Managerial Duties and Managerial Biases*

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Abstract

Traits and biases of CEOs are known to significantly affect corporate outcomes. However, analyzing individual managers in isolation can result in misattribution. Our analysis focuses on the role of CEO and CFO overconfidence in financing decisions. We show that, when considered jointly, the distorted beliefs of the CFO, rather than the CEO, dominate in generating pecking-order financing distortions. CEO overconfidence still matters indirectly for financing as the CEO's (and not CFO's) type determines investors' assessment of default risk and the resulting financing conditions. Moreover, overconfident CEOs tend to hire overconfident CFOs whenever given the opportunity, generating a multiplier effect.

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1 Introduction

Managerial biases, and especially managerial overconfidence, appear to have significant explanatory power for corporate decisions. The idea that personal traits matter for organizational outcomes dates back at least to Hambrick and Mason (1984). Recent empirical work has established that individual traits play a significant role in investment, merger, and financing decisions (see, e.g., the overview in Baker and Wurgler (2013)). The spectrum of managerial traits considered in the corporate-finance literature ranges from risk aversion, education, childhood experiences, and gender, to behavioral biases such as overconfidence, loss aversion, and escalation of commitment.[1] Kaplan, Klebanov, and Sorensen (2012) argue that these traits and biases have a first-order impact on corporate performance. Behavioral corporate finance, and in particular research on managerial biases, is currently the fastest-growing strand of behavioral-finance research.[2]

Much of this research focuses on the traits and biases of one manager, typically the chief executive officer (CEO). The emphasis on CEOs reflects both their central roles as the top decision makers in their firms and, more mundanely, data availability. Few papers touch on the roles of other top managers, such as the chief financial officer (CFO), and even less research considers different top mangers jointly.[3] In this paper, we argue that it is important to account for managers other than the CEO when assessing the magnitude and empirical relevance of managerial biases. Any analysis that considers the beliefs and traits of one manager in isolation bears the risk of misattributing corporate outcomes. Such misattribution is particularly likely if there is assortative matching of managers of a similar type.

In this paper, we aim to illustrate this point in the context of managerial biases in corporate financing decisions. Specifically, we jointly assess the influence of CEO and CFO overconfidence on the choice of external financing and on the financing conditions offered by investors. The focus on corporate-financing

[1] See Graham, Harvey, and Puri (2013), Bertrand and Schoar (2003), Malmendier and Tate (2005 and 2011), Malmendier et al. (2011), Chevalier and Ellison (1997), Huang and Kisgen (2013), Faccio, Marchica, and Mura (2016), Yim (2013), Camerer and Malmendier (2012), Bazerman and Neale (1992), and Ross and Staw (1993), among others.

[2] Malmendier (forthcoming) shows the publication growth rates of different types of behavioral-finance research in top finance and economics journals, including the explosion of research on managerial biases and social ties over the last years (31-70% growth, compared to 9-12% in other fields of behavioral finance research).

[3] Notable examples of CFO studies include Ben-David, Graham, and Harvey (2007), Ben-David and Graham (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).

decisions provides us with a set of outcome variables over which two different types of managers plausibly exert a large influence: the CEO since she is the ultimate decision-maker, and the CFO since the firm's financial activities and operations are his core responsibilities (see, e.g., Berk and DeMarzo (2007)).[4] And the focus on overconfidence as the managerial trait reflects that this particular bias is the most extensively researched and most robustly documented non-traditional influence on corporate decision-making, or "the mother of all biases," as Bazerman (2006) put it.[5]

We define managerial overconfidence as managers' overoptimistic belief about the future returns, or cash flows, accruing to their firms. To proxy for such overestimation, we employ the widely used *Longholder* measure of personal overinvestment of managers in their own firms in the form of delayed option exercise in general (see, e.g., the overview in Malmendier and Tate (2015)). The basic idea of this proxy is simple: While rational managers typically exercise executive stock options some years before expiration, depending on how much the options are in the money, overconfident managers delay exercise to benefit from expected future stock-price increases. That is, overconfidence leads managers to believe that there are significant value increases to be reaped in the future and that it is better to wait before exercising.

Using this proxy, we find that optimistic beliefs of both the CEO and the CFO predict that external financing is tilted towards debt, but the CFO's beliefs strictly outweigh those of the CEO, which is consistent with the CFO's core compentency in designing the financing model. Vice versa, it is the CEO who matters for investors' assessment of the investment risk and thus the appropriate cost of financing. We find that firms with overconfident CEOs tend to obtain significantly better financing conditions, as measured by the interest rates on their corporate loans. This is consistent with the CEO being responsible for project implementation and completion. Moreover, the latter result is driven by firms where overly positive beliefs make a difference for project continuation in the bad states of the world. As we show, this is the case for firms with a medium range of variability in earnings. Finally, we also show that overconfident CEOs tend

[4] Our approach can be applied to other C-suite managers and their areas of decision-making, e.g., the COO and operating decisions. The intersection of ExecuComp and Thompson data is currently too small to perform such an analysis in our data. (See Section 3 for details about the construction of the data set.)

[5] More than half (53%) of all papers on managerial biases published in top finance and economics journals analyze overconfidence biases (Malmendier (forthcoming)). See also Meikle, Tenney, and Moore (2016) for a survey of the large research on the organizational consequences of overconfidence in firms.

to select like-minded CFOs when given the opportunity, confirming the presence of assortative matching.

Our theoretical framework differs from previous work on CEO overconfidence (Malmendier and Tate (2005), Malmendier and Tate (2008)) along two important dimensions. First, we consider the possibility of CEOs *and* CFOs exhibiting overconfidence. Here, it is important to be precise about the definition of overconfidence. In the case of the CEO, overconfidence reflects a biased belief in her own abilities to generate returns. In the case of the CFO, he also overestimates future returns. However, his overconfident beliefs about future returns are likely to (also) stem from overestimating the CEO's ability to generate returns, i.e., reflect an overoptimistic belief in another person (the CEO) or the firm. Despite these potential differences in the nature of the bias, we stick to a common label, overconfidence, both for simplicity and because the correct proxy for the bias of both managers, precisely under this definition, is the same empirical measure, late exercise of executive stock options.[6] A second difference relative to some of the prior work is that we allow the CEO's optimistic beliefs to affect her effort. Our model illustrates the circumstances under which overconfidence induces a CEO to exert more effort than a rational CEO, and how the CFO, in turn, accounts for such behavior in his financing choice.

The model generates three main testable predictions. First, holding constant the CEO's type, an overconfident CFO exhibits a preference for debt over equity (pecking order) when accessing external finance. Intuitively, overconfident CFOs perceive the value of their firm (or the stream of future cash flows generated by the CEO's investment choices) to be underestimated in the broader market. Since equity prices are more sensitive to differences in opinions about future cash flows, overconfident CFOs f ind equity too costly ("even more overpriced") relative to debt. This argument is similar to the prediction for CEOs in Malmendier et al. (2011), with the important difference that we allow the CFO to choose the means of financing.[7]

Second, the overconfident CEO exerts a significant *indirect* influence on financing, even when we shut down any direct influence: The CEO's bias can lower the cost of financing, especially for firms in intermediate ranges of profit variability. The reason is that overconfident CEOs overestimate returns to effort. The

[6] In fact, the empirical proxy could also be used for a theoretical concept of overconfidence that incorporate overoptimism about own ability on the side of the CFO. The different plausible theoretical approaches do not matter for our results.

[7] Empirically, we will also analyze the role of the CEO in determining the type of financing directly, and show that it is the belief of the CFO, not the CEO, that matters.

optimistic beliefs induce higher effort, similarly to the mechanisms in Pikulina, Renneboog, and Tobler (2014) or Gervais, Heaton, and Odean (2011). Following a negative shock, a rational CEO is less willing to work hard than an overconfident CEO, who might be optimistic enough to work towards the good outcome regardless. In this case, overconfidence helps solve the incentive problem. Anticipating such behavior, debtholders require a lower premium on debt from an overconfident than from a rational CEO.[8]

This second prediction has an additional advantage in terms of empirical testability, namely, that it can be refined to pinpoint which firms drive the association between CEO overconfidence and the cost of debt. Specifically, this association should vary non-monotonically with profit variability: A very mild shock does not matter much for the effort choice of either type of CEO, and a rather severe shock diminishes the incentives to work for both types of CEO. For some intermediate range, however, a rational CEO anticipates the project to be out of the money and does not exert effort, while an overconfident CEO might overestimate the returns to effort enough to work hard. This non-monotonicity is specific to our model of biased beliefs and the implied incentive-based explanation of favorable financing conditions. It helps rule out alternative explanations under which the CEO overconfidence proxy captures some omitted firm characteristic. It also implies that favorable financing conditions offered to overconfident managers do not merely reflect that investors are mislead by the manager's confidence and rate her abilities higher than they are. While such a ratings effect is a plausible additional channel for our findings (and has been shown experimentally by Schwardmann and van der Weele (2017)), non-monotonicity implies that a rational justification for the favorable financing conditions — investors correctly anticipate that an overconfident CEO will put all her effort behind the project she is engaging in.

As a third prediction, the model reveals another indirect channel through which CEO overconfidence affects financing: hiring. We show that an overconfident CEO who is in the position to select a new CFO is more likely to choose one who shares her views regarding the firm's profitability. While CEOs do not have discretion about the hiring of new CFOs, they do have a significant say in the selection of board members (Shivdasani and Yermack (1999); Cai, Garner, and Walkling (2009); Fischer, Gramlich, Miller,

[8] Designing different contracts based on the CEO's degree of bias requires stakeholders be able to recognize managerial overconfidence. Otto (2014) argues that this assumption is supported by the empirical evidence.

and White (2009)), who in turn choose the CFO. Hence, this prediction implies a potential multiplier effect of overconfident managers.

All predictions find strong support in the data. We replicate the *Longholder_Thomson* measure from Malmendier et al. (2011) to capture CEOs' overestimation of future returns accruing to their firms for our sample. This proxy measures delayed option exercise relative to a benchmark model of optimal exercise of executive stock options. We then generate a parallel CFO measure. As a robustness check, we also construct a continuous version of our Longholder proxy following Otto (2014).

We test the first prediction, on the choice between debt and equity, using various measures of net debt issuance from Compustat, SDC, as well as traditional financing-deficit models. We find that overconfident executives are reluctant to issue equity. Relatedly, we estimate a positive association between overconfidence and leverage choices. In both sets of estimations, CFO overconfidence is statistically and quantitatively more important than CEO overconfidence and, if analyzed jointly, CEO overconfidence is insignificant in our data. Thus, the manager whose beliefs matter for capital budgeting decisions *directly* appears to be the CFO.[9]

To test the second model prediction, on the cost of financing, we merge DealScan data on syndicated loans with our data set. We show that overconfident CEOs are charged significantly lower interest rates, controlling for the known determinants of the cost of debt. Hence, CEO overconfidence exhibits a strong *indirect* influence on financing by affecting investors' assessment of risk and the resulting cost of financing.

The effect is non-monotonic, following the pattern predicted by our model: It is significant only for companies with intermediate profit variability. This result holds regardless of whether we use earnings volatility, analyst coverage, or analyst forecast variability as proxies for profit variability, and it is robust over a broad range of plausible cutoff points for the 'intermediate' range. This type of non-monotonicity is consistent with the explanation offered by our model, namely, differences in effort provision in bad states of the world. Investors anticipate that overconfident CEOs will push ahead when rational managers start to divert effort. The result also addresses concerns about other, unobserved determinants of the cost of debt. Such alternative determinants would need to exhibit the same non-monotonicity, and they would need to

[9] Note that our estimates are not directly comparable to the earlier literature in that our more recent data does not reveal a strong CEO effects in capital structure decisions to begin with, even when neglecting the CFO.

be correlated only with the CEO Longholder variable, not the CFO Longholder variable.

Third, we test who is likely to be chosen as CFO conditional on the beliefs of the CEO. Based on our theoretical prediction, we expect the commonality of beliefs to play an important role. Indeed, we find that companies with overconfident CEOs are more likely to appoint like-minded CFOs. The statistical and economic magnitudes of the effect are large. Thus, CEOs exert indirect influence on corporate financing also via their influence on CFO selection.

Overall, our findings confirm the thrust of the existing literature in that they provide evidence on the significant role of managerial biases for corporate outcomes. By focusing on the CFO and showing that his beliefs affect outcomes in his domain, we help complete the literature on managerial overconfidence, which had focused on the CEO. The domain specificity of the bias (i.e., the relevance of CFO overconfidence for financing and of CEO overconfidence for other managerial tasks) corroborates the empirical importance of managerial overconfidence and implicitly the interpretation of the widely used *Longholder* proxy.

Our results caution against the focus on one single manager, which characterizes much of the existing literature. In considering only the CEO, for example, empirical analyses run the risk of misattributing outcomes to CEO biases. Our results suggest that previously identified effects of CEO overconfidence on the choice of external financing could reflect biases of the CFO – though with the explicit caveat that our newer data does not suggest strong CEO effects in capital structure decisions to begin with, even when neglecting the CFO. This may reflect a higher degree of delegation of financing decisions from CEOs to CFOs. Moreover, we also show that the impact of CEO biases increases rapidly whenever the CEO has the opportunity to select other top managers. Hence, our research implies that the managerial-traits analyses might need to move towards more complete firm data sets, that include several or all top managers who influence firm outcomes. In terms of practical implications, the joint consideration of managerial biases is important for boards when composing the C-suite and, more generally, when devising corporate-governance responses to biased managerial behavior.

Literature Review. In addition to the literature on managerial traits cited above, our analysis relates to previous work on the role of CFOs and their biases in determining corporate outcomes, including,

among others, Ben-David et al. (2007), Ben-David and Graham (2013), Jiang et al. (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 (2013) establish a link between the gender of CEOs and CFOs and the returns to acquisitions (where male executives are likely to be more overconfident). More broadly, our paper extends the literature that shows that differences in beliefs between investors and managers, together with moral hazard, affect capital struture choices (Dittmar and Thakor (2007) and Boot and Thakor (2011)). Outside the behavioral realm, Jiang et al. (2010) and Kim, Li, and Zhang (2011) show that CFOs' equity incentives have much stronger explanatory power for earnings management and stock crashes than those of CEOs. In this paper, we confirm that the traits of CFOs have more explanatory power than those of CEOs for financing decisions. We 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 for corporate financing outcomes.

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 reflect overconfidence. From a theoretical perspective, Hackbarth (2009) predicts higher debt ratios for managers who overestimate earnings growth. Landier and Thesmar (2009) and Graham et al. (2013) confirm empirically that overconfidence is associated with higher leverage and, in particular, with a preference for short-term debt. Consistent with this prior work, our model connects overconfidence with higher debt ratios; but we also find that overconfidence at the CFO level, rather than at the CEO level, matters most in this context.

Our second set of results, on CEO overconfidence predicting better terms of financing, 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 continue to appoint overconfident managers, who exhibit poor decision making in a host of contexts (see the overview in Malmendier and Tate (2015)). More recent papers point out that overconfident managers may increase firm value (Goel and Thakor (2008)), engage in more innovative activities (Hirshleifer, Low, and Teoh (2012)), and 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 can be advantageous in oligopolistic market settings with strategic interaction between firms (Englmaier (2010), Englmaier (2011)). Consistent with this latter view, our theoretical model illustrates that overconfident CEOs may exert more effort, in line with the work of Gervais and Goldstein (2007) and Hilary, Hsu, Segal, and Wang (2016). We provide a new angle on the "bright side" of overconfidence by showing that overconfident CEOs obtain lower interest rates on corporate loans. Moreover, we also identify the firms that may benefit most from hiring an overconfident manager – those experiencing profit variability of an intermediate range. Our results on better financing conditions for overconfident CEOs are also consistent with the experimental evidence that overconfidence leads others to rate a person as significantly more likely to be successful (Schwardmann and van der Weele (2017)). However, the concentration of the effect among firms with medium-variability returns points to the effort angle, rather than the mere ability of overconfident CEOs to persuade others of their success chances.

Finally, our model relates to studies of dissent between managers in organizations (Landier and Thesmar (2009); Landier, Sauvagnat, Sraer, and Thesmar (2013)), which suggest that CEOs are more likely to hire like-minded executives. Relatedly, Graham, Harvey, and Puri (2015), Acemoglu, Aghion, Lelarge, Reenen, and Zilibotti (2007), and Bloom, Sadun, and Van Reenen (2012) analyze empirically when and where managers are likely to delegate decisions. For example, for 48.2% of the CEOs in the Graham et al. (2015) survey "gut feel" is an important element in the decision to delegate corporate investment tasks to lower level executives. Our empirical results support the inclination to lean on "like-minded" people in the context of an easily measurable, widely studied, and relevant personal bias, managerial overconfidence. They are also consistent with the finding in Goel and Thakor (2008) 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, and show that the commonality of personal traits plays an important role.

2 Theoretical Framework

2.1 Setting of the Model

We consider a simple model of investment and financing 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. The project costs I and generates an uncertain return $\tilde{R}$, which equals either $I+\sigma$ or $I-\sigma$, each with probability 1/2, where $\sigma \in (0, I]$ measures the return variability. If the CEO exerts effort, she increases the expected return to $\tilde{R}+\Delta$.[10] Effort is costly, which is modeled as giving up a private benefit, similarly to Dewatripont and Tirole (1994) and Holmstrom and Tirole (1997, 1998).[11] For simplicity, we assume no discounting, and there are no other assets.

The CFO's job is to raise external financing, either by issuing debt with a face value of D or by issuing shares for a fraction γ of the firm.[12] External investors are risk neutral and must break even in equilibrium. As in previous models of overconfidence (Malmendier and Tate (2005, 2008)), we abstract from the problem of optimal compensation. We simply assume that the CEO and the CFO own fractions α and β of the firm, respectively, where $\alpha, \beta > 0$ and $\alpha + \beta \leq 1$. This assumption is common in the literature on managerial myopia (cf. Stein (1989); Edmans (2009)), and ensures that managers "care" about firm value.

Managers might be rational, or might exhibit overconfidence. We define overconfidence as overoptimistic beliefs about the (additional) future cash flows accruing to the firm that stem from the CEO's efforts. Specifically, an overconfident CEO believes that, by exerting effort, she increases cash flows by an amount $\Delta + \omega$. Similarly, an overconfident CFO believes that, whenever the CEO exerts effort, the return of the project increases by $\Delta + \omega$. Both managers are aware of each other's beliefs. When one manager is biased and the other is not, they agree to disagree. At the cost of some ambiguity in terminology, we refer to both

[10] Note that, if the CEO does not exert effort, the expected net return is zero. This assumption merely serves to reduce the number of cases to consider, e.g., to exclude cases of severe financial constraints (very low $E[\tilde{R}]$) or cases where moral hazard becomes irrelevant to financing (very high $E[\tilde{R}]$).

[11] See also Tirole (2010), Pagano and Volpin (2005), and Matsa (2010). In these papers, the private benefit is interpreted as the benefit from working on other projects (which reduces the expected revenue of the main project), or as the personal benefit from "softer" management (less stress and confrontation), or simply as opportunity costs of managing the project diligently.

[12] For tractability, we do not consider the possibility of issuing debt and equity simultaneously, following prior literature.

belief distortions as "overconfidence." The common label is appropriate in our context, despite the subtle conceptual differences between CEO and CFO overconfidence, as the proper empirical proxy for both biases is the same – late option exercise. However, for a CFO, late option exercise indicates an overestimation of the future returns to the company at which he is employed, not necessarily an overestimation of his ability.

We focus the analysis on the parameter range where moral hazard affects both rational and overconfident CEOs, $\Delta > B/\alpha \geq \omega$. The first inequality guarantees that the CEO's effort is not only socially valuable ($\Delta > B$), but also individually valuable to the (rational) CEO given her compensation ($\alpha\Delta > B$). The second inequality implies that the additional return to effort an overconfident CEO mistakenly expects to obtain ($\alpha\omega$) is bounded above by the private benefit from shirking B. These restrictions merely streamline the theoretical discussion, and we show the robustness of our results to removing them in Appendix A.5.[13]

The CEO maximizes her expected utility, given by a fraction α of the expected net return plus, if applicable, the private benefit. The CFO maximizes his expected payoff, given by a fraction β of the expected net return. Both managers form expectations using their personal beliefs.[14]

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, in equilibrium investors rationally predict the effort a CEO will put into the project. One interpretation is that investors recognize managerial overconfidence and anticipate how it affects managerial behavior.[15] For the empirical results, however, it is not necessary that investors recognize the cause of managers' effort choices, only that they predict them correctly. For example, they may expect managers to exert effort in bad states of the world because they perceive them

[13] Broadly speaking, if the first part of the double-inequality does not hold, i.e., $\Delta \leq B/\alpha$, the rational CEO never exerts effort (except in the knife-edge case $\Delta = B/\alpha$); and if the second part does not hold, i.e., $B/\alpha < \omega$, the optimal debt contract becomes more complicated, without generating new insights.

[14] Alternatively, we can model the CFO as maximizing firm value, or as maximizing existing shareholders' surplus. The CFO's decision remains the same since the optimization is equivalent up to a multiplication factor when he is a partial owner of the firm. Yet another possibility is that the CFO gives some weight to the CEO's well-being, which includes the private benefit B. In unreported results, we have modeled the CFO as "fully committed to the CEO," i.e., as maximizing the CEO's expected utility including B, and the model delivers the exact same insights.

[15] This assumption is supported by the evidence in Otto (2014) that shareholders recognize managerial optimism and adjust incentive contracts accordingly. It is also consistent with the evidence in Malmendier and Tate (2008) and Hirshleifer et al. (2012), who show that the option-exercise based measure of overconfidence is correlated with press portraits, suggesting that outsiders are able to identify overconfident managers.

to enjoy "leisure" less.

The timing is as follows. At $t = 0$, the CEO announces the planned investment, and the CFO chooses between debt and equity financing. If funding is obtained, the profitability of the investment ($I+\sigma$ or $I-\sigma$) is revealed at $t = 1$, and the CEO decides at $t = 2$ whether to exert effort. At $t = 3$, the cash flow is realized and investors are repaid. Figure 1 shows the full timeline. The dotted line on the left captures the model extension from Section 2.5, where we analyze the possibility of endogenous pairing between CEO and CFO.

Before moving to the solution of the model, we emphasize that its timing and assumptions are flexible enough to also accommodate other interpretations frequently offered in the literature. One common model set-up, for example, revolves around liquidity shocks (cf. Holmstrom and Tirole (1997)): After receiving outside financing, the manager has the option to either invest in a profitable project, or "shirk" and simply hold the cash. Project profitability is fixed, but the cash flow available to investors is affected by a "liquidity shock" known to the manager before making the effort choice. The liquidity shock might represent additional costs of the initial investment, or a shortfall in returns. It might also be modeled as a mean-preserving spread as in Matsa (2010) (from whom we borrow our proxy for earnings volatility in Section 5.1). The key feature in all of these cases is that a shock affects the firm's net worth, which in turn affects its financing capacity.

2.2 CEO Overconfidence and Moral Hazard

Solving the model 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 denote the return the CEO expects to obtain from exerting effort as $\Delta + \hat{\omega}_{CEO}$ with $\hat{\omega}_{CEO} = \omega$ if she is overconfident, and $\hat{\omega}_{CEO} = 0$ if she is rational. As standard in this type of models, we assume that the manager exerts effort rather than shirking when she is indifferent.

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 regarding the CEO's effort choice, one for each financing choice and each state of the world. For debt financing and in the good state of the world, the CEO exerts effort if

$$\alpha \cdot \max\{0, I + \sigma + \Delta + \hat{\omega}_{CEO} - D\} \geq \alpha \cdot \max\{0, I + \sigma - D\} + B, \tag{1}$$

where D is the face value of the debt. In the bad state, the IC for exerting effort under debt financing is

$$\alpha \cdot \max\{0, I - \sigma + \Delta + \hat{\omega}_{CEO} - D\} \geq \alpha \cdot \max\{0, I - \sigma - D\} + B. \tag{2}$$

Under equity financing, the CEO obtains a fraction $\alpha(1-\gamma)$ of the payoff, plus the private benefit if she does not exert effort. In this case, the ICs for the good and the bad state of the world, $\alpha(1-\gamma)(I+\sigma+\Delta+\hat{\omega}_{CEO}) \geq \alpha(1-\gamma)(I+\sigma) + B$ and $\alpha(1-\gamma)(I-\sigma+\Delta+\hat{\omega}_{CEO}) \geq \alpha(1-\gamma)(I-\sigma) + B$, can both be simplified to

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

2.3 CEO Overconfidence and the Cost of Debt

The CFO chooses between debt and equity at $t = 0$. We first derive the optimal debt contract conditional on the choice of debt. In the next subsection, we will consider the optimal equity contract conditional on equity financing (derived in Appendix A.2), and then solve for the CFO's choice between debt and equity.

We denote the return to the project in state $S \in \{Good, Bad\}$ and with effort $e \in \{0, 1\}$ as $\pi(S, e)$. For example, $\pi(Good, 1)$ equals $I + \sigma + \Delta$. Similarly, we denote the return expected by the CEO and the CFO, given their beliefs, as $\hat{\pi}_{CEO}(S, e)$ and $\hat{\pi}_{CFO}(S, e)$. We express e as a function of S using the notation e_S.

Conditional on debt financing, the CFO solves the following maximization program:

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

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

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

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. Note that, as the CFO's compensation is linear in the value of the firm, the CFO maximizes shareholder value, albeit as perceived by him. The participation constraint in (4c) accounts for the possibilities that returns are larger than D, in which case incumbent shareholders obtain the residual revenues, and that returns are lower than D, in which case debtholders obtain all returns. We denote the face value of debt that solves the maximization problem given the CEO's belief $\hat{\omega}_{CEO}$ as $D^*_{\hat{\omega}}$. We will see

below that the optimal contract does not depend on the CFO's beliefs. We can now establish our first result.

Proposition 1 (Cost of Debt). *The cost of debt financing under the equilibrium debt contract is lower for firms with an overconfident CEO, and is independent of the CFO's beliefs. Specifically, the cost is strictly lower for intermediate ranges of return variability, with a face value of debt $D^*_\omega = I$ for an overconfident CEO and $D^*_0 = I+\sigma$ for a rational CEO. It is identical for sufficiently low variability (with $D^*_0 = D^*_\omega = I$) or high return variability (with $D^*_0 = D^*_\omega = I + \sigma$).*

Proof: See Appendix A.1.[16]

Proposition 1 delivers the prediction that overconfident CEOs work harder than rational CEOs when their firm faces medium return volatility, holding constant investment opportunities, and are rewarded with better financing terms.[17] Intuitively, for small levels of ex-ante variability in returns, both types of CEOs exert high effort regardless of the realized state of the world. Even in the bad state, payoffs are high enough to make effort worthwhile for both types. For very high levels of variability, instead, both types of CEOs shirk in the bad state of the world. Anticipating such behavior debtholders seek compensation in the good state of the world by imposing a higher face value of debt. For moderate levels of variability, instead, the low payoff in the bad state deters a rational CEO from working hard, but not an overconfident CEO, who overestimates the value she can generate.[18]

We note that the result that overconfident managers may be more motivated to work hard is shared by a number of models with biased agents, such as Bénabou and Tirole (2002), Puri and Robinson (2007), and, in the managerial context, Otto (2014). Hence, although our setting and predictions are specific, its main message is common to a broader literature. The more subtle result that the effect is driven by medium-volatility firms is, instead, distinctive of our modelling approach. What exactly constitutes a 'medium range of volatility' depends of course on the parametrization of our model, including the unknown traits (B, ω)

[16] The thresholds for high, medium, and low variability are made precise in the proof. As discussed there, for all three ranges of return variability to be non-empty, we need a sufficiently wide distribution of profit variabilities σ across firms.

[17] We obtain the same results if we reduce the role of the CFO to choosing debt or equity while the CEO rejects or accepts the contract proposed by investors, i. e., if the contract maximizes the CEO's rather than the CFO's utility.

[18] In a more general model where managers also choose the investment level, this insight still holds to the extent that the resulting overinvestment problem (Malmendier and Tate (2005) and Goel and Thakor (2008)) is not "too severe" relative to the moral hazard problem.

of the CEO. In the empirical analysis, we will first use terciles as a natural starting point and employ a number of different proxies to split the sample into terciles of volatility. We then explore a wide range of alternative sample splits to test for the existence and robustness of the predicted non-monotonicity.

In Appendix A.2, we solve for the optimal equity contract in a similar fashion, and derive how the cost of equity financing (conditional on obtaining equity financing) responds to overconfidence. Here, the optimal contract either assigns a fraction $\gamma^*_{\hat{\omega}} = I/(I + \Delta)$ to outside investors, with the CEO exerting effort in both states of the world; or, if the moral hazard problem is too severe, it assigns full ownership $\gamma^*_{\hat{\omega}} = 1$, with the CEO not exerting effort in either state of the world. Consistent with the analysis of the optimal debt contract, overconfident CEOs also enjoy a lower cost of equity financing within certain parameter ranges. However, the theoretical prediction varies with parameters B, Δ, and I, which are hard to pin down empirically, and is less robust, for example, to strategic reasons for equity issuance (signaling, market timing). We will thus focus the empirical analysis of the cost of financing on the case of debt issuance.

2.4 CFO Overconfidence and the Choice between Debt and Equity

In order to solve for the CFO's choice between the optimal debt contract (derived in the previous subsection) and the optimal equity contract (derived in Appendix A.2), we compare his perceived expected utility under the different financing scenarios. Since both a rational and an overconfident CFO correctly take the CEO's beliefs and their impact on the cost of debt and equity into account, even a rational CFO's choice will be affected by the CEO being overconfident. Proposition 2 summarizes the results:

> **Proposition 2 (Choice between Debt and Equity).** *An overconfident CFO uses (weakly) more debt financing and less equity financing than a rational CFO, both under an overconfident and under a rational CEO.*
>
> ***Proof:*** *See Appendix A.3.*

As made more precise in the proof, there are parameter ranges for which both types of CFOs strictly prefer debt over equity; and there are parameter ranges where an overconfident CFO strictly prefers debt

over equity while a rational CFO does not. In the latter case, the overconfident CFO uses more debt financing than a rational CFO, as long as the rational CFO does not always pick debt when indifferent between the two financing choices. The intuition is similar to the one in Malmendier et al. (2011), albeit applied to the CFO: A biased CFO overestimates the return to the investment project when the CEO puts effort into the project. For this reason, they perceive external financing to be too costly. Under equity financing, this difference in opinion matters for all the states of the world; under debt financing it matters only for the default states, which explains the relative preference for debt.

2.5 CEO Overconfidence and CFO Hiring

The CEO's beliefs might also affect the selection of new CFOs. The recruiting of the CFO is a prerogative of the board of directors. However, a large empirical literature documents the strong influence of the CEO on the appointment of board members (Shivdasani and Yermack (1999); Cai et al. (2009); Fischer et al. (2009)), and CEOs also control the selection of all other C-suite managers. In our simplified setting, we assign the CEO sole discretion in replacing a CFO. 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 Appendix A.4.*

Proposition 3 is not immediate since the CEO and the CFO maximize different objective functions even when they share the same degree of bias. The reason for the assortative matching result of Proposition 3 is that there is no disagreement regarding the CEO's moral hazard problem. Therefore, all that matters for the financing choice of the CFO is the commonality or discrepancy of beliefs. Since a rational CFO deviates from the preferred choices of the overconfident CEO (over some parameter ranges), overconfident CEOs prefer the financial decision-making of overconfident CFOs on average, and hence hire overconfident CFOs when given the opportunity.

We summarize our findings formulated as three testable predictions:

Prediction 1. Overconfident CFOs are more likely to issue debt rather than equity when accessing external financing, conditional on the CEO's type.

Prediction 2. CEO overconfidence is associated with a lower average cost of debt. This effect is driven by firms experiencing medium variability in their profits.

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

3 Data

3.1 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. Option-based measures, first proposed by Malmendier and Tate (2005), are by far most widely-used. The identification relies on individual choices and revealed beliefs: It infers managers' expectations about their companies from their personal investment choices. Managers who overestimate future cash flows tend to overinvest their own wealth in their companies and expect to personally benefit from future stock-price increases. In particular, they do not diversify their stock-based compensation and delay the exercise of executive stock options.[19] Galasso and Simcoe (2011), Malmendier et al. (2011), Otto (2014), and Hirshleifer et al. (2012) also adopt this measurement strategy.[20] The earnings-forecast-based approach, proposed by Otto (2014), infers overconfidence from overstated earnings forecasts. The survey-based approach, developed by Ben-David et al. (2007) and Ben-David and Graham (2013), constructs CFO overconfidence proxies based on miscalibrated stock-market forecasts of CFOs who participated in the

[19] Another way to overinvest in the own company is to delay the sale of stock. Overconfident managers also exhibit that behavior, and even buy additional stock of their firms. Empirical research has relied more on option-based measures than on stock purchases and sales as they raise fewer concerns about signaling to the market; cf. Malmendier and Tate (2008).

[20] Relatedly, Sen and Tumarkin (2015) measure overconfidence as the share retention rate after an option exercise.

Duke/CFO Business Outlook survey.[21] The media-based approach, employed by Malmendier and Tate (2008) and Hirshleifer et al. (2012), constructs CEO overconfidence measures based on the characterization of CEOs in the press.

In this paper, we follow the "revealed beliefs" route, i. e., the option-based approach, as it has been both most commonly employed in prior literature and is generally most robust in terms of alternative interpretations (see Malmendier and Tate (2015)). We replicate and expand the *Longholder_Thomson* proxy of Malmendier et al. (2011). In addition, we also replicate our results using a continuous variant of the option measure proposed by Otto (2014).

The *Longholder_Thomson* measure exploits the timing of option exercise to measure managerial overconfidence as follows. It is based on a benchmark model of option exercise for managers (Hall and Murphy (2002)), where the optimal exercise schedule 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 options are highly exposed to the idiosyncratic risk of their companies. Under the rational benchmark, risk-averse managers address their under-diversification by exercising options some time before expiration. Overconfident managers, who overestimate the expected future cash flows of their firms, postpone exercising in-the-money options in order to tap expected future gains. Malmendier and Tate (2005) capture this insight with a binary variable called *Longholder*. The variable indicates if a manager at some point during their tenure held an option until the last year before expiration even though the option was at least 40% in-the-money. The authors use option-package-level data from CEOs of 477 large publicly traded U.S. firms between 1980 and 1994 to identify late option exercise.

In order to replicate the original Longholder measure for a longer and more recent sample period, and for a broader set of managers and firms, we build on the *Longholder_Thomson* variant of the measure proposed by Malmendier et al. (2011). Their proxy has the same definition as the original Longholder measure, but uses the Thomson insider filing data set to identify option exercises of managers in public U.S. firms. We reconstruct the measure for our extended sample period, and we extend the measure to CFOs.

[21] This behavioral bias reflects an underestimation of variance but is sometimes also called overconfidence. However, it does not imply delayed option exercise. See Malmendier et al. (2011) (fn. 1) for a brief discussion.

The control group consists of managers who are also in the Thomson data but do not meet the criteria of overconfidence. We also use the data to construct a continuous version of the Longholder measure as proposed by Otto (2014). Here, we first calculate overconfidence dummies for each option exercise, and then average all executive-specific dummmies weighted by the number of shares exercised. Details of the construction and replications of all estimation results with the continuous measure are in Appendix C.

We note that the discrete and continuous measures are strongly correlated, with correlation coefficients of 41.9% for CEOs and 46.5% for CFOs. The estimation results are also generally similar under both measures for our main specifications, and differ only when we work with relatively small and selected samples. The differences may reflect the fact that the dummy approach generates more variation than thex‘ continuous measure,[22] or that the linearity implicit in the continuous measure might be an imperfect representation of the variation in overconfidence. In our context, we choose to emphasize the more widely used indicator version (in the main text) for a different and somewhat subtle reason: A necessary condition for a CEO to be a Longholder is that she experiences at least one instance where 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 such instances. This condition is very demanding, especially in the more limited data on CFOs, and likely to be met only for particularly successful companies. The indicator version avoids such issues of selection or misattribution. At the same time, we acknowledge the appeal of a continuous measure with its finer distinction, and replicate all estimations with the continuous measure in Appendix C.

We use the Thomson insider filing data to construct the updated *Longholder_Thomson* measures for both CEOs and CFOs. Thomson collects data from Forms 3, 4, and 5, which insiders report to the SEC. The data consists of two data sets called "Table 1" (Stock Transactions) and "Table 2" (Derivative Transactions). We extract the option exercise data from the "Table 2" data, which contains information from Form 4. (Changes in ownership must be reported to the SEC within two business days on Form 4.) These transactions data are available since 1996. However, as *Longholder* is constructed as a permanent characteristic, we can include the years 1992-1995 for those companies into our sample that had managers for which we can obtain

[22] For example, the standard deviations of the Longholder CEO and Longholder CFO dummies are 0.46 and 0.49, respectively, in our largest sample, but only 0.017 and 0.07 for the continuous measure.

transactions data in Form 4. We keep only records with Thomson cleanse indicators R, H, and C (very high degree of confidence in data accuracy and reasonableness) or Thomson cleanse indicators L and I (reasonably high degree of confidence). Following prior literature (e.g., Lakonishok and Lee (2001)), we drop records that are amendments to previous records and records with obvious errors, such as an indicated maturity date that is earlier than the exercise date, or options with missing exercise date. We also remove outliers with exercise prices below \$0.1 or above \$1000. We calculate the percentage-in-the-money for each option using stock price data from CRSP.

We obtain tenure as well as stock and option holdings of the CEOs and CFOs from ExecuComp. This step limits our sample to the intersection of the ExecuComp and Thomson databases, i. e., a subset of the S&P 1500 small-, medium-, and large-cap firms from 1992 to 2015. We use CUSIPs to merge the firm-level information in Thomson and Compustat/ExecuComp, and employ a conservative fuzzy algorithm to link the names of the executives in the two data sets. We verify manually the accuracy of each match, and discard all transactions in which the names do not coincide. In a few cases a firm has more than one CEO or CFO listed in ExecuComp. In these instances, we manually check the 10-K forms on the SEC website[23] and identified the executive who held the relevant position at the end of the fiscal year.

An empirical issue with the CFO data is the significantly lower number of transactions available to construct the overconfidence proxy. CFOs typically receive smaller option grants than CEOs, and are also covered less in ExecuComp. This introduces measurement error when we categorize a CFO as non-overconfident. To address this problem and ensure that we capture systematic behavior, we keep only managers for which we observe at least ten transactions. However, as discussed in more detail in Section 3.3 and shown in Appendix-Figure C.1, our estimates remain very stable when we alter the filter requirement.

Table 1 summarizes the data construction. Of the 8,054 CEOs and 7,402 CFOs in ExecuComp, about 20% (1,623 CEOs and 1,246 CFOs) are also recorded in Thomson and report at least ten transactions, corresponding to 5,810 firm-years. After dropping financial, utilities, and firms with missing manager or firm controls, the final sample consists of 4,581 firm-years.

[23] See http://www.sec.gov/edgar.shtml. The Edgar database contains 10-K forms starting in 1994. For some earlier cases we cannot recover the information and exclude those observations.

3.2 Alternative Interpretations

Before turning to the remaining data construction, we address possible 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. One might be concerned that such behavior indicates inertia or procrastination. We find, however, that 74% of overconfident CEOs and 69% of overconfident CFOs conduct other portfolio transactions one year prior to the year when their options expire, which is inconsistent with the interpretation that *Longholders* would persistently delay managing their personal portfolios.

Relatedly, we will show below that Longholders actively borrow more debt when the financing deficit is high. Such behavior is also hard to reconcile with inertia as the explanatory personality feature.

Insider Information. Managers may choose to hold exercisable options because they have positive inside information about future stock returns. One issue with this alternative explanation is that inside information should, by definition, be transitory rather than persistent, but Longholders persistently hold exercisable options for several years.

Another implication of the inside-information interpretation is that insiders should earn positive abnormal returns from holding options until expiration. While we cannot calculate expected returns from an ex-ante perspective, we can calculate the actual returns of Longholder CEOs and CFOs from holding options that were at least 40% in-the-money ("Longheld" transactions) until their expiration. We compare these actual returns to hypothetical returns from exercising these options 1, 2, 3, or 4 years earlier and investing the proceeds in the S&P 500 Index until the 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. We then re-estimate our regression model on the subset of Longholders who lose money by holding their options. The new estimates either confirm or even strengthen the results, whenever the sample is large enough to separately estimate "winner" and "loser" Longholder variables. The same has been found in previous research employing Longholder-type measures; see, e.g., Malmendier and Tate (2008).

Signaling. One might argue that managers who persistently hold exercisable options intend to signal

to the capital market that their firms have better prospects than other, similar firms. However, as in the discussion of insider trading, the persistence of Longholders' behavior is hard to reconcile with the signaling interpretation. A firm may be temporarily overvalued, and the CEO or CFO may be aware of it; but our measure captures persistent managerial behavior. Moreover, all estimations control for the number of vested options held by the manager (standardized by the total number of shares outstanding) to account for the possibility of signaling via option holdings.

Risk Tolerance. The *Longholder_Thomson* overconfidence measure captures a habitual tendency of managers to hold company risk. One might be concerned 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, high risk tolerance would not predict managers' aversion to equity financing, or preference for debt financing, which is a robust finding of our analysis. Moreover, if Longholder managers were simply more risk-loving and undertook riskier projects, we would expect the cost of debt to be higher for their firms. Our analysis shows the opposite.

Agency Problems. Another alternative interpretation is that, being more incentivized, option-holding managers are more willing to act in the interest of (existing) shareholders. However, in all of our regressions, we control for both the shares and the vested options owned by managers. Moreover, the observed differences in the behavior of Longholders, compared to managers who diversify their holdings, are not easily interpreted as shareholder-value maximizing. By increasing leverage, Longholders likely reduce the cash flow available to shareholders. This behavior might be costly to shareholders if it increases default probability and if there are non-negligible bankruptcy costs.

Firm performance. Another concern is a potential mechanical correlation of the *Longholder_Thomson* measure with past performance. Given the construction of the proxy, an executive cannot be identified as overconfident unless her firm's stock has appreciated by at least 40%. Therefore, one may worry that, in our empirical analysis, overconfident managers are simply those running particularly successful firms. To address this confound, we compute, for each firm, the buy-and-hold return over the previous 1, 2, 3, 4, and 10 years and test whether they are systematically correlated with the overconfidence measures. We find that

the correlations of the *Longholder* dummies with lagged buy-and-hold returns are small and often negative. For example, when we look at a ten-year horizon, which is the most relevant horizon for our analysis, the two correlation coefficients are not only very small in absolute value but also of opposite signs, positive for Longholder CEOs (0.024) and negative for the Longholder CFOs (-0.009). This is at odds with the idea that our measures are capturing a common underlying pattern of past performance in the data.

As a second way to address concerns about links with past performance, we re-run our analysis on the subsample of firms that have appreciated by more than 40% in the previous ten years. This subsample selection is quite restrictive – not because of the restriction of interest, i. e., the 40% requirement; but because it excludes all firms that, in a given year, have less than ten years of past data.[24] Despite the significant loss of sample size and power, we replicate our estimations on this subsample. Our main results are qualitatively and quantitatively unaffected, except in instances where we work with a very small sample and where the data offer limited variation due to our empirical strategy (cf. Table 4). We include examples of estimations of a CFO effect (debt issues) and a CEO effect (net interest) in Appendix-Tables C.8-C.9.

Mismeasurement. The *Longholder_Thomson* proxy draws a simple dichotomous distinction between overconfident and rational managers. It may thus be susceptible to mismeasurement in at least two ways. First, it is sensitive to data errors in the Thomson Reuters database (e.g., in the grant or expiration dates of the options). Second, it does not distinguish between managers who display a more or less persistent tendency to exercise in-the-money options late.

The continuous version of the Longholder measure developed by Otto (2014) is unlikely to be affected by occasional errors in the Thomson database, and allows us to distinguish, more finely, different degrees of overconfidence. As reported in Appendix C, we obtain largely similar results when following this approach.[25]

[24] The ten-year restriction reduces the sample by about 26%, but only 18% of the remaining firm-years feature returns lower than 40% over the previous ten years.

[25] To summarize briefly, results using the alternative measures are similar for the analyses of Debt Issuance using Compustat and CFO Hiring (Tables C.2 and C.6 in Appendix C); qualitatively similar but slightly weaker statistically for the Interest Rates regressions (Table C.5); statistically stronger for the Leverage regressions (Table C.4); and inconsistent only for the regressions which adopt the "Financing Deficit" approach (Table C.3). Also, quantitatively the variation explained under the dummy measure and the variation explained under the continuous measure are of the same order of magnitude. For example, we find that an increase of one standard deviation in CFO overconfidence using the continuous measure increases the odds ratio of issuing debt by 15.8% (Table C.2), which is in line with our results of Table 3.

Tax Advantages. Another possible concern is that tax reasons could explain delayed option exercise. Practitioners sometimes cast expectations of future stock-price increases as a motive for *early* exercise. The informal argument, also discussed in academic research (see McDonald (2005)), goes as follows: When exercising a stock option, executives pay ordinary income tax. Upon sale of the underlying shares, they pay only capital gain taxes, which are typically lower. It may thus be optimal to exercise options early if the stock price is expected to rise. Correspondingly, late exercisers may be those who predict poor performance. If option owners are on average correct, late exercise would be correlated with poor future performance.

We have implicitly already addressed these concerns in the discussion of "Signalling" and "Insider Information." First, the *Longholder_Thomson* proxy captures persistent behavior. While a manager may be more or less pessimistic about the firm's prospects at any given point in time, a standard model cannot explain a *systematic* pattern of optimistic (or pessimistic) expectations and resulting option exercise behavior. Second, stocks owned by *Longholders* do not appear to under- or outperform the market in the long run. Finally, and perhaps more importantly, the intuitive argument sketched above may be appealing but, as McDonald (2005) shows, its logic is not correct. In a rigorous framework where a manager does not borrow money to pay income taxes, accelerating the option exercise is not optimal in general.

Hence, while any empirical estimates using option-based overconfidence measures must be subjected to additional scrutiny, as they are not the result of exogeneous variation, the leading alternative interpretations appear to be addressed either in the details of the construction of the measure, or in the empirical results.

3.3 Other variables

Our 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 concerns about the lack of comparability in the accounting data. Below, we describe briefly the main variables of interest. Additional details are in Appendix B.

The key variables for our analysis of financial policies are Net Debt Issues and Net Financing Deficit. Using the definitions from Malmendier et al. (2011), we construct Net Debt Issues as long-term debt issues

minus long-term debt reductions. 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.

Standard firm-level control variables include Q, profitability, tangibility, size, book leverage, and annual changes in these variables. Q is given by assets plus market value of equity (price times common shares outstanding) minus common equity and balance sheet deferred taxes and investment tax credit, all divided by assets. Profitability is operating income before depreciation, normalized by assets at the beginning of the year. Tangibility is property, plants and equipment normalized by assets at the beginning of the year. Size is the natural logarithm of sales. Book leverage is the sum of debt in current liabilities and long-term debt, divided by the sum of debt in current liabilities, long-term debt, and common equity. We combine manager-level variables with firm-level variables to form the whole sample, a panel of 679 S&P 1500 firms from 1992 to 2015, corresponding to 4,581 firm-years indicated in Table 1.

Table 2 reports summary statistics for firm-level variables in Panel A, and for CEO- and CFO-specific variables in Panel B. Each panel contains separate tables for the different (sub)samples used in each analysis. Not surprisingly, the typical company in our data set is large relative to the Compustat universe. The average revenues in our overall sample (the data used in the Financial Deficit analysis of Table 4) amount to \$5.7 billion, relative to a mean of \$2.5 billion for the full Compustat data set over the same time period. Our companies also tend to have slightly lower book leverage (28.9% versus 31.5%) and significantly higher profitability (18.5% versus 7.0%). Relative to the ExecuComp data, of which our data is a subset, the differences are much less pronounced. The respective figures are \$4.7 billion, 36.2%, and 13.3%. Hence, our sample appears to be fairly similar to those studied in past empirical work on executive compensation.

Panel B of Table 2 reveals that, on average, CEOs tend to own significantly more stock of their companies than CFOs (1.81% versus 0.12% in the sample used in Tables 4 and 5). The difference is somewhat less pronounced for vested options (1.04% versus 0.26%). These figures are comparable to those we obtain when analyzing at the full ExecuComp dataset.[26] We have also analyzed managerial controls separately for the

[26] The average stock ownership in ExecuComp is 2.43% for CEOs and 0.15% for CFOs; the number of vested options scaled by number of shares is 0.73% for CEOs and 0.15% for CFOs. Thus, executives in our sample have similarly powered equity

full sample and for overconfident managers, and find that they tend to have fairly similar equity incentives.[27]

For completeness, Appendix-Table C.1 reports the descriptive statistics for our largest sample, used in Tables 4 and 5 of the paper, split by the four possible combinations of executives' biases (both executives rational, both overconfident, rational CEO and overconfident CFO, overconfident CEO and rational CFO).

Compared to the samples used in Malmendier and Tate (2005, 2008) and Galasso and Simcoe (2011), the Thomson and ExecuComp-based data sets in Malmendier et al. (2011) and Hirshleifer et al. (2012), and also compared to the survey sample of Ben-David and Graham (2013), our sample differs in three ways: First, it extends to a more recent time period. Second, it considers small and medium firms in addition to large firms. And third, it includes overconfidence measures for both the CEO and the CFO. The last difference is key in that we aim to fill a gap in the existing literature by estimating the effects of CEO and CFO overconfidence separately and jointly.

These differences in sample composition are important to recognize in order to understand differences in the observed frequency of overconfident managers. In our sample, the *Longholder_Thomson* measure classifies 66.5-69.8% of CEOs and 52.8-57.5% of CFOs as overconfident. 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 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. Thus, the restriction increases the percentage of overconfident CFOs considerably more than that of overconfident CEOs. Because CFOs' options packages are in practice much smaller than those of CEOs (see Table 2, Panel B), this observation cautions that managers are less likely

incentives, with a slight tilt toward option rather than stock awards, which is not surprising given the additional merge with option exercise data from *Thomson*.

[27] We have also included, in unreported tests, gender and age as additional managerial controls. Gender is available for all managers but exhibits very little variation, with only 2% of CEOs and 8% of CFOs being women. It has no effects on our estimates. Age is non-missing only for about two-thirds of the observations. Given that, when including it as control variable, we find very similar results, we chose to omit it and work with a more comprehensive sample.

to be classified as overconfident when they have fewer opportunities to trade options. Hence, a restriction to a subset of managers with similar transaction frequencies might generally be in order, especially when looking at CFOs or other managers that are less well covered than CEOs.

At the same time, we recognize a trade-off in using such a filter. One one hand, our proxy becomes more reliable; on the other hand, we are constrained to a smaller sample, which may suffer from different selection problems. Thus, we have re-done our analysis relaxing this restriction, requiring 1, 2, ..., 9 transactions recorded. (For example, when we require a single transaction registered in Thomson, we have 10,184 firm-years, more than twice the size of the sample with the 10 transactions requirement). We find that our results are largely unaffected.[28] For reference, we plot our main coefficient of interest in each regression versus the minimum number of transactions required for each executives in Appendix Figure C.1. Only the coefficients estimated in the most conservative regressions are shown. Economic magnitudes are generally larger with stricter requirements when we focus on CFOs, and are roughly independent from such restrictions when we look at the debt regressions (where we focus on CEOs). Hence, as expected, measurement error in the construction of the Longholder proxy is more of an issue with CFOs, rather than CEOs.

Finally, we merge our ExecuComp-Compustat data with the Dealscan database on syndicated loans to test our predictions regarding the relation between executive overconfidence and the cost of debt. Dealscan provides detailed information regarding the pricing, type, maturity, and size of loans. The coverage is typically limited to large and medium size firms, which are the main focus of our analysis. We merge this data set with the quarterly Compustat file, using the mapping provided by Chava and Roberts (2008).[29] Our outcome of interest 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 1,651 observations (408 different firms). We discuss the main control variables used in these tests in more detail in Section 5.

[28] The only exception is given by the leverage regressions of Section 4.3, where we use firm-fixed effects.

[29] The data is made available at finance.wharton.upenn.edu/ mrroberts/styled-9/styled-12/index.html. The crosswalk is available only up to 2012.

4 Overconfidence and Financing Choices

Prediction 1 of our model is that overconfident CFOs exhibit a preference for debt over equity, conditional on accessing the market for external financing. We test both the influence of the CFO, as predicted by the theoretical model, and the influence of the CEO, whose overconfidence has been found to play a significant role in prior literature.

We use three different empirical approaches. First, we focus on those firms that access external funding (debt or equity) in a given year, and ask whether they are more likely to issue debt than equity if they are lead by overconfident managers (Section 4.1). We estimate the corresponding logit models on two different data sets, Compustat and SDC, with the tables of the SDC estimation being relegated to Appendix C for brevity. 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. Under the second and third approach, instead, we make use of our full sample and control for firm fixed effects. The second approach (Section 4.2) employs the standard financing deficit framework' of Shyam-Sunder and Myers (1999), also used in Malmendier et al. (2011). The third approach (Section 4.3) extends the test of the potential influence of managerial bias to the resulting leverage structure. We ask whether the influence of managerial characteristics on the flow of financing is strong and persistent enough to affect firms' capital structures, above and beyond the influence of permanent firm characteristics. If so, firms run by overconfident executives should be systematically more leveraged.

4.1 Debt Issues

We first test whether overconfident managers are more likely to issue debt than equity in the Compustat data set. (Given that the SDC sample is smaller and more selected, we relegate those parallel estimations to Appendix C, where we show that they do not differ from the Compustat results reported in the main text.) As implied by the model, we need to condition the regression analysis on accessing external capital. The conditional analysis also controls for potential differences in the baseline frequencies of debt and equity

issues by overconfident managers and their rational peers. Therefore, the regression sample only includes observations with either positive net debt issues or positive net equity issues. In total, we have 2,939 firm-years with external financing (635 firms). We test whether, conditional on using external financing, overconfident managers prefer debt over equity using the following logit model:

$$\begin{aligned} &\Pr(\text{NDI}_{i,t}|\text{LTCEO}_{i,t}, \text{LTCFO}_{I,t}, X_{i,t}, \delta_t) \\ &= G(\beta_1 \text{LTCEO}_{i,t} + \beta_2 \text{LTCFO}_{i,t} + X'_{i,t}B + \delta_t + \varepsilon_{i,t}), \end{aligned} \tag{5}$$

where G is the cumulative logistic distribution function, and the subindex i,t indicates year t in which company i accessed external financing. The dependent variable $\text{NDI}_{i,t}$ is an indicator of firm i issuing positive net debt in year t. As discussed in Section 3.3, net debt issues are calculated as long-term debt issues minus long-term debt reductions (cf., among many others, Shroff (2015)).[30] $\text{LTCEO}_{i,t}$ and $\text{LTCFO}_{i,t}$ represent the *Longholder_Thomson* measures for managerial overconfidence of the CEO and the CFO, respectively. $X_{i,t}$ is the vector of standard firm-level and manager-level control variables for firm i in year t. Firm-level control variables are the traditional determinants of capital structure—book leverage, log(Sales), profitability, Q, and tangibility—, and also include two-digit SIC industry fixed effects, following the specification of Ben-David and Graham (2013). Manager-level control variables are option-excluded stock ownership and vested options, and control for the incentive effect of stock-based executive compensation. In addition, we include a vector of year fixed-effects. Standard errors are adjusted for firm-level clustering, here and in all the estimations that follow. We note that the fixed effects do not cause incidental parameter problems in our logit estimations.[31] Coefficient estimates are transformed to indicate, for a unit increase in each independent variable, the expected change in the log odds of issuing debt.

[30] Alternatively, we construct debt issues as change in total assets minus net equity issues and retained earnings, following Baker and Wurgler (2002). We generally find very similar results, in particular if we include the full set of control variables.

[31] 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 estimate coefficients consistently. This does not apply to industry fixed-effects (Bester and Hansen (2016)). Nevertheless, we have used a number of alternative estimation strategies as robustness checks. Our results do not change if we estimate a linear probability model or a conditional logit model. Moreover, we get similar point estimates for our baseline model with a coarser industry classification (Fama-French 12 industries). These remarks also apply to the results of Appendix-Table C.7, where we adopt the same empirical strategy for the SDC data.

Table 3 reports the results. We start by only including the CEO overconfidence proxy (columns 1 and 2), replicating the analyses of prior literature. We then use the CFO instead of the CEO measure (columns 3 and 4), which captures the predictions of our model. Finally, we include both overconfidence measures jointly (columns 5 to 7). The joint analyses test whose managerial trait predicts a more pronounced pecking-order preference, and whether the separately estimated overconfidence coefficients are robust.

In the baseline logit estimations with only the CEO overconfidence proxy we estimate a small positive and insignificant log odds ratio, whether we only control for industry specific effects (column 1) or include the whole range of firm-level and manager-level controls as well as year dummies, which remove cyclical effects of debt issues (column 2). 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. Most importantly, the inclusion of control variables does not alter the lack of explanatory power of the CEO overconfidence proxy, and if anything, appears to reduce the size of the coefficient. In other words, in this first data set, CEO overconfidence appears to be less predictive of financing choices than found in previous analyses for earlier sample periods and (partly) different firms.

In columns 3 and 4, we turn to the prediction of our model and replace the CEO overconfidence measure with the CFO overconfidence measure. For the baseline regression with only industry controls, the estimated coefficient of the CFO overconfidence measure is large and significant at the 1% level (coefficient = 0.354, t-statistic = 3.182). It indicates that the odds of debt issues for overconfident CFOs is 45% higher than for rational CFOs. This finding remains unaffected when we control for CFO-level variables, firm-level variables, industry dummies and year dummies in column 4. The estimated coefficient of CFO overconfidence increases slightly to 0.392. The stability of the coefficient estimate also helps address concerns about potential confounds related to an executive's risk tolerance (see Section 3). If risk tolerance, rather than overconfident beliefs, induced the manager to issue more debt and raise default risk, the explanatory power of Longholder

should decline once we include both book leverage (as a measure for firm-level risk) and vested options (as proxy for willingness to hold risk in a manager's portfolio). However, the coefficient on Longholder CFO turns out to be unaffected by the inclusion of these variables.

In columns 5 to 7, we include both CEO and CFO overconfidence measures, first in the baseline regression, then adding only managerial controls, and finally including the full set of controls. These specifications test whether the finding of a significant CFO effect is robust to the inclusion of the corresponding CEO controls. We find that, while the coefficient on CEO overconfidence remains insignificant, CFO overconfidence retains its economic and statistical magnitude. In the estimation that includes the full set of control variables (column 7), the coefficient on Longholder CFO is 0.437 (and highly significant with a t-statistic of 3.725). It 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 17%, 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.[32] Though the low partial R-squared indicates other drivers 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.

For robustness, we also explore to what extent mismeasurement in growth opportunities migh contribute to the relatively low R-squared in some of our regressions. We use the minimum distance estimator developed by Erickson, Jiang, and Whited (2014) to control for measurement error in Q. We replicate all the tests of this paper and find that, while the explanatory power of Q does increase, our results are mostly unaffected.

As mentioned above, we have re-estimated the model in 5 using the SDC data on equity and bond issues by US corporations, following Malmendier et al. (2011). The advantage of the SDC data is that it identifies the timing of issuances more precisely, relative to the (noisier) accounting data from Compustat. Its disadvantage is that it misses those increases or decreases in firms' external financing that are not recorded as new issues in SDC, and that the sample size is much smaller. More details regarding the sample

[32] For example, we find that the R-squared increases by .55% relative to the R-squared if CFO overconfidence is not included in the regression, 16.25%, which is equivalent to calculating the partial R-squared via the partial correlation.

construction are in Appendix A.5. As Appendix-Table C.7 shows, we obtain qualitatively similar results.

4.2 Financing Deficit and Managerial Overconfidence

We now turn to our second approach of testing Prediction 1, using the standard 'financing deficit framework' of Shyam-Sunder and Myers (1999). This framework allows to analyze whether, for a given need of external funding, managers display a preference for debt over equity. Here, we examine the impact of managerial overconfidence on the association between the net financing deficit and the choice of external financing, as done in Malmendier et al. (2011) for the CEO. The estimation framework allows for overconfident managers and their rational peers to have different baseline needs for external financing. Another advantage of this approach is that it utilizes all firm-years, resulting in a larger sample.

We estimate OLS regressions using the following equation:

$$\begin{aligned} D_{i,t} = \beta_1 \text{FD}_{i,t} + \beta_2 \text{LTCEO}_{i,t} + \beta_3 \text{LTCFO}_{i,t} + \beta_4 \text{FD}_{i,t} \text{LTCEO}_{i,t} \\ \beta_5 \text{FD}_{i,t} \text{LTCFO}_{i,t} + X'_{i,t} B_1 + \text{FD}_{i,t} X'_{i,t} B_2 + \theta_i + \delta_t + \varepsilon_{i,t} \end{aligned} \tag{6}$$

where $D_{i,t}$ is Net Debt Issues and $\text{FD}_{i,t}$ is the Net Financing Deficit, which measures the amount of external financing needed in a given year. $\text{LTCEO}_{i,t}$ and $\text{LTCFO}_{i,t}$ are our measures of managerial overconfidence (Longholder CEO and Longholder CFO), and $X_{i,t}$ is a set of manager-level and firm-level control variables including executive stock and vested options holdings, changes in Q, profitability, tangibility, and size. In the most conservative specifications, we also interact our vector of controls with the financing deficit variable. We note that the coefficients on the control variables generally show the expected signs (not shown for brevity).[33] We also include firm and year fixed-effects. The coefficients of interest are β_4 and β_5, which measure the effects of CEO and CFO overconfidence, respectively, on debt financing, conditional on the amount of financing deficit. If, for given financing needs, overconfident CFOs issued disproportionately more debt than unbiased managers, as predicted by our model, we would estimate β_5 to be positive.

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

We start again from the relationship between CEO overconfidence and financing, which has been the focus of prior research, before turning to CFO biases, which our model predictions pertain to. The baseline regression in column 1 of Table 4 includes only the CEO overconfidence measure, its interaction with the net financing deficit, and firm fixed effects. Column 2 adds the full set of control variables, including CEO stock and option holdings, firm-level variables, and year fixed-effects. In column 3, we further add the interactions between the net financing deficit and the control variables. (In columns 3, 6, and 9, FD is interacted with year dummies, so the stand-alone variable is redundant and omitted from the table.) Across all three specifications, we find little evidence for a role of CEO overconfidence in financing decisions, consistent with the results from the debt issuance regressions above. The coefficients of CEO overconfidence interacted with net financing deficit are positive but insignificant, except in column 3, where the coefficient is equal to 0.164, and is significant at the 5% level.

In columns 4 to 6, we employ the specifications from columns 1 to 3 but replace the CEO overconfidence measure with the CFO overconfidence measure. We find that CFO overconfidence increases the sensitivity of net debt issues to the net financing deficit significantly. The coefficient estimates of the interaction of CFO overconfidence and net financing deficit lie between 0.179 and 0.243. These results corroborate our finding that CFO biases influence a firm's tilt towards debt financing.

Finally, we include CEO and CFO overconfidence measures jointly (columns 7 to 9). The results are very similar to those from the separate estimations. The estimated effect of CFO overconfidence on the sensitivity of net debt issues to the net financing deficit ranges from 0.166 to 0.247, and is significant at the 1% or 5% level. The effect of CEO overconfidence remains small and insignificant. The estimated effect of CFO overconfidence is also quantitatively important. To get a sense of the magnitude, consider that in column 8 the stand-alone coefficient on the financing deficit is 0.094. This sensitivity more than triples for overconfident CFOs, to 0.302 (0.094 + 0.208). Moreover, the statistical significance of the coefficient tends to grow in the most demanding specifications, in which the control variables are interacted with the financing deficit (columns 6 and 9), suggesting that Longholder CFO is not simply picking up variation associated with other known predictors of debt issuance. We also note that the variation in net debt

issues explained by CFO overconfidence is substantial. In column 9, the R-squared rises from 30.8% if the interaction between Longholder CFO and the net financing deficit is excluded (unreported) to 49% when we include it as explanatory variable.

Taking the results from the three estimations of overconfidence on debt issuance together, CFO overconfidence emerges as a statistically and economically significant determinant while CEO overconfidence exerts at most marginal influence. These findings are consistent with Prediction 1 of our model.

4.3 Leverage and Managerial Overconfidence

Given the magnitude of our estimates so far, it is conceivable that the effect of managerial overconfidence might even translate into a measurable impact on firms' capital structure. As overconfident CFOs tend to prefer debt over equity issuances, their companies should display, on average, higher leverage. Note that this implication holds only if the overconfidence-induced bias towards debt is persistent and strong enough to dominate other determinants of leverage, e.g., the well-documented persistence of past leverage ratios.

To investigate this question, we estimate the following specification, following the empirical strategy in Bertrand and Schoar (2003) and Malmendier et al. (2011):

$$\text{Leverage}_{i,t} = \beta_1 \text{LTCEO}_{i,t} + \beta_2 \text{LTCFO}_{i,t} + X'_{i,t} B + \theta_i + \delta_t + \varepsilon_{i,t}. \tag{7}$$

$\text{LTCFO}_{i,t}$ and $\text{LTCEO}_{i,t}$ are the usual Longholder proxies for managerial overconfidence, $X_{i,t}$ is a vector of control variables, θ_i are firm fixed effects, and δ_t are year dummies. After controlling for firm fixed-effects, the identifying variation comes from firms that switch from an unbiased to an overconfident manager, and vice versa. Our dependent variable is market leverage, expressed as the ratio of long-term debt plus debt in current liabilities over the market value of assets, i.e., over market capitalization (price times common shares outstanding) plus the value of debt from the numerator. This estimation uses again the full sample.[34]

Table 5 reports the results. In column 1, we include only Longholder CEO, plus firm and year dummies.

[34] We lose 24 observations relative to the specification in Table 4 because either long-term debt or short-term debt is missing.

The sign of the coefficient estimate for CEO overconfidence is consistent with Malmendier et al. (2011): CEO overconfidence is associated with higher leverage. However, this effect is very small and insignificant in our sample, with a coefficient of 1.485 (t-statistic of 1.127). Even if the coefficient were significant, it would imply that switching from a non-overconfident to an overconfident CEO induces an increase in leverage by slightly more than 1 percentage point, relative to a sample mean of 14.57 (and a standard deviation of 15.36). 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 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, we estimate 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 3.678 (with a t-statistic of 2.815). When we consider both managerial biases jointly, in columns 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., 3.800 with a t-statistic of 2.904 in the specification with the full slate of controls (column 6). Among the managerial controls, CFO stock ownership is 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 financing deficit (in column 7) and lagged one-year returns (in column 8). Both variables have significant explanatory power for market leverage. The coefficient on Net Financing Deficit is positive, giving support to traditional pecking-order models of corporate financing (Shyam-Sunder and Myers (1999)). The coefficient on past returns is negative, likely capturing both market timing reasons (see, e.g., Welch (2004)) and a mechanical effect: past high returns lower market leverage simply because they increase the denominator. In all cases, our coefficient of interest is unaffected.

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 variation from firms that switch

to managers with different beliefs. The partial R-squared is lower but of the same order of magnitude as other common predictors of financial leverage, such as lagged one-year returns or tangibility (whose partial R-squared is about 1%).

We also explore the inclusion of additional lags of stock returns. In unreported tests, we find that the explanatory power of lagged stock returns declines as the time lag increases. The coefficient on Longholder CFO, instead, remains very stable. In all cases, having a CFO Longholder in a firm predicts a significantly higher market leverage ratio.[35] The latter finding helps address concerns about insider information as an alternative interpretation, i.e., the interpretation that Longholders are managers with positive inside information, who may be reluctant to issue equity and choose high leverage. As discussed in Section 3, this concern is unlikely to hold up since positive insider information should be transitory rather than persistent, and since we control for the amount of vested options held at the same point in time. The inclusion of lagged returns (and Q) further addresses this concern, as these controls are strong predictors of future returns. Nevertheless, the magnitude or significance of the Longholder coefficient is unaffected.

In summary, our analysis of leverage confirms the empirical relevance of our findings regarding Prediction 1: The influence of CFO overconfidence appears to be strong and persistent enough to translate into a measurable influence even on the overall leverage ratio.

5 Overconfidence and the Cost of Debt

5.1 Empirical Strategy

We now turn to our second, novel prediction that CEO overconfidence is associated with a lower cost of debt, as investors anticipate the continued commitment of an overconfident CEO to the investment project even in bad states of the world. To test this prediction, we merge our overconfidence measures with the

[35] The effect of overconfidence on market leverage is also significant in all specifications when using Otto (2014)'s measure (see Appendix-Table C.3). We find that a standard deviation increase in CFO overconfidence is associated with a 2.47% increase in leverage. Results are slightly weaker for book leverage (perhaps because it is a noisier measure of the desired capital structure) but still positive in all specifications and significant at the 5% or 10% level.

DealScan data. To match the finer time periods in DealScan, we re-construct our firm-level control variables using the Compustat quarterly database, following Valta (2012), among others. We measure the cost of debt financing as the spread between the interest rate paid by the firm and the LIBOR (in basis points). This variable is slightly right-skewed, and we employ the natural logarithm in our specifications. (Results are unaffected if we use the actual spread.) We relate this outcome variable to managerial overconfidence as follows:

$$\log(\text{Net Interest}_{i,t}) = \beta_1 \text{LTCEO}_{i,t} + \beta_2 \text{LTCFO}_{i,t} + X'_{i,t} B + \delta_t + \varepsilon_{i,t} \tag{8}$$

where $\text{LTCEO}_{i,t}$ and $\text{LTCFO}_{i,t}$ 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, and also includes industry fixed-effects. At the firm level, we include log(Assets) as larger firms might be perceived as less risky by lenders;[36] book leverage, given that highly indebted firms presumably face a higher cost of debt; cash holding scaled by total assets as an additional proxy for a firm's liquitidy; and the 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 assets over the past eight quarters. At the loan level, we include log(Maturity) (in months) and log(Loan Amount) (in millions of dollars). We do not have a prior on the signs of their coefficients. Loans with a shorter horizon and for a higher amount may, intuitively, be riskier, and so may be associated with higher spreads; however, in equilibrium, these may be 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 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. Finally, δ_t captures year-quarter fixed-effects.

[36] We use log(Assets) rather than log(Sales) as a proxy for size here for consistency with Valta (2012). Using our usual proxy, log(Sales), produces the same results.

5.2 Baseline Results

Table 6 shows the main results of estimating equation (8). In this analysis, our prediction pertains to the role of the CEO rather than the CFO since the actual implementation of an investment project, and its continuation under adverse circumstances, rely first and foremost on the effort and decision-making of the CEO. Column 1 shows the baseline version of the estimation, which includes only Longholder CEO, industry fixed effects, and year-quarter fixed effects as independent variables. We find that CEO overconfidence is associated with a lower cost of debt. The coefficient is -0.191 and highly significant (p-value < 0.01). The estimated effect is economically sizeable, amounting to about one fifth of a standard deviation of the outcome variable. Since our dependent variable is log-transformed, we can interpret the coefficient as indicating a percentage change in interest rates, i. e., a reduction of 19.1%, or 24.44 basis points relative to a sample mean of 127.97 basis points.

In column 2 we include the control variables mentioned above. Our coefficient of interest is slightly reduced (-0.158), but the statistical significance increases, with a t-statistic over 3. Among the other regressors, four firm-level control variables are significant: Leverage and maturity enter with a positive sign, and size and loan amount are associated with lower interest rates. Earnings volatility is associated with higher interest rates, albeit insignificantly. The same holds in all other estimations shown in Table 6. (Only the coefficient of log(Maturity) becomes insignificant when we include loan type dummies.) The managerial control variables for the CEO are insignificant or very small.

In columns 3 and 4 we turn to CFO overconfidence. We find some association between Longholder CFO and lower interest rates in the baseline estimation, and the coefficient becomes marginally significant in the specification with control variables. However, when we include our measures of CEO and CFO overconfidence jointly (in columns 5 and 6), the association with CFO overconfidence becomes insignificant while the coefficient of Longholder CEO is still large in magnitude and significant (-0.139, with a t-statistic of -2.532). Hence, it appears that the effect of optimistic beliefs on banks' willingness to finance a loan more cheaply does not extend to the CFO. The interpretation implicitly offered by the model is that the CFO is involved in financing choices but not in decisions and effort choices pertaining to the implementation

and continuation of the project.

This result persists even when we add loan-type fixed effects in column 7. The latter specification is very conservative and has to be interpreted with some caution: A CEO's beliefs may affect financing costs also via the type of loan that financial intermediaries are willing to grant, as some types of loans come with higher interest rates than others. Hence, the inclusion of controls for the type of loan may absorb some of the relation between overconfidence and the cost of debt. Moreover, the analysis within loan type is very demanding statistically, as our sample includes 18 different loan types.[37] Nevertheless, we estimate a similar effect. The coefficient on Longholder CEO is somewhat reduced (-0.091, corresponding roughly to a 10% reduction in interest rate spreads) and still marginally significant, with a p-value less than 0.10.

Overall, having an overconfident CEO run the firm appears to induce more favorable financing conditions. Longholder CFOs affect the type of financing but not the cost of financing.

5.3 Effect of Overconfidence in Different Subsamples

The possibly most interesting and distinctive prediction of our models is with regards to the types of firms that are able to obtain more favorable debt financing under an overconfident CEO: firms that experience intermediate ranges of return variability. That is, CEO overconfidence should matter most for loan pricing when the uncertainty about future cash flows of an investment project is large enough to reduce the incentives to 'work hard' on the implementation and continuation of the project in bad states of the world for rational CEOs, but not for overoptimistic CEOs. In such firms, overconfidence drives a wedge into managerial choices as overconfident CEOs continue to believe that they can generate a positive outcome when the intermediate signal is negative, and rational CEOs do not. If instead uncertainty is very small or very large, there are no such differences in CEO behavior – rational and overconfident CEOs will either both continue or both abandon their investment efforts upon negative intermediate news. Anticipating these choice, we do not

[37] Indeed, the R-squared from a regression that excludes Longholder CEO is already very high in this last specification (67.6%), which limits the additional variation that can be explained by our overconfidence proxy, which is 0.18%. The most common loan types are: revolving loans provided over more than one year (950 observations), 364-days facilities (263 observations), and generic term loans (124 observations).

predict differences in loan pricing between firms with and without overconfident CEOs in the latter cases.

To test the predicted non-monotonicity (in variability) of the effect of CEO overconfidence, we construct several empirical proxies for firms' return variability. A first natural proxy is earnings volatility, estimated from actual earnings realizations. As defined above, we use the ratio of the standard deviation of the past eight earnings changes to average book assets over the past eight quarters. This is a popular proxy for profit variability (at least) since Brealey, Hodges, and Capron (1976); recent uses include Valta (2012) and Matsa (2010). It is particularly suitable in our context, as it allows for earnings variability to vary over time and through a firm's life cycle. That is, since the measure uses the standard deviation of actual realizations of earnings in the eight quarters preceding the loan issue, it allows for a firm to experience different levels of volatility throughout its life cycle and as the managerial composition changes. At the same time, we find that the correlation of the volatility measure with its own lagged value at annual frequencies is about 78% in our data. Firms appear to experience similar volatility over time, driven by the type of projects pursued in their industry or firm. Hence, in practice, lagged values of volatility are strong predictors of future firm-level risk, making our measure of return variability a good proxy for a firm's risk from the lenders' perspective.

It is also worth clarifying why we measure the volatility of earnings, not the volatility of individual project returns for our empirical analysis. In our model, the firm's investment consists of one project, and the two types of volatility coincide. In practice, firms invest in more than one project, and the volatility of cash flows from any single project is unlikely to affect the cost of financing. For example, if a single project is very risky but the firm is fully solvent, lenders will not be concerned about managerial efforts and loan repayment, as they will be able to recover the full amount of the loan. It is the occurrence of firm-level shocks, as captured by the firm's earnings, that induces or exacerbates the agent's moral hazard problem and lenders' uncertainty about repayment. Hence, the volatility of overall earnings captures precisely the mechanism the model illustrates: Lenders price the risk that, following a negative shock, a CEO will have little incentive to carry through with a project.

In addition to employing earnings volatility, we use two measures that capture uncertainty as perceived by outside observers: (1) analyst coverage, measured as the number of analysts who made at least one

annual earnings forecast and are included in IBES (similarly to Hong, Lim, and Stein (2000)); and (2) the coefficient of variation of analysts' annual earnings forecasts, defined as the standard deviation of forecasts normalized by the absolute value of the mean forecast. As for the first, Whited and Wu (2006) show that low analyst coverage is associated with financial constraints, which in turn might indicate 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. One appealing feature of the coefficient of variation of earnings estimates, as a proxy for earnings variability, is that it is not related to past earnings but to expectations of future earnings, held by sophisticated market participants. For this last measure, we restrict our sample to firms that are covered by at least ten analysts (896 observations). Both of these additional measures capture the uncertainty a firm faces only indirectly as they rely on outsiders' (analysts') views, but provide useful robustness checks.

For each of our three proxies, we proceed as follows. First, we sort firms every year into a region of low, medium, or high variability. We then estimate equation (8) on each of the three resulting subsamples, separately for each of the three proxies. Our theoretical model does not pin down the thresholds between low, medium, and high variability, and we use tercile splits as a natural starting point. Terciles allow us to test for the predicted non-monotonicity while leaving sufficient statistical power in each subsample and producing estimates of comparable reliability across subgroups. However, we also check a wide range of different percentile cutoffs to test the robustness of our results, using percentile cutoffs of 35-30-35, 30-40-30, and 25-50-25.

The results are reported in Table 7. For brevity, we employ directly the empirical model with the full set of controls, mirroring column 7 of Table 6, and report only the coefficients of Longholder CEO and Longholder CFO. Thus, in all estimations, we continue to control for loan riskiness in multiple ways, as discussed above.

Starting from the earnings volatility proxy, in Panel A, we see that the coefficient on Longholder CEO is large and significant in the intermediate tercile, with a coefficient equal to -0.306 and a t-statistic equal to

3.279.[38] In terciles 1 and 3, instead, the coefficients on CEO overconfidence are small (-0.083 and -0.110) and insignificant. In terms of economic magnitude, the estimate in the medium terciles implies that a Longholder CEO is charged a spread that is about 30% lower than of an unbiased manager. Despite the small sample size, the differences between the low and medium sample and between the high and the medium sample are also statistically significant at the 5% and 10% confidence level, respectively, with χ^2-statistics 5.034 and 2.988 computed under the null hypothesis of equality of the Longholder CEO coefficients.

When using alternative sample splits, shown below the tercile splits in Panel A, we obtain qualitatively very similar results, with the Longholder CEO coefficient being highly statistically significant only in the medium variability subsample. We also replicate the result that the economic magnitude is always largest in the medium region (except in the 25-50-25 split, where the high-variability coefficient is slightly larger, albeit only marginally significant).

We also obtain similar results when we use the two alternative proxies for σ, analyst coverage and the coefficient of variation (CV) of earnings estimates. In the case of analyst coverage, shown in Panel B, the estimated effect of having an overconfident CEO on the cost of debt financing is large and significant (at least at the 10% level) only in the medium range for the tercile split and all other quantile splits. In the low analyst-coverage and the high analyst-coverage subsamples, instead, shown in columns 1 and 3 of Panel B, the Longholder CEO coefficients are always small and insignificant. The same holds for the estimated effect of CFO overconfidence. We note though that the differences in the estimated coefficients on CEO Longholder between subsamples are generally not significant at conventional levels.

The CV-based estimates, instead, shown in Panel C, are very precise under the tercile split. Here, the differences between the coefficient estimates across the bottom and medium subsamples and across the top and medium subsamples are different at the 5% and 1% significance levels (with corresponding χ^2 statistics of 4.142 and 9.747), respectively. Also under the alternative quantile splits, shown in the lower part of Panel C, the coefficient estimates in the medium range are always significant and typically largest in absolute value, though we note that the bottom range also features some negatively significant estimates, even for the CFO.

[38] In this subsample, the increase in the R-squared due to the inclusion of CEO overconfidence is 1.3% (74.5% versus 73.3%).

The latter inconsistency reflects that the distribution of the coefficient of variation is very right-skewed in our sample, with a median of 1.25% and a mean of 2.88%, so that the low and medium CV subsamples are relatively similar in terms of the sorting variable.

Overall, these results, as well as the estimates from a host of regressions using alternative definitions of "medium" uncertainty and corresponding alternative sample splits,[39] reveal that CEO overconfidence predicts a willingness of banks to finance at lower costs only over a medium range of uncertainty—exactly as predicted by the model. The reliability of our results in the medium range of uncertainty, and the lack thereof in the remaining subsamples, provide a strong corroboration of our theoretical interpretation.

The subsample results are central to the test of our model-based hypotheses in that they address concerns about unobserved covariates and alternative explanations more sharply. If an unobserved variable were to explain our findings, it ought to vary non-monotonically with earnings volatility in order to rationalize the findings on loan pricing. In addition, such an alternative interpretation of the Longholder coefficients would also need to offer an explanation for why the CEO proxy and not the CFO proxy is significant here, while the CFO proxy is significant for the financing choices analyzed above. This variation is predicted by the model but hard to attribute to an unobserved variable being correlated with the Longholder proxy. Both restrictions taken together, non-monotonicity and variation in which Longholder proxy matters, seem unlikely to be met by a hypothetical unobserved variable.

6 CFO Hiring Decisions

As the final step in our empirical analysis, we provide evidence on the third prediction, namely, that overconfident CEOs are more likely to hire similarly optimistic CFOs. We perform the analysis with the

[39] In addition to the quantile splits shown in Table 7, we explored further variations by increasing and decreasing the top and bottom ranges in 5%-steps and reestimating the model. Appendix-Table C.5, Panel B, shows the result for our main proxy, earnings volatility. Our results are very stable. We find the same pattern of non-monotonicity. CEO overconfidence is significant at the 5% level and large only in the intermediate tercile, with a coefficient of -5.287 and a t-statistic of -2.423. We do not observe similar patterns for CFO overconfidence and when using the other, more indirect, proxies for earnings volatility (omitted for brevity). In addition, we replicate the results using the continuous overconfidence proxy of Otto (2014). As shown in Panel A of Appendix-Table C.5, the baseline CEO Longholder coefficients for the overall sample are less strong under the continuous measure, and significant only in the specification of column 2.

understanding that the CEO does not select other top executives single-handedly, though she is able to influence the board toward the selection of a CFO who will not systematically contradict her views (Landier et al. (2013)), and can strongly affect 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 25.3%, significant at the 1% level. However, as the CFO may have been appointed before the CEO, the correlation might reflect firm effects or other factors outside the CEO's managerial choice. Thus, our main analysis focuses on CFOs appointed after a given CEO, and we test whether a CFO is more or less likely to be overconfident depending on the CEO's bias.

We identify all cases in which a firm in our data 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 the end of year $t-1$. The analysis requires the following variables to be available: (i) the time t Longholder CFO proxy; (ii) the time $t-1$ Longholder CEO proxy; (iii) all relevant control variables at time $t-1$. These filters leave us with 202 observations. We estimate the following logit model:

$$\Pr(\text{LTCFO}_{i,t} = 1 | \text{LTCEO}_{i,t-1}, X_{i,t-1}, \delta_t) = G(\beta\, \text{LTCEO}_{i,t-1} + X'_{i,t-1}B + \delta_t + \varepsilon_{i,t}) \tag{9}$$

where $\text{LTCFO}_{i,t}$ and $\text{LTCEO}_{i,t-1}$ are our overconfident proxies for the CFO and the 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 8. 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 sort into specific industries. For instance, Hirshleifer et al. (2012) find that overconfident CEOs are more common in innovative industries.[40] Column 3 adds our usual set of managerial controls, and column 4 also includes firm-level variables. Among the control variables, only CEO Vested Options are significant and predict a lower probability of selecting an overconfident CFO. The inclusion of

[40] We include dummies for the Fama and French (1997) 12 industries classification rather than two-digit SIC Code industry dummies (as in the other tables) because of the small number of observations. However, using the more detailed industry classification has no effect on our results.

this variable does not diminish the coefficient on Longholder CEO, though, but increases its size.

All four empirical models consistently show that overconfident CEOs are more likely to appoint 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), the estimates imply that an overconfident CEO is over seven times more likely to hire an overconfident CFO relative to a rational CEO. Not surprisingly, given the magnitude of this estimate, the incremental explanatory power of Longholder CEO is also large, with a Pseudo R-squared of 22.1%, relative to 15.1% when the overconfidence proxy is dropped.

Our results indicate that, above and beyond the direct influence of CEOs' biased beliefs on corporate outcomes, they exert an indirect influence via assortative matching. These results relate to the finding of Landier et al. (2013) that firms who appoint a large fraction of executives to board after the appointment of the CEO tend to underperform their rivals. Our model does not allow us though to explore the link between firm value and (dis-)agreement among top managers as we do not allow for varying project quality. Whether the relation between firm performance and board structure can be linked to CEO's characteristics might be an interesting question for future research.

7 Conclusion

A key question in the analysis of managerial biases and the assessment of their empirical relevance is how to account for the beliefs and choices of other managers with whom a biased manager interacts. Prior research has mostly focused on one type of manager, typically the CEO,thereby running the risk of misattribution. For example,the estimated impact of CEO overconfidence on financing choices might reflect, at least partly, the influence of overconfident CFOs, who might assortatively match with overconfident CEOs.

In this paper, we have taken a first step towards advancing this line of research. We have considered the beliefs of two key managers, the CEO and the CFO, jointly, in the context of financing decisions. We find that CFOs' behavioral traits have significant predictive power in explaining capital-structure decisions while CEOs' behavioral traits play a significant role in predicting the cost of debt. Specifically, while firms with

overconfident CFOs are more likely to issue debt when accessing external capital, CFOs are not relevant for loan interest rates. Instead, the cost of debt financing varies significantly by the type of CEO who runs the firm. Overconfident CEOs are able to obtain cheaper debt financing than their rational peers. Finally, overconfident CEOs are more likely to appoint overconfident managers as CFOs. We provide a unifying theoretical framework that can parsimoniously accommodate these results.

Our findings corroborate previous findings on the significant role of managerial biases in corporate decisions, and point to the importance of extending the analysis beyond the person of the CEO. As such, our results help to address concerns about possible confounds of the Longholder overconfidence proxy in prior research. We find that CEO overconfidence influences those corporate outcomes that are determined by CEOs, while CFO overconfidence does not. Similarly, CFO overconfidence affects outcomes that fall in the realm of the CFO and, here, CEO overconfidence does not matter. Given these results, it is unlikely that the "Longholder" construct captures other unobserved factors that are correlated with late option exercise.

We would like to emphasize that our results do not question the validity of previous work on overconfidence that exclusively focused on CEOs. In our more recent data we estimate a weak influence of CEO traits on financing decisions even when CEO's overconfidence is considered in isolation. This trend might reflect that, as noted by practitioners, CFOs' importance has increased sharply over the past decade.[41]

Furthering this research, it will also be interesting to explore the traits of other (C-suite) managers such as CTOs or COOs and their influence on corporate decisions. Can we test whether their beliefs, biases, and personal characteristics are associated with other firm outcomes related to their duties, and not associated with outcomes that do not fall into their decision-making realm? Such an analysis will require a more comprehensive data set than the one employed here, and will be feasible as more detailed data on board members' characteristics become available.

Our findings also suggest that the economic implications of managerial characteristics are richer than

[41] For example, according to a 2014 survey of finance executives run by Accenture PLC, over 70% of the respondents believed that "the CFO's influence over executing business transformation initiatives has grown." (See the report at `https://www.accenture.com/t20150523T035018Z__w__/us-en/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Dualpub3/Accenture-2014-High-Performance-Finance-Study-CFO-Architect-Business-Value.PDF#zoom=50`.)

demonstrated in previous research, pointing to their influence on effort choices and on hiring decisions. Future research on interaction and peer effects among managers that accounts for biased belief formation thus appears to be another promising avenue. Finally, while our last set of estimations points to a significant role of CEO biases in the hiring of other managers, our findings do not rule out a significant influence of boards on the choice of managers. As such, it might be interesting to explore how managerial traits and biases of candidates affect how boards make hiring decisions.

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8 Figures and Tables

Figure 1
Timeline of the Model

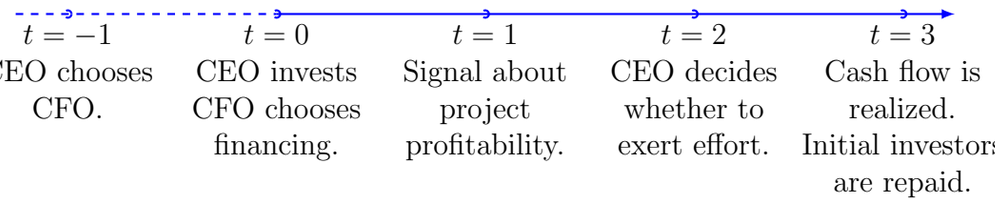

Table 1
Data Construction

	CEOs	**CFOs**
Executives in ExecuComp	8,054 executives	7,402 executives
...matched with Thomson	3,372 executives	2,908 executives
Executives with at least 10 transactions	1,623 executives	1,246 executives
...corresponding to...	13,898 firm-years	9,374 firm-years
Compustat sample with non-missing CEO/CFO Longholder	5,810 firm-years	
Final sample (excluding financial, utilities and firms with missing controls)	4,581 firm-years	

Table 2
Summary Statistics
Panel A. Firm Variables

	Debt Issues - Compustat (Table 3)			
Variable	Obs.	Mean	Median	St. Dev.
Net Debt Issue Indicator	2,939	0.507	1	0.500
Q	2,939	2.396	1.816	2.121
Profitability	2,939	0.178	0.172	0.150
Tangibility	2,939	0.323	0.217	0.304
log(Sales)	2,939	7.166	7.102	1.622
Book Leverage	2,939	0.311	0.282	0.447
	Financing Deficit and Leverage (Tables 4 and 5)			
Assets ($m)	4,581	5,792	1,643	14,465
Sales ($m)	4,581	5,706	1,536	17,359
Capitalization ($m)	4,581	8,311	2,264	20,864
Net Financing Deficit ($m)	4,581	-254	-16	2,170
Net Fin. Def. / Assets	4,581	-0.030	-0.018	0.366
Net Debt Issues / Assets	4,581	0.027	0	0.159
Book Leverage	4,557	0.289	0.257	0.432
Q	4,581	2.416	1.874	1.960
Change in Q	4,581	-0.034	0.030	1.628
Profitability	4,581	0.185	0.174	0.140
Change in Profitability	4,581	-0.002	0.002	0.097
Tangibility	4,581	0.296	0.198	0.286
Change in Tangibility	4,581	-0.007	-0.003	0.144
log(Sales)	4,581	7.278	7.228	1.578
Change in log(Sales)	4,581	0.108	0.097	0.221
Market Leverage	4,557	14.570	10.559	15.364
	Cost of Debt Financing (Tables 6 and 7)			
Interest Spread [bp]	1,651	127.970	100	102.497
Loan Maturity [months]	1,651	46.409	60	21.778
Loan Amount [$m]	1,651	590.82	300	1,080.37
log(Assets)	1,651	7.951	7.841	1.377
Book Leverage	1,651	0.234	0.23	0.15
z-Score	1,651	3.585	2.452	4.475
Earnings Volatility	1,651	0.018	0.008	0.072
Cash Holding	1,651	0.122	0.062	0.191
Analyst Coverage	1,651	12.009	10	7.600
Coeff. Var. of Earn. Est.	896	0.029	0.013	0.064

Continued on next page

Table 2 – *Continued*

Panel B. Manager Variables

	Debt Issues - Compustat (Table 3)			
Variable	Obs.	Mean	Median	St. Dev.
CEO Longholder	2,939	0.682	1	0.466
CEO Stock Ownership [%]	2,939	1.882	0.341	0.467
CEO Vested Options [%]	2,939	1.037	0.649	2.068
CFO Longholder	2,939	0.529	1	0.499
CFO Stock Ownership [%]	2,939	0.121	0.041	0.319
CFO Vested Options [%]	2,939	0.260	0.129	0.772
	Financing Deficit and Leverage (Tables 4 and 5)			
CEO Longholder	4,581	0.683	1	0.466
CEO Stock Ownership [%]	4,581	1.806	0.305	4.839
CEO Vested Options [%]	4,581	1.032	0.665	1.835
CFO Longholder	4,581	0.530	1	0.499
CFO Stock Ownership [%]	4,581	0.120	0.041	0.302
CFO Vested Options [%]	4,581	0.249	0.128	0.644
	Cost of Debt Financing (Tables 6 and 7)			
CEO Longholder	1,651	0.665	1	0.472
CEO Stock Ownership [%]	1,651	1.318	0.283	3.876
CEO Vested Options [%]	1,651	0.869	0.587	1.097
CFO Longholder	1,651	0.543	1	0.498
CFO Stock Ownership [%]	1,651	0.114	0.040	0.349
CFO Vested Options [%]	1,651	0.214	0.113	0.489

Table 3
Debt Issues (Compustat)

Table 3 shows the estimated log odds ratios from logistic 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 issuance 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 by 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. Standard errors are clustered by firm, and corresponding t-statistics are shown in parentheses. ***, **, 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	0.111	-0.007			0.012	0.020	-0.126
	(0.944)	(-0.058)			(0.096)	(0.170)	(-1.086)
Longholder CFO			0.354***	0.392***	0.352***	0.412***	0.437***
			(3.182)	(3.430)	(3.062)	(3.510)	(3.725)
CEO Shares		-0.008				-0.028*	-0.009
		(-0.568)				(-1.735)	(-0.659)
CEO Vested		-0.005				-0.007	0.037
Options		(-0.144)				(-0.084)	(1.131)
Q		-0.058		-0.059			-0.060
		(-1.486)		(-1.395)			(-1.423)
Profitability		0.731		0.706			0.706
		(1.213)		(1.184)			(1.179)
Tangibility		0.274		0.296			0.324
		(0.949)		(1.021)			(1.103)
log(Sales)		0.478***		0.475***			0.477***
		(9.757)		(9.873)			(9.856)
Book Leverage		0.096		0.100			0.093
		(0.687)		(0.709)			(0.677)
CFO Shares				-0.085		-0.182	-0.078
				(-0.621)		(-1.055)	(-0.582)
CFO Vested				-0.120		-0.577**	-0.193**
Options				(-1.451)		(-2.486)	(-2.237)
Manager Ctrl.	NO	YES	NO	YES	NO	YES	YES
Firm Controls	NO	YES	NO	YES	NO	NO	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	NO	YES	NO	YES	YES
Observations	2,939	2,939	2,939	2,939	2,939	2,939	2,939
Pseudo R-squared	0.042	0.163	0.047	0.169	0.047	0.107	0.170

Table 4
Financing Deficit

Table 4 presents the estimates of 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 issuance minus long-term debt reduction. Longholder CEO (LTCEO) and Longholder CFO (LTCFO) are binary variables where 1 signifies that the CEO or CFO, at some point during their 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 the Net Financing Deficit, which is defined as 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 or CFO as a percentage of common shares outstanding. Vested Options is the number of exercisable options held by the CEO or 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) also include the interaction of Net Financing Deficit with the control variables including year dummies, so the standalone variable is redundant and its coefficient omitted from the table. Standard errors are clustered by firm, and corresponding t-statistics are shown in parentheses. ***, **, 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 × LTCEO	0.024	0.054	0.164**				-0.024	0.011	0.104*
	(0.207)	(0.545)	(2.112)				(-0.244)	(0.129)	(1.781)
FD × LTCFO				0.243**	0.210*	0.179***	0.247**	0.208**	0.166***
				(2.151)	(2.026)	(2.981)	(2.269)	(2.110)	(2.958)
FD	0.203**	0.158**		0.106***	0.099***		0.118*	0.094*	
	(2.317)	(2.498)		(2.828)	(2.803)		(1.837)	(1.716)	
LTCEO	-0.003	-0.001	0.003				-0.005	-0.001	0.003
	(-0.295)	(-0.083)	(0.274)				(-0.488)	(-0.141)	(0.313)
LTCFO				0.012	0.010	-0.003	0.013	0.008	-0.008
				(0.850)	(0.704)	(-0.259)	(0.908)	(-0.568)	(-0.616)
Manager Contr.	NO	YES	YES	NO	YES	YES	NO	YES	YES
Firm Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
FD x Controls	NO	NO	YES	NO	NO	YES	NO	NO	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	YES	NO	YES	YES	NO	YES	YES
Observations	4,581	4,581	4,581	4,581	4,581	4,581	4,581	4,581	4,581
R-squared	0.208	0.294	0.447	0.272	0.337	0.482	0.273	0.338	0.490

Table 5
Leverage

Table 5 presents the estimates of 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. Longholder CEO (LTCEO) and Longholder CFO (LTCFO) are binary variables where 1 signifies that the CEO or CFO, at some point during their 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 or CFO as a percentage of common shares outstanding. Vested Options is the number of exercisable options held by the CEO or 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 (FD) which is cash dividends plus investment plus change in working capital minus cash flow after interest and taxes, normalized by lagged assets. Returns_{t-1} are lagged one year returns. All the regressions include year and firm fixed-effects. Standard errors are clustered by firm, and corresponding t-statistics are shown in parentheses. ***, ** and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LTCEO	1.485	0.890			1.063	0.483	0.444	0.382
	(1.127)	(0.690)			(0.794)	(0.371)	(0.344)	(0.298)
LTCFO			4.151***	3.678**	4.044***	3.800***	3.681***	3.730***
			(3.045)	(2.815)	(2.972)	(2.904)	(2.831)	(2.874)
CEO Shares		0.062				0.107*	0.102*	0.107*
		(0.908)				(1.798)	(1.686)	(1.776)
CEO Vested		0.140				0.125	0.115	0.114
Options		(1.376)				(1.150)	(1.055)	(1.020)
CFO Shares				-0.482		-0.795	-0.758	-0.697
				(-1.132)		(-1.438)	(-1.396)	(-1.318)
CFO Vested				-0.330*		0.208	0.213	0.208
Options				(1.800)		(1.096)	(1.132)	(1.127)
Q		-0.676***		-0.658***		-0.654***	-0.758***	-0.633***
		(-4.260)		(-4.209)		(-4.205)	(-4.422)	(-3.859)
Profitability		-15.100***		-15.245***		-145.206***	-14.660***	-14.111***
		(-5.542)		(-5.627)		(-5.601)	(-5.361)	(-5.053)
Tangibility		6.825***		6.894***		6.901***	6.759***	6.737***
		(4.688)		(4.757)		(4.769)	(4.531)	(4.446)
log(Sales)		3.049***		3.009***		3.066***	3.282***	3.096***
		(4.117)		(4.085)		(4.143)	(4.333)	(4.087)
FD							2.906***	2.967***
							(4.253)	(4.343)
Returns_{t-1}								-0.918***
								(-4.446)
Manager Controls	NO	YES	NO	YES	NO	YES	YES	YES
Firm Controls	NO	YES	NO	YES	NO	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	4,557	4,557	4,557	4,557	4,557	4,557	4,557	4,557
R-squared	0.089	0.142	0.094	0.147	0.095	0.148	0.161	0.169

Table 6
Cost of Debt Financing

Table 6 presents regressions of log(Interest Spread) on our overconfidence measures and several control variables, including year-quarter and industry fixed-effects. Log(Interest Spread) is the difference between the interest rate of the loan in basis points and the London Interbank Offered Rate. Longholder CEO (LTCEO) and Longholder CFO (LTCFO) are binary variables where 1 signifies that the CEO or CFO, at some point during their 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 or CFO as a percentage of common shares outstanding. Vested Options is the number of exercisable options held by the CEO or CFO as a percentage of common shares outstanding. Book Leverage is (long-term debt + debt in current liabilities) / (long-term + debt in current liabilities + common equity). Z-Score is 1.2 × (current assets - current liabilities) + 1.4 × retained earnings + 3.3 × pretax income + 0.6 × market capitalization / total liabilities xtotal assets + 0.9 × sales, all scaled by total assets. Cash holding is cash and short-term investments divided by total assets. Earnings Volatility is the standard deviation of the past eight earnings changes to the average book asset size over the past eight quarters. Control variables are all measured at the beginning of the year. Standard errors are clustered by firm, and corresponding t-statistics are shown in parentheses. ***, **, and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Longholder	-0.191***	-0.158***			-0.187**	-0.139**	-0.091*
CEO	(-2.652)	(-3.143)			(-2.498)	(-2.532)	(-1.890)
Longholder			-0.071	-0.103*	-0.012	-0.059	-0.066
CFO			(-0.937)	(-1.965)	(-0.153)	(-1.056)	(-1.350)
log(Assets)		-0.197***		-0.202***		-0.197***	-0.195***
		(-7.121)		(-7.278)		(-7.139)	(-7.642)
Leverage		0.974***		0.978***		0.947***	0.719***
		(4.594)		(4.668)		(4.602)	(3.953)
Z-Score		-0.013*		-0.014**		-0.013*	-0.015**
		(-1.807)		(-2.050)		(-1.915)	(-2.405)
log(Amount)		-0.111***		-0.111***		-0.111***	-0.102***
		(-4.369)		(-4.426)		(-4.415)	(-4.075)
log(Maturity)		0.190***		0.195***		0.190***	0.072
		(5.877)		(5.932)		(5.881)	(1.403)
Earnings Volatility		0.327		0.321		0.324	0.352
		(1.320)		(1.252)		(1.326)	(1.495)
Cash Holding		0.235		0.212		0.234	0.205
		(1.158)		(1.045)		(1.156)	(1.179)
CEO Shares		0.005				0.005	0.004
		(0.871)				(0.778)	(0.743)
CEO Vested		0.034				0.019	0.017
Options		(1.606)				(0.744)	(0.727)
CFO Shares				0.037		0.039	0.042
				(1.136)		(1.145)	(1.409)
CFO Vested				0.075		0.051	0.040
Options				(1.321)		(0.813)	(0.813)
Manag. Controls	NO	YES	NO	YES	NO	YES	YES
Firm Controls	NO	YES	NO	YES	NO	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year-Quarter FE	YES	YES	YES	YES	YES	YES	YES
Loan Type FE	NO	NO	NO	NO	NO	NO	YES
Observations	1,651	1,651	1,651	1,651	1,651	1,651	1,651
R-squared	0.419	0.617	0.412	0.614	0.420	0.619	0.673

Table 7

Net Interest Rates Across Subsamples (Different Cutoffs)

Panels A, B and C test the relation between CEO overconfidence and the cost of debt across different subsamples, using different cutoffs for low, medium, and high variability in each sorting variable (Earnings Volatility in Panel A, Analysts Coverage in Panel B, and Coefficient of Variation of Earnings Forecasts in Panel C). All panels show regressions of log(Interest Rate Spread) on our measures of overconfidence and the same control variables and fixed effects as in Column 7 of Table 6. We estimate the empirical model specified in equation 8 in the main text in each subsample. ***, ** and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

Panel A. Sorting by by Earnings Volatility

	(1)	(2)	(3)
	Bottom Tercile	Medium Tercile	Top Tercile
Longholder CEO	-0.083	-0.306***	-0.110
	(-1.348)	(-3.279)	(-1.355)
Longholder CFO	-0.087	0.028	-0.024
	(-1.322)	(0.340)	(-0.317)
Observations	549	549	553
R-squared	0.800	0.745	0.759
	Bottom 35%	Medium 30%	Top 35%
Longholder CEO	-0.094	-0.324***	-0.103
	(-1.568)	(-3.409)	(-1.228)
Longholder CFO	-0.077	0.005	-0.015
	(-1.239)	(0.067)	(-0.194)
Observations	580	496	575
R-squared	0.797	0.763	0.750
	Bottom 30%	Medium 40%	Top 30%
Longholder CEO	-0.075	-0.233***	-0.115
	(-1.158)	(-3.154)	(-1.306)
Longholder CFO	-0.104	0.000	0.006
	(-1.532)	(0.001)	(0.077)
Observations	495	658	498
R-squared	0.810	0.711	0.768
	Bottom 25%	Medium 50%	Top 25%
Longholder CEO	-0.062	-0.174***	-0.178*
	(-0.772)	(-2.678)	(-1.735)
Longholder CFO	-0.068	-0.005	-0.005
	(-0.801)	(-0.080)	(-0.060)
Observations	417	823	411
R-squared	0.833	0.692	0.787

Continued on next page

Table 7 – *Continued*

Panel B. Sorting by Analysts' Coverage

	(1)	(2)	(3)
	Bottom Tercile	Medium Tercile	Top Tercile
Longholder CEO	-0.086	-0.153*	-0.005
	(-1.339)	(-1.712)	(-0.055)
Longholder CFO	-0.043	-0.050	-0.079
	(-0.632)	(-0.578)	(-1.019)
Observations	549	554	548
R-squared	0.694	0.724	0.767
	Bottom 35%	Medium 30%	Top 35%
Longholder CEO	-0.085	-0.177*	-0.010
	(-1.331)	(-1.940)	(-0.107)
Longholder CFO	-0.041	-0.049	-0.082
	(-0.608)	(-0.569)	(-1.059)
Observations	583	495	573
R-squared	0.696	0.729	0.768
	Bottom 30%	Medium 40%	Top 30%
Longholder CEO	-0.090	-0.157**	-0.008
	(-1.256)	(-2.159)	(-0.078)
Longholder CFO	-0.032	-0.053	-0.064
	(-0.451)	(-0.679)	(-0.775)
Observations	500	653	498
R-squared	0.730	0.728	0.772
	Bottom 25%	Medium 50%	Top 25%
Longholder CEO	-0.098	-0.160**	0.026
	(-1.257)	(-2.512)	(0.222)
Longholder CFO	-0.079	-0.058	-0.035
	(-1.033)	(-0.815)	(-0.374)
R-squared	429	818	404
Observations	0.773	0.688	0.779

Continued on next page

Table 7 – *Continued*

Panel C. Sorting by Coefficient of Variation of Earnings Estimates

	(1)	(2)	(3)
	Bottom Tercile	Medium Tercile	Top Tercile
Longholder CEO	-0.148	-0.321**	0.096
	(-1.588)	(-2.545)	(0.612)
Longholder CFO	-0.250**	-0.065	-0.158
	(-2.461)	(-0.606)	(-0.960)
Observations	293	296	307
R-squared	0.883	0.834	0.775
	Bottom 35%	Medium 30%	Top 35%
Longholder CEO	-0.179**	-0.310**	0.081
	(-1.980)	(-2.264)	(-0.552)
Longholder CFO	-0.228**	-0.098	-0.131
	(-2.292)	(-0.858)	(-0.859)
Observations	313	270	313
R-squared	0.870	0.851	0.766
	Bottom 30%	Medium 40%	Top 30%
Longholder CEO	-0.185*	-0.199*	0.047
	(-1.936)	(-1.819)	(-0.350)
Longholder CFO	-0.255**	-0.006	-0.143
	(-2.569)	(-0.057)	(-0.004)
Observations	269	357	270
R-squared	0.895	0.815	0.818
	Bottom 25%	Medium 50%	Top 25%
Longholder CEO	-0.258**	-0.199**	-0.004
	(-2.420)	(-2.003)	(-0.029)
Longholder CFO	-0.284***	-0.035	-0.194
	(-3.073)	(-0.385)	(-1.203)
Observations	231	440	225
R-squared	0.909	0.793	0.839

Table 8
CFO Hiring

Table 8 shows 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 and year and the following variables are not missing: (i) the overconfidence proxy for the new CFO at time; (ii) the overconfidence proxy for the incumbent CEO at time; (iii) manager and firm control variables at time. 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, QQ, 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	1.124***	1.436***	2.031***	2.010***
	(2.791)	(3.247)	(4.413)	(4.309)
CEO Vested Options			-0.780***	-0.792***
			(-3.404)	(-2.980)
CEO Shares			-0.027	-0.024
			(-0.765)	(-0.658)
Q				-0.071
				(-0.454)
Profitability				1.705
				(0.890)
Tangibility				1.484*
				(1.764)
Log(Sale)				-0.023
				(-0.161)
Book Leverage				0.064
				(0.177)
Manager Controls	NO	NO	YES	YES
Firm Controls	NO	NO	NO	YES
Industry FE	NO	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	202	202	202	202
Pseudo R-squared	0.085	0.143	0.205	0.221

Appendix

This Appendix consists of three parts. Appendix A provides the proofs referenced in Section 2 of the paper. Appendix B lists detailed definitions of the variables in our empirical analysis. Appendix C provides summary statistics for specific subsamples of the data, as well as numerous robustness checks.

A Proofs

We prove Propositions 1, 2, and 3 of the paper in subsections A.1, A.3, and A.4, respectively. In subsection A.2, we define the optimal equity contract, which is a necessary step to prove Propositions 2 and 3. In subsection A.5, we discuss the robustness of our theoretical results to different parametric assumptions.

A.1 Optimal Debt Contract

Proof of Proposition 1. We show that the face value of debt offered to overconfident and rational CEOs is identical for the case of low variability, with $D^*_{\hat{\omega}} = I$; that it is lower for overconfident CEOs than rational CEOs for the case of intermediate variability, with $D^*_{\omega} = I$ and $D^*_0 = I + \sigma$, respectively; and that it is again identical for the case of high variability, with $D^*_{\hat{\omega}} = I + \sigma$. The ranges of return variability σ are $\sigma \leq \Delta - B/\alpha$ for low return variability; $\Delta - B/\alpha + \omega \geq \sigma > \Delta - B/\alpha$ for intermediate return variability; and $\sigma > \Delta - B/\alpha + \omega$ for high return variability.

First, we show jointly that $D^*_{\hat{\omega}} = I$ for the case of low variability ($\sigma \leq \Delta - B/\alpha$) and also, when the CEO is overconfident, for the case of intermediate variability ($\Delta - B/\alpha + \omega \geq \sigma > \Delta - B/\alpha$). We can summarize the full range of both cases as $\sigma \leq \Delta - B/\alpha + \hat{\omega}_{CEO}$.

We start by showing that the CEO's IC constraint (4b) is satisfied in both states of the world. In the good state, the CEO exerts effort iff

$$\begin{aligned} \alpha \cdot \max\{0, I + \sigma + \Delta + \hat{\omega}_{CEO} - I\} &\geq \alpha \cdot \max\{0, I + \sigma - I\} + B \\ \iff \max\{0, \sigma + \Delta + \hat{\omega}_{CEO}\} &\geq \max\{0, \sigma\} + B/\alpha \\ \iff \sigma + \Delta + \hat{\omega}_{CEO} &\geq \sigma + B/\alpha \\ \iff \Delta + \hat{\omega}_{CEO} &\geq B/\alpha, \end{aligned} \tag{A.1}$$

which holds given our model assumption $\Delta > B/\alpha$. In the bad state, the CEO exerts effort iff

$$\begin{aligned} \alpha \cdot \max\{0, I - \sigma + \Delta + \hat{\omega}_{CEO} - I\} &\geq \alpha \cdot \max\{0, I - \sigma - I\} + B \\ \iff \max\{0, -\sigma + \Delta + \hat{\omega}_{CEO}\} &\geq \max\{0, -\sigma\} + B/\alpha \\ \iff -\sigma + \Delta + \hat{\omega}_{CEO} &\geq B/\alpha \\ \iff \Delta - B/\alpha + \hat{\omega}_{CEO} &\geq \sigma, \end{aligned} \tag{A.2}$$

which is exactly the parameter range we are considering. Thus, the CEO exerts effort in both states.

We can now plug these effort choices into the participation constraint (4c), and obtain

$$\frac{1}{2}(\min\{I, I + \sigma + \Delta\} + \min\{I, I - \sigma + \Delta\}) = I, \tag{A.3}$$

i.e., the participation constraint holds with equality since $\sigma \leq \Delta - B/\alpha + \hat{\omega}_{CEO}$ and, per model assumption, $B/\alpha \geq \omega$, and thus $\sigma < \Delta$. Hence, under $D^*_{\hat{\omega}} = I$, all surplus goes to existing shareholders, which in turn implies that the (perceived) firm value is maximized under this contract. The expected utility of a rational CFO is $\beta\Delta$, whereas the overconfident CFO expects to get $\beta(\Delta + \omega)$.

To prove uniqueness, consider any other contract with face value $\tilde{D} \gtrless I$. We can rule out $\tilde{D} < I$, as it does not satisfy the participation constraint. For $\tilde{D} > I$, there are two cases to consider: either the CEO exerts effort in both states of the world, or she does not. If she does, the surplus is the same as under $D^*_{\hat{\omega}} = I$ and debtholders extract positive rents. Hence this type of contract cannot be optimal for the CFO. If she does not, the resulting welfare loss implies that the rents that the CFO can extract (under debtholders' break-even constraint) will not be maximized. Hence, $D^*_{\hat{\omega}} = I$ is optimal when $\sigma \leq \Delta - B/\alpha + \hat{\omega}_{CEO}$.

Second, we show that $D^*_{\hat{\omega}} = I + \sigma$ for the case of high variability ($\sigma > \Delta - B/\alpha + \omega$) and, when the CEO is rational, also for the case of intermediate variability ($\Delta - B/\alpha + \omega \geq \sigma > \Delta - B/\alpha$). We can summarize these two cases as $\sigma > \Delta - B/\alpha + \hat{\omega}_{CEO}$.

We start again from the IC constraint (4b) and show that, under $D^*_{\hat{\omega}} = I + \sigma$, the CEO exerts effort in the good state and shirks in the bad state. In the good state, the CEO exerts effort iff

$$\begin{aligned} \alpha \cdot \max\{0, I + \sigma + \Delta + \hat{\omega}_{CEO} - I - \sigma\} &\geq \alpha \cdot \max\{0, I + \sigma - I - \sigma\} + B \\ \iff \max\{0, \Delta + \hat{\omega}_{CEO}\} &\geq \max\{0, 0\} + B/\alpha \\ \iff \Delta + \hat{\omega}_{CEO} &\geq B/\alpha, \end{aligned} \tag{A.4}$$

which is implied by our initial assumption $\Delta > B/\alpha$. In the bad state, the CEO shirks iff

$$\begin{aligned} \alpha \cdot \max\{0, I - \sigma + \Delta + \hat{\omega}_{CEO} - I - \sigma\} &< \alpha \cdot \max\{0, I - \sigma - I - \sigma\} + B \\ \iff \max\{0, -2\sigma + \Delta + \hat{\omega}_{CEO}\} &< \max\{0, -2\sigma\} + B/\alpha \\ \iff \max\{0, -2\sigma + \Delta + \hat{\omega}_{CEO}\} &< B/\alpha. \end{aligned} \tag{A.5}$$

This is satisfied both if $-2\sigma + \Delta + \hat{\omega}_{CEO} \leq 0$ since $0 < B/\alpha$; and if $-2\sigma + \Delta + \hat{\omega}_{CEO} > 0$ since, over the parameter range $\sigma > \Delta - B/\alpha + \hat{\omega}_{CEO}$, it must also hold that $2\sigma > \Delta - B/\alpha + \hat{\omega}_{CEO}$, and hence $-2\sigma + \Delta + \hat{\omega}_{CEO} < B/\alpha$. Therefore, under $D^*_{\hat{\omega}} = I + \sigma$, the CEO exerts effort in the good state of the world and shirks in the bad state of the world.

Turning to the participation constraint (4c) and plugging in these effort choices, we can now show that the participation constraint holds with equality:

$$\frac{1}{2}(\min\{I + \sigma, I + \sigma + \Delta\} + \min\{I + \sigma, I - \sigma\}) = I. \tag{A.6}$$

Again, debtholders receive I in expectation, and all surplus goes to existing shareholders. In this case, a rational CFO's expected utility is $\beta\Delta/2$, and an overconfident CFO expects to get $\beta(\Delta + \omega)/2$.

To see that this is an optimal contract, and that it is the unique optimal contract, consider an alternative contract $\tilde{D} \neq D^*_{\hat{\omega}}$. We can again rule out $\tilde{D} < I$ since debtholders would not break even. For $\tilde{D} \geq I$, we first ask in which state of the world the CEO would exert effort under such a contract. In the bad state of the world, the CEO exerts effort under contract $\tilde{D}$ iff

$$\alpha \cdot \max\left\{0, I - \sigma + \Delta + \hat{\omega}_{CEO} - \tilde{D}\right\} \geq \alpha \cdot \max\left\{0, I - \sigma - \tilde{D}\right\} + B. \tag{A.7}$$

With $\tilde{D} \geq I$, the IC becomes

$$\alpha \cdot \max\left\{0, I - \sigma + \Delta + \hat{\omega}_{CEO} - \tilde{D}\right\} \geq B, \tag{A.8}$$

which holds only if $I - \tilde{D} \geq \sigma - (\Delta + \hat{\omega}_{CEO} - B/\alpha)$. However, as we are analyzing the parameter space of $\sigma - (\Delta + \hat{\omega}_{CEO} - B/\alpha) > 0$, this implies $I - \tilde{D} > 0$, contradicting that $\tilde{D} \geq I$. Hence, the CEO shirks in the bad state of the world, and we are left with two cases: Either the CEO exerts effort only in the good state of the world, or in neither state. Because debtholders cannot obtain more than $I - \sigma$ in the bad state of the world, the participation constraint requires $\tilde{D} \geq D^*_{\hat{\omega}} = I + \sigma$ in order for debtholders to break even. As $\tilde{D} \neq D^*_{\hat{\omega}}$, we must have $\tilde{D} > D^*_{\hat{\omega}}$. Thus, if the CEO exerts effort only in the good state of the world, debtholders extract a strictly positive rent (given the higher face value $\tilde{D} > D^*_{\hat{\omega}}$), contradicting optimality. And if the CEO exerts effort in neither state, the contract with face value $D^*_{\hat{\omega}}$ generates higher total surplus for the CFO because of the CEO's higher effort choice (in the good state of the world), in combination with the lower face value. This contradicts optimality. ■

A.2 Optimal Equity Contract and Cost of Equity

As an intermediate step in the analysis of the CFO's choice between debt and equity, we first define in Lemma 1 the optimal equity contract, conditional on equity financing, and discuss the resulting cost of equity. As in the case of debt, we will see that the optimal equity contract is independent of the CFO's type.

We adopt the same notation as for the debt contract. Let $\hat{\pi}_{CFO}(S, e)$ be the return to the project under the CFO's beliefs. We denote the fraction of the firm owned by new shareholders as γ. The CFO solves the following program to determine the (second-best) optimal equity contract:

$$\max_{\gamma} \beta(1-\gamma)E[\hat{\pi}_{CFO}(S, e_S)] \tag{A.9a}$$

$$u_{CEO}(S, \gamma, e_S) \geq u_{CEO}(S, \gamma, e'_S)\, \forall S \,\text{and}\, e_S \neq e'_S \tag{A.9b}$$

$$\gamma E[\pi(S, e_S)] \geq I \tag{A.9c}$$

Lemma 1 (Optimal Equity Contract). *The optimal equity contract depends on the CEO's but not on the CFO's bias. In particular, we have*

$$\begin{array}{rl} \gamma^*_{\hat{\omega}} = \frac{I}{I+\Delta} \;\; \textit{and} \;\; e_S = 1\, \forall S & \textit{if} \;\; \frac{\Delta + \hat{\omega}_{CEO}}{I+\Delta}\Delta \geq \frac{B}{\alpha} \;\; \textit{and} \\ \gamma^*_{\hat{\omega}} = 1 \;\; \textit{and} \;\; e_S = 0\, \forall S & \textit{if} \;\; \frac{\Delta + \hat{\omega}_{CEO}}{I+\Delta}\Delta < \frac{B}{\alpha}. \end{array}$$

Proof of Lemma 1. We start from the IC constraint under equity financing, shown in inequality (3) in the paper. We know from (3) that the CEO's choice of effort is independent of the state of the world. She exerts effort in both states iff

$$\alpha(1-\gamma)(\Delta + \hat{\omega}_{CEO}) \geq B \iff \gamma \leq 1 - \frac{B/\alpha}{\Delta + \hat{\omega}_{CEO}} \tag{A.10}$$

In this case, the participation constraint of new shareholders becomes

$$\gamma(I+\Delta) \geq I \tag{A.11}$$

Conversely, she does not exert effort in either state of the world if and only if $\gamma > 1 - \frac{B/\alpha}{\Delta+\hat{\omega}_{CEO}}$. In the latter case the participation constraint becomes $\gamma \geq 1$, and the only feasible equity financing contract assigns full ownership to new shareholders, while the CFO obtains zero payoff. In the former case, instead, the participation constraint is satisfied with equality, $\gamma^*_{\hat{\omega}} = \frac{I}{I+\Delta}$, and the resulting (perceived) payoff of the CFO is $\beta(1-\gamma^*_{\hat{\omega}})E[\hat{\pi}_{CFO}(S,1)] = \beta\frac{\Delta}{I+\Delta}(I+\Delta+\hat{\omega}_{CFO}) = \beta(\Delta + \frac{\Delta}{I+\Delta}\hat{\omega}_{CFO}) > 0$.

Hence, inducing effort is optimal if $\gamma^*_{\hat{\omega}} = \frac{I}{I+\Delta}$ satisfies the IC constraint, i.e., if $\frac{I}{I+\Delta} \leq 1 - \frac{B/\alpha}{\Delta+\hat{\omega}}$ or, solving for B/α, if $\frac{B}{\alpha} \leq \frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta$. If, instead, $\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta < \frac{B}{\alpha}$, the CEO cannot be induced to exert effort under any equity contract that allows new shareholders to break even. Therefore, the project is going to deliver I in expectation and the only contract satisfying equity holders' participation constraint requires $\gamma^*_{\hat{\omega}} = 1$. ■

A.3 Choice between Debt and Equity

We show that an overconfident CFO is weakly more likely to issue debt than a rational CFO, whether the CEO is overconfident or rational. Specifically, there are parameter ranges for which an overconfident CFO strictly prefers debt while a rational CFO does not (and is instead indifferent between the two financing choices).[42] Whenever the overconfident CFO strictly prefers equity, instead, so does the rational CFO.

The proof of Proposition 2 involves comparing the CFO's perceived utility under debt and equity financing. We use again the notation $\hat{\omega}_{CEO}$ to capture both the case of a rational CEO ($\hat{\omega}_{CEO} = 0$) and of an overconfident CEO ($\hat{\omega}_{CEO} = \omega$). As before, "perceived firm value" is short-hand for "expected payoff to incumbent shareholders under the CFO's beliefs."

Proof of Proposition 2. Recall from the proof in Appendix A.2 that the optimal equity contract depends on whether $\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta} < B/\alpha$ or not. This holds whether the CEO is rational or overconfident.

If $\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta < B/\alpha$, the optimal equity contract assigns all surplus to new shareholders ($\gamma^* = 1$), and the CEO shirks in both states of the world. We have also shown that the optimal debt contract induces the CEO to exert effort in at least in one state of the world, achieving a strictly higher firm value, and that not all surplus goes to the lenders. Since investors must break even (under any type of financing), the gain in firm value translates into rents to incumbent shareholders, and thus to the CFO. Therefore, both types of CFOs prefer debt financing over the parameter range $\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta < B/\alpha$.

If instead $\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta \geq B/\alpha$, the optimal equity contract does not assign all surplus to new shareholders, and the CEO exerts effort in both states of the world. As a result, a rational and an overconfident CFO have different perceptions of the value created by the CEO:

i. Rational CFO. Under the optimal equity contract, incumbent shareholders obtain $(1-I/[I+\Delta])(I+\Delta) = \Delta$. Under the optimal debt contract, we have to consider two cases: If $\sigma \leq \Delta - B/\alpha + \hat{\omega}_{CEO}$, the CEO exerts effort in both states of the world, and the expected firm value is $(I+\sigma+\Delta+I-\sigma+\Delta)/2 - I = \Delta$. If $\sigma > \Delta - B/\alpha + \hat{\omega}_{CEO}$, the CEO exerts effort only in the good state of the world, and the expected firm value is $(I+\sigma+\Delta+\Delta-I-\sigma)/2 = \Delta/2$. Comparison of these firm values gives us the CFO's choice, shown in the first table below.

[42] If the rational CFO randomizes his financing choice when indifferent, with positive probabilities for both debt and equity, an overconfident CEO uses strictly more debt, on average, than a rational CFO over this parameter range.

Rational CFO	**Debt**	**Equity**	***Preferred Choice***
$\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta \geq B/\alpha$ and $\sigma \leq \Delta - B/\alpha + \hat{\omega}_{CEO}$	Δ	Δ	Indifferent
$\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta \geq B/\alpha$ and $\sigma > \Delta - B/\sigma + \hat{\omega}_{CEO}$	$\Delta/2$	Δ	Equity

ii. Overconfident CFO. The overconfident CFO believes incorrectly that the CEO's effort is worth $\Delta+\omega$ instead of Δ. Thus, as the CEO exerts effort in both states of the world under equity financing, the CFO perceives firm value to incumbent shareholders under equity financing to be $(1-\frac{I}{I+\Delta})(I+\Delta+\omega) = \Delta+\frac{\Delta}{I+\Delta}\omega$. The same misperception applies under debt financing when $\sigma \leq \Delta - B/\alpha + \hat{\omega}_{CEO}$: As the CEO exerts effort in both states of the world, and the face value of debt is I, the CFO perceives firm value to equal $(I+\sigma+\Delta+\omega+I-\sigma+\Delta+\omega)/2 - I = \Delta+\omega$. If instead $\sigma > \Delta - B/\alpha + \hat{\omega}_{CEO}$, the CEO shirks in the bad state of the world, and the CFO's perceived firm value is therefore $(I+\sigma+\Delta+\omega-I-\sigma)/2 = (\Delta+\omega)/2$.

The next table below summarizes these computations and the CFO's choices.

Overconfident CFO	**Debt**	**Equity**	***Preferred Choice***
$\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta \geq B/\alpha$ and $\sigma \leq \Delta - B/\alpha + \hat{\omega}_{CEO}$	$\Delta+\omega$	$\Delta+\frac{\Delta}{I+\Delta}\omega$	Debt
$\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta \geq B/\alpha$ and $\sigma > \Delta - B/\alpha + \hat{\omega}_{CEO}$	$(\Delta+\omega)/2$	$\Delta+\frac{\Delta}{I+\Delta}\omega$	Equity

In summary, for either rational or overconfident CEOs, we find that both types of CFOs choose debt financing for some parameter ranges ($\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta < B/\alpha$), and both types choose equity financing for other ranges ($\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\Delta \geq B/\alpha$ and $\sigma > \Delta - B/\alpha + \hat{\omega}_{CEO}$). However, we also find that in some instances only the overconfident CFO strictly prefers debt ($\frac{\Delta+\hat{\omega}_{CEO}}{I+\Delta}\ \Delta \geq B/\alpha$ and $\sigma \leq \Delta - B/\alpha + \hat{\omega}_{CEO}$). In other words:
- If the rational CFO strictly prefers debt, so does the overconfident CFO.
- If the rational CFO is indifferent between debt and equity, the overconfident CFO strictly prefers debt.
- If the rational CFO strictly prefers equity, so does the overconfident CFO.

Taken together, these results imply that, conditioning on the CEO's type, an overconfident CFO weakly prefers debt relative to a rational CFO. ■

A.4 Hiring Decision

Proof of Proposition 3. The CEO is indifferent between the two types of CFOs if she expects either type to make the same financing choice. Therefore, we only need to analyze cases in which the two types of CFOs may behave differently, given the CEO's bias.

We start by considering the rational CEO's choice ($\hat{\omega}_{CEO} = 0$). From Section A.3 above we know that if $\frac{\Delta^2}{I+\Delta}\Delta \geq B/\alpha$ and $\sigma \leq \Delta - B/\alpha$, the overconfident CFO strictly prefers debt (see A.3.ii) but the rational CFO does not (see A.3.i); he is indifferent. The rational CEO, instead, is always indifferent between a debt and an equity contract, as she expects to obtain $\alpha\Delta$ under either contract. Therefore, she will not exhibit any preference regarding the CFO to be appointed.

Moving to an overconfident CEO's choice ($\hat{\omega}_{CEO} = \omega$), from Section A.3 above, we know that if $\frac{\Delta+\omega}{I+\Delta}\Delta \geq B$ and $\sigma \geq \Delta - B + \omega$, the rational CFO is indifferent between debt and equity, whereas the overconfident CFO strictly prefers debt. With debt financing, the overconfident CEO expects to obtain $\alpha(\Delta + \omega)$; with equity her perceived future payoff is only $\alpha(\Delta + \frac{\Delta}{I+\Delta}\omega)$. Therefore, under the CEO's beliefs, debt strictly dominates equity, and she prefers an overconfident CFO, who chooses debt financing for sure, to a rational CFO, who instead, being indifferent, may choose equity.

In sum, a rational CEO is indifferent between appointing an overconfident or a rational CFO; an overconfident CEO weakly prefers an overconfident CFO.[43] ■

A.5 Robustness of the Theoretical Results

We now provide a detailed discussion of the robustness of our results to reverting either of our two assumptions regarding the extent of the moral hazard problem for the rational CEO ($\Delta > B/\alpha$) and for the overconfident CEO ($B/\alpha \geq \omega$).

a. Assume $B/\alpha \geq \Delta$. If $B/\alpha > \Delta$, a rational CEO never exerts effort. The optimal debt contract is thus $D_0^* = I + \sigma$. Similarly, the optimal debt contract is $\gamma_0^* = 1$, and the CEO will not exert effort either. In both cases, the value of the project to incumbent shareholders is zero. In the knife-edge case $B/\alpha = \Delta$, it is still possible to induce the rational CEO to exert high effort in the good state of the world, but only under a debt contract, by keeping her indifferent between shirking and working hard (again $D_0^* = I + \sigma$).

The overconfident CEO, instead, can still be induced to exert effort if $B/\alpha > \Delta$, namely, as long as $\omega \geq B/\alpha - \Delta$. Under the optimal contract, she will work hard, either in both states of the world or only in the good one, at least under a debt contract.

Hence, by altering the assumption $\Delta > B/\alpha$, we affect the rational CEO's effort decision, but not the main insight that overconfidence can ameliorate conditional financing terms.

b. Assume $\omega > B/\alpha$. In our main analysis, the assumption $\omega \leq B/\alpha$ implies that the discrepancy in beliefs between the overconfident CEO and debtholders is not "too large" and that, whenever the CEO exerts effort, she does not default. We analyze how removing this assumption affects the optimal debt contract and CFO's choice between debt and equity.

b.i) Optimal debt contract. For $\omega > B/\alpha$, there is an additional case to consider under debt financing: The overconfident CEO may exert effort in the bad state of the world. Consider the incentive constraint

$$\alpha \cdot \max\{0, I - \sigma + \Delta + \hat{\omega}_{CEO} - D\} \geq \alpha \cdot \max\{0, I - \sigma - D\} + B \tag{A.12}$$

[43] As in Appendix-Section A.3, we use the expression '*weakly* prefers' because we have not specified how to break indifference between debt and equity. If we assume that a CFO randomizes between the two financing choices whenever indifferent, with some positive weight on the debt choice, an overconfident CEO will *strictly* prefer an overconfident CFO to a rational one.

There are two subcases. First, suppose that $\sigma \leq \Delta - 1/2(B/\alpha - \omega)$. In this case, the optimal contract for the overconfident CEO requires $D^*_\omega = I + \sigma - \Delta$. Plugging D^*_ω into the constraint (A.12) we get

$$\alpha \cdot \max\{0, I - \sigma + \Delta + \omega - (I + \sigma - \Delta)\} \geq \alpha \cdot \max\{, I - \sigma - (I + \sigma - \Delta)\} + B \tag{A.13}$$

or

$$\alpha \cdot (2\Delta - 2\sigma + \omega) \geq B, \tag{A.14}$$

which is satisfied under $\sigma \leq \Delta - 1/2(B/\alpha - \omega)$. Hence, the overconfident CEO mistakenly expects not to default after exerting effort, but debtholders correctly anticipate that they will receive only $I - \sigma + \Delta$ in the bad state of the world. At the same time, the IC A.1 is satisfied, delivering $I + \sigma - \Delta$ to debtholders in the good state of the world. Therefore, debtholders will break even in expectation. The proofs of optimality and uniqueness are similar to those in subsection A.1 and are omitted for brevity.

Now consider the subcase $\sigma > \Delta - 1/2(B/\alpha - \omega)$. Here, it is not possible to induce the overconfident CEO to exert effort and simultaneously ensure debtholders to break even. Intuitively, any debt contract that induces effort in the bad state of the world would require a face value of debt that is too low to satisfy debtholders' participation constraint.

Without making any assumption on the relative size of ω and B/α, we conclude that the optimal debt contract for an overconfident CEO is given by:

- $D^*_\omega = I + \sigma$ if $\sigma > \Delta - B/\alpha + \omega$ or $\Delta - 1/2(B/\alpha - \omega) < \sigma \wedge \sigma > \Delta$;
- $D^*_\omega = I + \sigma - \Delta$ if $\Delta - 1/2(B/\alpha - \omega) \geq \sigma > \Delta$;
- $D^*_\omega = I$ if $\Delta - B/\alpha + \omega \geq \sigma \wedge \Delta \geq \sigma$.

Thus, although the optimal debt contract becomes more complicated in this more general case, the basic insight of Proposition 1 remains unaffected, with overconfidence reducing the cost of debt when profit variability is large but not extreme.

b.ii) Financing choice. Moving to the analysis of the CFO's choice between debt and equity, we find that if $\omega > B/\alpha$, the different structure of the optimal debt contract can affect the overconfident CFO's preference between debt and equity whenever:

(i) the CEO is overconfident, with bias ω;
(ii) $\frac{\Delta+\omega}{I+\Delta}\Delta \geq B/\alpha$ (i.e., equity financing is available with $\gamma^*_\omega = I/(I + \Delta)$); and
(iii) $\Delta - 1/2(B/\alpha - \omega) \geq \sigma > \Delta$.

In this case, the rational CFO is indifferent between debt and equity. The reason is that he correctly anticipates that the CEO defaults in the bad state of the world but, because of the lower cost of debt, firm value will still be maximized. In particular, the *unbiased* expected value of the firm is $(I + \sigma + \Delta + 0 - (I + \sigma - \Delta))/2 = \Delta$. This is equivalent to the firm value obtained under an equity contract, making him indifferent between the two funding choices. For an overconfident CFO (who shares the bias ω of the CEO) the *perceived* expected firm value under optimal debt contract $D^*_\omega = I + \sigma - \Delta$ equals $(I + \sigma + \Delta + I - \sigma + \Delta + \omega)/2 - (I + \sigma - \Delta) = 2\Delta + \omega - \sigma$. Therefore, he (weakly) prefers debt if

$$2\Delta + \omega - \sigma \geq \Delta + \frac{\Delta}{I + \Delta}\omega, \tag{A.15}$$

Without further assumptions we cannot establish whether A.15 holds or not. Notice, however, that this inequality reduces to

$$\omega \frac{I}{I + \Delta} \geq \sigma - \Delta \tag{A.16}$$

The left-hand side of this expression is increasing in ω. This means that we can always find a sufficiently large value for ω such that A.16 holds. In particular, we can exploit the fact that $\sigma \leq I$. Replacing $\sigma = I$ in A.16 and rearranging terms, we get

$$\omega \geq I - \frac{\Delta^2}{I} \tag{A.17}$$

In other words, the overconfident CFO displays a preference for debt for sufficiently high overconfidence, with expression A.17 providing a lower bound for ω. Note that this kind of indeterminacy result for certain parameter ranges is common when debt is very risky (see for example the model in Malmendier et al. (2011)). Here, however, the main contribution is to distinguish the role of CEO and CFO's traits, with the latter dominating in financing choices.

B Variables Definitions

Below, we provide detailed definitions of the variables used in the empirical analyses. For the variables extracted from Compustat, ExecuComp and Dealscan we also indicate the data item (in italic).

Table B.1
Variables Definitions and Sources

Variable	**Definition**
Manager Variables	*(constructed from Thomson Insider Filing Dataset, CRSP and ExecuComp)*
LTCEO/LTCFO	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	option-excluded shares (*shrown_excl_opts*) held by the CEO/CFO as a percentage of common shares outstanding (*csho*)
Vested Options	number of exercisable options (*opt_unex_exer_num*) held by the CEO/CFO as a percentage of common shares outstanding (*csho*)
Firm Variables	*(constructed from Compustat (Annual or Quarterly), SDC, Dealscan)*
Net Debt Issues ($m)	long term debt issuance (*dltis*) - long term debt reduction (*dltr*)
Net Debt Issues Indicator (Compustat)	binary variable where 1 signifies that Net Debt Issues during the year is positive
Net Debt Issues Indicator (SDC)	binary variable where 1 signifies that the company issued bonds during the year
Book Leverage	(long-term debt (*dltt*) + debt in current liabilities (*dlc*)) / (long-term debt (*dltt*) + debt in current liabilities (*dlc*) + common equity (*ceq*))
Net Financing Deficit($m)	cash dividends (*dv*) + investment + change in working capital - cash flow after interest and taxes, where
...investment	*capx + ivch + aqc + fuseo - sppe - siv* for firms with cash flow format code (*scf*) 1 to 3; *capx + ivch + acq - sppe - siv - ivstch - ivaco* for firms with cash flow format code 7; 0 for other firms
...change in working capital	*wcapc + chech + dlcch* for firms with cash flow format code 1; *wcapc + chech - dlcch* for firms with cash flow format code 2 and 3; *recch invch apalch txach aoloch + chech fiao - dlcch* for firms with cash flow format code 7; 0 for other firms
...cash flow after interest and taxes	*ibc + xidoc + dpc + txdc + esubc + sppiv + fopo + fsrco* for firms with cash flow format code 1 to 3; items *ibc + xidoc + dpc + txdc + esubc + sppiv + fopo + exre* for firms with cash flow format code 7; 0 for other firms

Continued on next page

Table B.1 – *Continued*

Variable	**Definition**
Book Leverage	(long-term debt (*dltt*) + debt in current liabilities (*dlc*)) / (long-term debt (*dltt*) + debt in current liabilities (*dlc*) + common equity (*ceq*))
Market Leverage	(long-term debt (*dltt*) + debt in current liabilities (*dlc*)) / (price (*prcc*) × common shares outstanding (*csho*) + debt in current liabilities (*dlc*) + long-term debt (*dltt*))
Q	(assets (*at*) + price (*prcc*) × common shares outstanding (*csho*) - common equity (*ceq*) - balance sheet deferred taxes and investment tax credit (*txditc*)) / assets (*at*)
Profitability	operating profit (*oibdp*) / lagged assets (*at*)
Changes in Profitability	profitability - lagged profitability
Tangibility	property, plants and equipment (*ppent*) / lagged assets (*at*)
Changes in Tangibility	tangibility - lagged tangibility
log(Sales)	log(sales (*sale*))
Changes in log(Sales)	log(sales) - lagged log(sales)
log(Interest Spread)	difference between the interest rate the borrower pays in basis points and the London Interbank Offered Rate (variable *allindrawn* in Dealscan)
Z-Score	1.2 × (current assets (*actq*) - current liabilities (*dlcq*)) / total assets (*atq*) + 1.4 × (retained earnings (*req*) / total assets (*atq*)) + 3.3 × (pretax income (*piq*) / total assets (*atq*)) + 0.6 × (market capitalization (*cshoq* × *prccq*) / total liabilities (*ltq*)) + 0.9 × (sales (*saleq*) / total assets (*atq*))
Earnings Volatility	(standard deviation of the past eight earnings changes) / (average book asset size over the past eight quarters). Earnings are defined as sales (*saleq*) - cost of goods sold (*cogsq*) - selling, general and administrative expenses (*xsgaq*)
log(Amount)	log (natural logarithm) of the amount of the loan (in million dollars) (*amt*)
Analysts' Coverage	number of analysts making at least one annual earnings forecast in a given year
Coefficient of Variation of Earnings Estimates	standard deviation of annual earnings forecasts normalized by the absolute value of the mean forecast (We require at least ten forecasts made.)

C Robustness Checks

Appendix C presents additional details about the data and a series of robustness checks for all estimations presented the paper.

In Appendix-Table C.1 we show the descriptive statistics for our largest sample (employed in Tables 4 and 5 in the main text) split by the four possible combinations of executives' biases, as identified by the *Longholder_Thomson* measure: (a) both executives are classified as overconfident; (b) the CEO is rational and the CFO is overconfident; (c) the CEO is overconfident and the CFO rational CEO; and (d) both are overconfident.

Appendix-Tables C.2−C.6 show the estimation results if we use Otto (2014)'s continuous empirical measure of CEO overconfidence. Under this approach, overconfidence is measured as the weighted average of transaction-specific overconfidence dummmies. We first classify each option exercise of an executive. The transaction-specific dummy takes the value 1 if the options were exercised within one year of their expiration date and were at least 40% in the money at the end of the preceding year. Otherwise, the dummy takes the value 0. We then average the value of the optimism dummies for each executive across his or her transactions, weighting each observation by the number of options that were exercised. Therefore, the final overconfidence measure takes values between 0 and 1. We repeat all of our empirical analyses using this measure and show the results below, omitting the coefficients on the control variables for brevity. The specifications and the control variables are exactly the same, except in Appendix-Table C.6 (CFO Hiring) where, given the nature of our dependent variable, we estimate a Tobit rather than a logit model. The continuous Longholder proxies are normalized by their respective sample standard deviations for ease of interpretation.

Appendix-Table C.7 reports our estimations of the relation between managerial overconfidence and propensity to issue debt using SDC data rather than Compustat. To generate the data for this analysis, we match all issues of debt, equity, and hybrid securities (convertible debt and convertible preferred stock) with the ExecuComp-Compustat merged sample described in the main text. We have 694 observations when no control variables are required, and 647 observations in the subsample where all control variables are available. Moreover, as the industry dummies perfectly predict some of the debt issues, the actual sample usable for identification varies further, between 694 and 585 observations (when the full set of controls is included). The estimations mirror those using the Compustat data in the main text (in Table 3): We estimate again a logit model with a dummy equal to one if a firm issued debt in a given year, and 0 otherwise, i. e., if the firm issued equity or hybrid securities, and using the same control variables. Given the small sample, we choose to display the estimations using all available observations for the respective specifications. Results of this exercise confirm those in the main text and are reported in Table

As mentioned in the main text, we have also re-run all our tests by restricting the analysis to firms that have appreciated by more than 40% in the previous ten years. This robustness check has the limitation that it mechanically excludes from the sample all firms that, in any given year, have been listed for less than 10 years. We show the replications of Tables 3 and 6 in the main text (Tables C.8 and C.9 of this Appendix).

Finally, we check the robustness of our results to varying the minimum number of transactions. In our main tests, we require CEOs and CFOs to have at least 10 transactions recorded. Figure C.1 plots the coefficients of interest in each regression using an array of minimum transaction requirements between 1 and 10. We only plot only the coefficients from the most conservative regressions (last column of each table).

Table C.1
Summary Statistics Split by Executives' Bias

	Panel A. Both Executives Overconfident				Panel B. Rational CEO, Overconfident CFO			
Variable	Obs.	Mean	Median	St. Dev.	Obs.	Mean	Median	St. Dev.
Assets ($m)	1,928	6,009	1,710	14,230	499	5,739	1,467	11,608
Sales ($m)	1,928	7,018	1,575	23,654	499	4,622	1,203	8,395
Capitalization ($m)	1,928	8,822	2,268	24,762	499	7,576	2,006	14,265
Net Fin. Deficit ($m)	1,928	-258	-14	1,739	499	50	-23	2,886
Net Fin. Deficit / Assets	1,928	-0.010	-0.016	0.305	499	-0.041	-0.023	0.418
Net Debt Issues / Assets	1,928	0.031	0.000	0.169	499	0.028	0.000	0.191
Book Leverage	1,922	0.304	0.278	0.395	498	0.255	0.254	0.213
Q	1,928	2.264	1.785	1.735	499	2.449	1.972	2.029
Change in Q	1,928	-0.022	0.023	1.389	499	-0.111	0.016	1.698
Profitability	1,928	0.185	0.177	0.124	499	0.191	0.180	0.132
Change in Profitability	1,928	-0.003	0.002	0.078	499	-0.005	0.002	0.112
Tangibility	1,928	0.321	0.201	0.302	499	0.278	0.201	0.305
Change in Tangibility	1,928	-0.007	-0.003	0.115	499	-0.005	-0.003	0.285
log(Sales)	1,928	7.355	7.263	1.589	499	7.227	7.023	1.543
Change in log(Sales)	1,928	0.097	0.093	0.221	499	0.091	0.074	0.226
Market Leverage	1,922	0.154	0.122	0.152	498	0.131	0.104	0.131
CEO Stock Ownership (%)	1,928	2.070	0.374	4.809	499	1.147	0.186	4.937
CEO Vested Options (%)	1,928	1.023	0.696	1.254	499	0.690	0.396	0.906
CFO Stock Ownership (%)	1,928	0.149	0.056	0.282	499	0.106	0.043	0.178
CFO Vested Options (%)	1,928	0.303	0.165	0.877	499	0.234	0.143	0.274

Continued on next page

Table C.1 – *Continued*

	Panel C. Overconfident CEO, Rational CFO				**Panel D. Both Executives Rational**			
Variable	Obs.	Mean	Median	St. Dev.	Obs.	Mean	Median	St. Dev.
Assets ($m)	1,199	6,578	1,951	17,990	955	4,394	1,307	10,766
Sales ($m)	1,199	5,250	1,758	11,508	955	4,197	1,328	10,327
Capitalization ($m)	1,199	9,803	2,879	21,782	955	5,788	1,767	11,801
Net Fin. Deficit ($m)	1,199	-470	-13	2,828	955	-134	-21	1,410
Net Fin. Deficit / Assets	1,199	-0.049	-0.015	0.374	955	-0.041	-0.024	0.432
Net Debt Issues / Assets	1,199	0.022	0.000	0.122	955	0.026	0.000	0.159
Book Leverage	1,186	0.256	0.213	0.307	954	0.317	0.279	0.661
Q	1,199	2.621	1.999	2.233	955	2.449	1.819	1.960
Change in Q	1,199	-0.011	0.036	2.004	955	-0.049	0.054	1.507
Profitability	1,199	0.191	0.175	0.156	955	0.176	0.161	0.153
Change in Profitability	1,199	0.000	0.000	0.115	955	0.000	0.005	0.100
Tangibility	1,199	0.283	0.198	0.260	955	0.274	0.192	0.268
Change in Tangibility	1,199	-0.008	-0.004	0.098	955	-0.006	-0.002	0.137
log(Sales)	1,199	7.362	7.377	1.531	955	7.043	7.073	1.613
Change in log(Sales)	1,199	0.120	0.104	0.212	955	0.124	0.108	0.229
Market Leverage	1,186	0.127	0.079	0.143	954	0.159	0.109	0.176
CEO Stock Ownership (%)	1,199	1.775	0.316	4.676	955	1.652	0.253	5.014
CEO Vested Options (%)	1,199	1.188	0.758	2.718	955	1.032	0.598	1.790
CFO Stock Ownership (%)	1,199	0.080	0.023	0.270	955	0.120	0.039	0.408
CFO Vested Options (%)	1,199	0.199	0.085	0.481	955	0.212	0.110	0.307

Table C.2
Debt Issues (Compustat)

Logit regressions with the Net Debt Issues Indicator as the dependent variable, regressed on Otto (2014)'s overconfidence measure (normalized by its sample standard deviation) for CEOs and CFOs and the same control variables as in Table 3. ***, **, 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	0.088	0.095			0.071	0.050	0.050
	(1.565)	(1.407)			(1.222)	(0.812)	(0.714)
Longholder CFO			0.076	0.140***	0.052	0.081	0.133**
			(1.363)	(2.617)	(0.883)	(1.400)	(2.253)
Manager Controls	NO	YES	NO	YES	NO	YES	YES
Firm Controls	NO	YES	NO	YES	NO	NO	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	NO	YES	NO	YES	YES
Observations	2,938	2,938	2,938	2,938	2,938	2,938	2,938
Pseudo R-Squared	0.044	0.153	0.047	0.157	0.047	0.099	0.157

Table C.3
Financing Deficit

Replication of the estimation of Table 4 with Otto (2014)'s overconfidence measure (normalized by its sample standard deviation) for CEOs and CFOs and the same control variables as in Table 4. ***, **, 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 × Longh. CEO	0.005	0.011	0.046				-0.024	-0.007	-0.015
	(0.099)	(0.226)	(1.107)				(-0.374)	(-0.114)	(-0.511)
FD × Longh. CFO				0.045	0.017	0.027	0.064	0.022	0.034
				(0.497)	(0.221)	(0.762)	(0.614)	(0.239)	(0.862)
FD	0.207***	0.175***		0.194***	0.180***		0.209***	0.184***	
	(3.277)	(3.525)		(3.165)	(3.058)		(3.453)	(3.455)	
Longholder CEO	-0.008	-0.005	0.001				-0.008	-0.005	0.002
	(-1.234)	(-0.690)	(0.127)				(-1.467)	(-0.735)	(0.560)
Longholder CFO				-0.003	-0.004	-0.003	-0.001	-0.003	-0.004
				(-0.831)	(-1.006)	(-0.663)	(-0.214)	(-0.663)	(-0.872)
Manager Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
Firm Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
FD × Controls	NO	NO	YES	NO	NO	YES	NO	NO	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	YES	NO	YES	YES	NO	YES	YES
Observations	4,581	4,581	4,581	4,581	4,581	4,581	4,581	4,581	4,581
R-squared	0.208	0.291	0.438	0.229	0.303	0.496	0.233	0.303	0.499

Table C.4
Leverage

OLS regressions with market leverage as dependent variable, regressed on Otto (2014)'s overconfidence measure (normalized by its sample standard deviation) for CEOs and CFOs and the same control variables as in Table 5. ***, **, 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	1.265*	0.592			0.838	0.185	0.192	0.179
	(1.863)	(0.921)			(1.244)	(0.293)	(0.290)	(0.266)
Longholder CFO			2.499***	2.223***	2.305***	2.203***	2.175***	2.185***
			(5.248)	(4.718)	(4.448)	(4.256)	(4.183)	(4.166)
Manager Contr.	NO	YES	NO	YES	NO	YES	YES	YES
Firm Controls	NO	YES	NO	YES	NO	YES	YES	YES
Return_{t-1}	NO	NO	NO	NO	NO	NO	NO	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	4.552	4.552	4.552	4.552	4.552	4.552	4.552	4.552
R-squared	0.090	0.143	0.093	0.145	0.094	0.146	0.158	0.166

Table C.5
Cost of Debt Financing

Panel A shows regressions of log(Interest Spread) on Otto (2014)'s overconfidence measures (normalized by its sample standard deviation) for CEOs and CFOs and the same control variables and fixed effects as in Table 6. Log(Interest Spread) is the difference (in basis points) between the interest rate the borrower pays and the LIBOR. In Panel B we test the relation between CEO overconfidence and the cost of debt across different subsamples, using different cutoffs for low, medium, and high Earnings Volatility. The controls variables are as in column (7) of Panel A. ***, ** and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

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Panel A. Baseline Regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Longholder CEO	-0.028	-0.049**			-0.037	-0.042*	-0.032
	(-0.817)	(-2.137)			(-1.027)	(-1.712)	(-1.418)
Longholder CFO			0.012	-0.030	0.024	-0.017	-0.019
			(0.387)	(-1.486)	(0.751)	(-0.757)	(-0.924)
Manager Controls	NO	YES	NO	YES	NO	YES	YES
Firm Controls	NO	YES	NO	YES	NO	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year-Quarter FE	YES	YES	YES	YES	YES	YES	YES
Loan Type FE	NO	NO	NO	NO	NO	NO	YES
Observations	1,650	1,650	1,650	1,650	1,650	1,650	1,650
R-squared	0.405	0.613	0.405	0.611	0.406	0.613	0.669

Panel B. Earnings Volatility Subsamples

	Bottom Tercile	Bottom 35%	Bottom 30%	Bottom 25%
Longholder CEO	-0.007	-0.023	0.008	0.012
	(-0.147)	(-0.608)	(0.182)	(0.231)
Longholder CFO	0.003	0.001	0.003	0.028
	(0.098)	(0.035)	(0.069)	(0.639)
Observations	548	579	494	417
R-squared	0.797	0.795	0.808	0.832
	Medium Tercile	Medium 35%	Medium 30%	Medium 25%
Longholder CEO	-0.083**	-0.082**	-0.064**	-0.049*
	(-2.488)	(-2.426)	(-2.237)	(-1.806)
Longholder CFO	-0.022	-0.037	0.006	-0.012
	(-0.778)	(-1.128)	(0.199)	(-0.473)
Observations	549	496	658	822
R-squared	0.736	0.751	0.705	0.688
	Top Tercile	Top 35%	Top 30%	Top 25%
Longholder CEO	-0.019	-0.026	-0.019	0.007
	(-0.471)	(-0.667)	(-0.454)	(0.161)
Longholder CFO	0.024	).010	0.031	0.029
	(0.787)	(0.348)	(1.030)	(0.895)
Observations	553	575	498	411
R-squared	0.757	0.748	0.766	0.783

Table C.6
CFO Hiring

Tobit regressions with CFO overconfidence as dependent variable and CEO overconfidence as main regressor. Both proxies are constructed following Otto (2014) and are normalized by their sample standard deviations. Control variables and sample restrictions are as in Table 8. ***, **, and * indicate statistically different from zero at the 1%, 5%, and 10% level of significance, respectively.

	(1)	(2)	(3)	(4)
Longholder CEO	0.275	0.281*	0.327*	0.343**
	(1.600)	(1.700)	(1.917)	(2.036)
Manager Controls	NO	NO	YES	YES
Firm Controls	NO	NO	NO	YES
Industry FE	NO	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	202	202	202	202
Pseudo R-Squared	0.007	0.106	0.119	0.140

Table C.7
Debt Issues (SDC)

Table C.7 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 as dependent variable, conditioning on having issued debt, equity, or hybrid securities. Data on public issues are from SDC and include 330 firms. Equity issues are issues of common stock or non-convertible preferred stock. Debt issues are issues of non-convertible debt. Hybrid issues are issues of convertible debt or convertible preferred stock. The overconfidence proxy and the control variables are as in Table 3. Standard errors are clustered by firm, and corresponding t-statistics are shown in parentheses. ***, **, 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	0.716**	0.201			0.528*	0.309	-0.062
	(2.537)	(0.506)			(1.856)	(0.923)	(-0.149)
Longholder CFO			0.819***	0.781**	0.688**	0.922***	0.804**
			(3.019)	(2.162)	(2.476)	(2.801)	(2.158)
Manager Controls	NO	YES	NO	YES	NO	YES	YES
Firm Controls	NO	YES	NO	YES	NO	NO	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	NO	YES	NO	YES	YES
Observations	694	611	694	587	694	598	585
Pseudo R-squared	0.092	0.550	0.098	0.558	0.105	0.253	0.557

Table C.8
Debt Issues (Compustat), Restricted Sample

Logit regressions with the Net Debt Issues Indicator as the dependent variable, regressed on our measure of overconfidence for CEOs and CFOs and the same control variables as in Table 3. The sample includes only firms in the Restricted Sample, i.e., firms that have appreciated by more than 40% in the previous ten years (therefore excluding from the sample all the firms that, in any given year, have been listed for less than 10 years). ***, **, 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	0.010	-0.063			-0.102	-0.103	-0.183
	(0.0623)	(-0.398)			(-0.612)	(-0.617)	(-1.132)
Longholder CFO			0.419***	0.457***	0.439***	0.483***	0.501***
			(2.982)	(3.075)	(3.054)	(3.098)	(3.289)
Manager Controls	NO	YES	NO	YES	NO	YES	YES
Firm Controls	NO	YES	NO	YES	NO	NO	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	NO	YES	NO	YES	YES
Observations	1,744	1,744	1,744	1,744	1,744	1,744	1,744
Pseudo R-Squared	0.041	0.170	0.048	0.176	0.048	0.115	0.176

Table C.9
Cost of Debt Financing, Restricted Sample

Regressions of log(Interest Spread) on our overconfidence measures for CEOs and CFOs and several control variables (defined in Table 6), 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. The sample includes only firms in the Restricted Sample, i.e., firms that have appreciated by more than 40% in the previous ten years (therefore excluding from the sample all the firms that, in any given year, have been listed for less than 10 years). ***, **, 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	-0.237***	-0.186***			-0.266***	-0.189***	-0.135**
	(-2.611)	(-3.092)			(-2.926)	(-3.010)	(-2.384)
Longholder CFO			0.016	-0.050	0.089	0.012	-0.000
			(0.168)	(-0.851)	(1.010)	(0.192)	(-0.004)
Manager Controls	NO	YES	NO	YES	NO	YES	YES
Firm Controls	NO	YES	NO	YES	NO	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES
Year-Quarter FE	YES	YES	YES	YES	YES	YES	YES
Loan Type FE	NO	NO	NO	NO	NO	NO	YES
Observations	1,162	1,162	1,162	1,162	1,162	1,162	1,162
R-squared	0.479	0.668	0.468	0.664	0.481	0.674	0.711

Figure C.1
Coefficient Estimates with Different Transactions Thresholds

These panels report the relevant coefficient estimates from the empirical analysis of the paper (Tables 3 through 8). For brevity only the coefficient from the most conservative test (last column of each table) is shown. The x-axis reports the minimum number of transactions required for CEOs and CFOs to be included in the sample. The y-axis has the value of the estimated coefficient of interest. Panels a, b, c and d report the coefficient on Longholder CFO. Panel c reports the coefficient on Financing Deficit × Longholder CFO. Panels e, f, g, h and i report coefficients on Longholder CEO. Panels f, g, h, where we divide the sample using different measures of volatility, have three different coefficients. The coefficients on Longholder estimated in the low, medium and high volatility subsamples are plotted using dotted, solid and dashed lines, respectively.