is large relative to the Compustat universe.

The average revenues in our data amount to $5.6 billion, relative to a mean of $2.4 for the full Compustat dataset over the same time period. Our companies also tend to have slightly lower book leverage (28.5% versus 31.2%) and much higher profitability (.18 versus .07). The differences are much less pronounced relative to the Execucomp database, of which our data constitutes a subset. (The respective figures are $4.6 billion, 30.5%, and .17.) Hence, our sample appears to be fairly representative of those studied in past empirical works on executive compensation.

Panel B reveals that, on average, CEOs tend to have much higher stock ownership relative to CFOs (18.26% versus 1.22% in the sample used in Tables IV and V). If we look at vested options, the difference is somewhat less pronounced (10.35% versus 2.41%). We have also analyzed managerial controls separately for the full sample and for overconfident managers and find that they tend to have fairly similar equity incentives.

Compared to the sample of Forbes 500 firms from 1980 to 1994 used in Malmendier and Tate (2005, 2008), Malmendier, Tate and Yan (2011), Galasso and Simcoe (2011), Hirshleifer, Low and Teoh (2012) and the survey sample from 2001 to 2010 of Ben-David, Graham and Harvey (2013), our sample differs in two ways. First, it covers a different time period and it considers small and median firms in addition to large firms. Second, it includes overconfidence measures for both the CEO and the CFO, which fills a gap in the existing literature by providing a way to estimate the effects of CEO overconfidence and CFO overconfidence separately and jointly. The difference in sample also helps to understand the different frequencies, with 66.5-69.8% of CEOs and 52.8-57.5% of CFOs being identified as overconfident with the Longholder_Thomson dummies. These frequencies are two- to three-times as high as in the first wave of overconfidence research, which used option exercise date from the 1980s until mid-1990s, but in line with the more recent wave of overconfidence research, which also uses the more recent option-exercise data (see for example Malmendier and Tate (2015)). An interesting observation is that the restriction to managers with at least 10 transactions increases the relative frequency of firm-years with overconfident managers, especially among CFOs. If we do not impose this requirement, the frequencies drop to 60% for CEOs and 43% for CFOs. Note in particular that the restriction increases the percentage of over-

confident CFOs considerably more than that of overconfident CEOs. Because CFOs' options packages are in practice much smaller than those of CEOs (see Table 1, Panel B), this observation cautions that managers are more likely to be classified as non-overconfident when they have fewer opportunities to trade options. Hence, a restriction to a subset of managers with similar transaction frequencies might be in order even when not looking at CFOs or other managers that are less well covered than the CEO, e.g., in previous work such Malmendier and Tate (2005, 2008).

We complement our main data with the SDC database on bond and equity issuance and confirm our result that overconfident CFOs present a higher propensity to issue debt relative to equity also in this smaller sample. Because in this case we restrict our attention to firms issuing either debt, equity or hybrid securities, our sample drops to 619 observations (277 firms). Following Malmendier, Tate and Yan (2011), we define equity issues as issues of common stock or nonconvertible preferred stock; debt issues are issues of nonconvertible debt; and hybrid issues are issues of convertible debt or convertible preferred stock.

Finally, we merge our Execucomp-Compustat data with the Dealscan database on syndicated loans to test our main predictions regarding the relation between executive overconfidence and the cost of debt. Dealscan provides detailed information regarding loan pricing and type, maturity and size. The coverage is typically limited to large and medium size firms, which are the main focus of our analysis. We merge this dataset with the quarterly Compustat file, using the mapping provided by Chava and Roberts (2008) and available on Michael Roberts' website.[16] Our outcome of interest in this case is the amount the borrower pays in basis points over the London Interbank Offered Rate, a variable called *allindrawn* in Dealscan. In our main specification, we are able to use 1,641 observations (408 different firms). We will discuss in detail the main control variables used in these tests in Section IV.

[16] http://finance.wharton.upenn.edu/~mrrobert/styled-9/styled-12/index.html

III. Overconfidence and Financing Choices

A. Empirical Strategy

Prediction 1 of our model is that overconfident CFOs will exhibit a preference for debt over equity. In order to test it, we follow three different approaches, testing for the impact of CEOs and CFOs both separately and jointly.

First, we focus on firms making use of external funding (debt or equity) and ask whether overconfident CFOs are more likely to issue debt. We estimate the corresponding logit models on two different data sets, Compustat (in Section III.B) and SDC (in Section III.C). These analyses restrict the sample to firms that, in a given year, issue either debt or equity. Hence, we cannot include firm fixed effects to control for time-invariant firm characteristics for lack of sufficient variation over time.

In our second and third approach we make use of our full sample and control for firm fixed effects. In second approach (Section III.D), we use the standard 'financing deficit framework' of Shyam-Sunder and Myers (1999), also used in Malmendier, Tate and Yan (2011). In the third approach (Section III.E), we ask whether the influence of managerial characteristics is strong enough to even affect firms' capital structures, above and beyond the influence of permanent firm characteristics and consistent with the findings in Bertrand and Schoar (2003). If so, firms run by overconfident executives with a strong preference for debt should be systematically more leveraged, even after controlling for firm fixed effects and our large set of control variables.

B. Debt Issues using Compustat

We first test whether overconfident managers are more likely to issue debt than equity when using external capital as captured in the Compustat dataset. To control for the different baseline frequencies of debt and equity issues by overconfident managers and their rational peers, we condition the regression analysis on accessing external capital. Therefore, the regression sample only includes observations with either positive net debt issues or positive net equity issues, which are firm-years with external financing. In total, we have 2,580 observations (593 firms). We test whether, condi-

tional on using external financing, overconfident managers prefer debt over equity using the following logit model:

$$\begin{aligned} &Pr\left(NDI_{i,t} = 1 | external\ capital, LTCEO_{i,t}, LTCFO_{i,t}, X_{i,t}, \delta_t\right) \\ &\quad = G\left(\beta_1 + \beta_2 LTCEO_{i,t} + \beta_3 LTCFO_{i,t} + X'_{i,t}B + \delta_t + \epsilon_{i,t}\right) \end{aligned} \tag{6}$$

The dependent variable NDI is an indicator of positive net debt issues. LTCEO and LTCFO represent the Longholder_Thomson measure for managerial overconfidence of the CEO and the CFO, respectively. X denotes a set of standard firm-level and manager-level control variables. Firm-level control variables are the traditional determinants of capital structure – book leverage, Log(Sales), profitability, Q, and tangibility. X also includes two-digit SIC industry fixed effects (following Ben-David and Graham (2013). Manager-level control variables are option-excluded stock ownership and vested options, which control for the incentive effect of stock-based executive compensation. In addition, we include year fixed effects δ_t. In all of our analyses, standard errors are adjusted for firm-level clustering. The coefficients estimated in equation (6) tell us, for a unit increase in each independent variable, the expected change in the log odds of issuing debt. We note that the fixed effects are not a reason for concern about incidental parameter problems in our logit estimations.[17]

Table II reports the results. We start by only including the CEO overconfidence measure (columns 1 and 2), then exclude CEOs and include only CFOs (columns 3 and 4), and finally include both jointly (columns 5 to 7). The joint analyses test whose managerial overconfidence leads to a more pronounced pecking-order preference and whether the separately estimated impacts of CEO and CFO overconfidence are robust when estimated jointly.

In the baseline logit regression in column 1, we only include the CEO overconfidence proxy

[17] The incidental parameters problem arises in panel estimations if, with increasing sample size, the number of fixed effect parameters also grows, implying that it is impossible to get consistent coefficient estimates. This does not apply to industry fixed effects (Bester and Hansen (2016)). We have, however, also used a number of alternative different estimation strategies as a robustness check. Our results do not change if we estimate a linear probability model or a conditional logit model. Moreover, we get similar point estimates if we estimate our baseline model using a coarser industry classification (Fama-French 12 industries). These remarks apply also to our results of Section C, where we adopt the same empirical strategy.

and industry dummies. The coefficient of CEO overconfidence is positive but insignificant. In column 2, we include the standard firm-level control variables from the capital structure literature to capture the cross-sectional determinants of net debt issues: Q, size, profitability, tangibility and book leverage. We also include the manager control variables: stock and option holdings, all measured at the beginning of the year. We continue to control for industry effects and add year dummies to remove cyclical effects of debt issues. Our conclusions are unaffected, with the coefficient on Longholder CEO becoming even smaller in magnitude. We note that the estimated coefficients of the firm-level control variables are generally similar to those found in the existing capital-structure literature. Firm size is positively related to the likelihood of debt issues, possibly reflecting easier access to bank loans or bond markets for larger firms with sufficient collateral. Profitability and tangibility also have the expected, positive sign, but are not statistically significant predictors of debt issuance. Q is negatively correlated with debt issues, although not significantly. One plausible explanation is that a high value of Q captures overvaluation and, hence, the firm might lean towards issuing stock at favorable conditions.

In columns 3 and 4, we replace the CEO overconfidence measure with the CFO overconfidence measure. For the baseline regression, the estimated coefficient of the CFO overconfidence measure is large and significant at the 1% level (coefficient = 0.372, *t*-statistic = 3.207). It indicates that the odds ratio of debt issues for overconfident CFOs is 45% higher than that of rational CFOs. In column 4, controlling for CFO-level variables, firm-level variables, industry dummies and year dummies, the estimated coefficient of CFO overconfidence increases slightly to 0.403.

In columns 5 to 7, we include both CEO and CFO overconfidence measures in the baseline regression, first adding only managerial controls, and finally including the full set of control variables. We find that, while the coefficient on CEO overconfidence remains insignificant, CFO overconfidence retains all its power. The economic magnitude remains very similar. In column 7, the coefficient on Longholder CFO is 0.438 (and highly significant with a *t*-statistic of 3.512) and implies that an overconfident CFO is 55% more likely than a rational CFO to issue debt, conditional on accessing external markets. The Pseudo R-squared is 15.77%, very much in line with previous capital structure fixed-effect regressions on debt issuance and previous literature on managerial

overconfidence. Note that the partial R-squared of the overconfidence proxy is naturally low in an industry fixed-effects regression.[18] Though the low partial R-squared suggests that CFO overconfidence is not the primary driver of capital structure decision, the key insight here is that we have detected a significant influence, corroborating that overconfident beliefs affect corporate decisions and disentangling the role of CFOs and CEOs.

We also estimate the same specification using Otto (2014)'s measure, we find very similar results (Online Appendix A3, Table A2), with CFO overconfidence entering significantly in all the regressions and CEO overconfidence having very little explanatory power. For example, in the specification of column 7 (when all controls are included), the Longholder CFO coefficient estimate is 0.854 and is significant at the 1% level, while the CEO overconfidence coefficient estimate is minuscule (0.023) and insignificant.

C. Debt Issues using SDC Data

As a robustness check, we estimate equation (6) using the SDC data on equity and bond issuance by US corporations. The advantage of the SDC data is that it identifies the timing of issuances more precisely, relative to the (noiser) accounting data from Compustat. However, it misses out on those increases or decreases in firms' use of external financing that are not issuances captured in SDC, and the sample size and heterogeneity of firms in the sample is considerably reduced.

We identify issues of nonconvertible debt as debt issues and issues of convertible debt or convertible preferred stock as hybrid issues, and match all issuances of debt, equity or hybrid securities with our initial Execucomp-Compustat merged sample. Given the much smaller sample, we keep all available observations for each specification estimated, which initially range from 619 observations in total to 563 for the sample where all control variables are available. However, as the industry dummies perfectly predict some of the debt issuances, we end up with an actual sample varying between 565 and 490 observations.

We estimate again a logit model with a dummy equal to one if a firm issued debt in a given

[18] For example, we find that the R-squared increases by .55% relative to 15.22% (the R-squared if CFO overconfidence is not included in the regression), which is equivalent to calculating the partial R-squared via the partial correlation.

year and 0 if not (that is, if the company issued hybrid securities or equity). The control variables are the same as in the previous analysis (Table II) and generally have the predicted sign.[19] In Table III, column 1, we estimate equation (6) including only the Longholder CEO proxy and industry dummies. In this specification CEO overconfidence is marginally significant. The coefficient becomes insignificant and its magnitude drops to a quarter once control variables are included (column 2). The association between CFO overconfidence and propensity to issue debt, instead, is strong and robust statistically (columns 3 and 4) with a log odds coefficient over 0.8. The inclusion of Longholder CEO and firm and managerial controls (columns 5-7) further increases the magnitude of the coefficient. We note that the association between CEO overconfidence and propensity to issue debt from column 1 is completely absorbed by CFO overconfidence in column 5. This is consistent with CEO's influence on capital structure being exerted primarily through his hiring choices, as in our model.

Overall, Table III confirms the findings from the parallel estimations on Compustat in the previous subsection: Conditional on making use of external funds, overconfident CFOs strongly prefer debt. In terms of magnitude, the estimated effect is even stronger in the SDC data, with overconfident CFOs being about one and a half times more likely to issue debt relatively to their rational peers although the additional variation explained by Longholder CFO is small.[20] Again, this is not surprising as, with a small sample and a relatively large number of predictors, the incremental explanatory power of any additional regressor is likely to be small.

Finally, we note that the results using Otto (2014)'s measure (Online Appendix A3, Table A3) are inconsistent with the estimates described above. We notice that estimates in Table A3 are quite sensitive to the firm level controls, suggesting that, at least in this smaller sample, this overconfidence proxy may be capturing a good amount of firm level variation, rather than a mere managerial fixed effects. As anticipated, this discrepancy in results only occurs when we use particularly small

[19] Both profitability and size significantly increase the probability of issuing debt, possibly reflecting the role of stable cash-flows and collaterals. The coefficient of Q is negative. Leverage is also negatively related with debt issuance, although not significantly. Only the coefficient on tangibility, negative and significant, is perhaps surprising.

[20] The pseudo R-squared is 55.13% in the specification with CFO overconfidence and 55.12% if excluded.

and selected samples.

D. Financing Deficit and Managerial Overconfidence

We turn now to our second approach to test Prediction 1: Given a financial deficit, do overconfident managers prefer debt financing over equity financing? We implement the standard 'financing deficit framework' of Shyam-Sunder and Myers (1999), which is also used in Malmendier, Tate, and Yan (2011). By construction, the net financing deficit variable measures the amount of financing needed in a given year. The idea is to allow for overconfident managers and their rational peers having a different baseline rate of debt or equity financing, and to examine the impact of managerial overconfidence on the association between the net financing deficit and external financing. An advantage of this approach is a larger sample size, as the full sample can be used in such estimations. The specification for the OLS regression reported in Table IV is as follows:

$$D_{i,t} = \beta_1 + \beta_2 FD_{i,t} + \beta_3 LTCEO_{i,t} + \beta_4 LTCFO_{i,t} + \beta_5 FD_{i,t} \times LTCEO_{i,t} + \beta_6 FD_{i,t} \times LTCFO_{i,t} + X'_{i,t}B + FD_{i,t} \times X'_{i,t}B_2 + \theta_i + \delta_t + \epsilon_{i,t} \quad (7)$$

where D is Net Debt Issues and FD is the Net Financing Deficit. LTCEO and LTCFO are our measures for managerial overconfidence (Longholder CEO and Longholder CFO). X is a set of manager-level and firm-level control variables including executive stock and option holdings, changes in Q, profitability, tangibility and size; in the most conservative specifications, we also include our vector of controls interacted with the Net Financing Deficit variable. For brevity, we do not report the coefficients on the control variables but note that they generally show the expected relation with debt financing.[21] We control for firm and year fixed effects in all regressions. The coefficients of interest are β_5 and β_6. If, for given financing needs, overconfident CFOs issue disproportionately more debt relatively to unbiased managers, we would estimate β_6 to be positive.

The first two columns in Table IV show results for CEO overconfidence. Column 1 is a baseline OLS regression, which only includes the CEO overconfidence measure, its interaction with the net financing deficit and firm fixed effects. Column 2 adds a set of control variables including CEO

[21] For example, Q is negatively related to debt issuance, whereas tangibility and size exhibit a positive association. (All variables are in first differences.)

stock and option holdings, firm-level variables, and year fixed effects to the set firm fixed effects. In column 3, we further add the interaction effects of Net Financing Deficit with the control variables including the manager control variables, the firm-level control variables and year fixed effects. Again, we do not find a significant effect of CEO overconfidence on the sensitivity of net debt issues to the net financing deficit. The coefficients of CEO overconfidence interacted with net financing deficit are positive but insignificant, except in column 3, where the coefficient is equal to 0.154 and significant at the 10% level.

The regressions in columns 4 to 6 replace the CEO overconfidence measure with the CFO overconfidence measure and are otherwise identical to the regressions in columns 1 to 3. We find that CFO overconfidence increases the sensitivity of net debt issues to the net financing deficit significantly. The coefficient of the interaction of the CFO overconfidence measure and net financing deficit is between 0.193 and 0.240, and all coefficient estimates are significant at the 5% or 1% level.

Finally, we jointly include CEO and CFO overconfidence measures in the regressions (columns 7 to 9). The estimated results remain very similar. The estimated effect of CFO overconfidence on the sensitivity of net debt issues to net financing deficit ranges from 0.206 and 0.185, significant at the 5% level. But the effects of CEO overconfidence remain small and insignificant.

The effect of CFO overconfidence is also quantitatively important. To get a sense of the magnitude, consider that, in column 5, the standalone coefficient on the financing deficit is 0.073. This sensitivity almost quadruples for overconfident CFOs to 0.279 (0.073 + 0.206). Also, the variation in net debt issues explained by CFO overconfidence is substantial. In column 9, the R-squared rises from 28.28% if the interaction between Longholder CFO and the net financing deficit is excluded (unreported) to 46.9% when we include it as explanatory variable. We also note that that the statistical significance of our coefficient of interest tends to grow in the most demanding specifications in which control variables are interacted with the financing deficit (columns 6 and 9), suggesting

that Longholder CFO is not simply picking up variation associated with well-known predictors of debt issuance.[22]

E. Leverage and Managerial Overconfidence

Finally, given the quantitative relevance of our results on debt issuance, we explore whether managerial overconfidence might have an effect on firms' capital structure. If overconfident CFOs are more likely to issue debt over equity, then their companies might display, on average, higher leverage. Note that this is the case only if the overconfidence-induced bias towards debt is strong enough to dominate other determinants such as the persistence of past leverage ratios.

To investigate this question, we estimate the following empirical specification, which follows the empirical strategy in Bertrand and Schoar (2003) and Malmendier, Tate and Yan (2011):

$$Leverage_{i,t} = \beta_1 + \beta_2 LTCEO_{i,t} + \beta_4 LTCFO_{i,t} + X'_{i,t}B + \theta_i + \delta_t + \epsilon_{i,t} \quad (8)$$

LTCFO and LTCEO are our usual proxies for managerial overconfidence (Longholder CEO and Longholder CFO), X is a set of control variables, θ_i are firm fixed effects, and δ_t are year dummies. In this empirical context we can, again, use the full sample. After controlling for firm fixed effects, the only variation we are capturing comes from firms that switch from an unbiased to an overconfident manager, and vice versa. Our dependent variable is market leverage, expressed as the percent of long-term debt (item 9) plus debt in current liabilities (item 34), out of market value of assets, i.e., divided by market capitalization (price (item 199) x common shares outstanding (item 25)) plus the numerator. Note that, relative to the empirical specification in Table IV, we lose 20 observations because either long-term debt or short-term debt are missing.

Table V reports the results. In column 1, we include in our specification only Longholder CEO, plus firm and year dummies. The sign of the coefficient estimate for CEO overconfidence is consistent with Malmendier, Tate and Yan (2011): CEO overconfidence is associated with higher leverage. However, this effect is very small and insignificant in our sample, with a coefficient of 0.924 (*t*-statistic = 0.6). That is, switching from a non-overconfident to an overconfident CEO induces an

[22] For completeness, we note that, under Otto (2014)'s measure (Online Appendix A3, Table A4), coefficient on Longholder CFO is always positive but unstable in magnitude across different specifications and no longer significant.

increase in leverage by less than 1 pp. Even quantitatively, the magnitude is small relative to the sample distribution of the dependent variable, which has a mean of 10.3 and a standard deviation of 15.6.

The coefficient estimate is further reduced, and remains insignificant, when control variables are included (column 2). All the firm level control variables, on the other hand, have the expected sign: larger firms and with higher tangibility are more levered, whereas profitability and *Q* are negatively related to leverage. We do not find any association with managerial controls (shares and vested options owned).

Turning to the CFO effect, in columns 3 and 4, Longholder CFO has a strong and sizeable positive association with market leverage. It makes little difference whether or not we include control variables. In column 4, the coefficient is 3.700 (*t*-statistic of 2.227), roughly a quarter of a standard deviation. When we consider both managers and their potential biases jointly, in column 5 and 6, the effect of CEO overconfidence vanishes further, while the coefficient estimate on Longholder CFO becomes slightly larger and more precisely estimated, e.g., 3.972, with a *t*-statistic of 2.378 in the specification with the full slate of controls (column 6). Among the managerial controls, we find share ownership to be negatively related to leverage, perhaps because risk aversion induces CFOs to adopt more conservative financial policies when their wealth is heavily invested in their company. To further probe the robustness of this result, we also add controls for Net Financing Deficit (in column 7) and lagged one year returns (in column 8). Both variables have significant explanatory power for market leverage, entering with the expected sign: The coefficient on Net Financing Deficit is positive, giving support to traditional pecking-order models of corporate financing (Shyam-Sunder and Myers (1999)). The control for past returns likely captures both market timing reasons (see, e.g., Welch, 2004) and a mechanical effect: high returns lower market leverage simply because they increase the denominator. Both contribute to the estimated magnitude of the effect – a 1% higher return in the previous year translates in a decrease in leverage of almost 1%. Most importantly, however, our coefficient of interest is unaffected.

We also explored including additional lags of stock returns in unreported tests. As expected, their explanatory power declines as the time lag increases. The coefficient on Longholder CFO,

instead, remains very stable. Once we are at four additional lags (up to $t-5$) however, the *p*-value decreases to 0.107. The reduced statistical significance largely reflects that the requirement of having at least five years of lagged returns available on CRSP reduces our sample by more than 400 observations (and 61 firms).

In terms of fit, the inclusion of Longholder CFO increases the R-squared by about half a percentage point as we can see, for example, comparing columns 2 and 6. This number is not large but not negligible, either, given that our conservative strategy allows us to capture only the variability due to firms that switch to managers with different preferences. In terms of partial R-squared, Longholder CFO has an explanatory power which is lower but in the same order of magnitude of other common predictors of financial leverage, such as lagged returns or tangibility (whose partial R-squared is about 1%).

In unreported tests, we find that results are weaker when using book leverage as dependent variable, perhaps because it represents a noisier measure of the desired capital structure, with our main coefficient being positive in all specifications but *t*-statistics around 1. As shown in Online Appendix A3, Table A5, the effect of overconfidence on market leverage remains significant in all the specifications when using Otto (2014)'s proxy for overconfidence. Moreover, in unreported results, we find that the association is significant at the 5% level even when using book leverage as dependent variable.

IV. Overconfidence and the Cost of Debt

A. Empirical Strategy

We now turn to our second, and novel, prediction that CEO overconfidence should be associated with a lower cost of debt, as investors anticipate the resulting extra effort such a CEO will exert. To test this prediction, we merge our overconfidence measures with the DealScan database. This data allows to distinguish finer time periods and associated costs of debt. In order to control better for time-varying characteristics of the firm, which may affect the cost of debt, our time unit will thus be quarters in the regressions that follow; accordingly, we construct our main firm-level control variables using the Compustat quarterly database.

We measure the cost of debt financing as the spread between the actual interest rate paid by the firm and the Libor (in basis points). Because this variable is slightly right-skewed, we take its natural logarithm in our specifications, although no result is affected if we use the actual spread as dependent variable. We complement our overconfidence measures with a series of controls at the firm, loan, and manager level. The resulting specification is as follows:

$$Log\big(Net\ Interest_{i,t}\big) = \beta_1 + \beta_2 LTCEO_{i,t} + \beta_3 LTCFO_{i,t} + X'_{i,t}B + \delta_t + \epsilon_{i,t} \qquad (9)$$

where LTCEO and LTCFO are our usual proxies for overconfidence (Longholder CEO and Longholder CFO) and $X_{i,t}$ is a vector of control variables at the manager, firm, and loan level, which also include year-quarter and industry fixed-effects.

At the firm level, we start by including Log(Assets), as we expect larger firms to be perceived as less risky by lenders. We add Book Leverage, given that highly indebted firms presumably face a higher cost of debt, and z-score, which captures the firm's default risk. Following Valta (2012), we also include earnings volatility, defined as the ratio of the standard deviation of the past eight earnings changes to the average book asset size over the past eight quarters.

At the loan level, we include Log(Maturity) (in months) and Loan Amount. We do not have a prior on the signs of the coefficients on these controls. Loans with shorter horizon and for a higher amount may, intuitively, be riskier, and so be associated with higher spreads; however, in equilibrium, these may be precisely the loans made only to solid, safe firms. Finally, in some specifications we also add loan type fixed effects.

At the managerial level, we include as usual both the total number of shares and the number of vested shares owned by each executive, standardized by the number of shares outstanding, to capture the moral hazard problem generated by the separation of ownership and control.

B. Baseline Results

Table VI shows the main results of estimating equation (9). In column 1, we include only Longholder CEO, year-quarter, and industry fixed effects (at the 2-digits SIC level). As predicted by our model, CEO overconfidence is associated with a lower cost of debt. The coefficient on Longholder

CEO is -0.172, statistically significant ($p < 0.05$) and economically sizeable, being roughly equal to one fifth of a standard deviation of the outcome variable. Since our dependent variable is in Log form, we can also interpret the coefficient as saying that interest rates are 15.8% lower for overconfident than for unbiased CEOs, relative to a sample mean of 127.97 basis points. In column 2 we include all the control variables mentioned above, except loan type fixed effects. Our coefficient of interest is estimated to be slightly reduced (-0.147), but the *t*-statistic is actually higher in absolute value, with a value of almost 3. In columns 3 and 4 we turn to CFO overconfidence. We do find some association between Longholder CFO and lower interest rates, but only in column 4, when all the control variables are included. This association vanishes once CEO and CFO overconfidence are jointly included (column 5 and 6), while the coefficient on Longholder CEO is still large in magnitude and significant (-0.134, with a *t*-statistic of -2.514). Finally, in column 7 we add loan-type fixed effects.[23] In this more demanding specification the coefficient on Longholder CEO is somewhat reduced (-0.093, corresponding to a 9% difference in interest rate spreads) and marginally significant, with a *p*-value < 0.10. We notice, though, that CEO's preferences may affect the cost of financing also via the kind of loans that financial intermediaries are willing to grant. In other words, analyzing the impact of overconfidence on interest rates within specific loan categories is a very conservative test. Indeed, in this last specification the R-squared from a regression that excludes Longholder CEO is already very high (67.2%) and this limits the additional variation that can be explained by our overconfidence proxy, which is 0.18%. (Results excluding Longholder CEO not reported.)

Regarding the other regressors, three out of four of our firm-level control variables are significant. Leverage enters with a positive sign, whereas size and loan amount are associated with lower interest rates. Earnings volatility is associated with higher interest rates, although this effect is not statistically significant (*t*-statistic equal to 1.603). Managerial control variables are generally insignificant. One exception is the number of vested options owned by the CFO, normalized by the number of outstanding shares, which is positive and significant (coefficient of 0.019 and *t*-statistic

[23] Our sample includes 18 different loan types. The most common ones are: revolving loans provided over more than one year (946 observations), 364 days facilities (263 observations) and generic term loans (123 observations).

equal to 3.009 in the last specification). While we do not have a particular explanation for this result, we notice that it is at odds with one possible alternative interpretation of our overconfidence measure, the "signaling" argument. If managers were to hold vested options in order to communicate the quality of their projects, we would expect a negative coefficient in a separating equilibrium.

C. Effect of Overconfidence in Different Subsamples

The model outlined in Section 2 has a refined prediction regarding the range of parameters for which overconfidence should affect the cost of debt financing: CEO overconfidence should matter the most when uncertainty about future cash flows (the parameter σ in the model) is large enough to reduce the incentives to work hard for rational CEOs in the worst states of the world, but not for very optimistic CEOs. We should not observe large differences in loan pricing if uncertainty is either very small or very large, but only for intermediate values.

To test the predicted non-monotonicity of the effect of CEO overconfidence, we construct several empirical proxies for σ. The most natural proxy is earnings volatility, as it is estimated over actual earnings realizations. As explained above, we use the ratio of the standard deviation of the past eight earnings changes to the average book asset size over the past eight quarters. This a popular proxy for profit variability, at least since Brealey, Hodges and Capron (1976); recent uses include Valta (2012) and Matsa (2010). Very volatile earnings are likely to be associated with a substantial probability of realization of a very negative state of the world, where debt overhang will matter the most.

We verify the robustness of our results to using two additional measures that capture uncertainty as perceived by outside observers: (1) analysts' coverage, measured as the number of individual analysts who made at least an annual earnings forecasts and appear on IBES (similarly to Hong, Lim and Stein (1999)) and (2) the coefficient of variation of analysts' annual earnings forecasts, defined as the standard variation of forecasts normalized by the absolute value of the mean forecast. As for the first, Whited and Wu (2006) argue that low analyst coverage is associated with measures of financial constraints, suggesting that firms with low coverage may be perceived as having substantial uncertainty regarding their ability to repay their debt. As for the second, a large

literature in accounting (see for example Cheng and Warfield (2005)) argues that the coefficient of variation is associated with larger earnings surprises in absolute value. For this measure, we restrict our sample to firms having a coverage of at least ten analysts (892 observations). We acknowledge that these latter measures are rather indirect but include them as robustness checks.

For each of our three proxies for σ, we proceed as follows. First, every year we sort firms according to their earnings volatility, analysts coverage or coefficient of variation of earnings forecasts into terciles and then estimate equation (9) in each of the three resulting subgroups. As mentioned above, our theoretical model does not pin down the thresholds between low, medium, and high ranges of volatility. Hence, the terciles split is merely as a natural starting point, which allows us to test for the predicted non-monotonicity while leaving sufficient statistical power in each subsample. We have checked a wide range of different percentile cutoffs to test the robustness of our results, moving in 5 or 10 pp steps, and found very similar estimates (see Online-Appendix Table A8).[24]

The results are reported in Table VII. For brevity, we employ directly the empirical model with the full set of controls, mirroring column 7 of Table VI, and report only the coefficients on Longholder CEO and Longholder CFO.

In Panel A, we see that the coefficient on Longholder CEO is large and significant in the intermediate tercile of earnings volatility, with a coefficient equal to -0.271 and a *t*-statistic equal to -3.072. In this subsample, the increase in the R-squared due to the inclusion of CEO overconfidence is 1.27% (74.39% versus 73.12%). In terciles 1 and 3, the coefficients on CEO overconfidence are still negative, but small (-0.079 and -.130) and insignificant, with *t*-statistics lower than -1.5 in absolute value in both cases. In terms of economic magnitude, the estimate in the medium terciles implies that a Longholder CEO is going to pay a spread that is about 24% lower than an unbiased manager.

We obtain similar results when we use the two additional proxies for σ (Panels B and C). In

[24] We have also used quartiles of each sorting variable, and find that, for each of the proxies, the effect of overconfidence is always largest in absolute value (and statistically significant) either in the second or the third quartile.

columns 1 and 3 of each panel, the coefficients on Longholder CEO are always smaller and unstable.

The effect of CFO overconfidence is also very unstable, generally insignificant (with the exception of column 1 in Panel C), and the coefficients even switch signs in some subsamples, suggesting that the role of CFO overconfidence in loan pricing is limited if not non-existent.

Overall, these results are strongly consistent with the predictions of our model. Given that managers are not assigned randomly to firms, we cannot rule out that some omitted variable correlated with CEO overconfidence might influence our results. However, we believe it to be unlikely for two reasons. First, even after controlling for a number of variables related to loan riskiness, the effect of CEO overconfidence remains robust. Second, and more importantly, this omitted variable ought to vary non-monotonically with earnings volatility in order to explain the set of results reported in Table VII.

As always, we replicated the results using the continuous version of the overconfidence proxy following Otto (2014). As shown in Online Appendix A3, Table A6, results are somewhat weaker in the overall sample, with Longholder CFO remaining marginally significant in the most conservative regression of column 7. However, under the most direct proxy (earnings volatility), we find the same pattern of non-monotonicity (Table A7, Panel A). CEO overconfidence is (marginally) significant and relatively large only in the intermediate tercile, with a coefficient of -0.26 and a *t*-statistic equal to -1.755. We do not observe similar patterns for CFO overconfidence and when using the other, more indirect, proxies for earnings volatility.

V. CFO Hiring Decisions

As the final step in our empirical analysis, we provide evidence on the prediction that overconfident CEOs are more likely to hire similarly optimistic CFOs. Though a CEO may not select other top executives singlehandedly, existing evidence suggests that the CEO is able to influence the board toward the selection of a CFO who will not systematically contrast her views (Landier et al. (2012)), and strongly affects the overall composition of the board (Shivdasani and Yermack (1999)).

As a first piece of suggestive evidence we note that our measures of CEO and CFO overconfidence are strongly correlated (the correlation coefficient is 0.268, significant at the 1% level). However, CFOs may have been appointed before the CEO, and hence the correlation may simply reflect firm effects or other factors outside the CEO's managerial choice. Thus, our main analysis focuses on the beliefs of CFOs appointed *after* a given CEO and the question whether he is more or less likely to be overconfident, conditioning on CEO's bias.

We identify all the cases in which a given firm in our dataset changes CFO, using the *execid* identifier provided by Execucomp. We assume that, for any new CFO appointed in year t, the relevant decision maker is the CEO of the company at time $t-1$. The analysis requires the following variables to be available: (i) the time t overconfident CFO proxy; (ii) the time $t-1$ overconfident CEO proxy; (iii) all the relevant control variables at time $t-1$. These filters leave us with 198 observations. We estimate the following logit model:

$$\begin{aligned} &Pr\left(LTCFO_{i,t} = 1 | LTCEO_{i,t-1}, X_{i,t-1}, \delta_t\right) \\ &= G\left(\beta_1 + \beta_2 LTCEO_{i,t-1} + X'_{i,t-1}B + \delta_t + \epsilon_{i,t}\right) \end{aligned} \tag{10}$$

where $LTCFO_{i,t}$ and $LTCEO_{i,t-1}$ are our overconfident proxies for CFO and CEO, respectively, $X_{i,t-1}$ is a vector of control variables and δ_t is a vector of year dummies.

Results are reported in Table VIII. In column 1, we include only our CEO overconfidence proxy and year fixed effects as regressors. In column 2, we add industry fixed effects, which take into account the fact that overconfident executives may tend to sort in specific industries. For instance, Hirshleifer et al (2012) find that overconfident CEOs are more common in innovative industries.[25] Column 3 adds our usual managerial controls, and column 4 includes firm-level variables. Among all of the control variables, we find that only CEO's vested options significantly reduce the probability of selecting an overconfident CFO; however, the inclusion of this variable does not diminish but rather increases the coefficient on Longholder CEO.

All empirical models consistently show that overconfident CEOs are more likely to appoint

[25] We include industry dummies using the Fama and French (1997) 12 industries classification rather than two digits SIC Code industry dummies (as in the other tables) because of the small number of observations. That said, the use of the latter, more stringent industry classification has no effect on our results.

overconfident CFOs. Despite the small number of observations, the coefficient on Longholder CEO is always significant at the 1% level. In our most demanding model (column 4) we find that an overconfident CEO is almost seven times more likely to hire an overconfident CFO relative to a rational CEO. Not surprisingly, given the magnitude of this estimate, also the incremental explanatory power of Longholder CEO is large, with the Pseudo R-squared of this regression being 20%, relative to 12.9% when our overconfidence proxy is dropped.

We obtain similar results when using Otto (2014)'s measure (Online Appendix A3, Table A8), where we estimate a Tobit model, given that the dependent variable is now continuous and bounded below by zero, with coefficients around .5 in all the specifications.

Our results relate to recent work by Landier et al. (2013), who find that firms with boards that have a larger fraction of executives appointed after the CEO tend to underperform their rivals. We point out, however, that in our model we do not allow for varying project quality, so we cannot make precise inferences regarding the link between firm value and the agreement (or disagreement) among top managers. It would be interesting, in future research, to use a more sophisticated theoretical framework to examine how the relation between firm performance and board structure is related to CEO's characteristics.

VI. Conclusion

We test, separately and jointly, whether CEO overconfidence and CFO overconfidence affect various types of corporate decisions. We find that CFOs' behavioral traits have significant predictive power to explain capital structure decisions while CEOs' behavioral traits play a significant role in predicting the cost of debt: While firms with overconfident CFOs are more likely to issue debt when accessing external capital, CFOs are not relevant for loan interest rates, which instead are lower for overconfident CEOs. Finally, overconfident CEOs are more likely to appoint overconfident managers as CFOs. We also provide a unifying theoretical framework that can parsimoniously accommodate these results.

Our findings corroborate the significant role of managerial biases in corporate decisions and points to the importance of extending the analysis beyond the person of the CEO. The economic

implications of managerial characteristics are richer than demonstrated in previous research, and future research of interaction and peer effects is warranted and necessary. In particular, it will be interesting to explore the traits of managers such as CTOs or COOs and their influence on corporate decisions, and see whether their personal characteristics are associated with other firm outcomes. This will require a more comprehensive data set than the one employed here, and will be feasible as more and more detailed data on board members' characteristics are becoming available

Finally, we do not rule out an interpretation in which boards choose certain managers in order to pursue corporate objectives that are consistent with their personal traits. The choice of appointing overoptimistic managers presents a series of trade-offs highlighted in previous work and we believe to have added useful elements to this complex picture. It would be interesting to see when and why boards choose to appoint overconfident managers, and which purposes they seek to achieve.

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Figure 1
Timeline of the Model

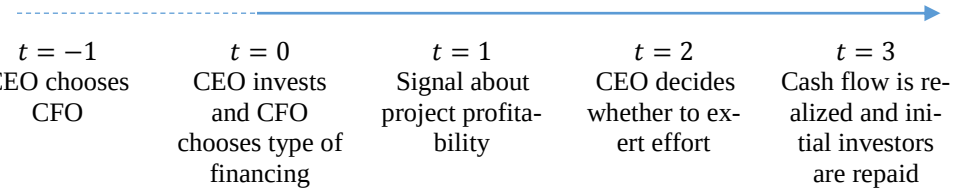

Table I
Summary Statistics

This table presents the summary statistics for the samples of the tables specified above in italic.

Panel A. Firm Variables

	Table II			
Variable	**Obs.**	**Mean**	**Median**	**St. Dev.**
Net Debt Issue Indicator (Compustat)	2,580	0.489	0.000	0.500
Q	2,580	2.404	1.796	2.207
Profitability	2,580	0.178	0.172	0.153
Tangibility	2,580	0.333	0.225	0.312
Log(Sale)	2,580	7.123	7.053	1.628
Book Leverage	2,580	0.304	0.278	0.453
	Table III			
Variable	**Obs.**	**Mean**	**Median**	**St. Dev.**
Net Debt Issue Indicator (SDC)	619	0.658	1.000	0.475
Q	608	2.299	1.646	2.471
Profitability	590	0.181	0.173	0.135
Tangibility	589	0.405	0.280	0.371
Log(Sale)	608	8.167	8.402	1.862
Book Leverage	608	0.394	0.383	0.318

Panel A. Firm Variables - *Continued*

	Tables IV and V			
Variable	**Obs.**	**Mean**	**Median**	**St. Dev.**
Assets (Million $)	3,972	5,638.99	1,593.42	14,470.17
Sales (Million $)	3,972	5,700.76	1,472.42	18,027.90
Capitalization (Million $)	3,972	7,998.42	2,151.62	20,911.50
Net Financing Deficit (Million $)	3,972	-250.21	-15.343	2,227.17
Net Financing Deficit / Assets	3,972	-0.032	-0.017	0.381
Net Debt Issues / Assets	3,972	0.025	0	0.155
Book Leverage	3,952	0.282	0.251	0.419
Q	3,972	2.423	1.852	2.032
Change in Q	3,972	-0.053	0.019	1.722
Profitability	3,972	0.186	0.174	0.144
Change in Profitability	3,972	-0.002	0.003	0.102
Tangibility	3,972	0.304	0.202	0.293
Change in Tangibility	3,972	-0.007	-0.003	0.152
Log(Sale)	3,972	7.242	7.19	1.586
Change in Log(Sale)	3,972	0.112	0.102	0.228
Market Leverage	3,952	0.146	0.104	0.155
	Tables VI and VII			
Variable	**Obs.**	**Mean**	**Median**	**St. Dev.**
Interest Spread on Loans (Basis Points)	1,641	127	100	102.497
Loan Maturity (Months)	1,641	46.409	60	21.778
Loan Amount (Million $)	1,641	590.82	300	1,080.37
Log(Assets)	1,641	7.951	7.841	1.377
Book Leverage	1,641	0.234	0.230	0.150
Z-Score	1,641	3.585	2.452	4.475
Earnings Volatility	1,641	0.018	0.008	0.072
Analysts' Coverage	1,641	12.009	10	7.6
Coeff. of Variation of Earn. Estimates	892	0.029	0.013	0.064

Panel B. Manager Variables

	Table II			
Variable	**Obs.**	**Mean**	**Median**	**St. Dev.**
CEO Longholder	2,580	0.689	1.000	0.463
CEO Stock Ownership (%)	2,580	18.409	3.298	46.382
CEO Vested Options (%)	2,580	10.129	6.715	12.783
CFO Longholder	2,580	0.528	1.000	0.499
CFO Stock Ownership (%)	2,580	1.188	0.410	3.341
CFO Vested Options (%)	2,580	2.439	1.308	3.565
	Table III			
Variable	**Obs.**	**Mean**	**Median**	**St. Dev.**
CEO Longholder	619	0.698	1.000	0.460
CEO Stock Ownership (%)	596	12.103	2.019	40.959
CEO Vested Options (%)	596	6.609	3.880	8.255
CFO Longholder	619	0.575	1.000	0.495
CFO Stock Ownership (%)	575	1.175	0.332	9.221
CFO Vested Options (%)	575	1.467	0.793	2.099
	Tables IV and V			
Variable	**Obs.**	**Mean**	**Median**	**St. Dev.**
CEO Longholder	3,972	0.688	1.000	0.463
CEO Stock Ownership (%)	3,972	18.256	3.006	49.473
CEO Vested Options (%)	3,972	10.349	6.819	14.151
CFO Longholder	3,972	0.534	1.000	0.499
CFO Stock Ownership (%)	3,972	1.220	0.398	4.555
CFO Vested Options (%)	3,972	2.413	1.306	3.400
	Tables VI and VII			
Variable	**Obs.**	**Mean**	**Median**	**St. Dev.**
CEO Longholder	1,641	0.665	1.000	0.472
CEO Stock Ownership (%)	1,641	13.194	2.817	38.866
CEO Vested Options (%)	1,641	8.655	5.871	9.486
CFO Longholder	1,641	0.543	1.000	0.498
CFO Stock Ownership (%)	1,641	1.160	0.403	3.613
CFO Vested Options (%)	1,641	2.122	1.131	3.020

Table II
Debt Issues (Compustat)

Table II shows the estimated log odds ratios from logit regressions. The binary dependent variable is equal to 1 if Net Debt Issues during the year are positive. Net Debt Issues is long term debt minus long term debt reduction. Longholder CEO/Longholder CFO is a binary variable where 1 signifies that the CEO/CFO at some point during his tenure held exercisable options until the last year before expiration, given that the options were at least 40% in the money entering their last year. We require managers to have at least ten transactions recorded in Thomson Reuters to be included in the sample. Stock Ownership is option-excluded shares held by the CEO/CFO as a percentage of common shares outstanding. Vested Options is the number of exercisable options held by the CEO/CFO as a percentage of common shares outstanding. Q is the book value of assets plus the market value of equity minus the book value of equity minus deferred tax, divided by the book value of assets. Profitability is operating income before depreciation divided by lagged assets. Tangibility is property, plants and equipment divided lagged assets. Book Leverage is the sum of current liabilities and long term debt divided by the sum of current liabilities, long term debt and book equity. Stock Ownership, Vested Options, Q, Profitability, Tangibility, Log(Sales), and Book Leverage are measured at the beginning of the year. 2-digit SIC level industry fixed effects are included in all regressions. All standard errors are adjusted for clustering at the firm level. ***, ** and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Longholder CEO	0.118	0.009			0.011	0.043	-0.111
	(0.975	(0.079)			(0.086)	(0.335)	(-0.898)
Longholder CFO			0.372**	0.403**	0.370**	0.429***	0.438**
			(3.207)	(3.339)	(3.086)	(3.477)	(3.512)
CEO Shares		-0.001				-0.002	-0.001
		(-0.605)				(-1.440)	(-0.703)
CEO Vested Options		-0.000				-0.007	0.003
		(-0.004)				(-1.172)	(0.703)
Q		-0.067		-0.065			-0.065
		(-1.561)		(-1.479)			(-1.485)
Profitability		0.582		0.551			0.564
		(0.976)		(0.938)			(0.955)
Tangibility		0.403		0.400			0.420
		(1.369)		(1.353)			(1.404)
Log(Sale)		0.460**		0.448**			0.452**
		(9.085)		(8.879)			(8.744)
Book Leverage		0.058		0.060			0.053
		(0.523)		(0.55)			(0.50)
CFO Shares				-0.005		-0.006	-0.003
				(-0.400)		(-0.570)	(-0.267)
CFO Vested Options				-0.022		-	-0.025
				(-1.282)		(-3.292)	(-1.372)
Observations	2,580	2,580	2,580	2,580	2,580	2,580	2,580
Pseudo R-squared	0.045	0.152	0.050	0.157	0.050	0.102	0.158
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	NO	YES	NO	YES	YES
Firm Controls	NO	YES	NO	YES	NO	NO	YES
Manager Controls	NO	YES	NO	YES	NO	YES	YES

Table III
Debt Issues (SDC)

Table III presents the estimated log odds ratios from logit regressions with a binary variable equal to one if the firm issued debt during the fiscal year, conditioning on having issued debt, equity or hybrid securities. Data on public issues are from SDC. There are 330 firms. Equity issues are issues of common stock or nonconvertible preferred stock. Debt issues are issues of nonconvertible debt. Hybrid issues are issues of convertible debt or convertible preferred stock CEO Longholder/CFO Longholder is a binary variable where 1 signifies that the CEO/CFO at some point during his tenure held exercisable options until the last year before expiration, given that the options were at least 40% in the money entering their last year. Manager-level control variables include Stock Ownership and Vested Options. Stock Ownership is option-excluded shares held by the CEO/CFO as a percentage of common shares outstanding. Vested Options is the number of exercisable options held by the CEO/CFO as a percentage of common shares outstanding. Firm-level control variables include changes in Q, Profitability, Tangibility and Log(Sales). Q is the book value of assets plus the market value of equity minus the book value of equity minus deferred tax, divided by the book value of assets. Profitability is operating income before depreciation divided by assets at the beginning of the year. Tangibility is property, plants and equipment divided by assets at the beginning of the year. Manager-level and firm-level control variables are all measured at the beginning of the year. 2-digit SIC level industry fixed effects are included in all the regressions. All standard errors are adjusted for clustering at the firm level. ***, ** and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Longholder CEO	0.541*	0.137			0.353	0.065	-0.089
	(1.858)	(0.35)			(1.194)	(0.194)	(-0.205)
Longholder CFO			0.853***	0.865**	0.776***	0.987***	0.912**
			(3.131)	(2.365)	(2.76)	(2.94)	(2.38)
Observations	565	513	565	491	565	500	490
Pseudo R-squared	0.092	0.538	0.106	0.551	0.109	0.239	0.551
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	NO	YES	NO	YES	YES
Firm Controls	NO	YES	NO	YES	NO	NO	YES
Manager Controls	NO	YES	NO	YES	NO	YES	YES

Table IV
Financing Deficit

Table IV presents the results for OLS regressions with Net Debt Issues normalized by assets at the beginning of the year as the dependent variable. Net Debt Issues is long term debt minus long term debt reduction. CEO Longholder/CFO Longholder is a binary variable where 1 signifies that the CEO/CFO at some point during his tenure held exercisable options until the last year before expiration, given that the options were at least 40% in the money entering their last year. FD is Net Financing Deficit which is cash dividends plus investment plus change in working capital minus cash flow after interest and taxes, normalized by assets at the beginning of the year, which is identical to that in Malmendier, Tate and Yan (2011). Manager-level control variables include Stock Ownership and Vested Options. Stock Ownership is option-excluded shares held by the CEO/CFO as a percentage of common shares outstanding. Vested Options is the number of exercisable options held by the CEO/CFO as a percentage of common shares outstanding. Firm-level control variables include changes in Q, Profitability, Tangibility and Log(Sales). Q is the book value of assets plus the market value of equity minus the book value of equity minus deferred tax, divided by the book value of assets. Profitability is operating income before depreciation divided by assets at the beginning of the year. Tangibility is property, plants and equipment divided by assets at the beginning of the year. Manager-level and firm-level control variables are all measured at the beginning of the year. Columns (3), (6) and (9) include also the interaction of Net Financing Deficit and all the manager and firm control variables. All standard errors are adjusted for clustering at the firm level. ***, ** and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
FD x	0.0121	0.043	0.154*				-0.035	0.002	0.085
Longh. CEO	(0.103)	(0.445)	(1.832)				(-0.354)	(0.019)	(1.387)
FD x				0.240**	0.206**	0.193**	0.247**	0.206**	0.185**
Longh. CFO				(2.085)	(1.967)	(3.158)	(2.228)	(2.090)	(3.207)
FD	0.184**	0.137**	0.415**	0.082**	0.073**	0.365**	0.099	0.073	0.337**
	(2.100)	(2.302)	(3.107)	(2.620)	(2.593)	(2.386)	(1.609)	(1.455)	(2.362)
Longh. CEO	-0.0077	-0.006	-0.000				-0.007	-0.004	0.002
	(-0.608)	(-0.537)	(-0.036)				(-0.574)	(-0.335)	(0.141)
Longh. CFO				0.006	0.000	-0.000	0.008	-0.003	-0.006
				(0.390)	(0.015)	(-0.010)	(0.477)	(-0.179)	(-0.375)
Observations	3,972	3,972	3,972	3,972	3,972	3,972	3,972	3,972	3,972
R-squared	0.182	0.282	0.413	0.255	0.331	0.463	0.256	0.332	0.469
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	YES	NO	YES	YES	NO	YES	YES
Firm Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
Manager Con-	NO	YES	YES	NO	YES	YES	NO	YES	YES
Contr. x NFD	NO	NO	YES	NO	NO	YES	NO	NO	YES

Table V
Leverage

Table V presents the results for OLS regressions with market leverage (multiplied by 100) as dependent variable. Market leverage is long-term debt plus debt in current liabilities item, all divided by price times common shares outstanding plus the numerator CEO. Longholder/CFO Longholder is a binary variable where 1 signifies that the CEO/CFO at some point during his tenure held exercisable options until the last year before expiration, given that the options were at least 40% in the money entering their last year. Stock Ownership is option-excluded shares held by the CEO/CFO as a percentage of common shares outstanding. Vested Options is the number of exercisable options held by the CEO/CFO as a percentage of common shares outstanding. Firm-level control variables include Q, Profitability, Tangibility, Log(Sales) and Net Financing Deficit. Q is the book value of assets plus the market value of equity minus the book value of equity minus deferred tax, divided by the book value of assets. Profitability is operating income before depreciation divided by lagged assets. Tangibility is property, plants and equipment divided by lagged assets. Manager-level and firm-level control variables are all measured at the beginning of the year. Net Financing Deficit (NFD) which is cash dividends plus investment plus change in working capital minus cash flow after interest and taxes, normalized by lagged assets. All the regressions include year and firm fixed-effects. All standard errors are adjusted for clustering at the firm level. ***, ** and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Longholder CEO	0.924	0.613			0.446	0.095	0.040	-0.024
	(0.600)	(0.415)			(0.284)	(0.0632)	(0.0267)	(-0.0164)
Longholder CFO			3.965**	3.700**	3.906**	3.972**	3.932**	3.999**
			(2.334)	(2.227)	(2.318)	(2.377)	(2.361)	(2.405)
CEO Shares		0.005				0.010	0.009	0.010
		(0.673)				(1.390)	(1.286)	(1.340)
CEO Vested		0.034				0.032	0.031	0.034
Options		(1.414)				(1.293)	(1.253)	(1.370)
CFO Shares				-0.024*		-0.046**	-0.044**	-0.040*
				(-1.705)		(-2.150)	(-2.069)	(-1.875)
CFO Vested				0.127		0.083	0.082	0.079
Options				(1.356)		(0.798)	(0.789)	(0.760)
Q		-0.620***		-0.620***		-0.610***	-0.710***	-0.580***
		(-4.193)		(-4.200)		(-4.175)	(-4.332)	(-3.736)
Profitability		-13.725***		-13.764***		-13.665***	-13.268***	-12.719***
		(-4.808)		(-4.861)		(-4.838)	(-4.762)	(-4.432)
Tangibility		7.291***		7.323***		7.309***	7.225***	7.211***
		(4.714)		(4.765)		(4.776)	(4.531)	(4.449)
Log(Sale)		2.791***		2.898***		2.958***	3.222***	3.022***
		(3.558)		(3.581)		(3.659)	(3.902)	(3.657)
NFD							2.720***	2.797***
							(4.046)	(4.173)
Return $t-1$								-0.920***
								(-4.361)
Obs.	3,952	3,952	3,952	3,952	3,952	3,952	3,952	3,952
R-squared	0.097	0.147	0.101	0.151	0.101	0.152	0.164	0.172
Firm Contr.	NO	YES	NO	YES	NO	YES	YES	YES
Man. Contr.	NO	YES	NO	YES	NO	YES	YES	YES

Table VI
Net Interest Rates

Table VI presents regressions of Log(Interest Spread) on our overconfidence measures and several control variables, including year and industry fixed-effects. Log(Interest Spread) is the difference between the interest rate the borrower pays in basis points and the London Interbank Offered Rate (variable *allindrawn* in Dealscan). CEO Longholder/CFO Longholder is a binary variable where 1 signifies that the CEO/CFO at some point during his tenure held exercisable options until the last year before expiration, given that the options were at least 40% in the money entering their last year. Stock Ownership is option-excluded shares held by the CEO/CFO as a percentage of common shares outstanding. Vested Options is the number of exercisable options held by the CEO/CFO as a percentage of common shares outstanding. Firm-level control variables include Book Leverage, Z-Score, Log(Assets) and Earnings Volatility. Book Leverage is (long-term debt + debt in current liabilities) / (long-term + debt in current liabilities + common equity). Z-Score is 1.2 x (current assets - current liabilities) / total assets + 1.4 x (retained earnings / total assets) + 3.3 x (pretax income / total assets) + 0.6 x (market capitalization / total liabilities) + 0.9 x (sales / total assets). Earnings Volatility is defined as the ratio of the standard deviation of the past eight earnings changes to the average book asset size over the past eight quarters. Loan level controls include Log(Loan Amount) (where the dollar value is in million) and Log(Loan Maturity) (where maturity is measured in months). Manager-level and firm-level control variables are all measured at the beginning of the year. The regressions include year-quarter fixed-effects and 2-digit SIC level industry fixed effects. All standard errors are adjusted for clustering at the firm level. ***, ** and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Longholder CEO	-0.172**	-0.147***			-0.166**	-0.134**	-0.093*
	(-2.355)	(-2.977)			(-2.190)	(-2.514)	(-1.926)
Longholder CFO			-0.069	-0.104**	-0.017	-0.063	-0.070
			(-0.912)	(-2.048)	(-0.218)	(-1.148)	(-1.428)
Log(Size)		-0.192***		-0.188***		-0.183***	-0.185***
		(-6.914)		(-6.852)		(-6.682)	(-7.216)
Leverage		0.935***		0.954***		0.925***	0.720***
		(4.611)		(4.670)		(4.582)	(3.957)
Z-Score		-0.008		-0.010*		-0.009	-0.012**
		(-1.370)		(-1.917)		(-1.641)	(-2.247)
Log(Amount)		-0.119***		-0.119***		-0.120***	-0.107***
		(-4.720)		(-4.864)		(-4.836)	(-4.190)
Earnings Volatility		0.376		0.372		0.379	0.390
		(1.429)		(1.346)		(1.430)	(1.603)
CEO Shares		0.000				0.000	0.000
		(0.752)				(0.478)	(0.542)
CEO Vested Options		0.005*				0.002	0.002
		(1.930)				(0.851)	(0.971)
CFO Shares				0.000		0.001	0.002
				(0.108)		(0.243)	(0.630)
CFO Vested Options				0.027***		0.025***	0.019***
				(3.754)		(3.589)	(3.009)
Observations	1,641	1,641	1,641	1,641	1,641	1,641	1,641
R-squared	0.414	0.622	0.408	0.623	0.414	0.627	0.674
Loan Type FE	NO	NO	NO	NO	NO	NO	YES

Table VII
Net Interest Rates Across Subsamples

Panel A, B and C present regressions of Log(Interest Rate Spread) on our measures of overconfidence and several control variables in different subsamples. Every year we divide our companies according to their (lagged) earnings volatility (Panel A), analysts' coverage (Panel B), coefficient of variation of earnings estimates (CV) (Panel C) in terciles. Then, we run our empirical specification (9) in each subgroup. Control variables (not showed) are as in column 7 of Table VI. We also include Industry, Year-Quarter and Loan Type fixed effects in each regression. All standard errors are adjusted for clustering at the firm level. ***, ** and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

Panel A
Sorting by Earnings Volatility

	(1) Low Earnings Volatility	(2) Medium Earnings Volatility	(3) High Earnings Volatility
Longholder CEO	-0.079	-0.271***	-0.130
	(-1.209)	(-3.072)	(-1.465)
Longholder CFO	-0.082	0.032	0.010
	(-1.209)	(0.429)	(0.121)
Observations	553	561	527
R-squared	0.789	0.744	0.749

Panel B
Sorting by Analysts' Coverage

	(1) Low Coverage	(2) Medium Coverage	(3) High Coverage
Longholder CEO	-0.073	-0.200**	0.001
	(-1.078)	(-2.235)	(0.012)
Longholder CFO	-0.059	-0.091	-0.044
	(-0.846)	(-1.125)	(-0.569)
Observations	581	550	510
R-squared	0.683	0.742	0.776

Panel C
Sorting by Coefficient of Variation of Earnings Estimates

	(1) Low CV	(2) Medium CV	(3) High CV
Longholder CEO	-0.157*	-0.404***	0.068
	(-1.764)	(-3.027)	(0.500)
Longholder CFO	-0.215**	0.007	-0.148
	(-2.220)	(0.066)	(-1.002)
Observations	311	298	283
R-squared	0.872	0.847	0.802

Table VIII
CFO Hiring

Table VIII has the estimated log odds ratios from logit regressions with Longholder CFO as the dependent variable. The sample includes all instances in which a new CFO is appointed between year $t-1$ and year t and the following variables are not missing: (i) the overconfidence proxy for the new CFO at time t; (ii) the overconfidence proxy for the incumbent CEO at time $t-1$; (iii) firm and manager's control variables at time $t-1$. Longholder CEO/Longholder CFO is a binary variable where 1 signifies that the CEO/CFO at some point during his tenure held exercisable options until the last year before expiration, given that the options were at least 40% in the money entering their last year. We require managers to have at least ten transactions recorded in Thomson Reuters to be included in the sample. Stock Ownership is option-excluded shares held by the CEO as a percentage of common shares outstanding. Vested Options is the number of exercisable options held by the CEO as a percentage of common shares outstanding. Q is the book value of assets plus the market value of equity minus the book value of equity minus deferred tax, divided by the book value of assets. Profitability is operating income before depreciation divided by assets at the beginning of the year. Tangibility is property, plants and equipment divided by assets at the beginning of the year. Book Leverage is the sum of current liabilities and long term debt divided by the sum of current liabilities, long term debt and book equity. Stock Ownership, Vested Options, Q, Profitability, Tangibility, Log(Sales), and Book Leverage are measured at the beginning of the year. Year fixed effects are included in all the regressions and Fama and French (1997) 12 industry dummies effects are included in columns 2-4. All standard errors are adjusted for clustering at the firm level. ***, ** and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)
Longholder CEO	1.101***	1.351***	1.877***	1.904***
	(2.710)	(3.053)	(4.054)	(3.988)
CEO Vested Options			-0.070***	-0.071***
			(-2.950)	(-2.602)
CEO Shares			-0.001	-0.001
			(-0.399)	(-0.333)
Q				-0.046
				(-0.288)
Profitability				0.699
				(0.349)
Tangibility				1.525*
				(1.807)
Log(Sale)				-0.006
				(-0.0387)
Book Leverage				0.236
				(0.630)
Observations	198	198	198	198
Pseudo R-squared	0.085	0.135	0.185	0.200
Year FE	YES	YES	YES	YES
Industry FE	NO	YES	YES	YES
Manager Controls	NO	NO	YES	YES
Firm Controls	NO	NO	NO	YES