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Credit ratings and capital structure: New evidence from overconfident CFOs

By

Shee-Yee Khoo^a, Huong Vu^{a*} and Patrycja Klusak^b

^a *University of Aberdeen, King's College, AB24 3FX, UK.*

^b *Norwich Business School, University of East Anglia; Bennett Institute for Public Policy, University of Cambridge, UK*

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Abstract

In this paper, we examine the impact of credit rating changes on the financing decisions of overconfident CFOs. We find that CFO overconfidence significantly increases the sensitivity of net debt issuances to the rating changes, particularly when firms have no access to low-risk debt. Specifically, we establish that speculative-grade firms with overconfident CFOs reduce net debt issuance following rating changes (i.e. upgrades and downgrades). Our results hold after controlling for CEO bias. Furthermore, we document that CEO overconfidence has explanatory power on firm financing policies as it generates the potential multiplier effect on debt conservatism, as well as on investment return. Findings of our paper are robust to model specifications and to the endogeneity bias.

Keywords: Credit Ratings, Corporate Finance, Capital Structure, Behavioural Finance, CEO Overconfidence, CFO Overconfidence

JEL classification: G24, G32, G40

1. Introduction

In this paper, we empirically investigate the effects of CFO overconfidence on the adjustments of capital structure in US non-financial firms experiencing credit rating changes. Kisgen (2006, 2009) is the first to examine the impact of credit rating changes on capital structure among US non-financial companies. Specifically, he finds that there is an asymmetric adjustment of leverage to credit rating changes in the previous year, whereby firms only decrease leverage following a credit rating downgrade but do not make significant adjustment following an upgrade. Such financing behaviour has been noted in the follow-up work by Huang and Shen (2015) and Wojewodzki, Poon and Shen (2018). However, none of these studies account for the heterogeneity in the personal traits of key executives who make such capital structure adjustments, thereby implicitly assuming they are homogeneous.

It is widely documented in the behavioural finance literature that corporate managers exhibit overconfidence in belief, which in turn has a profound effect on their decisions on important corporate matters, particularly capital structure policy (Sharot 2011; Fast et al. 2012; Hackbarth 2008; Malmendier, Tate and Yan 2011; Shefrin 2018). A vast majority of these studies concentrate on CEO's irrationality, specifically CEO overconfidence and its impact of on capital structure policy. Hackbarth (2008) show that overconfident managers exhibit a standard pecking order preference in their financing decisions. Specifically, they prefer internal capital to debt and only issue equity as the last resort to fund investment opportunities. In comparison with rational CEOs, overconfident CEOs choose higher debt versus equity as they believe that their firms' equity is undervalued by the capital market (Malmendier, Tate and Yan 2011). In other words, overconfident CEOs perceive a smaller cost to issuing debt than equity. Nevertheless, excessive preference for internal capital to external capital could lead to debt conservatism, whereby the overconfident CEOs underutilise debt relative to its tax benefits (Malmendier, Tate and Yan 2011). Given the particularly strong preference for internal

capital over external financing, the investment of overconfident CEOs is strongly associated with the availability of internal cash flows (Malmendier and Tate 2005; Aktas, Louca and Petmezas 2019).

Notwithstanding the evidence for CEO overconfidence and capital structure in the literature, studies on the impact of CFO's irrationality on corporate financial policies remain scarce. To the best of our knowledge, study by Malmendier, Pezone and Zheng (2020) is the only one to analyse the effect of CFO overconfidence bias on capital structure. However, authors do not investigate the causal relationship between CFO overconfidence and capital structure adjustments following a credit rating change. Given that CFOs are primarily responsible for financial policies, and credit rating is the second order (after financial flexibility) consideration when it comes to how much debt to hold (Graham and Harvey 2001), we present an original research question of how credit rating changes affect overconfident CFOs' capital structure decisions. To provide an answer to this question, we extend the study of Malmendier, Pezone and Zheng (2020) by empirically investigating the influence of credit rating changes on the financing decisions of CFOs subject to overconfidence bias. Using a rich dataset containing 1,347 CFOs from 803 US non-financial firms rated by Standard & Poor's (S&P) between 2006 and 2019, we reveal original insights about the effects of rating changes on financing decisions in firms where the CFOs are overconfident.

In general, rating changes exert a significant impact on the firms' cost of capital and their access to debt financing (Agha and Faff 2014). Notably, firms with better credit ratings have lower cost of borrowing as lower yields are associated with higher credit ratings (Billett and Garfinkel 2004). As such, upgraded (downgraded) firms are more likely to increase (decrease) leverage for investments due to the decreased (increased) cost of debt. However, considering that overconfident managers display debt conservatism and exhibit great reluctance in tapping funds from capital markets (Malmendier, Tate and Yan 2011), we argue

that overconfident CFOs would decrease leverage after credit rating upgrades. This is most pronounced in firms without an investment grade rating, whilst less prevalent among firms with investment-grade ratings. This is because overconfident managers are willing to issue debt which they, and the markets, consider as low-risk¹ (Malmendier, Tate and Yan 2011), whereby risk refers to the risk of default and correlates strongly with rating levels. Furthermore, in comparison with rational CFOs, we postulate that overconfident CFOs have a stronger tendency to reduce leverage in response to rating downgrades due to their debt conservatism. Taking upgrades and downgrades together, we expect that CFO overconfidence significantly increases the sensitivity of corporate financing to rating changes.

In this study, we measure CFO overconfidence using option-based measures first proposed by Malmendier and Tate (2005). We classify a CFO as overconfident if he/she holds options that are beyond a threshold of 67% in-the-money at least twice during their tenure period. The rationale behind is that rational CFOs would exercise in-the-money options once vested in order to divest themselves of firms' idiosyncratic risk. Our empirical results support the prediction that overconfident CFOs issue significantly less net debt following rating actions (i.e. an upgrade or a downgrade). With regards to rating upgrades, net debt issuance of firms with overconfident CFOs decreases by 1.33% following a rating upgrade from the previous year. Consistent with our expectations, the decrease of net debt following rating upgrades is only significant among speculative-grade firms. In investment-grade firms (firms with the access to low-risk debt), we find that overconfident CFOs issue 1.77% more debt following rating upgrades. In case of rating downgrades, overconfident CFOs reduce net debt issuance by 3.7% more than their rational counterparts, which supports our predictions.

¹ Low-risk debt is the debt with relatively low cost due to low default risk. In this paper, we define firms having the access to low-risk debt as those in the investment grade rating categories (ratings at and higher than BBB-).

Since CEOs are the ultimate decision makers in the firms, their behavioural traits play a crucial role in corporate financing decisions. Hence, we control our empirical models for CEO overconfidence² when assessing the magnitude and empirical relevance of CFO overconfidence on corporate financial policies following rating changes. Firstly, our results show that the evidence concerning overconfident CFOs reducing debt following rating upgrade is robust even after controlling for CEO overconfidence. Secondly, we also document a multiplier effect of CEO overconfidence and CFO overconfidence on investment return across firms in both investment grade rating categories (with low-risk debt) and speculative grade rating categories (without low-risk debt). Specifically, firms in the investment grade rating categories will not reduce debt following rating downgrades if both CEO and CFO exhibit overconfidence bias (i.e. multiplier effect on investment return). With regards to rating upgrades, debt is reduced only if CFO and CEO are both overconfident (i.e. multiplier effect on debt conservatism). Our results are strongly robust to different sets of year and industry level fixed effects.

Our empirical findings are particularly useful for corporate stakeholders in better understanding how credit ratings affect financing decisions of overconfident CFOs. We show that overconfident CFOs are more likely to pursue excessively conservative debt policies when ratings change, especially when firms have no access to low-risk debt (they are in the speculative grade ratings). In such cases, the board could encourage overconfident CFOs to utilise debt in order to take full advantage of tax benefit (of debt), particularly after a rating upgrade. Our original contributions to the literature are two-fold. First, we provide original insights about the relevance of CFO overconfidence bias to corporate capital structure, thereby filling the void in the behavioural finance literature. Second, we add to the existing credit rating

² We measure CEO overconfidence in the same way as we measure CFO overconfidence (i.e. using option-based measures).

literature an original evidence concerning the effects a manager's personal trait might have on his/her reactions to credit rating actions.

The rest of the paper is organised as follows. Section 2 reviews the literature. Section 3 explains the hypotheses. Section 4 discusses the sample selection and the research methodologies. Section 5 summarises the data sample. Section 6 discusses our empirical results. Finally, Section 7 concludes.

2. Literature Review

Behavioural corporate finance studies have challenged conventional ideas in the neoclassical corporate finance. While the traditional corporate finance researchers consider financial executives as rational decision makers, behavioural corporate finance researchers argue that managerial executives have different psychological characteristics, hence behaving less than fully rational (Tversky and Kahneman, 1974). The effect of overconfidence on managerial decisions was first documented in Roll (1986). Since then, the literature on managerial bias began to grow. A majority of studies focus on overconfidence and optimism among corporate managers and how they impact their decisions, including corporate investment, cash holding, financing and dividend policies (e.g. Malmendier and Tate 2005; Malmendier, Tate and Yan 2011; Deshmukh, Goel and Howe 2013; Huang, Tan and Faff 2016; Aktas, Louca and Petmezas 2019; Chen, Ho and Yeh 2020).

The trait of overconfidence, which stems from the notion of a 'better-than-average' effect, is commonly found among corporate executives (Larwood and Whittaker 1977). This well-documented managerial bias is known to influence managers' capital structure decisions, i.e. the choice between internal capital and external capital, and the choice between debt and equity. Hackbarth (2008) presents a theoretical model in which overconfident managers exhibit a standard pecking order preference. In other words, overconfident managers do not have a

target leverage since they have a strong preference for internal funds over debt and they issue debt only after the internal funds have depleted.

Overconfident managers tend to overestimate firms' future cash flows and believe that their firms' risky securities are undervalued by the market (Heaton 2002). Excessive overconfidence causes the managers to believe that external finance is unduly costly, particularly equity. This is because equity prices are generally more sensitive to biases in beliefs than debt. Therefore, overconfident managers prefer to use cash or riskless debt and are less inclined to seek external financing. Under the influence of the pecking order preference, Hackbarth (2008) argues that overconfident managers choose higher leverage than rational managers. This is because equity prices are more sensitive to differences in opinions about future cash flows between the managers and the investors (Malmendier, Tate and Yan 2011). In addition, overconfident managers perceive firms' default risk to be lower due to the higher perceived growth rate of earnings, which creates discrepancies between companies' real financing costs and their perceived financing costs (Hackbarth 2008).

Based on a survey of 1,017 chief executive officers (CEOs) and 1,276 chief financial officers (CFOs) across different regions, Graham, Harvey and Puri (2013) show that firms with overconfident managerial executives (i.e. CEO and CFO) are likely to hold more debt. They also find significant differences in the personality traits between US and non-US managerial executives, where the former group is more optimistic than the latter. Moreover, the overestimation of future returns from investment projects cause overconfident CEOs to believe that the future will be better than the recent past (Heaton 2002). Consistent with this view, Landier and Thesmar (2009) and Huang, Tan and Faff (2016) find that overconfident CEOs use more short-term debt than rational CEOs because they believe they can refinance short-term debt at lower costs in the future.

Even though overconfident CEOs choose debt over equity when accessing external capital markets, their preference is to finance expected future investment without having to access external markets (Malmendier, Tate and Yan 2011). Chen, Ho and Yeh (2020) find that overconfident CEOs have a stronger tendency to hold cash for future investments. Along the same lines, Deshmukh, Goel and Howe (2013) show that overconfident CEOs are more likely to reduce dividend payments in order to build financial slack for future investment because they view external financing as costly. In line with their findings, Malmendier, Tate and Yan (2011) document that overconfident CEOs exhibit debt conservatism which underutilises debt relative to the available debt tax shield due to their reluctance to access external financing. Overconfident CEOs who display debt conservatism rely excessively on internal funds if they hold a high level of cash holdings. Alternatively, if the initial cash holdings are low, overconfident CEOs may still choose lower debt financing if the perceived costs of external finance exceed overestimated investment returns. It is important to point out that debt conservatism can, but does not necessarily, imply low leverage. In fact, overconfident CEOs are keen to raise low-risk debt. When circumstances permit, they might even overinvest in it (Malmendier and Tate 2005).

Although the impact of CEO overconfidence on corporate financial policies is understood, it is noteworthy that CEOs may rely on CFOs to execute their financing decisions. Bertrand and Schoar (2003) show that CFOs appear to play a stronger role than CEOs in financial policies because financial activities are CFOs' core duties. Furthermore, Graham, Harvey and Puri (2015) provide evidence that CEOs are more likely to delegate financial decisions to CFOs when they are overloaded. Most recently, Malmendier, Pezone and Zheng (2020) show that the biased beliefs of CFOs dominate those of the CEOs in relation to pecking-order distortions and high leverage.

In contrast with the growing number of studies on the effects of managerial overconfidence on corporate financial policies, the literature provides little insight into the likely impact of credit ratings on managers who are subject to overconfidence bias. Graham and Harvey (2001) find that credit ratings are the second highest concern for CFOs when determining their capital structure. Consistent with Graham and Harvey (2001), Kisgen (2006) develops the Credit Rating-Capital Structure (CR-CS) hypothesis and shows that firms are more likely to reduce leverage when they are near a rating change. Extending his first paper, Kisgen (2009) finds that firms target a minimum credit rating in their capital structure decisions. Specifically, they decrease net debt issuance³ following credit rating downgrades in order to regain the previous higher credit rating, but do not increase net debt issuance following credit rating upgrades to avoid subsequent rating reversals. Using a cross-country sample, Huang and Shen (2015) further document the asymmetric adjustment of capital structure to rating downgrades and upgrades first documented for US firms by Kisgen (2009). Nevertheless, Agha and Faff (2014) find that only financially flexible firms can increase leverage after rating is upgraded to capitalise on the benefits of rating upgrades (i.e. reduced cost of capital).

To sum up, the managerial overconfidence has been subject to empirical scrutiny with a focus on important decisions such as capital structure and capital budgeting. However, none of the existing studies look at the impact credit ratings may have on the financing decisions of CFOs prone to overconfidence bias despite the growing evidence of the implications of ratings for corporate financial policies.

³ Kisgen (2006, 2009) defines net debt issuance as book long-term debt plus book short-term debt, scaled by total assets at the beginning of the year.

3. Hypotheses Development

Credit ratings play an important role in the financial markets, corporate financing and investment decisions. Firms without credit ratings face limited access to external debt while those failing to obtain investment-grade ratings incur higher cost of debt capital (Boot, Milbourn and Schmeits 2006). Agha and Faff (2014) document that a credit rating change is followed by a significant change in cost of capital. Notably, firms experience a decrease (an increase) in their cost of debt following credit rating upgrade (downgrade). Conditional on financial flexibility, firms might react to rating changes as signals of changes in financial distress cost or benefits (Agha and Faff 2014). Accordingly, upgraded firms (which are financially flexible) will increase their leverage to capitalise on the benefits of rating upgrades, whereas downgraded firms (which are financially inflexible) will reduce leverage due to the increased cost of capital. However, the above inverse relationship between rating actions and leverage documented in Agha and Faff (2014) does not account for the possibility that CFOs are subject to overconfidence bias.

Let us consider a firm experiencing a reduction in cost of debt following a rating upgrade. While rational CFOs would issue debt to reap the benefits of lower cost of debt and take advantage of the tax shield benefits, overconfident CFOs would be less likely to do the same if there was a disagreement about the appropriate interest rate between the overconfident CFOs and the investors (Malmendier, Tate and Yan 2011). Overconfident CFOs believe that their firms are less risky and/or more profitable than they actually are, therefore their perceived cost of debt is lower than the interest rate required by the creditors (Malmendier, Tate and Yan 2011). Upgrades in ratings would change the perception of risk of both the capital markets and the overconfident CFOs but might not help eliminating the disagreement on the appropriate interest rate between them. Therefore, we postulate that, while rational CFOs would issue more debt, overconfident CFOs would not. A second explanation is that, even when the

overconfident CFOs' perceived financing cost does not differ from the market's view, the overconfident CFOs may still be reluctant to issue debt following rating upgrades. This is because a credit rating upgrade signals a stronger capability of generating positive cash flows, hence increasing the chance to cover the investment outlay with internal capital.⁴ This is because overconfident CFOs could plough back even more profits instead of distributing the excess profits to the shareholders in the form of dividends (Deshmukh, Goel and Howe 2013). With a higher level of cash flows, overconfident CFOs are more likely to reduce risky debts and finance investments with internal capital following rating upgrades. In line with this reasoning, we propose the first hypothesis as follows:

***H1:** Overconfident CFOs issue less net debt following credit rating upgrades in the previous year.*

However, it is important to point out that overconfident managers are not reluctant to issue low-risk debt (Malmendier, Tate and Yan 2011). In other words, debt conservatism should not be found among firms with an access to low-risk debt financing. Those firms are most likely to have an investment-grade credit rating. Consequently, overconfident CFOs in investment-grade firms are more likely to issue debt following rating upgrades to finance desired (over-)investment. Conditional on firms having an investment-grade rating, we propose the alternative hypothesis as follows:

***H1a:** Overconfident CFOs in investment-grade firms issue more net debt following credit rating upgrades in the previous year.*

In contrast with rating upgrades, a credit rating downgrade increases the cost of debt capital and limits the access to debt market (Boot, Milbourn and Schmeits 2006; Agha and Faff

⁴ CRAs adjust the credit rating of an issuer based on its strength of generating cash flow (S&P 2013).

2014). Under this condition, overconfident CFOs abstain from issuing debt because they believe that rational investors demand higher interest rates than they deem appropriate due to their overestimation of future cash flows. Therefore, we anticipate that the tendency to issue less debt in response to rating downgrades is stronger among overconfident CFOs than rational CFOs. In this case, overconfident CFOs would either suggest that the CEOs should fund investment projects with internal capital or abandon projects should there be insufficient cash holdings. The effects of downgrades on financing behaviour among overconfident CFOs is similar between investment-grade and speculative-grade firms. This is because the corporate bond prices of both investment-grade and speculative-grade firms react negatively to downgrades (May 2010). This reasoning leads us to the expectation that the debt issuance of firms with overconfident CFOs decreases more significantly than rational CFOs following rating downgrades, regardless of the rating category. Hence, we propose our second hypothesis as follows:

***H2:** Overconfident CFOs issue less net debt following credit rating downgrades in the previous year.*

Hypothesis 2 is tested against a null that there is no change in the net debt issuance of firms with overconfident CFOs after rating downgrades occur.

4. Sample Selection and Methodology

4.1. Data Sample

Our sample consists of all non-financial publicly listed US firms rated by S&P in the period between 2006 and 2019. The beginning of the sample period is restricted by data availability. ExecuComp only started to provide data on executive package-level option holdings which are required to construct an overconfidence measure following changes in the reporting requirements by FAS 123R in 2006. Following the literature, we measure CFO

overconfidence based on executive option exercise behaviour (Malmendier and Tate 2005; Campbell et al. 2011; Hirshleifer, Low and Teoh 2012). Rating information is collected from S&P Ratings Direct database whereas accounting and financial data are obtained from Compustat for the same period on an annual basis. We exclude the companies in the financial services industry (SIC codes between 6000 and 6999) and utilities (SIC codes between 4900 and 4999).

To be included in the final sample, firms must have data on option holdings of two key executives, i.e. the CFO and the CEO, for a given firm-year to reduce misattribution bias. Our final sample consists of 4,975 firm-year observations for which ratings, accounting data and manager's stock option data are available. In total, there are 803 firms and 1,347 CFOs in the sample.

4.2. Methodology

4.2.1. Overconfidence Measure

In this paper, we identify overconfident CFOs by their option exercise behaviour, which is the most commonly approach employed in prior literature (e.g. Malmendier and Tate 2005; Campbell et al. 2011; Hirshleifer, Low and Teoh 2012). The rationale behind this method is that overconfident managers overestimate the expected payoffs of investment projects, since they believe that the future stock price will continue to rise under their leadership. This belief induces them to postpone exercising rights. As a result, overconfident managers are less likely to exercise their in-the-money vested stock options than do rational counterparts in order to benefit from the expected future gains (Malmendier and Tate 2005). Accordingly, we classify a CFO as overconfident after he/she fails to exercise options that are beyond a threshold of 67% in-the-money at least twice during their tenure period. The threshold of 67% is chosen based on a model of Hall and Murphy (2002) on executive stock holdings and exercising decisions. Because overconfidence is a persistent trait, a CFO once identified as overconfident

remains so for the rest of the sample period. Finally, we construct a dummy variable based on this option-based identification of overconfident CFOs as follows.

OCFO: a dummy variable that takes the value of one if a CFO fails to exercise vested options at least twice during his or her tenure and the option is at least 67% in-the-money, zero otherwise.

Following Campbell et al. (2011) and Hirshleifer, Low and Teoh (2012), we measure in-the-money options with average moneyness of the CFO's option portfolio for each year using data from the ExecuComp database. This measure of overconfidence generates similar results as in Malmendier and Tate (2005). Specifically, the average option moneyness is calculated as follows:

$$OptM_{it} = \overline{RV}_{it} / \overline{K}_{it} \quad (1)$$

where *OptM* is the average moneyness measured in percentages; \overline{RV} is the average realisable value per option, which is equal to the total realisable value of options divided by the number of options held by the CFOs for each CFO-year.⁵ \overline{K} is the estimated average exercise price, which is derived by subtracting the average realisable value per option from the fiscal year-end closing stock price. We include only the vested options held by the CFOs as our main interest is to identify CFOs who chose to hold options that could have been exercised. We also apply the procedure described above to identify overconfident CEOs in our sample.

⁵ Total realisable value of the options is the difference between the exercise price of the options and the closing stock price of the company at fiscal year-end.

4.2.2. Empirical Models

The pecking order theory asserts that the cost of financing increases with asymmetric information, therefore firms that follow pecking order would issue securities with the lowest information costs first before issuing securities with higher information costs (Frank and Goyal 2003). In other words, firms first issue debt rather than equity when their internally generated funds are inadequate for investments (i.e. financing deficit). We postulate that overconfident CFOs do not increase or might even decrease debt levels following a credit rating upgrade in the previous year due to their strong preference for internal capital and their disagreement with investors on perceived cost of debt. Following Frank and Goyal (2003), we estimate a modified pecking order model to test our Hypothesis 1 and Hypothesis 2 as follows:

$$\begin{aligned} NetD_{it} = & \alpha + \beta_1 FD_{it} + \beta_2 OCFO_{it} + \beta_3 UP_{i,t-1} + \beta_4 DOWN_{i,t-1} + \beta_5 UP_{i,t-1} * OCFO_{it} + \\ & \beta_6 DOWN_{i,t-1} * OCFO_{it} + \beta_7 FD_{it} * OCFO_{it} + \varepsilon_{it} \end{aligned} \quad (2)$$

where $NetD_{it}$ represents the net debt issuance. Following Frank and Goyal (2003) and Malmendier, Pezone and Zheng (2020), we measure net debt issuance ($NetD$) by long-term debt issuance minus long-term debt reduction. FD_{it} represents financing deficit, which is defined as cash dividends plus investment plus change in working capital minus cash flow after interest and taxes. Our definition of financing deficit is consistent with Frank and Goyal (2003). $NetD_{it}$ and FD_{it} are scaled by market value of total assets at the beginning of the year.⁶

$OCFO$ is a binary variable for overconfident CFOs, which takes the value of one if a CFO fails to exercise vested options at least twice during his or her tenure and the option is at least 67% in-the-money, zero otherwise. $UP_{i,t-1}$ and $DOWN_{i,t-1}$ are dummy variables that

⁶ We also scale the variables by book value of total assets at the beginning of the year, and the results are very similar and do not affect our conclusions.

equal one if the firm rating was upgraded or downgraded in the previous year, respectively.⁷ The changes in ratings are lagged by one year to alleviate the potential endogeneity issues. Ratings in our paper are long-term domestic currency issuer credit ratings assigned by S&P, which are converted into numerical values based on a 21-notch scale.⁸ ε_{it} is the i.i.d idiosyncratic error-term. The effects of rating changes on financing behaviour of overconfident CFOs are captured by β_5 and β_6 , whereas β_7 tests the financing hierarchy among overconfident CFOs.

We are aware that the behavioural traits of CEOs also play a vital role in firms' financing decisions. While CFOs suggest strategies for financing plans using their knowledge and understanding of the firms' financial position, it is likely that CEOs have the ultimate say. To control for CEOs' behavioural traits in our model, we construct three dummy variables based on the possible combinations of executives' biases as identified by the executive option exercise behaviour,⁹ as follows.

OCFO_RCEO: a dummy variable that takes the value of one if the CFO is overconfident and the CEO is rational, zero otherwise.

RCFO_OCEO: a dummy that takes the value of one if the CFO is rational and the CEO is overconfident, zero otherwise.

OCFO_OCEO: a dummy that takes the value of one if both CFO and CEO are overconfident, zero otherwise.

⁷ We also re-estimate Eq. (2) using *UP* and *DOWN* that represent the number of notches changed in the previous year. Eq. (2) is estimated for upgrades and downgrades separately. The regression results are very similar and do not affect our conclusions. Refer to Appendices B and D for the full results.

⁸ Refer to Appendix A for a full conversion table.

⁹ We classify an executive (i.e. CFO or CEO) as overconfident after he/she fails to exercise options that are beyond a threshold of 67% in-the-money at least twice during their tenure period. More details in Section 4.2.1.

Accordingly, we estimate the following model to account for CEOs' behavioural traits:

$$\begin{aligned}
 NetD_{it} = & \alpha + \beta_1 FD_{it} + \beta_2 Y_{it} + \beta_3 UP_{i,t-1} + \beta_4 DOWN_{i,t-1} + \beta_5 UP_{i,t-1} * Y_{it} + \\
 & \beta_6 DOWN_{i,t-1} * Y_{it} + \beta_7 FD_{it} * Y_{it} + \varepsilon_{it}
 \end{aligned} \tag{3}$$

where $NetD_{it}$ is defined as net debt raised for the year divided by market value of total assets at the beginning of the year. FD_{it} represents financing deficit to market value of total assets. $UP_{i,t-1}$ ($DOWN_{i,t-1}$) is a binary variable indicating that rating has been upgraded (downgraded) in the previous year.¹⁰ Y_{it} represents the set of three dummy variables for three combinations of executives' biases, which are $OCFO_RCEO$, $RCFO_OCEO$ and $OCFO_OCEO$. ε_{it} is the i.i.d idiosyncratic error-term. The benchmark group in this regression is the firms with both CFOs and CEOs being rational.

To test our Hypothesis 1a, the regression models of Eq. (2) and Eq. (3) are estimated separately for investment-grade and speculative-grade subsamples. We also include a full set of year dummies and industry dummies in our regression models to control for the macro-economic conditions and the time-invariant industry heterogeneity. Additionally, our regression models are also controlled for industry dummies by year to allow for the time-varying industry effects. The industry dummies by year capture all the time-variant shocks at industry level that affect both the corporate rating changes and the corporates' capital market activities, hence alleviate the potential omitted variable bias in our models. We identify industry groups using the Fama and French 12 industry classifications. In all estimations, the standard errors are robust to heteroscedasticity.

¹⁰ We also re-estimate Eq. (3) using UP and $DOWN$ that represent the number of notches changed in the previous year. Eq. (3) is estimated separately for upgrades and downgrades. The regression results are very similar and do not affect our conclusions. Refer to Appendices C and E for the full results.

5. Descriptive Analysis

In this section, we describe the data for which full descriptive summary is provided by Table 1. Panel A of Table 1 presents the descriptive statistics of all the variables for the entire sample over the period 2006-2019. Panel B and Panel C show the descriptive statistics for the subsamples split by rational CFOs and overconfident CFOs, respectively. Panel A of Table 1 shows that the average net debt issuance is 1.2% of total assets. The average *Rating* in our sample is 11.8, which is equivalent to BBB-. Panel B of Table 1 reveals that, on average, overconfident CFOs issue significantly more net debt than rational CFOs at the 1% level. This result is consistent with the literature that overconfident managers choose higher leverage than rational managers (Heaton 2002; Hackbarth 2008). Nonetheless, firms with overconfident CFOs have significantly less external financing needs than firms with rational CFOs at the 1% level. One possible explanation for this finding is that overconfident managers tend to accumulate more cash and distribute less dividends than do rational managers due to their pecking order preference (Deshmukh, Goel and Howe 2013; Chen, Ho and Yeh 2020).

Figure 1 depicts the sample rating distribution in more details. Specifically, it displays the sample distributions of S&P's corporate credit ratings separately for rational CFO and overconfident CFO subsamples. Our sample consists of non-defaulting firms that lie in all categories of the rating scale. The highest obtainable rating for US firms in our sample is 21 (which is equivalent to AAA rating), while the lowest is 2 (which is equivalent to CC rating). According to Figure 1, the distributions of S&P's credit ratings for both types of managers are symmetric spanning the entire rating spectrum. The ratings of overconfident CFOs group tend to cluster around the investment-speculative rating borderline (i.e. BB+ and BBB-), while the ratings of rational CFOs subsample are slightly more dispersed.

Table 2 displays the annual net debt issuance for firms experiencing rating upgrades and downgrades in the previous year for the four groups of firms categorised by their CEOs'

and CFOs' bias. Panel A displays the *Mean Net Debt Issuance* following rating changes in the previous year for the full sample, while Panels B and C show the *Mean Net Debt Issuance* across investment-grade and speculative-grade subsamples, respectively. In Column 2, Panel A of Table 2, the mean net debt issuance by overconfident CFOs (when CEOs are rational) in firms experiencing rating downgrades (or upgrades) in the previous year is 1.9%, which is lower than 2.3% for firms not experiencing rating changes. It means that firms with overconfident CFOs tend to issue less debt after being upgraded or downgraded. This effect persists regardless of the CEOs' behavioural traits as we notice the same pattern in Column 4, Panel A of Table 2 which displays the mean net debt issuance by overconfident CFOs (when CEOs are also overconfident). In contrast with overconfident CFOs, rational CFOs tend to issue more net debt after rating is upgraded, compared to firms with stable ratings, which is illustrated in Column 1, Panel A of Table 2. Specifically, the mean *NetD* of firms with both executives being rational are higher for those being upgraded (0.8%) than for those with stable ratings (0.7%). When experiencing downgrades, firms with at least one overconfident executive tend to reduce net debt issuance (Columns 2, 3, 4, Panel A), and this effect does not occur in firms with both executives being rational (Column 1, Panel A). This is consistent with our prediction that the sensitivity of capital structure adjustments to rating downgrades becomes stronger if the managers involved in corporate financing exhibit overconfidence bias.

Conditional on the access to low-risk debt financing, Panel B of Table 2 shows that investment-grade firms with overconfident CFOs and rational CEOs (Column 2) reduce net debt issuance following rating upgrade. However, the opposite effect arises in Column 4 where both CEOs and CFOs are overconfident. In this case, the average *NetD* of investment-grade firms with both overconfident executives is 1.7% of total assets after being upgraded, which is slightly higher than that of firms with stable ratings (1.6%). Column 4 in Panel B of Table 2 is consistent with our Hypothesis 1a whereby overconfident CFOs in investment-grade firms

might issue more low-risk debt in response to rating upgrades. This is similar to the response of firms with both rational executives increasing net debt issuance following rating upgrades (Column 1). On the other hand, Columns 2 and 4 in Panel C of Table 2 show that overconfident CFOs in speculative-grade firms tend to issue less debt if being upgraded. This corroborates our prediction that Hypothesis 1 is more prevalent among high-risk companies. In the case of rating downgrades, both investment-grade and speculative-grade firms with at least one overconfident executive tend to reduce net debt issuance, and the reduction in debt issues is largest in firms have overconfident CFO and rational CEO (Column 2).

6. Empirical Results

6.1. Baseline Model Estimation

In this section, we discuss our empirical results concerning Hypothesis 1 and 2 tested with Eq. (2). The full results are presented in Table 3. Column 1 shows the baseline regression without fixed effects, while Columns 2 and 3 include industry and year dummies and industry dummies by year, respectively. In general, the results of the pooled-OLS regressions lend support to the Hypothesis 1 and Hypothesis 2 that a credit rating upgrade or downgrade in firms with overconfident CFOs is followed by a significant decrease in *NetD*, while the similar effect is not found in firms with rational CFOs.

The coefficients on the interactions between *OCFO* and *UP* are negative and significant in all specifications. Column 1 of Table 3 shows that overconfident CFOs decrease net debt issuance by 1.33% if the corporate credit rating is upgraded in the previous year. Similarly, the coefficients on the interactions between *OCFO* and *DOWN* are negative and significant at the 1% significance level. Specifically, rating downgrade leads to a decrease by 3.70% in net debt issuance in firms with overconfident CFOs. The results remain consistent after the inclusion of year and industry dummies and industry-year interaction dummies. These findings support our predictions that overconfident CFOs decrease net debt following credit rating upgrade or

downgrade in the previous year. On the other hand, there is no significant difference in capital structure adjustments following credit rating changes in firms with rational CFOs.

Using the modified financing deficit framework, the coefficient on FD and its interaction with the CFO overconfidence ($OCFO*FD$) are significant at 1% level and have the expected sign in all specifications (see Table 3). All other things being equal, for every one percent increase in net financing deficit, firms with overconfident CFOs issue 13.64% more $NetD$ than firms with rational CFOs (Column 1, Table 3). This indicates that CFO overconfidence significantly influences the likelihood of a firm using debt financing, which supports the evidence of Malmendier, Pezone and Zheng (2020). Consistent with our expectations, the coefficient on $OCFO$ in Eq. (2) suggests that firms with overconfident CFOs have higher $NetD$ than firms with rational CFOs, which is significant at 1% level. Our findings support the behavioural corporate finance literature that overconfident managers¹¹ follow a pecking order and choose more debt than rational managers when accessing external financing. The results remain robust after we control the model for year and industry fixed effects, as well as industry fixed effects by year.

To sum up, our baseline model shows that CFO overconfidence significantly increases the sensitivity of capital structure adjustments to rating changes due to their strong preference for pecking order framework, which aggravates debt conservatism. Notably, debt conservatism can be, but is not always, an indicator of low leverage (Malmendier and Tate 2005), because overconfident managers are even more reluctant to issue equity than to raise debt (Hackbarth 2008). As a result, overconfident managers choose higher leverage than rational managers, conditional on the need of external funding.

¹¹ The literature refers mainly to the CEOs, and the most recent literature also considers the CFOs.

6.2. CEO Effect

In the behavioural finance setting, financing decisions and investment decisions are interdependent rather than separable (Shefrin 2018). Overconfident managers often overestimate the value of future investment projects, and these faulty judgements may induce overinvestment. In particular, an overconfident CEO may undertake negative net present value (NPV) projects that are perceived to have positive NPV. Malmendier and Tate (2005) show that overconfident CEOs are more likely to overinvest if firms have access to internal capital and untapped debt capacity. As the ultimate decision makers on important corporate decisions, overconfident CEOs could have a significant impact on financing decisions due to their overoptimistic beliefs about the future cash flows accruing to the firm. To determine whether CFO overconfidence effects persist after controlling for CEOs' behavioural traits (i.e. overconfidence bias) in the context of financing deficit framework, we add three dummy variables that represent the biases of CEOs and CFOs to our model. The three dummy variables are *OCFO_RCEO* (CFO is overconfident but CEO is rational), *RCFO_OCEO* (CFO is rational but CEO is overconfident) and *OCFO_OCEO* (both CEO and CFO are overconfident). The benchmark group in our model includes firms in which both CEO and CFO are rational.

Table 4 presents the estimation result of Eq. (3). Across all three specifications, we find that the effects of CFO overconfidence on capital structure adjustments following rating changes remain robust even after controlling for CEO overconfidence. Specifically, the coefficients on the interactions between *OCFO_RCEO* and *UP* are negative and significant in all specifications. Column 1 of Table 4 shows that firms with overconfident CFOs (when CEOs are rational) reduce the net debt issuance by 2.13% of total assets following rating upgrade in the previous year. Nevertheless, such behaviour is not found in other groups in which CEOs are overconfident (coefficients of *RCFO_OCEO*UP* and *OCFO_OCEO*UP* are insignificant). Our findings suggest that debt conservatism is more prevalent among

overconfident CFOs than other executives, and the effects of CFO overconfidence matter more than CEO overconfidence in the firms' financing decisions.

In the case of downgrade, both CEO overconfidence and CFO overconfidence can affect the leverage adjustments. This is manifested in that all three interaction terms between executives' biases dummies (*OCFO_RCEO*, *RCFO_OCEO*, and *OCFO_OCEO*) with *DOWN* are negative and significant at the 5% and 10% level (see Table 4). In the year following rating downgrade, firms with at least one overconfident executive are more likely to reduce net debt issuance than firms where both executives are rational. At the 1% significance level, firms with overconfident CFOs (when CEOs are rational) issue 4.09% less net debt as a percentage of total assets and their behaviour following rating downgrades is robust (see Column 1 of Table 4). Notably, the magnitude of the change in net debt issuance following rating downgrade is largest among firms with overconfident CFOs and rational CEOs. Meanwhile, insignificant coefficients on *DOWN* in all specifications in Table 4 imply that firms with both rational executives do not make leverage adjustments following rating downgrades.

In Column 1 of Table 4, the coefficients on the three dummy variables for managers' overconfidence (*OCFO_RCEO*, *RCFO_OCEO*, and *OCFO_OCEO*) show that firms with at least one executive being overconfident issue significantly more debt than firms with both executives being rational, ranging from 0.79% to 1.33%. However, when comparing the magnitude of net debt issuance within firms with at least one overconfident executive, firms with overconfident CFOs issue more debt than firms with overconfident CEOs, suggesting that overconfident CFOs have stronger preference for pecking order framework than overconfident CEOs. Indeed, the coefficients of *RCFO_OCEO* interacted with *FD* are positive but insignificant after the inclusion of year and industry dummies and industry-year interaction dummies. On the other hand, the coefficient of *OCFO_RCEO* (*OCFO_OCEO*) interacted with *FD* equals 0.16 (0.13) and remains consistent and strong after controlling for year and industry

fixed effects. Consistent with Malmendier, Pezone and Zheng (2020), our findings reveal that CFO biases, rather than CEO biases, influence the firm's tendency to follow the pecking order framework.

In summary, Table 4 is consistent with our baseline results from the debt issuance regressions in Section 6.1, supporting Hypothesis 1 and Hypothesis 2. Our evidence also supports the notion that debt conservatism is a possible implication of overconfidence bias due to the preference for pecking order framework (Malmendier, Tate and Yan 2011).

6.3. Low-risk Debt Financing

The overconfidence hypothesis implies that overconfident managers can issue more debt if it involves a low-risk for which there is little to no disagreement on the appropriate interest rate (Malmendier, Tate and Yan 2011). Accordingly, we use the firms' credit rating level as a proxy for their access to low-risk debt financing (Billett and Garfinkel 2004). Specifically, we group firms into two different sub-samples: i) a sub-sample of firms in the investment-grade rating class has the capability of raising low-risk debt; ii) a sub-sample of firms in the speculative-grade rating class does not have the capability of raising low-risk debt. In this section, we turn our attention to the implications of credit rating changes and CFO overconfidence on debt financing decisions conditional on their access to low-risk debt financing.

The full empirical results are presented in Tables 5 and 6. Specifically, Table 5 provides the estimation result of Eq. (2) and Table 6 provides the estimation results of Eq. (3). In each table, Panel A shows the regressions for the subsample of investment-grade firms, while Panel B shows regressions for the subsample of speculative-grade firms. In general, the results of Eq. (2) support all our predictions. The coefficient on $OCFO*UP$ is insignificant among the investment-grade firms, but negative significant in the speculative-grade firms. Combined with UP , $OCFO*UP$ implies that overconfident CFOs in investment-grade (speculative-grade)

firms issue more (less) net debt following credit rating upgrade in the previous year, which supports our Hypothesis 1a (Hypothesis 1).

Consistent with our expectations, in Column 1 of Table 5, the coefficient on *UP* is positive and significant at the 5% level, showing that investment-grade firms with rational CFOs increase net debt issuance by 1.77% if corporate credit rating in the previous year is upgraded. However, *UP* is statistically insignificant in Panel B for speculative-grade firms. Our results imply that only rational CFOs in firms with the existing access to low-risk debt financing (investment-grade firms) have the capability of raising new debt at the lower cost of capital brought about by the rating upgrade. In the case of overconfident CFOs, the coefficient estimates of *OCFO* interacted with *UP* for the sub-sample of investment-grade firms are insignificant. This implies that there is no significant difference between overconfident CFOs and rational CFOs in investment-grade firms in their capital structure adjustments following credit rating upgrades, i.e. both overconfident CFOs and rational ones will issue more debt. On the other hand, in Column 4 of Table 5, the coefficient estimate of *OCFO* interacted with *UP* is negative and significant, suggesting that speculative-grade firms with overconfident CFOs decrease net debt issuance following rating upgrades. Specifically, the rating upgrade leads to a decrease by 2.22% in net debt issuance in speculative-grade firms with overconfident CFOs (see Column 4 of Table 5). This finding supports that debt conservatism is not observed in firms which have the access to low-risk debt (Malmendier, Tate and Yan 2011), i.e. firms with investment grade credit ratings. The results remain robust after we control the model for year and industry fixed effects, as well as industry fixed effects by year.

The coefficient on *DOWN* in Table 5 is insignificant in all specifications, whereas the coefficients on the interactions between *OCFO* and *DOWN* are negative and significant, which is consistent with our prediction underlying Hypothesis 2. The model shows that the net debt issuance in investment-grade firms with overconfident CFOs will decrease by 2.19% if there

has been a decrease in rating in the previous year (see Column 1 of Table 5). Similarly, the model shows that downgrade results in reduction in net debt issuance to total asset by 5.34% in speculative-grade firms with overconfident CFOs, and it is significant at the 1% level (see Column 4 of Table 6). Consistent with our expectations, both investment-grade and speculative-grade firms with overconfident CFOs react the same way to downgrades. This is because a credit rating downgrade leads to a significant increase in cost of debt, regardless of the credit rating level and the financial flexibility (May 2010; Agha and Faff 2014). Conditional on having overconfident CFOs, speculative-grade firms have higher sensitivity of net debt issues to the rating downgrades than investment-grade firms. This finding reaffirms that there is larger discrepancy in the appropriate interest rate for relatively high-risk debts than low-risk debts (Malmendier, Tate and Yan 2011).

Table 6 presents the regression results after controlling for CEO effects. The results remain very similar to the estimations from the debt issuance regressions above (see Table 5). Speculative-grade firms, rather than investment-grade firms, with both rational executives prefer a sequential choice over funding sources (*FD* is positive significant only for firms in the speculative ratings). On the other hand, Table 6 shows that the financing pattern of overconfident executives in both investment-grade and speculative-grade firms is consistent with the standard pecking order model. Interestingly, at the speculative-grade credit rating level, only the two dummy variables *OCFO_RCEO* and *OCFO_OCEO* are positive and significant. It implies that firms with overconfident CFOs issue significantly higher net debt than firms with both rational executives, regardless of the CEO biases. It implies that in the absence of rating changes CEOs tend to delegate capital structure decisions to CFOs (Graham, Harvey and Puri 2013).

The coefficients on *UP* remains positive and significant at the 5% level in all specifications for the subsample of investment-grade firms (see Columns 1 to 3 of Table 6),

which is consistent with our previous results that only rational executives in investment-grade firms can increase debt after firms are upgraded. The coefficient estimate of *OCFO_RCEO* and *UP* is negative and significant in Columns 1 and 2 of Panel A, but turn insignificant in Column 3 (see Columns 1 to 3 of Table 6). The interactions between *UP* and the other dummies (*RCFO_OCEO* and *OCFO_OCEO*) are statistically insignificant. It means that overconfident CFOs in investment-grade firms react to upgrades in the same way as the rational ones, i.e. they issue more debt, even after we control for CEO's overconfidence. This result implies that it is the CFO overconfidence that drives the financing sensitivity to upgrades. At the speculative-grade credit rating level, only the interactions between *OCFO_OCFO* and *UP* are negative and significant at the 5% level (see Column 4, Panel B of Table 6). This indicates that the behaviour of reducing debt after being upgraded in the previous year is only prevalent among speculative-grade firms with both overconfident executives, suggesting a potential multiplier effect of managerial overconfidence on the debt conservatism.

Concerning the rating downgrades, investment-grade firms with overconfident (rational) CFOs and rational (overconfident) CEOs decrease net debt issuance by 2.98% (2.92%) following credit rating downgrade in the previous year, which is significant at the 5% level (see Column 1 of Table 6). However, debt reduction is not prevalent in investment-grade firms where both CEO and CFO are overconfident. This is partially attributable to the potential multiplier effect of managerial overconfidence on the investment return since CFOs share the same overly optimistic views as CEOs (Malmendier, Pezone and Zheng 2020). As a result, investment-grade firms with both overconfident executives are less likely to reduce debt following rating downgrades. At the speculative-grade credit rating level, the model shows that the behaviour of reducing net debt issuance after being downgraded is driven by CFO overconfidence alone, not by CEO overconfidence. The coefficient on *RCFO_OCEO* interacted with *DOWN* in Panel B of Table 6 is insignificant in all specifications. This finding

implies that CFO overconfidence plays a stronger role than CEO overconfidence in corporate financing decisions following rating downgrades, when firms have only access to high-risk debt. The results are robust to the inclusion of year and industry fixed effects, as well as industry fixed effects by year.

Interestingly, the coefficients on *FD* are insignificant in Columns 1 to 3 of Table 5, which indicates that investment-grade firms with both rational executives do not follow the pecking order when considering sources of financing. However, the preference for financing hierarchy prevails among overconfident CFOs at all rating levels since the interaction term *OCFO*FD* is positive and significant for both investment-grade sub-sample and speculative-grade sub-sample. The coefficient on the interaction between *OCFO* and *FD* is positive and significant at the 1% level in all specifications of Panel A for investment-grade firms, while positive and marginally significant at the 10% level in Panel B for speculative-grade firms (see Table 5). Our finding is not only consistent with Malmendier, Pezone and Zheng (2020) that CFOs exhibit a pecking order preference, but also complements the behavioural finance literature in which the similar behaviour has been widely documented among overconfident CEOs (Heaton 2002; Hackbarth 2008; Huang, Tan and Faff 2016). Besides, at the speculative-grade credit rating levels, overconfident CFOs have significantly higher net debt than rational CFOs (variable *OCFO* in Columns 4 to 6 of Table 5 is positive and significant), but this does not occur among overconfident CFOs in investment-grade firms (variable *OCFO* in Columns 1 to 3 of Table 5 is insignificant). One of the possible explanations is that financing deficit is less prevalent in investment-grade firms than in speculative-grade firms due to the formers' stronger capability of generating revenues (Gonis, Paul and Tucker 2012). While investment-grade firms could finance deficits with internal resources when possible through ploughing back more profits, overconfident CFOs in speculative-firms have to seek more debt financing.

In summary, Tables 5 and 6 confirm our baseline results obtained from the regression on the full sample, supporting all of our predictions.

6.4. Endogeneity concerns

We aim to resolve the potential problems associated with endogeneity which might bias our results. Our primary concern is an unobserved variable bias. For example, the industry level heterogeneity, industry level shocks and country level shocks might simultaneously affect a company's capital market activities, rating changes and the propensity for a company to appoint an overconfident CFO. For this reason, our baseline model already controls for such unobserved factors with industry fixed effects, year fixed effects, and industry fixed effects by year. We also lag the changes in ratings by one year to alleviate the potential reverse causality following Kisgen (2006, 2009). We reckon that reverse causality is unlikely in our model since credit rating agencies do not downgrade a rating in the anticipation that leverage will decrease in the following year. Nevertheless, we still test the robustness of our main findings and deal with endogeneity concerns by employing a two stage least squares approach (2SLS) following Agha and Faff (2014).

In the first stage, we obtain predicted credit ratings for each firm-year as in Kisgen (2006) and Agha and Faff (2014). We do this by regressing the 21-notch corporate credit ratings on three determinants considered to be most crucial in determining firms' credit ratings. The three instrumental variables are firm size, profitability and leverage.^{12, 13} In the second stage, we re-estimate Eq. (2) from Section 4.2.2. by replacing the predicted *UP* and *DOWN* variables using the predicted rating scores obtained from the first stage regression. Since the purpose of

¹² The coefficients of the instrumental variables (i.e. firm size, profitability and leverage) are statistically significant at the 1% level and have the expected sign. The results are available upon request.

¹³ Firm size is the natural logarithm of total assets. Profitability is the ratio of profit before interest, tax, depreciation and amortisation to total assets. Leverage is the ratio of total debt to total capitalisation.

our study is establishing the effects of CFO overconfidence on firms' financing decisions, the endogeneity checks focus on these models (See Tables 3 and 5).¹⁴

Table 7 reports the results of 2SLS estimation. Panel A (Panel B and Panel C) of Table 7 is the replication of the estimation of Table 3 (Table 5) using the predicted rating upgrade and downgrade dummies lagged by one year as independent variables. In general, the results of the 2SLS estimation are consistent with our baseline regression model suggesting that a credit rating upgrade or downgrade in speculative-grade firms with overconfident CFOs is followed by a significant decrease in net debt issuance. The similar leverage-reducing behaviour following rating upgrades or downgrades may be the result of debt conservatism among overconfident CFOs (Malmendier, Tate and Yan 2011).

In Panel A of Table 7, the coefficients on *DOWN* are negative and significant, although the significance becomes weaker after controlling for industry by year fixed effects. The results imply that rational CFOs issue less debt following rating downgrades, which is consistent with Kisgen (2009).¹⁵ In the case of overconfident CFOs, we obtain weaker results for the coefficient estimates of *OCFO*DOWN* in Panel A of Table 7. The coefficients on the interactions between *OCFO* and *UP* are positive and significant in Specifications (1) and (2), but the significance disappears after controlling for industry fixed effects by year.

When taking firms with access to low-risk debt financing into consideration, the coefficient on *UP* in Panel B (Panel C) of Table 7 is only positive (negative) and significant for investment grade firms. This finding is similar to our baseline result. It suggests that investment-grade firms with rational CFOs increase net debt issuance after being upgraded. A rating upgrade to speculative grade firms with rational CFOs is associated with a reduction in

¹⁴ Our baseline results show that the effects of CFO overconfidence matter more than CEO overconfidence in the firms' financing decisions.

¹⁵ Managers are more likely to reduce debt following rating downgrades because a credit rating downgrade is followed by an increase in the firms' cost of capital (Kisgen 2009).

net debt issuance, which might be explained by a desire to avoid subsequent rating reversals, particularly in the case of financially inflexible firms (Agha and Faff 2014). We find similar effects among overconfident CFOs (which are reflected by insignificant coefficient estimate of $OCFO*UP$). The results indicate that overconfident CFOs in investment-grade firms issue more net debt following credit rating upgrade in the previous year, which are consistent with our results in Table 5. Unlike the baseline results where the interaction of overconfident CFO with rating upgrade among speculative grade firms is negative significant, our 2SLS results yield insignificant estimate of the coefficient on this interaction term. However, our conclusion about the overconfident CFO cutting leverage subsequent to rating upgrades do not change.

In Columns 4 and 5 of Table 7, we obtain results similar to our baseline model of Table 5 about the coefficient on $OCFO$ interacted with $DOWN$, i.e. it is negative and significant in all specifications for speculative-grade firms (see Panel C of Table 7). Overconfident CFOs issue 3.1% less net debt as a percentage of total market assets following rating downgrades (see Column 9 of Table 7). The results are consistent with our baseline models where speculative-grade firms with overconfident CFOs have higher sensitivity of net debt issues to the rating downgrades than investment-grade firms with overconfident CFOs.

The coefficients on the interaction between $OCFO$ and FD remain positive and significant in all specifications after controlling for endogeneity, reaffirming our baseline results that CFOs exhibit a stronger pecking order preference than rational CFOs (Malmendier, Pezone and Zheng 2020). Consistent with Table 5, variable $OCFO$ is only positive and significant for speculative-grade firms, which suggests that only speculative-grade firms with overconfident CFOs have significantly higher net debt than rational CFOs, possibly due to limited internal resources (Gonis, Paul and Tucker 2012).

In short, Table 7 confirms our baseline results that CFO overconfidence significantly increases the sensitivity of net debt issuances to the rating changes, particularly when firms have no access to low-risk debt.

7. Conclusion

In this paper, we investigate whether CFOs' overconfidence has an impact on the corporate financial decisions following rating changes. Given that overconfidence bias is the root of pecking order distortions, and debt conservatism may be a result of excessive preference for internal capital to external capital, we hypothesise that CFO overconfidence significantly increases the sensitivity of net debt issuance to the rating changes.

With a pooled-OLS model implemented on the full sample and the sub-samples split by credit rating levels, we find that overconfident CFOs display debt conservatism and exhibit great reluctance in accessing the external capital markets. Due to their pecking order preference, rating changes can alter the extent to which overconfident CFOs use debt for new projects. Our results also reveal that CEO biases in regard to investment returns have predictive power in financial policies when firms have high ratings. Nevertheless, CFOs appear to play a stronger role than CEOs in financial policies.

The key finding from our study is that credit ratings matter for overconfident CFOs' financing decision. Specifically, overconfident CFOs reduce net debt following credit rating upgrades unless they can borrow at a cheap cost. When taking firms with access to low-risk debt financing into consideration, we find that overconfident CFOs in investment-grade firms, but not in the speculative-grade firms, issue more debt following rating upgrades. This is because overconfident managers are more willing to issue low-risk debt for which there is little discrepancy in the appropriate interest rate between the managers and the capital market. Concerning downgrades, the tendency to reduce net debt issuance is stronger in firms with

overconfident CFOs compared to those with rational ones. This is because overconfident CFOs exhibit debt conservatism, while this behaviour is hardly found among rational CFOs.

In addition, we document that the phenomenon of reducing debt following rating upgrades by overconfident CFOs holds after controlling for CEO effects, suggesting that CFO overconfidence matters more than CEO overconfidence in driving the capital structure adjustments to rating upgrades. Nevertheless, the phenomenon of reducing debt following rating upgrades is only prevalent in speculative-grade firms when CEOs and CFOs are overconfident, which might be explained by the potential multiplier effects on debt conservatism. In case of rating downgrades, we find that either CEO or CFO overconfidence bias might lead to a decision to reduce debt when rating is downgraded. However, we do not observe this negative adjustment among high-rated firms where both executives are overconfident, possibly due to the multiplier effects of managerial overconfidence on investment return. At the speculative-grade credit rating level, overconfident CFOs reduce debt after being downgraded, regardless of whether the CEOs are overconfident or rational. Again, this finding suggests that CFO overconfidence matters more than CEO overconfidence in financing decisions, particularly when firms have no access to low-risk debt financing.

The novelty of our research stems from the fact that there is no prior paper which examines the influence of CFO overconfidence on corporate financial decisions following rating changes. We are also the first who consider the joint effect of executives' behavioural traits and credit rating changes on firms' financing decisions. Therefore, this paper not only makes significant contribution to the rating literature, but also to the behavioural finance literature. Our research outcomes are particularly useful for board of directors of firms where executives are subject to overconfidence bias. Our study will help them to better understand how managerial overconfidence affects their corporate financial policies.

Table 1: Summary statistics.

Panel A presents the summary statistics of the full sample over the period 2006 to 2019. Panel B presents the descriptive statistics for the sub-sample of firms with rational CFOs and firms with overconfident CFOs, along with two-sample mean t -test with unequal variance between them. A CFO is classified as overconfident after he or she fails to exercise options that are beyond the threshold (which is 67% in-the-money or more) at least twice during their tenure period. *Rating* is the credit rating that has been converted to numerical form from alphanumeric ratings assigned by Standard & Poor's. *NetD* is long-term debt issuance minus long-term debt reduction, scaled by market value of assets at the beginning of the year. *FD* represents net financing deficit, scaled by market value of assets at the beginning of the year. Net financing deficit is defined as cash dividends plus investment plus change in working capital minus cash flow after interest and taxes. *, ** and *** correspond to the significance at 10%, 5% and 1%, respectively.

Panel A: Full sample							
Variable	N	Mean	Median	S.d.			
Rating	4975	11.766	12.000	3.222			
NetD	4975	0.012	0.000	0.085			
FD	4975	0.019	0.000	0.084			
Panel B: Sub-sample							
Variable	Rational CFO			Overconfident CFO			t -statistics
	N	Mean	S.d.	N	Mean	S.d.	
Rating	3305	11.759	3.385	1670	11.782	2.871	-0.256
NetD	3305	0.009	0.085	1670	0.018	0.083	-3.506***
FD	3305	0.022	0.096	1670	0.014	0.054	3.926***

Table 2: Debt issuance decisions following rating changes.

This table presents the mean net debt issuance of the firms following rating changes in the previous year. Net debt issue equals long-term debt issuance minus long-term debt reduction, scaled by market value of total assets at the beginning of the year. Firms are categorised by the four combinations of executives' biases. Columns 1 to 4 show mean net debt issuance for firms with both rational executives, firms with overconfident CFOs and rational CEOs, firms with rational CFOs and overconfident CEOs and firms with both overconfident executives, respectively. Panels A to C show mean net debt issuance for the full sample, investment-grade sub-sample and speculative-grade sub-sample, respectively.

Rating Change (Previous Year)	<i>Mean Net Debt Issuance</i>			
	Both Executives Rational (1)	Overconfident CFO, Rational CEO (2)	Rational CFO, Overconfident CEO (3)	Both Executives Overconfident (4)
Panel A: Full sample				
Upgrade	0.008	0.019	0.016	0.020
Downgrade	0.007	0.019	0.013	0.019
No Upgrade/Downgrade	0.007	0.023	0.016	0.021
Panel B: Investment grade				
Upgrade	0.012	0.018	0.016	0.017
Downgrade	0.010	0.017	0.014	0.015
No Upgrade/Downgrade	0.010	0.020	0.016	0.016
Panel C: Speculative grade				
Upgrade	0.002	0.020	0.016	0.024
Downgrade	0.003	0.020	0.011	0.024
No Upgrade/Downgrade	0.003	0.028	0.016	0.029

Table 3: The effects of rating changes and CFO overconfidence on corporate financing – Eq. (2)

This table presents the OLS estimation results of Eq. (2). The dependent variable is *NetD*, which is defined as net debt raised for the year divided by market value of asset at the beginning of the year. CFO overconfidence is represented by the binary variable *OCFO* that takes the value of one if a CFO fails to exercise vested options at least twice during his or her tenure and the option is at least 67% in-the-money, zero otherwise. *FD* is defined as cash dividends plus investment plus change in working capital minus cash flow after interest and taxes, scaled by market value of asset at the beginning of the year. *UP* and *DOWN* are dummy variables equal to one if the firms are upgraded or downgraded at the end of previous fiscal year, respectively. *Year* represents year fixed effects, and *Ind* represents industry fixed effects. Standard errors are Huber-White robust standard errors. *t*-statistics are shown in parentheses. Statistical significance at the 1%, 5% and 10% levels is denoted as ***, ** and * respectively.

	(1) NetD	(2) NetD	(3) NetD
FD	0.1138*** (4.077)	0.1148*** (4.003)	0.1145*** (3.930)
UP	0.0027 (0.542)	0.0024 (0.493)	0.0031 (0.615)
DOWN	-0.0027 (-0.405)	-0.0008 (-0.118)	0.0024 (0.349)
OCFO	0.0133*** (4.474)	0.0127*** (3.963)	0.0127*** (3.769)
OCFO * FD	0.1364*** (3.286)	0.1305*** (3.128)	0.1261*** (3.047)
OCFO * UP	-0.0133* (-1.955)	-0.0129* (-1.906)	-0.0140** (-2.005)
OCFO * DOWN	-0.0370*** (-3.893)	-0.0354*** (-3.772)	-0.0342*** (-3.622)
Constant	0.0047*** (2.714)	-0.0053 (-0.963)	-0.0088 (-0.828)
N	4206	4206	4206
R-sq	0.029	0.052	0.084
adj. R-sq	0.028	0.046	0.051
<i>Ind</i> and <i>Year</i> effect	No	Yes	No
<i>Ind</i> * <i>Year</i> effect	No	No	Yes

Table 4: The effects of rating changes and CFO overconfidence on corporate financing controlling for CEO overconfidence – Eq. (3)

This table presents the OLS estimation results of Eq. (3). The dependent variable is *NetD*, which is defined as net debt raised for the year divided by market value of assets at the beginning of the year. *OCFO_RCEO* is a dummy that equals one if the CFO is overconfident and the CEO is rational, zero otherwise. *RCFO_OCEO* is a dummy that equals one if the CFO is rational and the CFO is overconfident, zero otherwise. *OCFO_OCEO* is a dummy that equals one if both CFO and CEO are overconfident, zero otherwise. The benchmark group includes firms with both rational CFO and CEO. *FD* is defined as cash dividends plus investment plus change in working capital minus cash flow after interest and taxes, scaled by market value of assets at the beginning of the year. *UP* and *DOWN* are dummy variables equal to one if the firms are upgraded or downgraded at the end of previous fiscal year, respectively. *Year* represents year fixed effects, and *Ind* represents industry fixed effects. Standard errors are Huber-White robust standard errors. *t*-statistics are shown in parentheses. Statistical significance at the 1%, 5% and 10% levels is denoted as ***, ** and * respectively.

	(1) NetD	(2) NetD	(3) NetD
FD	0.1092 ^{**} (3.978)	0.1096 ^{**} (3.903)	0.1119 ^{***} (3.907)
UP	0.0027 (0.543)	0.0022 (0.450)	0.0025 (0.502)
DOWN	-0.0026 (-0.400)	-0.0005 (-0.077)	0.0029 (0.420)
OCFO_RCEO	0.0133 ^{**} (2.096)	0.0140 ^{**} (2.205)	0.0134 ^{**} (2.082)
RCFO_OCEO	0.0079 ^{**} (2.119)	0.0077 ^{**} (2.056)	0.0070 [*] (1.856)
OCFO_OCEO	0.0132 ^{***} (4.176)	0.0121 ^{***} (3.629)	0.0119 ^{***} (3.445)
OCFO_RCEO * FD	0.1598 [*] (1.884)	0.1480 [*] (1.711)	0.1508 [*] (1.826)
RCFO_OCEO * FD	0.0970 [*] (1.652)	0.0929 (1.584)	0.0935 (1.579)
OCFO_OCEO * FD	0.1333 ^{**} (2.979)	0.1286 ^{***} (2.877)	0.1294 ^{***} (2.903)
OCFO_RCEO * UP	-0.0213 [*] (-1.938)	-0.0203 [*] (-1.846)	-0.0193 [*] (-1.710)
RCFO_OCEO * UP	-0.0040 (-0.509)	-0.0034 (-0.422)	-0.0013 (-0.155)
OCFO_OCEO * UP	-0.0105 (-1.446)	-0.0106 (-1.462)	-0.0120 (-1.609)
OCFO_RCEO * DOWN	-0.0409 ^{***} (-2.674)	-0.0383 ^{**} (-2.494)	-0.0385 ^{**} (-2.415)
RCFO_OCEO * DOWN	-0.0282 ^{**} (-2.167)	-0.0281 ^{**} (-2.216)	-0.0313 ^{**} (-2.335)
OCFO_OCEO * DOWN	-0.0348 ^{***} (-3.468)	-0.0339 ^{***} (-3.427)	-0.0322 ^{***} (-3.255)
Constant	0.0048 ^{***} (2.771)	-0.0038 (-0.728)	-0.0077 (-0.896)
N	4975	4975	4975
R-sq	0.030	0.050	0.078
adj. R-sq	0.027	0.043	0.048
<i>Ind</i> and <i>Year</i> effect	No	Yes	No
<i>Ind</i> * <i>Year</i> effect	No	No	Yes

Table 5: The effects of rating changes and CFO overconfidence on corporate financing – Eq. (2) – Investment-grade and speculative-grade sub-samples

This table presents the OLS estimation results of Eq. (2) for investment-grade and speculative-grade sub-samples. Specifications (1) to (3) show regressions for the sub-sample of investment grade credit rating firms. Specifications (4) to (6) show regressions for the sub-sample of speculative grade credit rating firms. *NetD* is defined as net debt raised for the year divided by market value of asset at the beginning of the year. CFO overconfidence is represented by the binary variable *OCFO* that takes the value of one if a CFO fails to exercise vested options at least twice during his or her tenure and the option is at least 67% in-the-money, zero otherwise. *FD* is defined as cash dividends plus investment plus change in working capital minus cash flow after interest and taxes, scaled by market value of asset at the beginning of the year. *UP* and *DOWN* are dummy variables equal to one if the firms are upgraded or downgraded at the end of previous fiscal year, respectively. *Year* represents year fixed effects, and *Ind* represents industry fixed effects. Standard errors are Huber-White robust standard errors. *t*-statistics are shown in parentheses. Statistical significance at the 1%, 5% and 10% levels is denoted as ***, ** and * respectively.

	Panel A: Investment grade			Panel B: Speculative grade		
	(1) NetD	(2) NetD	(3) NetD	(4) NetD	(5) NetD	(6) NetD
FD	0.0377 (1.141)	0.0422 (1.260)	0.0352 (1.053)	0.1453*** (4.391)	0.1385*** (4.006)	0.1462*** (4.234)
UP	0.0177** (2.353)	0.0187** (2.556)	0.0165** (2.125)	-0.0020 (-0.288)	-0.0025 (-0.368)	0.0024 (0.328)
DOWN	-0.0010 (-0.119)	-0.0004 (-0.046)	0.0030 (0.358)	-0.0000 (-0.002)	0.0025 (0.252)	0.0046 (0.434)
OCFO	0.0042 (1.563)	0.0048 (1.620)	0.0033 (1.098)	0.0264*** (4.288)	0.0229*** (3.662)	0.0251*** (3.533)
OCFO * FD	0.1673*** (3.466)	0.1751*** (3.681)	0.1810*** (3.955)	0.1274** (2.084)	0.1155* (1.884)	0.1080* (1.802)
OCFO * UP	-0.0135 (-1.364)	-0.0152 (-1.571)	-0.0115 (-1.106)	-0.0222** (-2.258)	-0.0203** (-2.015)	-0.0255** (-2.266)
OCFO * DOWN	-0.0219** (-2.058)	-0.0224** (-2.111)	-0.0207* (-1.878)	-0.0534*** (-3.710)	-0.0472*** (-3.301)	-0.0477*** (-3.284)
Constant	0.0100*** (6.480)	0.0039 (0.779)	0.0152** (2.081)	-0.0027 (-0.772)	-0.0161 (-1.599)	-0.0288* (-1.772)
N	2257	2257	2257	1949	1949	1949
R-sq	0.019	0.039	0.109	0.043	0.079	0.135
adj. R-sq	0.016	0.027	0.048	0.039	0.065	0.065
<i>Ind</i> and <i>Year</i> effect	No	Yes	No	No	Yes	No
<i>Ind</i> * <i>Year</i> effect	No	No	Yes	No	No	Yes

Table 6: The effects of rating changes and CFO overconfidence on corporate financing controlling for CEO overconfidence – Eq. (3) – Investment-grade and speculative-grade sub-samples

This table presents the OLS estimation results of Eq. (3) for investment-grade and speculative-grade sub-samples. Net debt issuance (*NetD*) are regressed against a set of explanatory variables (*FD*, *OCFO_RCEO* dummy, *RCFO_OCEO* dummy, *OCFO_OCEO* dummy, *UP* dummy and *DOWN* dummy). Specifications (1) to (3) show regressions for the sub-sample of investment grade credit rating firms. Specifications (4) to (6) show regressions for the sub-sample of speculative grade credit rating firms. *Year* represents year fixed effects, and *Ind* represents industry fixed effects. Standard errors are Huber-White robust standard errors. *t*-statistics are shown in parentheses. Statistical significance at the 1%, 5% and 10% levels is denoted as ***, ** and * respectively.

	Panel A: Investment grade			Panel B: Speculative grade		
	(1) NetD	(2) NetD	(3) NetD	(4) NetD	(5) NetD	(6) NetD
FD	0.0361 (1.110)	0.0402 (1.234)	0.0350 (1.063)	0.1393*** (4.278)	0.1337*** (3.938)	0.1429*** (4.238)
UP	0.0176** (2.348)	0.0183** (2.480)	0.0162** (2.068)	-0.0020 (-0.291)	-0.0035 (-0.503)	0.0012 (0.158)
DOWN	-0.0010 (-0.118)	0.0000 (0.001)	0.0040 (0.480)	-0.0000 (-0.002)	0.0027 (0.270)	0.0055 (0.531)
OCFO_RCEO	0.0051 (0.766)	0.0057 (0.832)	0.0017 (0.246)	0.0239** (2.132)	0.0215* (1.957)	0.0235** (2.058)
RCFO_OCEO	0.0047 (1.177)	0.0049 (1.250)	0.0045 (1.164)	0.0119 (1.620)	0.0099 (1.351)	0.0085 (1.118)
OCFO_OCEO	0.0039 (1.402)	0.0040 (1.292)	0.0030 (0.970)	0.0268*** (3.987)	0.0234*** (3.436)	0.0247*** (3.288)
OCFO_RCEO * FD	0.1945** (2.067)	0.2085** (2.307)	0.2340** (2.554)	0.1520 (1.201)	0.1370 (1.016)	0.1538 (1.198)
RCFO_OCEO * FD	0.1394*** (2.642)	0.1573*** (2.844)	0.1738*** (2.770)	0.0833 (1.026)	0.0595 (0.737)	0.0456 (0.580)
OCFO_OCEO * FD	0.1601*** (3.006)	0.1648*** (3.142)	0.1768*** (3.594)	0.1266* (1.898)	0.1159* (1.758)	0.1059 (1.622)
OCFO_RCEO * UP	-0.0246** (-2.120)	-0.0235** (-2.096)	-0.0165 (-1.365)	-0.0242 (-1.454)	-0.0208 (-1.236)	-0.0241 (-1.355)
RCFO_OCEO * UP	-0.0159 (-1.637)	-0.0177* (-1.809)	-0.0152 (-1.498)	-0.0020 (-0.157)	0.0050 (0.370)	0.0042 (0.294)
OCFO_OCEO * UP	-0.0107 (-0.996)	-0.0128 (-1.205)	-0.0106 (-0.930)	-0.0211** (-2.001)	-0.0197* (-1.828)	-0.0243** (-2.016)
OCFO_RCEO * DOWN	-0.0298** (-2.522)	-0.0308*** (-2.679)	-0.0303** (-2.234)	-0.0529** (-2.201)	-0.0466* (-1.921)	-0.0451* (-1.899)
RCFO_OCEO * DOWN	-0.0292** (-2.152)	-0.0300** (-2.143)	-0.0292** (-1.998)	-0.0292 (-1.540)	-0.0274 (-1.518)	-0.0310 (-1.555)
OCFO_OCEO * DOWN	-0.0179 (-1.421)	-0.0186 (-1.463)	-0.0181 (-1.389)	-0.0531*** (-3.583)	-0.0478*** (-3.242)	-0.0493*** (-3.194)
Constant	0.0100*** (6.486)	0.0081 (1.422)	0.0143** (2.225)	-0.0025 (-0.707)	-0.0182** (-2.047)	-0.0238* (-1.837)
N	2694	2694	2694	2281	2281	2281
R-sq	0.021	0.035	0.101	0.042	0.076	0.126
adj. R-sq	0.015	0.021	0.046	0.036	0.061	0.063
<i>Ind</i> and <i>Year</i> effect	No	Yes	No	No	Yes	No
<i>Ind</i> * <i>Year</i> effect	No	No	Yes	No	No	Yes

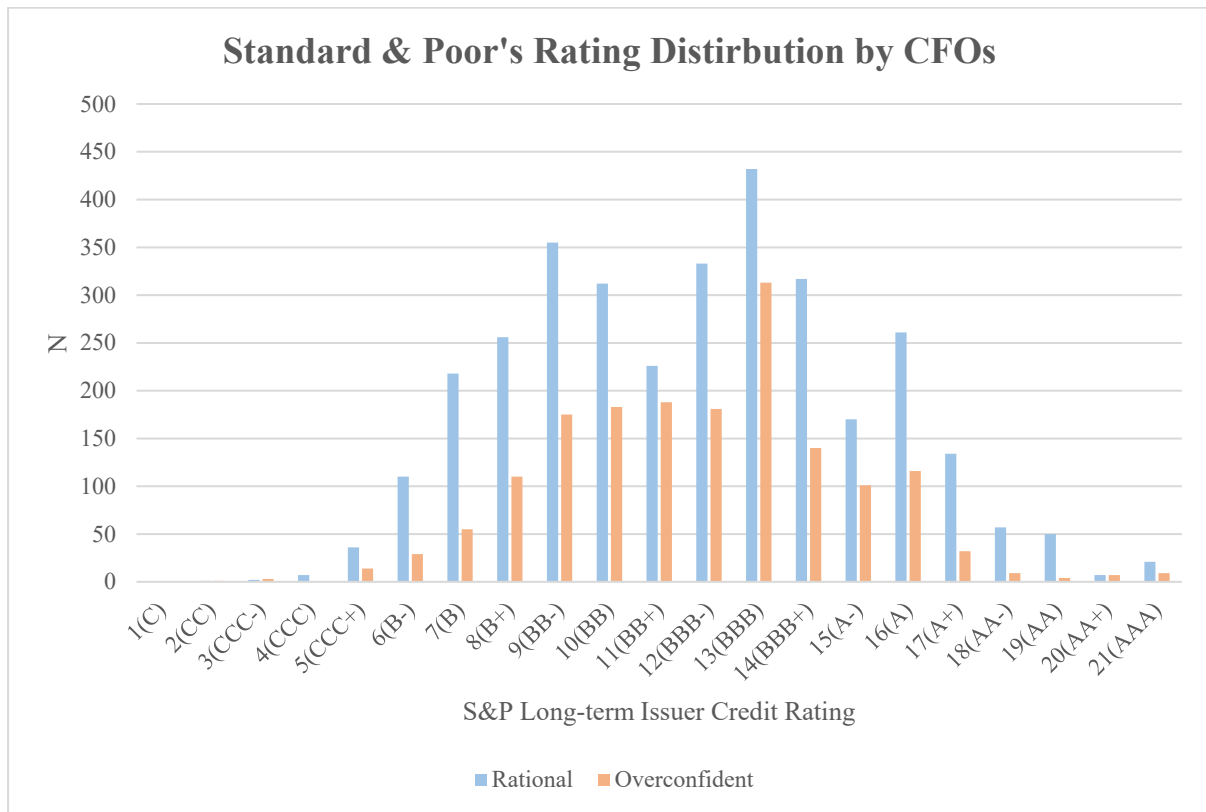
Table 7: Two stage least square (2SLS) model

This table presents the 2SLS estimation results. Panel A is the replication of the estimation of Table 3, while Panel B and Panel C are the replication of the estimation of Table 5 using the number of notches changed in predicted credit ratings as independent variable. The predicted credit ratings are obtained from the first stage regression. *UP* and *DOWN* are the number of notches upgraded and downgraded in the previous year, respectively. *NetD*, overconfidence proxy and *FD* are defined as in Table 3. Statistical significance at the 1%, 5% and 10% levels is denoted as ***, ** and * respectively.

	Panel A: Full			Panel B: Investment grade			Panel C: Speculative grade		
	(1) NetD	(2) NetD	(3) NetD	(4) NetD	(5) NetD	(6) NetD	(7) NetD	(8) NetD	(9) NetD
FD	0.1189*** (3.909)	0.1160*** (3.714)	0.1176*** (3.721)	0.0701* (1.796)	0.0745* (1.756)	0.0670 (1.621)	0.1412*** (3.891)	0.1230*** (3.226)	0.1351*** (3.330)
UP	-0.0061 (-1.532)	-0.0070* (-1.678)	-0.0051 (-1.193)	0.0085** (2.023)	0.0097** (2.214)	0.0109** (2.421)	-0.0169** (-2.030)	-0.0167* (-1.959)	-0.0193** (-2.125)
DOWN	-0.0122*** (-2.655)	-0.0111** (-2.390)	-0.0086* (-1.823)	-0.0116** (-2.283)	-0.0108* (-1.958)	-0.0070 (-1.282)	-0.0051 (-0.581)	-0.0004 (-0.047)	0.0000 (0.003)
OCFO	0.0047 (1.497)	0.0034 (1.076)	0.0038 (1.180)	0.0035 (1.235)	0.0029 (0.963)	0.0023 (0.741)	0.0164*** (2.670)	0.0144** (2.329)	0.0133** (2.094)
OCFO * FD	0.1345*** (2.893)	0.1340*** (2.887)	0.1264*** (2.749)	0.1348** (2.434)	0.1445** (2.568)	0.1610*** (3.004)	0.1482** (2.149)	0.1486** (2.195)	0.1295* (1.953)
OCFO * UP	0.0121** (1.970)	0.0107* (1.763)	0.0084 (1.367)	-0.0073 (-1.184)	-0.0091 (-1.440)	-0.0089 (-1.392)	0.0079 (0.656)	0.0062 (0.513)	0.0090 (0.696)
OCFO * DOWN	0.0032 (0.420)	0.0013 (0.173)	-0.0001 (-0.010)	0.0141 (1.105)	0.0134 (1.048)	0.0107 (0.951)	-0.0284** (-2.354)	-0.0327*** (-2.665)	-0.0310** (-2.476)
Constant	0.0067*** (2.891)	0.0050 (0.868)	0.0399 (1.228)	0.0090*** (4.619)	0.0096 (1.445)	-0.0035 (-1.089)	-0.0009 (-0.222)	0.0117 (1.123)	-0.0257** (-2.542)
N	3189	3189	3189	1700	1700	1700	1424	1424	1424
R-sq	0.037	0.054	0.087	0.029	0.045	0.120	0.052	0.089	0.152
adj. R-sq	0.035	0.046	0.053	0.025	0.030	0.055	0.047	0.072	0.077
<i>Ind & Year</i> effects	No	Yes	No	No	Yes	No	No	Yes	No
<i>Ind * Year</i> effects	No	No	Yes	No	No	Yes	No	No	Yes

Figure 1: Sample Distribution of Standard & Poor's Credit Ratings by Groups

This bar chart presents the sample distribution of Standard & Poor's domestic currency long-term issuer corporate credit rating for rational and overconfident CFO subsamples over the period 2006-2019.



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Appendix A: Credit rating classifications

This table shows the rating conversions from alphanumeric into numerical values based on a 21-point scale.

S&P Domestic Currency Long-Term Issuer Credit Rating	21-Point Credit Rating
AAA	21
AA+	20
AA	19
AA-	18
A+	17
A	16
A-	15
BBB+	14
BBB	13
BBB-	12
BB+	11
BB	10
BB-	9
B+	8
B	7
B-	6
CCC+	5
CCC	4
CCC-	3
CC	2
C	1

Appendix B: The effects of rating changes and CFO overconfidence on corporate financing – Eq. (2)

Replication of the estimation of Table 3 using the number of notches changed in the previous year as independent variable. *UP* and *DOWN* are the number of notches upgraded and downgraded in the previous year, respectively. *NetD*, overconfidence proxy and *FD* are defined as in Table 3. Statistical significance at the 1%, 5% and 10% levels is denoted as ***, ** and * respectively.

	Panel A: Upgrade			Panel B: Downgrade		
	(1) NetD	(2) NetD	(3) NetD	(4) NetD	(5) NetD	(6) NetD
FD	0.1208*** (3.998)	0.1248*** (3.998)	0.1276*** (4.115)	0.1123*** (3.651)	0.1143*** (3.627)	0.1161*** (3.607)
UP	-0.0007 (-0.233)	-0.0003 (-0.112)	-0.0001 (-0.026)			
DOWN				0.0014 (0.319)	0.0028 (0.647)	0.0037 (0.818)
OCFO	0.0127*** (4.337)	0.0124*** (3.902)	0.0119*** (3.561)	0.0134*** (4.536)	0.0130*** (3.995)	0.0127*** (3.695)
OCFO * FD	0.1367*** (3.073)	0.1314*** (2.931)	0.1174*** (2.672)	0.1325*** (2.833)	0.1292*** (2.765)	0.1258*** (2.720)
OCFO * UP	-0.0076 (-1.521)	-0.0078 (-1.576)	-0.0085 (-1.631)			
OCFO * DOWN				-0.0219*** (-3.308)	-0.0206*** (-3.184)	-0.0187*** (-2.857)
Constant	0.0049*** (2.940)	-0.0021 (-0.430)	-0.0067 (-0.740)	0.0039** (2.289)	-0.0074 (-1.218)	-0.0085 (-0.712)
N	3720	3720	3720	3683	3683	3683
R-sq	0.032	0.054	0.092	0.028	0.051	0.085
adj. R-sq	0.031	0.047	0.055	0.026	0.044	0.048
<i>Ind</i> and <i>Year</i> effect	No	Yes	No	No	Yes	No
<i>Ind</i> * <i>Year</i> effect	No	No	Yes	No	No	Yes

Appendix C: The effects of rating changes and CFO overconfidence on corporate financing controlling for CEO overconfidence – Eq. (3)

Replication of the estimation of Table 4 using the number of notches changed in the previous year as independent variable. *UP* and *DOWN* are the number of notches upgraded and downgraded in the previous year, respectively. *NetD*, overconfidence proxy and *FD* are defined as in Table 4. Statistical significance at the 1%, 5% and 10% levels is denoted as ***, ** and * respectively.

	Panel A: Upgrade			Panel B: Downgrade		
	(1) NetD	(2) NetD	(3) NetD	(4) NetD	(5) NetD	(6) NetD
FD	0.1164*** (3.915)	0.1188*** (3.890)	0.1247*** (4.411)	0.1073*** (3.553)	0.1085*** (3.519)	0.1124*** (3.555)
UP	-0.0007 (-0.232)	-0.0005 (-0.171)	-0.0006 (-0.180)			
DOWN				0.0014 (0.324)	0.0029 (0.669)	0.0040 (0.902)
OCFO_RCEO	0.0126** (1.989)	0.0134** (2.100)	0.0125** (1.993)	0.0132** (2.108)	0.0140** (2.219)	0.0132** (2.044)
RCFO_OCEO	0.0076** (2.071)	0.0076** (2.047)	0.0069** (1.983)	0.0091** (2.452)	0.0091** (2.439)	0.0083** (2.199)
OCFO_OCEO	0.0127*** (4.095)	0.0122*** (3.684)	0.0115*** (3.310)	0.0133*** (4.244)	0.0123*** (3.668)	0.0119*** (3.387)
OCFO_RCEO * FD	0.1227 (1.347)	0.1138 (1.224)	0.1085 (1.228)	0.1619* (1.868)	0.1509* (1.710)	0.1474* (1.756)
RCFO_OCEO * FD	0.1086* (1.683)	0.1089* (1.689)	0.1142* (1.662)	0.0770 (1.255)	0.0724 (1.188)	0.0691 (1.130)
OCFO_OCEO * FD	0.1436*** (2.989)	0.1378*** (2.862)	0.1314*** (2.635)	0.1281** (2.472)	0.1255** (2.442)	0.1285** (2.524)
OCFO_RCEO * UP	-0.0120 (-1.080)	-0.0115 (-1.050)	-0.0104 (-0.935)			
RCFO_OCEO * UP	-0.0025 (-0.445)	-0.0027 (-0.477)	-0.0012 (-0.193)			
OCFO_OCEO * UP	-0.0064 (-1.246)	-0.0071 (-1.385)	-0.0080 (-1.355)			
OCFO_RCEO * DOWN				-0.0260*** (-2.622)	-0.0236** (-2.423)	-0.0222** (-2.158)
RCFO_OCEO * DOWN				-0.0260*** (-3.213)	-0.0264*** (-3.309)	-0.0289*** (-3.434)
OCFO_OCEO * DOWN				-0.0194*** (-2.636)	-0.0187*** (-2.582)	-0.0166** (-2.343)
Constant	0.0050*** (2.997)	-0.0003 (-0.067)	-0.0060 (-0.824)	0.0040** (2.355)	-0.0053 (-0.933)	-0.0081 (-0.835)
N	4420	4420	4420	4360	4360	4360
R-sq	0.031	0.049	0.082	0.028	0.049	0.081
adj. R-sq	0.029	0.042	0.050	0.025	0.042	0.048
<i>Ind</i> and <i>Year</i> effect	No	Yes	No	No	Yes	No
<i>Ind</i> * <i>Year</i> effect	No	No	Yes	No	No	Yes

Appendix D: The effects of rating changes and CFO overconfidence on corporate financing – Eq. (2) – Investment-grade and speculative-grade sub-samples

Replication of the estimation of Table 5 using the number of notches changed in the previous year as independent variable. *UP* and *DOWN* are the number of notches upgraded and downgraded in the previous year, respectively. *NetD*, overconfidence proxy and *FD* are defined as in Table 5. Statistical significance at the 1%, 5% and 10% levels is denoted as ***, ** and * respectively.

	Panel A: Investment grade						Panel B: Speculative grade					
	<i>Upgrade</i>			<i>Downgrade</i>			<i>Upgrade</i>			<i>Downgrade</i>		
	(1) NDebt	(2) NDebt	(3) NDebt	(4) NDebt	(5) NDebt	(6) NDebt	(7) NDebt	(8) NDebt	(9) NDebt	(10) NDebt	(11) NDebt	(12) NDebt
FD	0.0433 (1.096)	0.0484 (1.192)	0.0419 (1.054)	0.0424 (1.227)	0.0446 (1.289)	0.0384 (1.105)	0.1527*** (4.319)	0.1489*** (4.027)	0.1580*** (4.360)	0.1440*** (3.844)	0.1397*** (3.592)	0.1488*** (3.850)
UP	0.0119* (1.753)	0.0134** (2.079)	0.0108 (1.621)				-0.0025 (-0.697)	-0.0026 (-0.703)	-0.0007 (-0.155)			
DOWN				-0.0027 (-0.480)	-0.0022 (-0.387)	0.0001 (0.017)				0.0050 (0.903)	0.0068 (1.210)	0.0075 (1.193)
OCFO	0.0040 (1.471)	0.0039 (1.294)	0.0024 (0.805)	0.0039 (1.447)	0.0048 (1.604)	0.0034 (1.118)	0.0253*** (4.228)	0.0232*** (3.802)	0.0241*** (3.425)	0.0265*** (4.370)	0.0225*** (3.598)	0.0249*** (3.405)
OCFO * FD	0.1703*** (3.288)	0.1821*** (3.551)	0.1824*** (3.733)	0.1515*** (2.891)	0.1599*** (3.091)	0.1614*** (3.292)	0.1243* (1.839)	0.1108 (1.615)	0.1040 (1.563)	0.1305* (1.801)	0.1304* (1.796)	0.1307* (1.853)
OCFO * UP	-0.0089 (-1.024)	-0.0108 (-1.285)	-0.0067 (-0.751)				-0.0146** (-2.089)	-0.0136* (-1.929)	-0.0163** (-1.965)			
OCFO * DOWN				-0.0123* (-1.680)	-0.0132* (-1.801)	-0.0107 (-1.356)				-0.0290*** (-3.210)	-0.0249*** (-2.848)	-0.0238** (-2.576)
Constant	0.0103*** (6.642)	0.0060 (1.162)	0.0167** (2.112)	0.0102*** (6.536)	0.0043 (0.827)	0.0147* (1.815)	-0.0028 (-0.839)	-0.0106 (-1.275)	-0.0259** (-2.003)	-0.0046 (-1.330)	-0.0203* (-1.808)	-0.0262 (-1.422)
N	2072	2072	2072	2055	2055	2055	1648	1648	1648	1628	1628	1628
R-sq	0.020	0.038	0.105	0.016	0.035	0.118	0.048	0.084	0.157	0.039	0.080	0.147
adj. R-sq	0.017	0.025	0.039	0.013	0.023	0.051	0.045	0.068	0.077	0.036	0.064	0.064
<i>Ind</i> and <i>Year</i> effect	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No
<i>Ind</i> * <i>Year</i> effect	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes

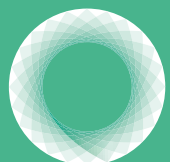
Appendix E: The effects of rating changes and CFO overconfidence on corporate financing – Eq. (3) – Investment-grade and speculative-grade sub-samples

Replication of the estimation of Table 6 using the number of notches changed in the previous year as independent variable. *UP* and *DOWN* are the number of notches upgraded and downgraded in the previous year, respectively. *NetD*, overconfidence proxy and *FD* are defined as in Table 6. Statistical significance at the 1%, 5% and 10% levels is denoted as ***, ** and * respectively.

	Panel A: Investment grade						Panel B: Speculative grade					
	Upgrade			Downgrade			Upgrade			Downgrade		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	NDebt	NDebt	NDebt	NDebt	NDebt	NDebt	NDebt	NDebt	NDebt	NDebt	NDebt	NDebt
FD	0.0415 (1.069)	0.0455 (1.159)	0.0419 (1.043)	0.0410 (1.202)	0.0430 (1.278)	0.0382 (1.118)	0.1467*** (4.220)	0.1433*** (3.930)	0.1552*** (4.707)	0.1374*** (3.739)	0.1348*** (3.528)	0.1447*** (3.850)
UP	0.0118* (1.750)	0.0128** (1.970)	0.0104 (1.544)				-0.0025 (-0.701)	-0.0031 (-0.859)	-0.0014 (-0.303)			
DOWN				-0.0027 (-0.479)	-0.0020 (-0.359)	0.0006 (0.108)				0.0050 (0.904)	0.0070 (1.241)	0.0081 (1.314)
OCFO_RCEO	0.0048 (0.714)	0.0048 (0.699)	0.0008 (0.112)	0.0048 (0.713)	0.0053 (0.779)	0.0014 (0.197)	0.0229** (2.051)	0.0217** (1.994)	0.0239** (2.130)	0.0243** (2.185)	0.0214** (1.963)	0.0236** (2.059)
RCFO_OCEO	0.0043 (1.090)	0.0041 (1.048)	0.0036 (1.005)	0.0046 (1.157)	0.0050 (1.280)	0.0046 (1.204)	0.0117 (1.621)	0.0105 (1.461)	0.0109 (1.531)	0.0148** (2.050)	0.0126* (1.734)	0.0102 (1.359)
OCFO_OCEO	0.0037 (1.340)	0.0032 (1.038)	0.0020 (0.645)	0.0036 (1.309)	0.0039 (1.252)	0.0029 (0.930)	0.0259*** (3.955)	0.0240*** (3.612)	0.0238*** (3.220)	0.0269*** (4.045)	0.0230*** (3.382)	0.0245*** (3.193)
OCFO_RCEO * FD	0.1911* (1.933)	0.2052** (2.156)	0.2337** (2.382)	0.1871* (1.955)	0.2053** (2.258)	0.2271** (2.457)	0.0906 (0.647)	0.0747 (0.498)	0.0729 (0.544)	0.1537 (1.176)	0.1392 (0.997)	0.1579 (1.160)
RCFO_OCEO * FD	0.1461*** (2.697)	0.1663*** (2.946)	0.1786** (2.547)	0.1427** (2.495)	0.1604*** (2.690)	0.1809*** (2.669)	0.1000 (1.081)	0.0816 (0.886)	0.0751 (0.777)	0.0463 (0.543)	0.0162 (0.194)	0.0063 (0.078)
OCFO_OCEO * FD	0.1658*** (2.928)	0.1723*** (3.075)	0.1782*** (2.953)	0.1415** (2.407)	0.1457** (2.518)	0.1544*** (2.898)	0.1396* (1.879)	0.1280* (1.724)	0.1215 (1.493)	0.1298 (1.570)	0.1301 (1.600)	0.1265 (1.580)
OCFO_RCEO * UP	-0.0188* (-1.685)	-0.0178* (-1.661)	-0.0102 (-0.931)				-0.0135 (-0.862)	-0.0119 (-0.776)	-0.0130 (-0.803)			
RCFO_OCEO * UP	-0.0104 (-1.167)	-0.0119 (-1.341)	-0.0092 (-1.013)				-0.0032 (-0.408)	0.0000 (0.004)	-0.0014 (-0.152)			
OCFO_OCEO * UP	-0.0069 (-0.750)	-0.0090 (-0.999)	-0.0060 (-0.617)				-0.0151** (-2.108)	-0.0145** (-2.008)	-0.0170** (-1.992)			
OCFO_RCEO * DOWN				-0.0221** (-2.474)	-0.0226** (-2.577)	-0.0230** (-2.285)				-0.0304** (-2.432)	-0.0255** (-2.097)	-0.0231* (-1.793)
RCFO_OCEO * DOWN				-0.0261*** (-2.619)	-0.0273*** (-2.620)	-0.0261** (-2.544)				-0.0267** (-2.500)	-0.0255** (-2.506)	-0.0284** (-2.550)
OCFO_OCEO * DOWN				-0.0088 (-1.075)	-0.0098 (-1.184)	-0.0073 (-0.825)				-0.0277*** (-2.581)	-0.0244** (-2.362)	-0.0240** (-2.270)
Constant	0.0103*** (6.652)	0.0103* (1.722)	0.0149** (2.250)	0.0103*** (6.542)	0.0093 (1.554)	0.0135** (1.994)	-0.0026 (-0.772)	-0.0119 (-1.605)	-0.0216** (-2.046)	-0.0043 (-1.257)	-0.0233** (-2.321)	-0.0231 (-1.536)
N	2487	2487	2487	2443	2443	2443	1933	1933	1933	1917	1917	1917
R-sq	0.019	0.032	0.097	0.019	0.034	0.114	0.046	0.078	0.141	0.037	0.077	0.138
adj. R-sq	0.015	0.019	0.039	0.014	0.021	0.056	0.041	0.062	0.069	0.032	0.061	0.065
Ind and Year effect	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No
Ind * Year effect	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes



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