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CEO overcaution and capital structure choices

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Abstract

This paper develops and empirically tests a new version of the trade-off theory of corporate capital structure choices that accounts for CEOs' biased beliefs, with a focus on overcaution. We characterize the bias as a distortion of expected rates of return on equity and debt that, for Overcautious CEOs, are overestimated compared to a rational CEO. The theory shows that if CEOs have higher bias in equity, than in debt-value estimation, overcautious CEOs will choose lower levels of debt compared to rational CEOs, and, if the degree of overcaution is sufficiently high, they will adopt a zero-leverage policy.

KEYWORDS
capital structure, leverage, overcaution, zero leverage

JEL CLASSIFICATION
G12, G32, G33, G34

1 | INTRODUCTION

From the array of models that has been proposed to explain firms' capital structure choices, trade-off theory[1] has been favored for its appealing simplicity and the advantage that it allows the determination of an optimal debt-equity mix that a firm with certain characteristics should hold. Nevertheless, according to the results obtained from a vast number of empirical studies, trade-off theory – both in its static (Bradley et al., 1984) and dynamic (Fischer et al., 1989) versions – is not able to explain many observed patterns in corporate capital structure choices. In particular, the observed heterogeneity in the capital structure of firms having similar characteristics and leverage changes within and across

[1] Trade-off theory hypothesizes the existence of an optimal level of leverage defined by the trade-off between the advantages of debt, represented by tax shields and agency benefits, and its costs, represented by the expected cost of bankruptcy and financial distress plus the cost of agency.

firms represent two of the most puzzling pieces of evidence against the trade-off model (Graham & Leary, 2011 and Hackbarth & Sun, Forthcoming).

Many authors, including among others Myers (1993), Graham (2000) and Baker and Wurgler (2002), point out that while several of the observed cross-sectional and within-firm patterns in leverage are consistent with trade-off theory, the latter fails to provide an explanation for the negative relationship between profitability and leverage. In fact, more profitable firms should be characterized by a greater advantage from the tax benefits of debt and thus, *ceteris paribus*, be more indebted. Related to this, the so called "mystery of the zero leverage firms" is even more puzzling. Graham (2000) and Strebulaev and Yang (2013) document a large sample of zero leverage firms which, since they are highly profitable, should be indebted given the considerable advantage that they might get from their potential tax shields. Lemmon et al. (2008) show that trade-off theory explains relatively little of the observed capital structure variation and argue that much of the remaining variation is firm-specific and time-invariant. Finally, among others, Huang and Ritter (2009) and Iliev and Welch (2010) document that dynamic trade-off theory fails to explain within-firm leverage variations, and suggest that the rate of reversion to target is too slow to be considered a first-order policy determinant, thus inconsistent with trade-off theory.

Among the answers that have been proposed to these puzzling results, the recent literature has been moving towards a behavioral explanation.[2] The empirical study of Bertrand and Schoar (2003) reports the existence of a significant managerial fixed effect in the explanation of the observed heterogeneity in capital structure choices. Graham and Narasimhan (2004) find a strong relationship between leverage and personal experiences during the Great Depression era, Becker et al. (2019) analyze the performance of firms led by extraverted CEOs, Driss et al. (2023) study the effect of governance on firm leverage, Halford and Hsu (2020) examine how CEO attractiveness relates to firm value, while Malmendier et al. (2011) extend the studies cited above to other CEO personal traits such as overconfidence and optimism. Ho et al. (2016) find similar results for the capital structure choices of U.S. banks facing a financial crisis. They show that during 2007–2008 financial crisis, banks led by overconfident CEOs are more likely to increase leverage. This is consistent with the hypothesis that overconfidence needs to be considered in explanations of the heterogeneity of the debt-equity mix among banks.

The present paper follows along this line of research and proposes a variation of the trade-off model of capital structure choices which integrates with the hypothesis of biased managerial beliefs. In particular, and differently from previous studies, we introduce the hypothesis of CEO overcaution, which is typically omitted by the current literature where the focus is on overconfidence. In general terms, we model these biased beliefs in terms of a gap between the market expected returns on equity and debt, and that resulting from the CEO's personal evaluation. We assume that overcautious (overconfident) CEOs overestimate (underestimate) the returns on equity and debt and thus underestimate (overestimate) the present and future values of the firm's assets. Conversely, we assume that rational CEOs correctly estimate both the rate of returns on equity and debt, and hence, the value of the firm.

In a related study, Hackbarth (2008) introduces a comprehensive theory of the effect of overconfidence[3] on CEO's decisions, considering both a trade-off model and a pecking-order theory setting.[4] His model builds on the definition of overconfidence based on biases applied to the first two moments of the firm value probability distribution. While our model is not as detailed as Hackbarth's from the perspective of the exploration of the impact of overconfidence on many CEOs' choices, the granularity that we introduce in the ranking of CEOs allows us to re-formalize the model in a different and insightful way. In particular, our model differs from Hackbarth's in two ways. First, it provides new insights regarding the relationship between CEO overcaution and the evidence of highly profitable underlevered firms, which remains unexplained in his model. Second, since we model overconfidence through a bias in the

[2] Of course, also non-behavioral explanations have been advanced. A recent example is the study by Bui (2022), which shows that the presence of corporate blockholders tends to reduce firm leverage.

[3] In his paper, Hackbarth refers to overconfident CEOs as overoptimists. Apart from the different terminology used, the effects of overoptimism considered by Hackbarth (2008) are not different from those also considered in this paper and, among the others, Malmendier and Tate (2015), for an overconfident CEO.

[4] The Pecking order theory developed by Myers and Majluf (1984) predicts a financing hierarchy in which mature firms, characterized by limited growth prospects, finance investments first with internal funds, then with debt, while issue equity only as a last resort

rate of return on equity, the risk perception bias plays a more evident role in our model. In Hackbarth's model, a CEO who perceives the project risk as lower with respect to the market (who is thus overconfident), only implies reduced expected costs of financial distress.[5] Our representation is instead underpinned by the intuition that lower perceived risk implies a lower estimated rate of return on equity and debt. The discrepancy between estimates by the CEO and by the market also generates a preference for the CEO to issue debt rather than equity for firms that are not excessively indebted, thus considering the expected costs of financial distress absent or negligible.

We contribute to the literature in two aspects. First, the existing literature has explored the implication of managerial traits only from the perspective of overconfidence, entirely omitting overcaution from the analysis. We fill this gap and show how the introduction of overcautious CEOs is important in explaining the adoption of a zero leverage policy from both theoretical and empirical perspectives. Theoretically, we show the existence of a trade-off between tax benefits, the expected costs of financial distress, and the overcautious CEO's psychological advantage of equity. Consequently, firms led by overcautious CEOs for whom the psychological benefits of equity combined with the expected costs of financial distress completely offset the tax benefits of debt increased by the psychological advantage of debt, choose to be all-equity despite the potential existence of tax shields. From the empirical perspective, we document that according to the ranking proposed by Campbell et al. (2011), 34% of the firm-year observations in our sample are associated with CEOs classified as overcautious. Moreover, out of 2564 observations on zero-leveraged firms, approximately 32% are associated with overcautious CEOs. Finally, our logit analysis shows that overcaution is highly significant in explaining both zero and almost zero leverage policy, and this result is robust to the introduction of a range of controls.

Second, we employ both overconfidence and overcaution in the analysis of firms' speeds of adjustment. Theoretically, we show that firms led by overcautious CEOs adjust to the target faster than overconfident CEOs when leading overlevered firms and more slowly when leading underlevered firms. We test this prediction empirically by employing a dynamic version of our model and estimate the speed of adjustment toward optimal levels of leverage for different subsamples of interest. In particular, by employing a standard dynamic panel model with fixed effects, we show that the speed at which firms led by overcautious CEOs of overlevered firms adjust towards their optimal debt-equity mix is significantly higher (approximately 76%) than that displayed by overlevered firms led by overconfident CEOs (approximately 57%).

To test the aforementioned predictions, we employ a comprehensive sample of 25,225 U.S. firm-year observations over the period 1996–2022. To measure CEO overcaution and overconfidence, we employ the options-based approach proposed by Campbell et al. (2011). This approach to measuring CEO behavioral biases is becoming increasingly popular in the corporate finance literature. Among others, Ho et al. (2016) employ it to study the effect of overconfidence in bank lending during the financial crisis, while Huang et al. (2016) use it to study the relationship between overconfidence and corporate debt maturity. More recently, Banerjee et al. (2018) apply this methodology to study the impact of overconfidence on the issue of security class actions, Phua et al. (2018) employ it to study whether overconfident CEOs are better leaders, while Andreou et al. (2018) use it to study the buyback anomaly.

The remainder of the paper is organized as follows. Section 2 presents the model, while Section 3 describes the data and the variables involved in the empirical investigation. Section 4 reports the main results and finally, Section 5 concludes.

2 | MODEL

2.1 | Framework

Consider a firm that, at time $t = 0$, has existing real investments with a final value $\tilde{X}$ realized at $t = 1$. The firm is funded by equity and debt, with the latter having face value D_1 due at time $t = 1$, and faces a constant marginal tax rate τ_c.

[5] Note that in the absence of costs of financial distress and tax benefits, the risk perception bias plays no role in the choice of the debt-equity mix. (See Hackbarth, 2008, Lemma 1, page 855.)

The corresponding corporate tax liability $(\tilde{X} - D_1)\tau_c$ is incurred at $t = 1$ only if the investment's final value $\tilde{X}$ exceeds the debt repayment D_1. If the firm does not honor the debt obligation due at $t = 1$, it is forced to fail. The firm value is reduced in this case by a fraction $k(\tilde{X}, D_1)$, which measures the costs of bankruptcy and financial distress incurred net of subsidies. The firm is characterized by an atomistic structure regarding its shareholders, who fully delegate the firm's operations to the CEO. We assume that the CEO acts fully in the interests of shareholders, but takes into account her/his personal beliefs about the characteristics of the firm and makes decisions accordingly.[6] Given these assumptions, the payoffs at $t = 1$ for the firm's debt-holders $\tilde{Z}$ and shareholders $\tilde{Y}$ are the following:

$$\tilde{Z} = D_1 \mathbb{1}_{\tilde{X} \geq D_1} + \left(\tilde{X} - k\left(\tilde{X}, D_1\right)\right) \mathbb{1}_{\tilde{X} < D_1},$$

and

$$\tilde{Y} = (\tilde{X} - D_1)(1 - \tau_c)\mathbb{1}_{\tilde{X} \geq D_1},$$

where $\mathbb{1}_j$ is a binary variable equal to one if condition j is satisfied and zero otherwise.

Let r_E and r_D be the rates of return on equity and debt, respectively, and $F(.)$ be the market probability distribution of the returns on the firm's assets. At time $t = 0$, the value of debt and equity are:

$$D = \frac{\mathbb{E}\left[\tilde{Z}\right]}{1 + r_D} = \frac{1}{1 + r_D}\left[\int_{D_1}^{\infty} D_1 dF\left(\tilde{X}\right) + \int_0^{D_1} \left(\tilde{X} - k\left(\tilde{X}, D_1\right)\right) dF\left(\tilde{X}\right)\right], \tag{1}$$

$$E = \frac{\mathbb{E}[\tilde{Y}]}{1 + r_E} = \frac{1}{1 + r_E}\left[\int_{D_1}^{\infty} (\tilde{X} - D_1)(1 - \tau_c)\ dF(\tilde{X})\right], \tag{2}$$

respectively. Thus, by the firm-value identity, the total value of the levered firm V_L is:

$$V_L = D + E = V_U + \mathrm{TB}(D) - \mathrm{CFD}(D),$$

where V_U is the value of an unlevered firm with equal characteristics, $\mathrm{TB}(D)$ is the tax benefit of debt and $\mathrm{CFD}(D)$ are the expected costs of financial distress.[7]

2.2 | Overconfidence and overcaution

In the corporate finance literature, there exist multiple definitions of overconfidence which implicitly focus on different aspects of managerial beliefs and behavior. Malmendier and Tate (2005) and Malmendier et al. (2011) define overconfidence as an "upward bias in the assessment of future outcomes". Hackbarth (2008) differentiates two kinds of optimism biases: growth perception bias, which implies a distortion in the conditional expected value of the firm, and risk perception bias, which is represented by a distortion in the variance. Malmendier and Tate (2015) generalize the definition of overconfidence and state it as "the overestimation of the value a manager believes he or she can create." They then specify that such overestimation has two sources: first, the CEO believes that the firm's current assets are undervalued by the market. Second, the CEO overestimates the value of future potential investments. In

[6] For simplicity, we assume the absence of agency costs and benefits. The introduction of these further features does not affect any of the theoretical results presented in the paper.

[7] By assuming, for simplicity, that $r_D = r_E = r$, we have that

$$\mathrm{TB}(D) = \frac{D_1 \times \tau_c}{1 + r},$$

and

$$\mathrm{CFD}(D) = \frac{1}{1 + r}\int_0^{D_1} k\left(\tilde{X}, D_1\right) dF\left(\tilde{X}\right).$$

particular, their characterization of overconfidence combines upward biases in terms of cash flows, probabilities of good scenarios and project quality, with downward biases in terms of probabilities of bad scenarios, risk, and expected occurrences of financial distress.

In what follows, we extend the definitions above to the case of overcaution and we formalize the main intuition from these studies by synthesizing the two biases described above in a single distortion in terms of the rates of return on the debtholder and stockholder cash flows. In particular, as in Hackbarth (2008) and Malmendier and Tate (2015), we consider a distortion in either or both the estimated cash flow $\tilde{X}$ or its riskiness.[8] Then, to see why these biases can be formalized in the way described above, consider for instance the case of an overconfident CEO. According to the definition, the CEO either overestimates the cash flow (growth perception bias), that is, $\tilde{X}^C = \tilde{X} + \tilde{x}^+$, where $\tilde{x}^+$ is a strictly positive random variable, or underestimates its riskiness (risk perception bias). In the case of growth perception bias, it immediately follows that $E^{\text{OVC}} = E + \frac{1}{1+r_E}\int_{D_1}^{\infty} \tilde{x}^+(1-\tau_c)dF(\tilde{X}) > E$ and $D^{\text{OVC}} = D + \frac{1}{1+r_D}\int_{0}^{D_1} \tilde{x}^+ dF(\tilde{X}) > D$. Hence, there exists a cost of equity and a cost of debt, with $r_E^{\text{OVC}} < r_E$ and $r_D^{\text{OVC}} < r_D$, such that $E^{\text{OVC}} = \frac{\mathbb{E}[\tilde{Y}]}{1+r_E^{\text{OVC}}}$ and $D^{\text{OVC}} = \frac{\mathbb{E}[\tilde{Z}]}{1+r_D^{\text{OVC}}}$. That is, discounting at r_E^{OVC} and r_D^{OVC} the market estimates of equity and debt, respectively, produce the same results as their values estimated by the overconfident CEO. Since the same rationale trivially applies to overcautious CEOs, what follows generalizes the previous observations by taking the perspective of a biased CEO (either overcautious or overconfident).

Let E^C be the value of equity as perceived by the CEO, and r_E^C be the rate of return on equity such that:

$$E^C = \frac{\mathbb{E}\left[\tilde{Y}\right]}{1+r_E^C}.$$

Similarly, let D^C be the value of debt as perceived by the CEO, and r_D^C be the rate of return on debt such that:

$$D^C = \frac{\mathbb{E}\left[\tilde{Z}\right]}{1+r_D^C}.$$

By Equations (1) and (2) we have:

$$E^C = \left[\frac{1+r_E}{1+r_E^C}\right]E = E + \left[\frac{r_E - r_E^C}{1+r_E^C}\right]E, \tag{3}$$

and

$$D^C = \left[\frac{1+r_D}{1+r_D^C}\right]D = D + \left[\frac{r_D - r_D^C}{1+r_D^C}\right]D, \tag{4}$$

where we denote with:

$$\text{PVE}\left(E; r_E^C\right) = \left[\frac{r_E - r_E^C}{1+r_E^C}\right]E, \tag{5}$$

and with

$$\text{PVD}\left(D; r_D^C\right) = \left[\frac{r_D - r_D^C}{1+r_D^C}\right]D, \tag{6}$$

the psychological values which identify the gaps in the evaluation of the biased CEO with respect to the market for equity and debt, respectively. Different amounts of information are available from the markets regarding the cash

[8] Note that in this framework we are implicitly assuming that the market is rational and produces the correct evaluation of the firm's assets and future investments. While this hypothesis may be questionable, it remains typical in corporate finance studies. Furthermore, it allows the comparative study of the non-rationality of CEOs with respect to the standard setting assuming rational markets.

flows that will accrue to debt versus equity holders. Specifically, it is reasonable to assume that the precision of the market evaluation of debt, as perceived by the CEO, is higher than that of equity. This is due to debt cash flows having a deterministic component; provided that the firm does not default, the coupons and redemption value of the bond are known with certainty, and market perceptions of the likelihood of default are captured by the bond's credit rating. On the other hand, no such information is provided for equity cashflows, making them considerably more variable and less certain. Motivated by this rationale, henceforth we present the results of the model under the following assumption:

Assumption 1. The relative bias in the CEO's evaluation of equity is higher than the relative bias in the CEO's evaluation of the cost of debt. That is,

$$\frac{\left|r_E - r_E^C\right|}{1 + r_E^C} \geq \frac{\left|r_D - r_D^C\right|}{1 + r_D^C} \tag{7}$$

By denoting the value of the levered firm in accordance with the CEO's beliefs as $V_L^C = E^C + D^C$, we have the following identities by Equations (3) to (6):

$$V_L = E + D = E^C + D^C - \text{PVE}\left(E; r_E^C\right) - \text{PVD}\left(D; r_D^C\right) \tag{8}$$

$$= V_L^C - \text{PVE}\left(E; r_E^C\right) - \text{PVD}\left(D; r_D^C\right), \tag{9}$$

and,

$$V_U = V_U^C - \text{PVE}\left(E; r_E^C\right), \tag{10}$$

where V_U^C is the value of an unlevered firm with equal characteristics as perceived by the CEO.

From the different ways in which PVE($E; r_E^C$) and PVD($D; r_D^C$) are specified, we elicit the following definitions in terms of the CEO's estimates of the returns on equity and debt:

Definition 1 (Overconfident CEO). We define as overconfident (OVC) a CEO who perceives the market return on equity r_E and on debt r_D as overestimated with respect to her/his own evaluations, r_E^{OVC} and r_D^{OVC}. Thus,

$$r_E^{\text{OVC}} < r_E \Rightarrow \text{PVE}\left(E; r_E^{\text{OVC}}\right) > 0,$$

and

$$r_D^{\text{OVC}} < r_D \Rightarrow \text{PVE}\left(D; r_D^{\text{OVC}}\right) > 0,$$

from which we have that $V_L^{\text{OVC}} > V_L$.

Definition 2 (Rational CEO). We define as rational (RA) a CEO who perceives the market return on equity r_E and on debt r_D as correctly estimated with respect to her/his own evaluations, r_E^{RA} and r_D^{RA}. Thus,

$$r_E^{\text{RA}} = r_E \Rightarrow \text{PVE}\left(E; r_E^{\text{RA}}\right) = 0,$$

and

$$r_D^{\text{RA}} = r_D \Rightarrow \text{PVE}\left(D; r_D^{\text{RA}}\right) = 0,$$

from which we have that $V_L^{\text{RA}} = V_L$.

Definition 3 (Overcautious CEO). We define as overcautious (CAU) a CEO who perceives the market return on equity r_E and on debt r_D as underestimated with respect to her/his own evaluations, r_E^{CAU} and r_D^{CAU}. Thus,

$$r_E^{CAU} > r_E \Rightarrow \text{PVE}\left(E; r_E^{CAU}\right) < 0,$$

and

$$r_D^{CAU} > r_D \Rightarrow \text{PVE}\left(D; r_D^{CAU}\right) < 0,$$

from which we have that $V_L^{CAU} < V_L$.

Denote the level of leverage of the firm by $L = D/(D+E)$. By assuming that the CEO acts in the interests of shareholders, (s)he chooses the target level of leverage L^T that maximizes the market value of the firm according to the following constrained optimization problem:

$$\max_L \; V_L^C - \text{PVE}\left(E; r_E^C\right) - \text{PVD}\left(D; r_D^C\right), \tag{11}$$

which, clearly, for the rational CEO, coincides with $\max_L \; V_L^{RA}$.

2.3 | Theoretical results

The following propositions synthesize the main theoretical implications of Equation (11).

Proposition 1. *Under Assumption 1, an overconfident (overcautious) CEO has a strictly higher (lower) target leverage with respect to a rational CEO.*

Proof. Equation (11) trivially implies that: □

$$\frac{\partial V_L}{\partial L}\frac{1}{E+D} = \frac{\partial V_L^C}{\partial L}\frac{1}{E+D} - \frac{\partial \text{PVE}\left(E; r_E^C\right)}{\partial L}\frac{1}{E+D} - \frac{\partial \text{PVE}\left(D; r_D^C\right)}{\partial L}\frac{1}{E+D}, \tag{12}$$

$$= \frac{\partial V_L^C}{\partial L}\frac{1}{E+D} + \left[\frac{r_E - r_E^C}{1+r_E^C}\right] - \left[\frac{r_D - r_D^C}{1+r_D^C}\right]. \tag{13}$$

Then, we have that for the overconfident CEO,

$$\left[\frac{r_E - r_E^C}{1+r_E^C}\right] > 0, \qquad \left[\frac{r_D - r_D^C}{1+r_D^C}\right] > 0,$$

and, by Assumption 1,

$$\left[\frac{r_E - r_E^C}{1+r_E^C}\right] - \left[\frac{r_D - r_D^C}{1+r_D^C}\right] > 0,$$

so that $\frac{\partial V_L^{OVC}}{\partial L} > \frac{\partial V_L^{RA}}{\partial L}$ everywhere except at $D = 0$.

Similarly, for the overcautious CEO we have

$$\left[\frac{r_E - r_E^C}{1+r_E^C}\right] < 0, \qquad \left[\frac{r_D - r_D^C}{1+r_D^C}\right] < 0,$$

and, by Assumption 1,

$$\left[\frac{r_E - r_E^C}{1 + r_E^C}\right] - \left[\frac{r_D - r_D^C}{1 + r_D^C}\right] < 0,$$

so that $\frac{\partial V_L^{CAU}}{\partial L} < \frac{\partial V_L^{RA}}{\partial L}$ everywhere except at $D = 0$. Finally, this implies that for the overconfident (overcautious) CEO, the maximum value of the function in Equation (11) is achieved, *ceteris paribus*, at a higher (lower) level of debt with respect to the rational CEO. Q.E.D.

The interpretation of Proposition 1 is as follows. If the return on equity (r_E) is perceived by the CEO as higher than (s)he expects (r_E^C) and Assumption 1 holds, then (s)he believes that financing with equity is overpriced with respect to debt (thus, disadvantageous). Conversely, if the return on equity is lower than the CEO's expectation, (s)he perceives financing with equity to be underpriced by the market with respect to debt (thus, advantageous).

Proposition 2. *Consider a firm led by an overcautious CEO with market value of equity E, and let $V_U = E'$ be the value of the firm under an all equity policy. If the expected psychological advantage of equity for the CEO is such that, for every $D > 0$,*

$$\frac{r_E^C - r_E}{(1 + r_E)} > \left(\frac{\text{TB}(D) - \text{CFD}(D) - \text{PVD}\left(D; r_D^{CAU}\right)}{E' - E}\right), \tag{14}$$

then the target leverage of the firm is zero and the CEO is said to be hypercautious.

Proof. The proof comes from an inspection of Equation (14). Rearranging the terms we have: □

$$-\frac{r_E - r_E^C}{1 + r_E}(E' - E) > \text{TB}(D) - \text{CFD}(D) - \text{PVD}\left(D; r_D^{CAU}\right),$$

which implies:

$$V_U^C - \left[\frac{r_E - r_E^C}{1 + r_E}\right] E' > V_U^C + \text{TB}(D) - \text{CFD}(D) - \text{PVD}\left(D; r_D^{CAU}\right) - \left[\frac{r_E - r_E^C}{1 + r_E}\right] E.$$

By Equation (10), the last equation further implies that:

$$V_U = V_U^C - \left[\frac{r_E - r_E^C}{1 + r_E}\right] E' > V_L^C - \left[\frac{r_E - r_E^C}{1 + r_E}\right] E - \text{PVD}\left(D; r_D^{CAU}\right) = V_L,$$

everywhere. It follows that the value of the unlevered firm (thus for the choice $D = 0$) is higher than the value of the levered firm at every level of debt higher than zero. Q.E.D.

We interpret the result in Proposition 2 as follows: the left-hand side ratio in Equation (14) is the psychological marginal advantage of equity,[9] while the right-hand side ratio is the net advantage of debt per unit of debt employed to finance the firm regardless of the debt benefits and costs.[10] It follows that the right-hand side of Equation (14) is

[9] To see this, note that from Equation (4):

$$-\frac{\partial \text{PVE}(E; r_E^C)}{\partial E} = \frac{r_E^C - r_E}{(1 + r_E)}$$

[10] To see this, note that in the absence of benefits and costs of debt, $V_U = E' = E + D = V_L$, from which it is immediate to see that $E' - E = D$

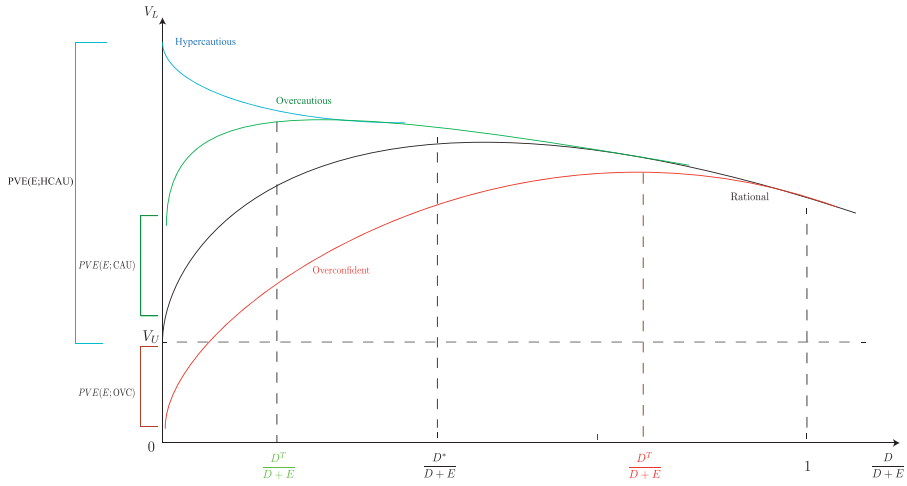

FIGURE 1 The figure graphically represents the patterns of the firm value function resulting from propositions 1 and 2.

interpreted as the marginal advantage of debt. If the psychological marginal advantage of equity offsets the marginal advantage of debt at any level of leverage, then the CEO chooses a zero leverage policy.

The patterns of the firm value function resulting from propositions 1 and 2 are graphically represented in Figure 1. As in the traditional trade-off theory, there exists an optimal level of leverage represented by D^*, which coincides with the target leverage for a firm led by a rational CEO. If the CEO is overconfident (i.e., $\text{PVE}(E; r_E^C) > 0$), (s)he perceives equity as overpriced and thus shows a preference for debt over equity. The target level of leverage chosen by the overconfident CEO is then higher than the optimal, which implies that the firm is overlevered. Conversely, an overcautious CEO (i.e., $\text{PVE}(E; r_E^C) < 0$) finds equity advantageous with respect to other external sources. Thus in this case the CEO chooses a target level of debt which is lower than the optimum, implying that the firm is underlevered. Another important prediction that comes from our model is the case identified by *hypercautious* CEOs. When the comparative advantage of equity with respect to debt together with the expected cost of financial distress offset the tax benefits of debt, the firm value function is everywhere decreasing with respect to leverage. Empirically, this feature provides a possible theoretical explanation of the mystery of zero leverage firms studied in Graham (2000) and Strebulaev and Yang (2013).

For the last of the theoretical predictions of the model, we switch to a dynamic setting and consider the following standard partial adjustment model. Let $L_t = D_t/(D_t + E_t)$ and $L_{t+1} = D_{t+1}/(D_{t+1} + E_{t+1})$ be the level of leverage of a firm in years t and $t + 1$, respectively. Every year, the firm fills a portion γ of the gap between its actual and desired level of leverage L_{t+1}^T. Formally,

$$L_{t+1} - L_t = \gamma \left(L_{t+1}^T - L_t \right). \tag{15}$$

Note that in our setting, firms with equal characteristics led by CEOs with different beliefs adjust their leverage towards different targets. In what follows, we assume that the level of leverage at time t reflects managerial beliefs. Specifically, we assume that if the firm at time t is underlevered, then the firm is led by a non-overconfident CEO (i.e., the CEO is overcautious or rational). On the contrary, if the firm is overlevered, then it is led by a non-overcautious CEO (overconfident or rational).

Proposition 3. *Consider the following partial adjustment models towards the optimal level of leverage* L^*_{t+1},

$$L^{OVC}_{t+1} - L_t = \gamma^{OVC}\left(L^*_{t+1} - L_t\right), \tag{16}$$

and

$$L^{CAU}_{t+1} - L_t = \gamma^{CAU}\left(L^*_{t+1} - L_t\right), \tag{17}$$

where L_t *is the level of leverage at time t, and* γ^{OVC} *and* γ^{CAU} *are the speeds of adjustment towards the target for an overconfident and an overcautious CEO, respectively. If the firm is underlevered at time t, that is,* $L_t < L^*_{t+1}$, *then, for every level of leverage* L_t *and optimal level of leverage* L^*_{t+1}, *we have* $\gamma^{OVC} > \gamma^{CAU}$. *Conversely, if the firm is overlevered at time t, that is,* $L_t > L^*_{t+1}$, *then, for every level of leverage* L_t *and optimal level of leverage* L^*_{t+1}, *we have* $\gamma^{OVC} < \gamma^{CAU}$.

Proof. Consider first the case of an underlevered firm. Proposition 1 trivially implies that $L^{CAU}_{t+1} < L^{OVC}_{t+1}$. Next, by taking the difference between the left-hand side terms of Equations (16) and (17) we get:

$$L^{OVC}_{t+1} - L^{CAU}_{t+1} = \left(\gamma^{OVC} - \gamma^{CAU}\right)\left(L^*_{t+1} - L_t\right).$$

Then, $\gamma^{OVC} > \gamma^{CAU}$ follows trivially by noting that we have assumed $L_t < L^*_{t+1}$. The proof for the overlevered firm is analogous with inverted inequalities and thus is omitted. Q.E.D. □

2.4 | Testable hypotheses

According to the main implications of our model, in what follows we empirically test the three hypotheses below. As highlighted in the introduction, the focus of this study is on overcaution as, at least in part, some of the predictions in terms of overconfidence already have well-established evidence in the existing literature. Nevertheless, in the empirical analysis we also report for completeness the results relative to overconfident leadership.

Hypothesis 1. Zero levered firms are more likely to be led by overcautious CEOs.

Hypothesis 2. Firms led by overcautious CEOs are more likely to enter and less likely to leave low leverage policies despite the existence of tax shields.

Hypothesis 3. Overlevered (underlevered) firms led by overcautious CEOs adjust to the target faster (more slowly) than overconfident CEOs.

3 | DATA AND VARIABLE DEFINITIONS

3.1 | Leverage and its determinants

Our sample draws from all firms included in the Compustat Industrial Annual Database between 1996 and 2022 continuously listed for at least 5 years. We do not consider data prior to 1996 because of the nonavailability of observations at the CEO level, which represent a primary ingredient of this study. Consistent with previous research in the field, we exclude from the sample financial firms (SIC 6000–6999), regulated utilities (SIC 4900–4999), regulated telephone companies (SIC 4813), non-US companies (FIC not equal to USA), non-publicly traded firms and subsidiaries (STKO equal to one and two), and all firms with asset book value (AT) adjusted for inflation at 1996 USD less than

$10 million. We collect from Compustat firm-year observations on long-term debt (DLTT), short-term debt (DLC), total asset book value (AT), the fiscal year-end common share price (PRCC_F) and fiscal year-end number of shares outstanding (CSHO). We define book leverage BL_{it} and market leverage ML_{it} of firm *i* in year *t* as follows:

$$BL_{it} = \frac{DLTT_{it} + DLC_{it}}{AT_{it}}, \quad ML_{it} = \frac{DLTT_{it} + DLC_{it}}{DLTT_{it} + DLC_{it} + CSHO_{it} \times PRCC\_F_{it}}. \tag{18}$$

Following Strebulaev and Yang (2013), we define from the market and book leverage values two binary variables concerning the zero leverage ZL_{it} and "almost zero" leverage AZL_{it} policies that a firm may have adopted. Therefore, ZL_{it} is a dummy variable equal to one if firm *i* has both market and book leverage equal to zero in year *t* and zero otherwise. Similarly, AZL_{it} is a dummy variable equal to one if firm *i* has both market and book leverage not higher than 5% in year *t* and zero otherwise.

Following, among others, Flannery and Rangan (2006) and Malmendier et al. (2011), we collect data on profitability, tangibility, market and book value of assets, net investment, change in working capital, cash flow after interest and taxes, research and development, capital expenditure, operating leases, operating income before interest and depreciation (OIBD), and taxes. We compute the market to book Ratio (Q) as the market value of assets divided by the book value of assets. Finally, we collect the annual consumer price index from the U.S. Bureau of Labor Statistics.

3.2 | Overconfidence and overcaution measures

Our classification of CEOs as overconfident or overcautious follows the methodology proposed by Campbell et al. (2011) based on the CEO's options exercise behavior. In their study, the authors classify a CEO as overconfident whenever (s)he delays the exercise of options that are deeply in the money and, conversely, as being of low confidence (overcautious) whenever (s)he exercises options almost at the money. We follow their approach and first compute an approximation of the option's moneyness. Then we consider the average behavior of the CEOs leading each firm during a particular year by determining the average moneyness of unexercised and exercised options. Finally, we rank the leadership during 1 year according to the following hypothesized thresholds: overconfident if on average they hold exercisable options that are more than 100% in the money and overcautious if they exercise options that are on average less than 30% in the money and do not hold any other options in their portfolio. Therefore, in our setting, a firm classified in a certain year as being led by an overconfident CEO means that, on average, the CEO leading it during that year behaved on average as if overconfident. This, differently from Campbell et al. (2011), allows us to work with a well-balanced panel where each observation has the same weight in the cross-section, independent of how many CEOs were in charge during a precise year.

To compute the option's moneyness, we rely on the approximation proposed by Core and Guay (2002). We merge our dataset with the following options data from Execucomp: total realizable value of exercisable options (OPT_UNEX_EXER_EST_VAL), number of exercisable options (OPT_UNEX_EXER_NUM), total value realized from exercising stock options (OPT_EXER_VAL) and number of options exercised (OPT_EXER_NUM). The moneyness for the unexercised options is defined as:

$$\text{Moneyness}_u = \frac{\text{OPT\_UNEX\_EXER\_EST\_VAL/OPT\_UNEX\_EXER\_NUM}}{\text{PRCC\_F} - \text{OPT\_UNEX\_EXER\_EST\_VAL/OPT\_UNEX\_EXER\_NUM}}$$

and for the exercised options as:

$$\text{Moneyness}_e = \frac{\text{OPT\_EXER\_VAL/OPT\_EXER\_NUM}}{\text{PRCC\_F} - \text{OPT\_EXER\_VAL/OPT\_EXER\_NUM}},$$

where the numerator contains proxies for the realized or realizable value per option and the denominator contains proxies for the exercise price.

Finally, as CEO-level control variables, we also collect from Execucomp observations on the CEOs' age, salary and bonus. We require each firms' average leadership to be classifiable – that is, the data required to compute the average moneyness are available through a continuous period of at least 5 years. Thus, we remove from the dataset all the firms for which moneyness is not available or negative, as well as all CEOs for whom the number of observations does not allow their ranking in one of the aforementioned categories. This leaves 25,225 firm-year observations for 2,620 firms.

3.3 | Summary statistics

Table 1 reports summary statistics for the firm-level and CEO-level variables. Panel A presents statistics for the full sample of firms, including the percentage of zero and almost zero levered firms, the percentage of overconfident CEOs and that of overcautious CEOs. The full sample counts 25,225 observations, where 2569 firm-year observations refer to zero levered companies (10% of the sample). For the overall sample (Panel A), the percentage of overconfident leadership is 44%, while the overcautious CEOs account for 34% of the sample. Notably, the percentage does not change significantly when considering only zero levered firms (Panel B). Indeed, the subsample displays 50% of overconfident CEOs and 32% of overcautious CEOs.

The two panels summarize the characteristics of the variables of interest used as explanatory variables for the zero leverage policy by Strebulaev and Yang (2013) for the entire sample and the zero levered subsample. By comparing the statistics between the two samples, we observe that there is no significant difference between zero levered and levered firms regarding firm characteristics. Differently, for the CEO salary and bonus, we observe some differences. In particular, both appear to be significantly lower (of respectively 0.2 and 0.13) in mean for zero levered firms. Nevertheless, as the subsequent analyses show, the introduction of these controls does not alter our model's predictions.

4 | EMPIRICAL RESULTS

In this section we test the three main predictions of the model.

4.1 | Zero leverage firms and overcaution

4.1.1 | Determinants of zero leverage policy

In what follows, we test the first implication of the model, that is, that overcautious CEOs are more likely to adopt a zero (or an almost zero) leverage policy despite the existence of tax shields. Following Strebulaev and Yang (2013), we test this hypothesis by employing the following multivariate logit regression model:

$$\mathbb{P}[z_{it} = 1] = F\left(\alpha + X'_{it}\beta + \delta^{\text{CAU}} D_{it}^{\text{CAU}} + \delta^{\text{OVC}} D_{it}^{\text{OVC}}\right) \tag{19}$$

where X_{it} is the matrix of firms' characteristics, D_{it}^{CAU} is a binary variable equal to one if the CEO is overcautious and D_{it}^{OVC} is a binary variable equal to one if the CEO is overconfident. z_{it} is a dummy variable that takes different specifications when we consider zero leverage and almost zero leverage firms. In particular, for zero leverage firms, z_{it} is equal to one if the firm i has both market and book leverage equal to zero at time t, and zero otherwise. For almost zero leverage firms, z_{it} is equal to one if the firm i has both market and book leverage less than 5% at time t, and zero otherwise.

Table 2 reports the results from the multivariate logit regressions using the zero leverage dummy as the dependent variable in the models of columns (1) to (3), and the almost zero leverage dummy as the dependent variable in the

TABLE 1 The table reports the summary statistics of the firm-year observations collected from Compustat for the period 1996–2022.

Panel A: Full Sample													
Variable	**Obs.**	**Mean**	**Median**	**Std. dev.**	**Min**	**Max**	**Variable**	**Obs.**	**Mean**	**Median**	**Std. dev.**	**Min**	**Max**
Market Leverage	25,225	0.2149	0.1624	0.2087	0.0000	0.9999	Overconfidence	25,225	0.4409	0.0000	0.4965	0.0000	1.0000
Book Leverage	25,225	0.2385	0.2245	0.1860	0.0000	0.8508	Overcaution	25,225	0.3431	0.0000	0.4748	0.0000	1.0000
ML Industry Median	25,225	0.1882	0.1750	0.1327	0.0000	0.8148	Infaltion	25,225	0.2074	0.2073	0.0345	0.1569	0.2927
BL Industry Median	25,225	0.2120	0.2142	0.1177	0.0000	0.6695	Capex	25,103	0.3634	0.0599	1.0259	0.0009	7.5970
Zero Levered	25,225	0.1018	0.0000	0.3024	0.0000	1.0000	Oper. Leases	23,309	0.3146	0.0655	0.7508	0.0009	5.0660
Almost Zero Levered	25,225	0.1989	0.0000	0.3992	0.0000	1.0000	OIBDP	25,203	1.2186	0.2023	4.4054	−21.9130	128.1370
Profitability	25,203	0.0003	0.0003	0.0002	−0.0004	0.0009	Taxes	25,222	0.2003	0.0296	1.0579	−34.8310	37.1620
Tangibility	25,199	0.0006	0.0004	0.0005	0.0000	0.0021	CEO Age	21,939	58.2374	58.0000	7.9186	31.0000	96.0000
Size	25,225	0.0068	0.0067	0.0016	0.0036	0.0111	CEO Salary	25,225	0.6465	0.5577	0.4227	0.0000	8.1000
Q	25,225	0.0030	0.0022	0.0028	0.0001	0.0160	CEO Bonus	25,225	0.3434	0.0000	1.1486	0.0000	76.9510
Panel B: Zero Levered Firms													
Profitability	2564	0.0003	0.0003	0.0002	−0.0004	0.0009	Overconfidence	2,569	0.4963	0.0000	0.5001	0.0000	1.0000
Tangibility	2569	0.0004	0.0003	0.0003	0.0000	0.0020	Overcaution	2,569	0.3227	0.0000	0.4676	0.0000	1.0000
Size	2569	0.0054	0.0052	0.0011	0.0036	0.0111	OIBDP	2,564	0.2049	0.0562	1.4898	−0.3440	58.4460
Q	2569	0.0049	0.0038	0.0034	0.0001	0.0160	Taxes	2,569	0.0507	0.0131	0.3623	−0.9240	14.0300
Inflation	2,569	0.1994	0.1953	0.0274	0.1569	0.2710	CEO Age	2,153	57.7585	57.0000	8.6206	35.0000	94.0000
Capex	2,550	0.0451	0.0142	0.2053	0.0009	7.5970	CEO Salary	2,569	0.4356	0.3750	0.2568	0.0000	1.5695
Oper. Leases	2,283	0.0908	0.0173	0.2369	0.0009	3.6330	CEO Bonus	2,569	0.2135	0.0010	0.5489	0.0000	11.3063

(Continues)

TABLE 1 (Continued)

Note: We exclude from the sample financial firms, regulated utilities, regulated telephone companies, non-US companies, non-publicly traded firms and subsidiaries, and all firms with asset book value adjusted for inflation at 1996 USD less than $10 million. We further exclude all of the observations for which the corresponding data at CEO level from Execucomp is not available. Market Leverage and Book Leverage are the debt to equity ratios computed from Equation (18). ML Industry Median and BL Industry Median are the median industry market and book leverage, respectively. Zero levered and Almost Zero Levered are dummies equal to one if both market and book leverage are equal to zero and less than 5%, respectively, and zero otherwise. Profitability is operating income before depreciation, normalized by assets at the beginning of the year. Tangibility is property, plant & equipment normalized by assets at the beginning of the year. Size is the natural logarithm of total assets adjusted at 1996 USD and expressed in millions. Q is the market value of assets over the book value of assets. Overconfidence and overcaution are dummy variables equal to one if the CEO is classified as an overconfident or an overcautious, respectively, and zero otherwise. Inflation is the annual consumer price index from the U.S. Bureau of Labor Statistics. Capex is the ratio of capital expenditure to book assets. Operating leases is the sum of current rental payments and the discounted present value of future rental commitments up to 5 years. OIBDP is the operating income before depreciation. Taxes is the amount of taxes payed by the firms. CEO age is the age of the CEO. CEO salary and CEO bonus are the CEO's monetary compensations expressed in thousands dollars. Market Leverage, Book Leverage, Profitability, Tangibility Size, Q, Capex, Oper. Leases, OIBDP, CEO Salary and CEO Bonus are winsorized at 1% level. Sample: 2620 firms. Period: 1996-2022.

models of columns (4) to (6). Following Strebulaev and Yang (2013), we include size, Q, profitability, tangibility and the book leverage industry median as the main explanatory variables together with some controls. Then, following Campbell et al. (2011), we include CEO-level variables as controls.

The models of Columns (1) and (4) employ the same variables used in the study of Strebulaev and Yang (2013) as determinants. Both the significance and direction of the variables are consistent with their study. In particular, firms are more likely to be zero levered and almost zero levered if they are small, profitable, have less tangible assets, and have a high market-book ratio. In columns (4) and (8), we add the managerial trait of interest. In the models, overcaution appears to be an important variable in the explanation of both the zero leverage and almost zero leverage policy. The coefficient on overcaution is significant and positive in both models, as predicted by our theoretical framework. The pseudo R-squared increases marginally, by less than 1%. However, this result is consistent with other well placed studies[11] that include a dummy variable through a similar ranking to that proposed by Campbell et al. (2013). Hence, the negligibility in the pseudo R-squared increment is most likely attributable to the low granularity of the variable introduced rather than to low importance of CEO overcaution as a zero leverage policy determinant. The results are robust to the introduction of the usual controls, as reported in columns (4) and (8). The CEO level controls are consistent, both in significance and direction, with the findings of Strebulaev and Yang (2013).

Another explanation that has been proposed to explain zero leverage behaviour is based on the hypothesis that debt is reduced by substitutes or non-debt tax shields (Shivdasani & Stefanescu, 2010). Among these substitutes, Strebulaev and Yang (2013) study whether operating leases play a role in the firm's decision of whether to be zero levered. In their multivariate logit regression, they find operating leases to be non-significant, and thus they reject the hypothesis of an impact of the latter on such choices. Our results are not totally consistent with theirs and show that higher operating leases imply a higher probability of choosing at least an almost all equity structure. Another explanation is that a zero leverage policy encapsulates the potential attempt by some firms to retain financial flexibility in anticipation of future investment. Our interpretation based on managerial overcaution does not contradict the two alternative explanations above. Overcautious CEOs, who believe that the cost of capital will rise in the future, may decide to procrastinate future investments and to retain flexibility regarding their capital structures accordingly. Regarding the debt substitutes hypothesis, there are no conflicts between overcaution and the choice of a non-debt form of financing. In fact, as implicit in the definition of overcautious CEOs, they irrationally prefer an equity (or similar) form of financing rather than debt.

[11] See for instance Ho et al. (2016, Table 3), Malmendier et al. (2011, Table VII, Models in Columns 2 and 3), or Banerjee et al. (2018, Tables 2 and 3).

TABLE 2 Logit regressions with zero leverage and almost zero leverage dummy variables as dependent variables.

	Zero Levered				Almost Zero Levered			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Overcaution		0.154*	0.180**	0.232**		0.128*	0.194***	0.275***
		(0.083)	(0.085)	(0.097)		(0.066)	(0.068)	(0.077)
Overconfidence		0.026	−0.085	−0.065		0.116*	−0.008	0.065
		(0.075)	(0.077)	(0.090)		(0.060)	(0.062)	(0.072)
Size	−848.566***	−845.194***	−833.843***	−829.801***	−899.184***	−895.326***	−878.349***	−868.087***
	(28.867)	(28.934)	(30.249)	(36.700)	(22.976)	(23.045)	(23.642)	(28.614)
Q	107.636***	111.179***	169.603***	169.770***	168.308***	167.915***	230.749***	217.972***
	(8.618)	(8.877)	(10.119)	(11.130)	(8.209)	(8.402)	(9.583)	(10.270)
Profitability	966.409***	989.844***	931.818***	1,133.375***	889.590***	902.181***	880.644***	1,079.176***
	(141.630)	(142.130)	(147.063)	(162.437)	(128.403)	(128.826)	(134.589)	(146.607)
Tangibility	−1,439.021***	−1,455.653***	−1,273.762***	−1,139.742***	−1,413.910***	−1,423.040***	−1,267.361***	−1,180.456***
	(115.463)	(116.056)	(117.225)	(122.567)	(85.530)	(85.792)	(87.690)	(92.995)
R&D	0.000***	0.000***	0.001***	0.001***	0.000**	0.000**	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Capex	−0.590***	−0.576***	−0.622***	−0.533**	0.241***	0.242***	0.234***	0.220***
	(0.218)	(0.216)	(0.241)	(0.236)	(0.058)	(0.058)	(0.059)	(0.064)
Oper. Leases	0.575***	0.574***	0.509***	0.548***	0.431***	0.429***	0.396***	0.485***
	(0.089)	(0.089)	(0.092)	(0.094)	(0.056)	(0.057)	(0.058)	(0.060)
Firm Age	−0.008*	−0.009**	−0.009*	−0.009	−0.019***	−0.020***	−0.010**	−0.009*
	(0.004)	(0.004)	(0.005)	(0.006)	(0.004)	(0.004)	(0.004)	(0.005)
CEO Age				0.015***				0.012***
				(0.004)				(0.003)

(Continues)

TABLE 2 (Continued)

	Zero Levered				Almost Zero Levered			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CEO Salary				–0.579***				–0.687***
				(0.137)				(0.102)
CEO Bonus				0.131**				0.112***
				(0.054)				(0.039)
Constant	3.149***	3.077***	2.058***	1.422***	4.445***	4.346***	3.757***	3.193***
	(0.169)	(0.178)	(0.239)	(0.355)	(0.142)	(0.149)	(0.188)	(0.280)
Year FE	NO	NO	YES	YES	NO	NO	YES	YES
Pseudo R-squared	0.2679	0.2684	0.290	0.300	0.249	0.249	0.280	0.289
Observations	14,907	14,907	13,743	11,778	14,907	14,907	14,907	12,940

Note: Zero leverage and almost zero leverage are binary variables equal to one if the firm holds both market and book leverage equal to zero and less than 5%, respectively, and to zero otherwise. Overconfidence and overcaution are dummy variables equal to one if the CEO is classified as overconfident or overcautious, respectively, following the approach described in Section 3.2, and to zero otherwise. Size is the natural logarithm of total assets adjusted at 1996 USD and expressed in millions. Q is the market value of assets over the book value of assets. Profitability is operating income before depreciation, normalized by assets at the beginning of the year. Tangibility is property, plant & equipment normalized by assets at the beginning of the year. R&D expenses is the ratio of research and development expenses to sales. Capex is the capital expenditure. Operating leases is the sum of current rental payments and the discounted present value of future rental commitments up to 5 years. Firm age is the number of years the firm has existed. CEO age is the age of the CEO. CEO Salary and CEO Bonus are the CEOs' monetary compensations. All standard errors are adjusted for heteroskedasticity, clustered at firm level, and reported in parentheses. *, ** and *** indicate significance at 10%, 5% and 1% level, respectively.

4.1.2 | Entry and exit decisions

In this section, we complement the analysis of the zero leverage policy by studying the relationship between overcaution and the decision to enter into or exit from a zero leverage policy. Following Strebulaev and Yang (2013), each firm that is zero levered at a certain time and shows debt higher than zero in a successive year is associated with an entry event. Conversely, each firm that is non zero levered at a certain time and shows debt equal to zero in future years is associated with an exit event. The same variables are also defined for the almost zero leverage policy in accordance with the definition of the latter. Then, the hypothesis we aim to test in this section is that overcautious behavior contributes to predicting entry decisions in zero leverage and almost zero leverage policies, as well as the decision to stick with such policies by avoiding exit decisions. Conversely, overconfident behavior contributes to predicting the avoidance of entrance to zero leverage and almost zero leverage policies or, if preexisting, decisions to exit. To perform the test we employ the following multivariate logit model:

$$\mathbb{P}\left[\text{Entry/Exit}_{it}=1\right]=F\left(\alpha+X'_{it}\beta+\delta^{\text{CAU}}D^{\text{CAU}}_{i,t-1}+\delta^{\text{OVC}}D^{\text{OVC}}_{i,t-1}+\delta^{\text{IZL}}D^{\text{IZL}}_{it}\right) \tag{20}$$

where Entry/Exit_{it} is a dummy variable that takes different specifications when we consider an entry or an exit event. In particular, for each firm i, Entry_{it} is equal to one for the first time in the time-series if the firm is levered at time $t-1$ and becomes all equity at time t. Then, $\text{Entry}_{i\tau}=1$ for all $\tau>t$ until an exit decision is observed in $T>t$, for which we set $\text{Entry}_{iT}=0$. In all other cases, $\text{Entry}_{it}=0$. Similarly, Exit_{it} is equal to one for the first time in the time-series if the firm is zero levered at time $t-1$ and becomes levered at time t. Then, $\text{Exit}_{i\tau}=1$ for all $\tau>t$ until an entry event is observed in T, for which Exit_{iT} is set back to zero. In all other cases, $\text{Exit}_{it}=0$. Likewise, the same variables are defined with respect to a threshold of 5% instead of 0% in the leverage ratio. Finally, X_{it} is the same set of explanatory variables considered in the previous analysis while D^{IZL}_{it} is a dummy variable equal to one if the firm is zero levered at the first observation in the employed time series and zero otherwise.

Table 3 reports the results of the multivariate logit regressions in Equation (20). All of the estimations include the set of variables in X_{it} – that is, size, market over book value of assets, profitability, tangibility, R&D expenses, capital expenditure, operating leases and firm age. Panel A reports the results relative to the zero leverage policy while Panel B reports the results for the almost zero leverage case. In both the panels, columns (1) to (4) refer to entry decisions while columns (5) to (8) refer to exit decisions. Overall, the results confirm the prediction of the theory regarding both entry and exit decisions for both zero and almost zero leverage policies. Indeed, regardless of the model specification, the coefficient associated with overcaution is statistically significant at least at the 95% level of confidence, with a positive sign for the entry decision (columns (1)-(4) in both panels) and a negative sign for the exit decision (columns (5)-(8) in both panels). Therefore, the empirical evidence confirms that CEO overcaution plays an important role in these decisions, also given the robustness of the results to the introduction of all the controls. For the overconfidence dummy, the coefficient associated with the entry decision in an all equity position is negative and statistically significant, while it is statistically insignificant in all other cases (except for the specification in column (8) of Panel B). The results of this model confirm that overconfident CEOs are less likely to enter an all equity position, but not an almost zero levered position, as Panel B shows, while this behavioral bias seems irrelevant in terms of exit decisions. In particular, by comparing the different models in columns (5)–(8) of Panel B, it is likely that the negative and statistically significant coefficient for overconfidence in column (8) is counterbalancing the effect that the inclusion of the CEO controls has on almost zero leverage exit decisions.[12] In particular, we could have concluded that overconfident CEOs are more likely to exit from an almost zero leverage policy if the coefficients in the baseline models, which do not include the controls, were statistically significant. Since this is not the case, we argue that the resulting significance is to be taken

[12] Untabulated results show that, in this case, the age of the CEO has an estimated coefficient of 0.015 with a standard error of 0.005, showing a positive impact on almost zero leverage exit decisions that is significant at the 99% level of confidence. Furthermore, we discard the hypothesis that the significance of CEO overconfidence in (8) is due to multicollinearity, as overconfidence is uncorrelated with all of the CEOs controls.

TABLE 3 Logit regressions with entry and exit dummy variables as dependent variables.

Panel A: Zero Levered Firms								
	Entry				**Exit**			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Overcaution (t-1)	0.510***	0.511***	0.586***	0.483**	−0.236*	−0.291**	−0.395***	−0.538***
	(0.170)	(0.170)	(0.173)	(0.188)	(0.139)	(0.145)	(0.148)	(0.159)
Overconfidence (t−1)	−0.294*	−0.297*	−0.379**	−0.469**	−0.189	−0.199	−0.086	−0.230
	(0.171)	(0.171)	(0.173)	(0.189)	(0.124)	(0.129)	(0.132)	(0.145)
Initially ZL		−0.404**	−0.564***	−0.493***		2.712***	2.844***	2.967***
		(0.171)	(0.172)	(0.181)		(0.128)	(0.135)	(0.146)
Size	−414.033***	−453.362***	−406.875***	−437.041***	−296.593***	88.161*	59.268	21.518
	(65.455)	(66.980)	(68.674)	(77.845)	(42.777)	(49.070)	(51.090)	(58.443)
Q	60.947***	64.705***	119.576***	114.652***	48.603***	−9.294	−28.500	−18.089
	(19.326)	(19.136)	(20.937)	(22.361)	(16.081)	(19.530)	(20.813)	(21.794)
Profitability	1,057.660***	1,108.362***	1,069.418***	901.406***	153.324	−207.122	−193.551	−354.156
	(320.469)	(319.912)	(319.024)	(338.998)	(266.502)	(285.515)	(292.520)	(305.176)
Tangibility	−1,552.331***	−1,628.620***	−1,397.359***	−1,459.106***	−717.813***	−164.842	−319.548*	−255.598
	(281.713)	(285.126)	(285.096)	(302.121)	(180.388)	(178.365)	(179.431)	(186.986)
R&D	0.000	0.000*	0.000**	0.000*	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Capex	−1.936**	−1.873**	−2.119**	−1.955**	0.052	−0.102	−0.077	−0.096
	(0.893)	(0.888)	(0.921)	(0.895)	(0.074)	(0.080)	(0.081)	(0.087)
Oper. Leases	0.421*	0.439*	0.364	0.364	0.257***	0.146	0.124	0.120
	(0.232)	(0.230)	(0.235)	(0.239)	(0.089)	(0.100)	(0.101)	(0.108)
Firm Age	−0.004	−0.005	−0.002	−0.003	−0.006	−0.000	−0.045***	−0.049***
	(0.010)	(0.010)	(0.011)	(0.012)	(0.008)	(0.009)	(0.011)	(0.012)

(Continues)

TABLE 3 (Continued)

Panel A: Zero Levered Firms								
	Entry				**Exit**			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Constant	−1.133***	−0.818*	−1.693***	−3.018***	−1.318***	−4.634***	−4.852***	−4.653***
	(0.413)	(0.430)	(0.546)	(0.775)	(0.296)	(0.370)	(0.581)	(0.761)
Year FE	NO	NO	YES	YES	NO	NO	YES	YES
CEO Control	NO	NO	NO	YES	NO	NO	NO	YES
Pseudo R squared	0.09	0.09	0.11	0.11	0.03	0.16	0.19	0.21
Observations	14,907	14,907	13,743	11,778	14,126	14,126	14,126	12,442
Panel B: Almost Zero Levered Firms								
	Entry				**Exit**			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Overcaution (t-1)	0.341***	0.349***	0.394***	0.471***	−0.176*	−0.184*	−0.288***	−0.447***
	(0.122)	(0.122)	(0.124)	(0.137)	(0.099)	(0.099)	(0.101)	(0.109)
Overconfidence (t−1)	−0.031	−0.042	−0.092	−0.093	−0.177*	−0.173*	−0.111	−0.233**
	(0.117)	(0.117)	(0.118)	(0.133)	(0.092)	(0.092)	(0.093)	(0.101)
Initially ZL		−1.699***	−1.818***	−1.661***		0.600***	0.628***	0.722***
		(0.192)	(0.193)	(0.196)		(0.104)	(0.106)	(0.112)
Size	−352.036***	−455.876***	−440.384***	−406.037***	−170.773***	−115.953***	−148.723***	−167.501***
	(38.355)	(39.546)	(40.157)	(48.762)	(31.305)	(32.968)	(33.874)	(39.247)
Q	44.076***	59.054***	97.209***	93.516***	−26.452*	−39.821**	−65.652***	−55.924***
	(14.270)	(13.914)	(15.018)	(16.196)	(15.137)	(15.828)	(16.722)	(17.315)
Profitability	751.971***	894.086***	931.268***	797.779***	235.431	215.658	154.277	85.176
	(233.918)	(234.369)	(235.779)	(254.421)	(222.632)	(224.485)	(227.100)	(238.540)
Tangibility	−1,140.093***	−1,330.836***	−1,207.303***	−1,187.464***	−541.340***	−466.687***	−598.171***	−602.476***
	(168.223)	(172.709)	(174.214)	(187.259)	(123.303)	(123.343)	(123.346)	(130.342)

(Continues)

TABLE 3 (Continued)

Panel B: Almost Zero Levered Firms								
	Entry				Exit			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
R&D	−0.000	−0.000	0.000	0.000	0.000**	0.000**	0.000*	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Capex	0.205**	0.253***	0.254***	0.182*	0.194***	0.172***	0.209***	0.240***
	(0.089)	(0.088)	(0.088)	(0.107)	(0.047)	(0.047)	(0.047)	(0.049)
Oper. Leases	0.089	0.138	0.106	0.082	0.079	0.058	0.059	0.051
	(0.111)	(0.108)	(0.110)	(0.126)	(0.066)	(0.067)	(0.066)	(0.069)
Firm Age	−0.016**	−0.018***	−0.015*	−0.015*	−0.003	−0.002	−0.036***	−0.035***
	(0.007)	(0.007)	(0.008)	(0.009)	(0.006)	(0.006)	(0.008)	(0.009)
Constant	−0.596**	0.239	−0.692*	−1.327**	−1.315***	−1.764***	−1.799***	−2.449***
	(0.259)	(0.268)	(0.367)	(0.528)	(0.225)	(0.242)	(0.366)	(0.503)
Year FE	NO	NO	YES	YES	NO	NO	YES	YES
CEO Control	NO	NO	NO	YES	NO	NO	NO	YES
Pseudo R squared	0.05	0.08	0.10	0.10	0.01	0.02	0.04	0.05
Observations	14,126	14,126	14,126	12,442	14,126	14,126	14,126	12,442

Note: Entry (exit) is a binary variable equal to one for every firm that is not zero levered (is zero levered) at the first observation sampled from Compustat, and that shows at least an observation in the sample with market leverage equal to (different from) zero, and to zero otherwise. Initially ZL is a binary variable equal to one if the firm is zero levered at the first observation sampled from Compustat. Zero leverage and almost zero leverage are binary variables equal to one if the firm holds market leverage equal to zero and less than 5%, respectively, and to zero otherwise. Overconfidence and overcaution are dummy variables equal to one if the CEO is classified as an overconfident or overcautious, respectively, following the approach described in Section 3.2, and to zero otherwise. Size is the natural logarithm of total assets adjusted at 1996 USD and expressed in millions. Q is the market value of assets over the book value of assets. Profitability is operating income before depreciation, normalized by assets at the beginning of the year. Tangibility is property, plant & equipment normalized by assets at the beginning of the year. R&D expenses is the ratio of research and development expenses to sales. Capex is the capital expenditure. Operating leases is the sum of current rental payments and the discounted present value of future rental commitments up to 5 years. Firm age is the number of years the firm has existed. CEO age is the age of the CEO. CEO Salary and CEO Bonus are the CEOs' monetary compensations. All standard errors are adjusted for heteroskedasticity, clustered at firm level, and reported in parentheses. *, ** and *** indicate significance at 10%, 5% and 1% level, respectively.

as less reliable, and likely due to a complex inter-relationship between the overconfidence dummy variable and the CEO control variables.

Regarding the other variables, we find that for both zero and almost zero leverage entry decisions, smaller and less tangible firms that have higher Q are more likely to become either zero or almost zero levered. This confirms previous evidence in the literature. Differently, the evidence on the other variables and on the whole exit decision regression diverges from the results in Strebulaev and Yang (2013). A first reason for this mixed evidence is definitely the huge difference in the samples analyzed. In their study, the authors employ a sample that dates back to 1962 with 157,536 observations (132,311 observations more than that employed here). Also, the match with observations on the variables necessary to compute options' moneyness, which is required in our study, contributes to significantly reducing the number of observations available. Second, although they consistently find an inverted sign for most of the variables regarding exit decisions, the significance associated with them is for the most part either weak or not robust. In this light, the analysis seems to confirm that the determinants of exit decisions used so far in the literature have yet to be fully discovered.

4.2 | Overconfidence, overcaution and speed of adjustment

In this section, we verify the empirical validity of the implications of our model about the speed of adjustment towards the target leverage. In a dynamic setting, the traditional trade-off theory predicts that CEOs should adjust relatively quickly to a certain desired level of leverage which, under the common assumptions of rationality, coincides with the optimal level of leverage that balances the tax benefits and the expected costs of financial distress. A widely used test of dynamic trade-off theory is to check whether the speed of adjustment towards optimal leverage is sufficiently high in order to confirm the main prediction of the theory.

The test of this hypothesis is usually performed by employing a dynamic panel model with fixed effects. In particular, Flannery and Rangan (2006) consider the following:

$$L_{i,t} - L_{i,t-1} = \gamma \left(L^*_{i,t} - L_{i,t-1} \right) + \varepsilon_{i,t}, \tag{21}$$

and

$$L^*_{i,t} = \alpha_i + \beta X_{it-1}, \tag{22}$$

where $L_{i,t}$ is the level of leverage of firm i at time t, $L^*_{i,t}$ is the optimal level of leverage given the conditions of the firm at time t, γ is the speed of adjustment towards the target and X_{it-1} is a matrix of lagged characteristics of firm i, current or lagged macroeconomic variables, and year dummies. As is well known, it is not possible to observe the optimal level of leverage. Thus, the following reduced form specification of the model is typically adopted:

$$L_{i,t} = (1-\gamma)L_{i,t-1} + \gamma\alpha_i + \gamma\beta X_{it-1} + \varepsilon_{i,t}. \tag{23}$$

As we show in Section 2, our version of trade-off theory implies the existence of a discrepancy between the target and optimal level of leverage for CEOs who are not rational. In particular, as we show formally in Proposition 3, our model predicts that the speed of adjustment towards the optimal level of leverage is slower for overlevered firms led by overconfident CEOs and for underlevered firms led by overcautious CEOs. To perform the analysis, we proceed in the following steps. First, we estimate Equation (23) and extract the predicted values L^*_{it} for each firm. Then, we classify each firm at each time as underlevered if $L_{i,t} < L^*_{it}$, and as overlevered if $L_{i,t} > L^*_{it}$. Finally, for each of the two subgroups, we further divide the sample into firms led by overcautious and overconfident CEOs and estimate Equation (23) for each of the subgroups. For the estimation method, we employ the Arellano and Bond (1991) estimator to adjust for short panel bias issues (see for instance Flannery & Hankins, 2013) and unobserved firm heterogeneity. According to

TABLE 4 Arellano-Bond panel regressions (STATA command xtabond) with lagged book leverage as dependent variable.

	Underlevered Overcautious	Firms Overconfident	Overlevered Overcautious	Firms Overconfident
Book Leverage$_{(t-1)}$	0.391***	0.352***	0.240***	0.434***
	(0.044)	(0.050)	(0.036)	(0.039)
Profitability$_{(t-1)}$	0.105***	0.095***	−0.011	0.032*
	(0.019)	(0.023)	(0.019)	(0.019)
Tangibility$_{(t-1)}$	−0.005	0.056***	−0.037**	−0.034*
	(0.017)	(0.021)	(0.016)	(0.018)
Size$_{(t-1)}$	−0.016***	−0.018***	−0.005	−0.004
	(0.005)	(0.007)	(0.007)	(0.006)
Capex$_{(t-1)}$	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
OIBDP$_{(t-1)}$	−0.000	0.000	0.000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Inflation$_{(t-1)}$	0.001***	0.001**	−0.001***	−0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
Taxes$_{(t-1)}$	0.000	−0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Median Ind. BL$_{(t-1)}$	−0.069	−0.327*	−0.083	0.237**
	(0.073)	(0.172)	(0.096)	(0.105)
Observations	2,185	1,828	1,605	1,770

Note: Overconfidence and overcaution are the subsamples of firms with leadership classified as overconfident or overcautious, respectively, following the approach described in Section 3.2, and to zero otherwise. Profitability is operating income before depreciation, normalized by asset at the beginning of the year. Tangibility is property, plant & equipment normalized by asset at the beginning of the year. Size is the natural logarithm of total assets adjusted at 1996 USD and expressed in millions. R&D expenses is the ratio of research and development expenses to sales. Capex is the capital expenditure. OIBDP is the operating income before depreciation. Inflation is the annual consumer price index from the U.S. Bureau of Labor Statistics. Taxes is the amount of taxes payed by the firm expressed in millions. BL Industry Median is the median industry book leverage. All of the variables are one-period lagged. All standard errors are adjusted for heteroskedasticity, clustered at firm level and reported in parentheses. *, ** and *** indicate significance at 10%, 5% and 1% level, respectively.

Yin and Ritter (2019), the speed of adjustment estimated by using market leverage is significantly upwardly biased due to the passive influence of stock price fluctuations. Accordingly, we proceed by estimating the speed of adjustment by employing book leverage exclusively in the analysis.

The results of the analysis are reported in Table 4. Consistent with previous findings in the literature,[13] the estimated speed of adjustment towards the optimal level of leverage is in three out of four cases (underlevered firms and overelevered firms led by overconfident CEOs) too low to validate the dynamic trade-off theory (the values span from 57%=1–43% in the fourth column to 65% in the second column). Moreover, Hypothesis 3 is rejected for overconfident CEOs leading underlevered firms, with a speed of adjustment of 65%, which is not statistically different from the 61% displayed by overcautious CEOs. Differently, by looking at the overlevered firms, we find that overcautious CEOs adjust with a speed of 76%, which is 19 percentage points higher than the 57% displayed by overconfident

[13] See, for instance, Huang and Ritter (2009), Flannery and Hankins (2013) and Yin and Ritter (2019).

CEOs. Therefore, we conclude that Hypothesis 3 should be rejected in general. A possible explanation for this lack of evidence could be that overconfidence is not just reflected in an upward bias relative to the cashflows, but also by an excessive confidence about past capital structure decisions. In such a case, an overconfident CEO may struggle to realize that they have ended up with a biased evaluation and, accordingly, may not adjust the target leverage appropriately. Nevertheless, our theory does not currently include this feature, which is therefore left for further research in this direction.

5 | CONCLUSIONS

In this paper we introduce a new version of the trade-off theory of corporate capital structure choices which accounts for CEOs' overcaution separately from overconfidence. The main predictions of the model are that: (i) hypercautious CEOs are more likely to adopt and less likely to leave a zero leverage policy, and (ii) non-rational CEOs adjust towards the optimal level of leverage more slowly than rational CEOs. We find that these predictions are supported empirically by the data.

The empirical evidence contributes in the following ways to the current literature. First, it additionally analyzes corporate capital structure choices from the perspective of overcautious CEOs. We find that overcautious CEOs hold cross-sectionally less debt than firms led by non-overcautious CEOs, complementing previous results on the existing heterogeneity in firms' capital structures. Second, our new model sheds some light on the so called "mystery of zero levered firms", suggesting a behavioral explanation for this phenomenon. We find that, in fact, firms led by overcautious CEOs are more likely to be zero or almost zero levered. Finally, the paper provides some new intuition regarding the excessively slow speed of adjustment of leverage observed in previous studies, suggesting that the low rate of reversion towards the optimum may be due to the heterogeneity in CEOs biased beliefs.

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APPENDIX A

Table A.1

TABLE A.1 Definitions, descriptions and sources of the main variables employed in the empirical analyses.

Variable Name	Description	Definition/Source
AZL	Dummy variable which identifies a zero leverage firm according to Strebulaev and Yang (2013)	AZL =1 if ML < 5% (or BL < 5%)
BL	Book value of leverage computed following Flannery and Rangan (2006)	(Long Term Debt + Short Term Debt) / Asset Book Value
Cautiousness	Dummy variable which identifies a cautiousCEO according to Campbell et al. (2011)	Cautiousness = 1 if Moneyness_e,â§0.3 and Moneyness_u = 0
ML	Market value of leverage computed following Flannery and Rangan (2006)	(Long Term Debt + Short Term Debt) /(Long Term Debt + Short Term Debt + Equity Value)
Moneyness_e	Moneyness of the options estimated by the CEO	See p.15
Moneyness_u	Estimated Moneyness of the options not exercised by a CEO following Core and Guay (2002)	See p.15
OPT_EXER_VAL	Value of the options in the CEO's portfolio that have been exercised during the fiscal year	EXECUCOMP
OPT_EXER_NUM	Number of options in the CEO's portfolio that have been exercised during the fiscal year	EXECUCOMP
OPT_UNEX_EXER_NUM	Number of options in the CEO's portfolio which are exercisable but have not yet been exercised	EXECUCOMP
OPT_UNEX_EXER_EST_VAL	Estimated value of the options in the CEO's portfolio which are exercisable but have not yet been exercised	EXECUCOMP
Overconfidence	Dummy variable which identifies an overconfident CEO according to Campbell et al. (2011)	Overconfidence =1 if Moneyness_u ≥ 1 and Moneyness_e >1
PRCC_F	Fiscal year end common share price	COMPUSTAT
ZL	Dummy variable which identifies a zero leverage firm according to Strebulaev and Yang (2013)	ZL =1 if ML = 0 (or BL = 0)