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Abstract

We examine whether CEO extraversion, an important personality trait associated with leadership, is associated with firms' expected cost of equity capital. We measure CEO extraversion using CEOs' speech patterns during the unscripted portion of conference calls. After controlling for multiple CEO and firm-specific variables, we find a strong positive incremental association between CEO extraversion and firms' expected cost of capital. Moreover, cost of equity increases when a more extraverted CEO replaces a less extraverted CEO. In addition, we find that firms with relatively extraverted CEOs take more risk and exhibit lower credit ratings, which is associated with higher cost of equity capital. These results are statistically and economically meaningful and do not appear to be driven by reverse causality, endogenous matching, look-ahead bias, or bias in analysts' earnings forecast.

JEL CLASSIFICATION
G11, G32, G41, M40, M41

1 | INTRODUCTION

A growing body of research highlights the importance of a CEO's personality in influencing their firm's corporate policies and outcomes. Although most of this research has focused on the traits of overconfidence and related overoptimism (e.g., Banerjee et al., 2018; Gervais et al., 2011; Hirshleifer et al., 2012; Malmendier & Tate, 2005,

2008), CEO extraversion has received recent attention as a potential explanation for firms' decisions (e.g., Becker et al., 2019; Gow et al., 2016; Green et al., 2019; Lartey et al., 2020; Malhotra et al., 2018).

Extraversion has been described as the most important of the Big Five personality traits (e.g., Cain, 2013), which also include emotional stability, agreeableness, conscientiousness, and openness to experience (Costa & McCrae, 1988, 1992; Digman, 1990; Goldberg, 1990; John & Srivastava, 1999; Norman, 1963). Studies have found that extraversion is the strongest and most consistent predictor of leadership—a trait considered desirable among CEOs (Bono & Judge, 2004; Judge et al., 2002). A key characteristic of extraverts is that they seek external stimulation (Eysenck, 1963), which generally causes them to (1) be warm, sociable, assertive, talkative, energetic, decisive, and gregarious (Barrick & Mount, 1991; John & Srivastava,1999); (2) display positive affect and desire for social engagement and attention (Wilt & Revelle, 2015); and (3) seek excitement (Costa et al., 1984), which is positively related to personal risk taking (Nicholson et al., 2005).

In this article, we examine how CEO extraversion affects firms' expected cost of equity capital. This question is important because cost of equity capital is a key benchmark used by corporate executives, equity analysts, investors, and finance and accounting scholars. Cost of equity capital represents the market's risk-adjusted expected rate of return on a company's equity. Traditionally, the literature has used a variety of firm-specific quantitative characteristics to proxy for risk. However, as firms are run by their CEOs, it is possible that qualitative CEO characteristics, such as extraversion, may provide incremental insight into firms' riskiness.

One of the key challenges in this research is to identify a reliable measure of CEO extraversion. Typically, personality measures rely on self-reported responses to long personality questionnaires that are difficult to collect from top executives in publicly traded firms. Fortunately, studies in psychology and computational linguistics use written or spoken language of their subjects to identify personality markers in language (e.g., Beukeboom et al., 2013; Dewaele & Furnham, 1999; Heylighen & Dewaele, 2002; Koomen & Dijkstra, 1975; Oberlander & Gill, 2006; Pennebaker & King, 1999; Yarkoni, 2010). For example, these studies find that extraverts exhibit a more imprecise, more abstract, and "looser" speech style compared to introverts.

To estimate CEO extraversion, we use a personality scoring linguistic technique developed by Mairesse et al. (2007). The algorithm used to measure extraversion includes word count, word repetition, concreteness, references to family and friends, and many other linguistic features. Mairesse et al. (2007) validate the measure by comparing the Big Five personality dimensions obtained using the linguistic technique to those obtained from self-reported personality questionnaires and independent observers. We apply their algorithm to the question-and-answer (Q&A) portion of 76,815 conference call transcripts for 1878 CEOs of S&P 1500 companies over a 10-year period from 2004 through 2013. Malhotra et al. (2018) and Green et al. (2019) validate and use this technique to examine the association between CEO extraversion and (1) merger and acquisition (M&A) activities and (2) CEO career benefits, respectively.

Using a large, unbalanced panel of CEO-firm-years, we find that CEO extraversion is positively associated with cost of equity. This association is robust to firm fixed effects and alternative measures of cost of equity. It is also economically significant. In firm fixed-effects models, a one standard deviation (1 SD) increase in extraversion is associated with an increase in expected annual cost of equity capital ranging from 0.35% to 0.38%. Given that the average expected equity risk premium in our sample ranges between 2.91% and 5.03%, our findings suggest that a 1 SD increase in CEO extraversion is associated with a 7%–13% increase in the equity risk premium compared to the sample mean. This magnitude of increase in cost of equity capital is similar to that found when firms increase their directors' and officers' liability insurance (Chen et al., 2016).

We conduct several tests to explore whether CEO risk-taking behavior explains the relation between CEO extraversion and implied cost of equity capital (ICC). First, using stock return volatility, return on assets (ROA) volatility, and financial leverage as measures of firm riskiness, we find that CEO extraversion affects cost of equity only for high-risk firms, suggesting that CEOs' risk-taking behavior is an important channel through which extraversion influences the cost of capital. Second, we find a negative and significant relation between CEO extraversion and firms' credit ratings, which supports our findings that firms with extraverted CEOs exhibit higher

risk taking and cost of capital. Third, we find mixed evidence on the impact of CEO extraversion on firm performance. CEO extraversion has a mild positive effect on sales growth and market share, which appears to offset the effect of higher cost of capital, and results in an insignificant relation between CEO extraversion and firm valuation. However, we do find weak evidence that CEO extraversion is associated with lower equity issuance and lower efficiency in generating revenue from a given set of inputs, that is, firm efficiency (Demerjian et al., 2012).

We make multiple contributions to the literature. First, we contribute to the literature on determinants of firms' cost of capital. Traditionally, this area has relied on observable firm-specific characteristics to explain cost of capital, including measures of risk, measures of information environment quality, firm size, leverage, and book-to-market ratio. Newer research examines the role of (1) social factors, such as political capital (Boubakri et al., 2012) and sustainability (Ng & Rezaee, 2015), and (2) CEO attributes and actions, such as ability (Mishra, 2014), compensation (Chen et al., 2013), financial leverage (Lartey et al., 2020), and level of inside debt (i.e., pensions and deferred compensation, Shen & Zhang, 2020). We complement this literature by finding that CEO extraversion is strongly associated with firms' expected cost of capital. The effect we document is economically significant and incremental to controls for standard measures of risk.

Second, we contribute to the broader literature on the effect of assorted CEO personality traits on corporate policies and outcomes. For example, Graham et al. (2013), Hirshleifer et al. (2012) and Malmendier and Tate (2005, 2008) find that CEOs' optimism and overconfidence affect their decision making and corporate investment policies. We extend this literature by examining whether CEO extraversion is another important personality trait that affects corporate policies and outcomes. Our results suggest that in some instances, CEO extraversion subsumes the effects of overconfidence.[1]

Finally, we contribute to the literature on CEO styles and risk-taking preferences on corporate policies and outcomes. Studies find that exposure to a particular macroeconomic shock (Great Depression, Malmendier et al., 2011), personal attribute (marital status, Roussanov & Savor, 2014; holding a pilot's license, Cain & McKeon, 2016), or career-specific experience (Schoar & Zuo, 2017) affects CEO risk taking and consequently corporate policies. In contrast, we use a stable personality trait that is arguably relatively exogenous. In this regard, we are similar to Bernile et al. (2017), who use early-life exposure to fatal disasters and are able to provide a causal link to risk preferences. By documenting a strong positive relation between extraversion and risk-taking behaviors, we provide a determinant of risk preferences rather than a manifestation.

2 | LITERATURE REVIEW

2.1 | CEO impact on cost of equity

Upper echelons theory suggests that organizational behaviors reflect the personal traits of top executives (Hambrick & Mason, 1984). Many empirical studies have found that CEOs can have a direct effect on firms' cost of equity. First, CEO compensation can signal risks underlying firms' future projects, and investors may price such risks in the cost of equity. For example, Chen et al. (2015) find that the sensitivity of an executive's wealth to changes in stock prices (delta) decreases ICC, whereas the sensitivity of an executive's wealth to changes in stock volatility (vega) increases ICC. Chen et al. (2013) find that CEO pay slice (i.e., pay disparity with other firm executives) is

[1]Although extraverted individuals may exude confidence, extraversion is conceptually distinct from overconfidence. Specifically, overconfidence is a biased belief. It is typically defined in the literature as (1) an overestimation of the precision of one's knowledge (i.e., miscalibration), (2) an overestimation of one's skills and abilities (i.e., better-than-average effect), or (3) the belief that one is more (less) likely to experience positive (negative) events than their peers (i.e., overoptimism) (Odean, 1998). In contrast, extraversion is a personality trait that reflects characteristic patterns of thoughts, feelings, and behaviors. Extraverts seek external stimulation and are typically characterized as sociable, assertive, talkative, energetic, decisive, gregarious, and excitement seeking. Empirical evidence on the impact of personality traits on overconfidence is mixed, with Pallier et al. (2002) finding no significant correlation between overall extraversion and overconfidence and Schaefer et al. (2004) finding that extraversion significantly predicts overconfidence.

associated with higher CEO entrenchment and succession risk, which results in higher implied cost of equity. Shen and Zhang (2020) find that CEO inside debt holdings (such as defined benefit pensions and deferred compensation) have a negative association with cost of equity. They argue that CEO debt-like compensation may constrain excessive managerial risk taking, which lowers investors' demand for risk compensation.

Other studies examine specific CEO personal traits and their impact on cost of equity. For example, Mishra (2014) finds that CEOs with higher general managerial ability (i.e., generalist CEOs) are associated with higher cost of equity. Tseng and Demirkan (2021) find that CEO overconfidence has a positive effect on firms' implied cost of equity. However, such positive association can be alleviated by diverting firm resources to corporate social responsibility initiatives that have a connection to the firm's economic factors. Aghazadeh et al. (2018) document a nonlinear (U-shaped) relation between CEO overconfidence and cost of equity. Lee et al. (2019) find a positive association between CEO connectedness and firms' cost of equity. They argue that CEO connectedness encourages greater agency problems and more risk taking by reducing the costs borne by the CEO from a termination. Recently, Hu et al. (2022) find that Chinese CEOs who have overseas experience tend to be associated with lower cost of equity capital.

The literature has not studied the effect of CEO personality on firms' cost of capital. We believe it is important to study CEO personality as it is a stable trait that tends to be exogenous to individuals' experience and growth. We focus on one of the most important personality traits, extraversion, as it has been shown to have a significant effect on firm policies and financial outcomes.

2.2 | Impact of CEO extraversion on firm policies and outcomes

Gow et al. (2016) find that CEO extraversion is negatively associated with both contemporaneous and future returns on firm assets and cash flows because of the clash of CEO dominance with disobedient teams in the decision-making process (e.g., Anderson et al., 2001; Barrick et al., 2002). Gow et al. (2016) also argue that extraverted CEOs tend to have short-lived enthusiasm and overconfidence, which leads to poor decisions. However, Green et al. (2019) find a positive association between CEO extraversion and CEO career and firm outcomes. They show that extraverted CEOs tend to earn higher salaries, enjoy longer tenures, and have more opportunities to serve on other company boards. Using a sample of CEO transitions, they also find that firms experiencing increases in CEO extraversion tend to have improvements in investor recognition and sales growth. Malhotra et al. (2018) find that firms led by extraverted CEOs are more likely to make large and successful acquisitions. Lartey et al. (2020) find that firms managed by extraverted CEOs tend to use greater financial leverage and adjust toward target leverage levels at a faster rate than firms managed by less extraverted CEOs. They suggest that this is because of the extraverted CEOs' innate affinity for risk taking. Becker et al. (2019) find that financial analysts tend to perceive extraverted CEOs as more successful, which results in more optimistic analyst forecasts of firm performance.

Despite this emerging area of research, we still have a limited understanding of whether and how CEO personality affects other firm outcomes, such as firm's cost of equity. Based on findings in the literature, we make several theoretical predictions in the next section.

2.3 | CEO extraversion and cost of equity

The relation between CEO extraversion and firms' expected cost of equity capital is ambiguous ex ante. On one hand, given extraverted CEOs' desire for social engagement and attention, they are more likely to interact with firm stakeholders and increase their firms' visibility. For example, Green at el. (2019) find that CEO extraversion is positively related to conference call participation and media coverage. In untabulated results, we also find that

extraverted CEOs participate more frequently in conference calls and talk more during these calls. These activities could improve the information environment of the firm, leading to higher analyst following and a larger investor base.[2] Merton (1987) finds that an increase in investor awareness and the investor base leads to more efficient risk sharing and reduces firms' cost of equity capital. This suggests that CEO extraversion is negatively related to firms' cost of capital.

On the other hand, extraverted CEOs' need for external stimulation and sensation seeking suggests they may be prone to risk taking. Several studies in psychology find that sensation seeking is a consistent predictor of various kinds of risk taking, including gambling and participating in high-risk activities (Zuckerman & Kuhlman, 2000; Zuckerman et al., 1964; Zuckerman, 1974). Nicholson et al. (2005) document that extraverts show a significantly higher propensity for personal risk taking along several dimensions, including health, recreation, and career choice. In a study on corporate decision making, Malhotra et al. (2018) find that extraverted CEOs follow a more aggressive M&A strategy, which suggests that extraverts take greater risk. Lartey et al. (2020) find that firms managed by extraverted CEOs tend to have higher financial leverage. If extraverted CEOs do indeed take on more risk, we expect their companies to have a higher cost of equity capital, ceteris paribus. If we expect that market participants respond to extraversion in ways that affect a firm's cost of equity, it is crucial that they can observe this personality trait, perhaps with error. We observe that the media often make comments about CEO personality traits (e.g., Best, 2017; Broughton, 2010; Burgis, 2011; Papadopoulos, 2019; Westwood, 2016). Anecdotal media observations qualitatively align with our extraversion scores, leading us to believe that market participants are able to discern extraversion.[3]

Given that prior research indicates both positive and negative potential consequences of CEO extraversion on firms' cost of equity capital, it becomes an important empirical question as to which effect prevails (if any). Thus, we examine the null hypothesis of no association between CEO extraversion and firms' cost of equity capital.

3 | DATA, SAMPLE, AND MEASURES

3.1 | Data sources

Our data are collected from several sources and include a large, unbalanced panel of firms from 2004 to 2013. We use the ExecuComp database to identify CEOs of S&P 1500 companies, their age, start date in their current position, gender, and compensation information. We restrict our sample to S&P 1500 firms because we rely on the ExecuComp database to gather information about CEO characteristics (CEO age, tenure, gender, overconfidence, etc.) and the ExecuComp database focuses on S&P 1500 companies. We use BoardEx to find the number of directorships held by each CEO and collect information about their education, past professional and social connections, and previous professional experiences. We compile conference call transcripts from Thomson Street Events for firms' quarterly earnings announcements. This results in 76,815 conference call transcripts for 1936 firms.

[2]The literature relates analyst following to the quality of a firm's disclosure and information environment (Barth et al., 2001; Botosan & Harris, 2000; Healy et al., 1999; Lang & Lundholm, 1996). The increase in investor base could follow either because of the effect of analyst coverage (Mola et al., 2013) or because investors with limited attention tend to buy stocks that are in the news (Barber & Odean, 2008). Green et al. (2019) find that firms experience, on average, an increase in analyst following, share turnover, and liquidity after hiring a more extraverted CEO.

[3]Some media also discuss their perceptions of CEO charisma (e.g., Tobak, 2012). Our study emphasizes extraversion because we believe that extraversion captures traits beyond charisma. As one of the Big Five personality traits, extraversion is considered largely stable and inherited, whereas studies show that charisma can be learned or changed through signaling (Antonakis et al., 2011; Ernst et al., 2022; Grabo et al., 2017). Although traits such as charisma may be more observable by the media, we argue that market participants can also assess CEO personality from other subtle cues and patterns in their speech. Therefore, we believe a systematic approach (such as using a linguistic computational algorithm) to assess CEO personality traits is needed to better understand the effect of CEO extraversion on firm behavior and corporate finance outcomes.

We collect information on the (1) number of analysts, analyst earnings forecasts, long-term growth rate forecasts, and dispersion of earnings forecasts and actuals from Institutional Brokers' Estimate System (IBES) summary and actuals files and (2) stock price, volume, and number of shares outstanding from Center for Research in Security Prices (CRSP) daily and monthly data sets. We limit our sample to common stocks (i.e., those with CRSP share codes 10 or 11). We obtain annual accounting information, including Standard Industrial Classification (SIC) codes, book value of equity, total assets, net income, dividends, long-term debt, fiscal-year-end number of shares outstanding, fiscal-year-end stock prices, and income before extraordinary items from the Compustat annual file. We use SIC codes to remove financial firms (6000–6999) and utilities (4900–4949). Finally, we obtain the risk-free rate, Fama–French (1993) factors, and momentum factors from Kenneth French's website.[4] The final sample includes 8048 firm-year observations for 1274 firms and 1878 unique CEOs.

3.2 | Estimating ICC

We estimate ICC for a given firm as the internal rate of return that equates the current stock price to the present value of expected future earnings. An advantage of this measure is that it does not rely on either a specific asset pricing model or noisy realized returns (Elton, 1999; Richardson et al., 2010). To estimate expected future earnings, we use two methods proposed in the literature: analyst earnings forecasts and cross-sectional earnings forecast models. Both methods are used in other finance and accounting studies (e.g., Gebhardt et al., 2001; Hou et al., 2012; Huynh et al., 2020; Li & Mohanram, 2014; Pham, 2019; Xu, 2020). Use of analyst earnings forecasts has been dominant in the literature because these forecasts are more accurate than cross-sectional models and may include more recent and relevant information. However, analyst earnings forecasts are not available for all firms, even among S&P 1500 companies. Moreover, Easton and Monahan (2005) find that implied cost of equity estimates may be unreliable when analyst forecasts are inaccurate and overly optimistic about future growth.[5] To mitigate the problem of bias in analyst earnings forecasts transferring to cost-of-equity estimates, we also use a cross-sectional earnings forecast model proposed by Hou et al. (2012). We believe this is an important measure to test the robustness of our results. In particular, Becker et al. (2019) find that analysts tend to believe that extraverted CEOs are more successful, which can result in more favorable forecasts (i.e., upward biases) for firms led by extraverted CEOs. However, the model-based cost of equity measure (instead of the analyst forecast-based measure) should be less influenced by analysts' biases.

Following Hou et al. (2012), for each year, we estimate up to 5 years of expected earnings. We first estimate five pooled, cross-sectional regressions using the previous 10 years of data for the following model:

$$E^{\mathrm{HVZ}}_{i,t+\tau} = \alpha_0 + \alpha_1 A_{i,t} + \alpha_2 D_{i,t} + \alpha_3 DD_{i,t} + \alpha_4 E_{i,t} + \alpha_5 NegE_{i,t} + \alpha_6 NegE_{i,t} \times E_{i,t} + \alpha_7 AC_{i,t} + \varepsilon_{i,t+\tau}, \quad (1)$$

where $E_{i,t+\tau}$ denotes earnings (Compustat item IB, income before extraordinary items) of firm i in year $t+\tau$ ($\tau = 1$ to 5); $A_{i,t}$ is total assets (Compustat item AT); $D_{i,t}$ is dividend payment (Compustat item DVT); $DD_{i,t}$ is an indicator variable that equals 1 if a company pays dividends, and 0 otherwise; $NegE_{i,t}$ is an indicator variable that equals 1 if a firm has negative earnings, and 0 otherwise; $NegE_{i,t} \times E_{i,t}$ is an interaction term that allows for different persistence of profits and losses (Li, 2011); and $AC_{i,t}$ is a measure of accruals (IBC − OANCF + XIDOC from Compustat). All explanatory variables

[4] https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/

[5] Because of the findings in Easton and Monahan (2005), some recent studies focus on liquidity and transparency as alternative outcomes related to information risk and, consequently, cost of capital (see, e.g., Barth et al., 2013; Hail & Leuz, 2006; Lang et al., 2012). However, we believe the use of these alternative measures is not appropriate in our setting because the psychology literature suggests that CEO extraversion could have two opposing effects on cost of capital: (1) reducing information risk (through their desire for attention and social engagement) and (2) increasing operational and financial risk (through sensation seeking and risk taking). Given that measures of liquidity and transparency capture only one effect of CEO extraversion on cost of capital, they are likely to offer an incomplete picture. For robustness, we use S&P 500 issuer credit ratings as an alternative measure of overall riskiness that is not subject to the Easton and Monahan (2005) criticism.

are measured as of year *t*. To reduce the effect of outliers, we winsorize continuous explanatory variables at the 1st and 99th percentiles. Finally, we calculate up to 5 years of expected earnings by multiplying the independent variables as of year *t* with coefficients from the pooled regressions.

Previous studies also develop a variety of methods to estimate ICC. To ensure that our results are not driven by any specific method and to follow the literature (Hou et al., 2012; Mishra, 2014), we construct three ICC estimates and report our main results based on their average. They differ in their use of forecasted earnings (i.e., analyst based or past earnings based), explicit forecast horizon, and assumptions regarding short- and long-term growth rates. Easton and Monahan (2005) and Lee et al. (2010) provide a comprehensive analysis and comparison of different ICC models. We select these three models because they broadly represent three types of valuation methods: Gebhardt et al. (2001) is based on a residual income valuation model, which we label GLS; Easton (2004) is based on an abnormal earnings growth model, which the author labels "modified price–earnings growth" (MPEG); and Gordon and Gordon (1997) is based on the Gordon growth model, which we label Gordon. We provide a description of each in Appendix A.

To align firms with different fiscal year-ends in calendar time, we estimate ICC for each firm at the end of June of each year by using end-of-June market capitalization. To ensure that accounting information is publicly available at the time of ICC estimation, we impose a minimum reporting lag of 3 months. That is, we use accounting data for firms with fiscal year-ends from April of year $t-1$ to March of year t. For the analyst-earnings forecast method, expected earnings are measured as of the middle of June of year t (i.e., the IBES cutoff date). For the cross-sectional earnings method, we forecast earnings for a given firm by multiplying its accounting variables (for the fiscal year ended between April of year $t-1$ and March of year t) with the coefficients from the pooled regression estimated using the previous 10 years of data. For each of the two earnings forecast methods (analyst based and past earnings based), we calculate an equal-weighted average of the three individual ICC measures. Finally, we subtract the 10-year government bond yield from each estimate because we focus on risk premia. In summary, this procedure yields two distinct composite ICC measures: ICC^{AN} based on analysts' forecasts, and ICC^{HVZ} based on the cross-sectional earnings forecast model of Hou et al. (2012). To follow Hou et al. (2012) and maximize coverage, we require a firm to have only one non-missing individual ICC estimate to compute its composite ICC.[6]

3.3 | Measuring extraversion

Studies in psychology and computational linguistics document that personality affects language use across different types of expression, including e-mails (Oberlander & Gill, 2006), personal narratives (Hirsch & Peterson, 2009), recorded conversations (Mehl & Pennebaker, 2003; Mehl et al., 2006), and personal blogs (Yarkoni, 2010). These studies also identify various markers of personality in language, particularly extraversion. For example, extraverts tend to speak faster (Koomen & Dijkstra, 1975) and louder (Scherer, 1979). They use more words overall (Gill & Oberlander, 2002; Mehl et al., 2006), more positive emotion words and fewer negative emotion words (Pennebaker & King, 1999), and tend to talk more about people, family, and social processes (Hirsch & Peterson, 2009; Pennebaker & King, 1999; Yarkoni, 2010). In contrast, introverts tend to be more concrete and precise than extraverts. For example, compared to extraverts, introverts tend to use more articles, numbers, quantifications, exclusive words (e.g., "but," "except"), negations (e.g., "not," "no"), and tentative words (e.g., "perhaps," "maybe"). Introverts also use fewer inclusion words and certainty words (e.g., "absolute," "always") (Beukeboom et al., 2013; Dewaele & Furnham, 1999; Heylighen & Dewaele, 2002; Oberlander & Gill, 2006; Pennebaker & King, 1999; Yarkoni, 2010). Overall, as Gill and Oberlander (2002) suggest, introverts exhibit a more careful, precise, and focused style, whereas extraverts exhibit a more imprecise, "looser" style.

[6]Our results are robust if we require a firm to have all three individual ICC measures to be included in the analysis. In addition, robustness tests find that our main results are unaffected when using each of the three individual measures (instead of using the mean of the three individual measures).

A software tool, Linguistic Inquiry and Word Count (LIWC) created by James W. Pennebaker (www.liwc.net), follows a dictionary approach and calculates the degree to which people use different categories of words (e.g., the degree to which text uses positive or negative emotions, self-references, causal words, and 85 other language dimensions). Mairesse et al. (2007) develop a method to measure the Big Five personality traits through computerized textual analysis by combining features from LIWC with 14 additional features from the MRC Psycholinguistic database (Coltheart, 1981). The MRC Psycholinguistic database contains statistics for more than 150,000 words, such as estimates of the age of acquisition, frequency of use, and familiarity. Mairesse et al. (2007) trained their algorithm using essays written by subjects who also filled out self-reported Big Five questionnaires (the same data set used by Pennebaker & King, 1999). Using algorithms based on linear regression, support vector machine regression, and tree-based methods, they found that the support vector machine (SVR) method performed best overall across the five personality traits.

Following Malhotra et al. (2018), we measure CEO extraversion by applying the SVR linguistic algorithm of Mairesse et al. (2007) to the language spoken by CEOs in the Q&A portion of conference calls. The Mairesse et al. (2007) algorithm is available through a Java command-line application, the Personality Recognizer, which reads text files and computes estimates of personality scores for the Big Five personality traits. The algorithm is independently validated in the conference call setting by Malhotra et al. (2018).[7]

We collect conference call transcripts for S&P 1500 companies for 2004–2013 from Thomson Reuters Street Events. Conference call transcripts generally follow a structure that includes three distinct segments: (1) the call participants list, (2) management discussion, and (3) questions from analysts with answers from management (Q&A). We focus exclusively on the Q&A segment because the management discussion segment is likely to be scripted by others and therefore may not be suitable for gauging personality. In contrast, language spoken by CEOs in response to analyst questions is likely unscripted (Matsumoto et al., 2011) because analysts' questions can be direct, complex, and difficult to anticipate. Moreover, as Malhotra et al (2018) argue, language spoken during the Q&A segment is particularly appropriate for assessing CEOs' extraversion because variations in extraversion are more readily revealed under complex and stressful conditions (Dewaele & Furnham, 1999).

Within the Q&A segment, there is a title above each section that denotes the speaker's name. We require that each speaker's name be included in the list of participants. We identify when the speaker is the CEO by hand matching the name from the conference call transcript to the CEO name in ExecuComp and the company ticker. Considering that longer texts yield more reliable personality scores and following Malhotra et al. (2018), we aggregate language spoken by a given CEO in the Q&A segment across all conference call transcripts in our sample.[8] We include only CEOs who spoke at least 500 words across the transcripts in our sample. The average word count for CEOs in our sample is 10,147 words per CEO per call, with a range of 506 to 113,956 words.

3.4 | Other control variables

Additional control variables related to the CEO include *CEO Age* in years, proportion of a firm's shares owned by the CEO (*CEO Ownership*), number of years the CEO has been in the position (*CEO Tenure*), *CEO Gender*, CEO's pay relative to the pay of other members of the top management team (*CEO Pay Slice*), *CEO Board*

[7]To provide better intuition about the algorithm underlying the personality measure, Malhotra et al. (2018, p. 381) provide the top 10 most important linguistic features for measuring extraversion. For example, individuals with high scores in extraversion tend to use fewer repetitive words in their speech, they often use first-person plurals (e.g., "we," "us," "our"), they are more likely to use words related to motion (e.g., "walk," "move," "go"), but they are less likely to mention precise numbers in their speech. The machine-learning algorithm uses these features to predict CEO extraversion scores based on CEO speech data during conference calls.

[8]We use all available earnings call transcripts because extraversion is a stable personality trait and more data reduce measurement error. This approach is standard in the extraversion literature (Green et al., 2019; Malhotra et al., 2018). In untabulated analyses, to verify the consistency of personality scores across time, we construct an annual extraversion measure using only conference call transcripts in a given calendar year. The intraclass correlation for individual CEO's annual extraversion measures is 89%, which suggests that our measure of extraversion does indeed capture a stable personality trait. We discuss the results based on this annual extraversion measure in Section 4.4.

Network, and *CEO Overconfidence*. We follow Campbell et al. (2011) and define a CEO as overconfident if the CEO delayed exercising deeply in-the-money stock options using compensation data from the ExecuComp database.

We also include control variables for firm riskiness, fundamental performance, and the information environment. Specifically, we measure risk using total return volatility (*Volatility*), four-factor model beta (*Beta*), book value of leverage (*Leverage*), and ROA volatility (*ROAVOL*). We collect data on total assets (*Firm Size*), book-to-market ratio (*B/M*), return on assets (*ROA*), and the long-term growth rate (*LTG*). Finally, to measure each firm's information environment, we construct measures of analyst bias (*Analyst Bias*) and analyst forecast error (*Analyst FERR*). Details about variable definitions are available in Appendix B.

3.5 | Descriptive statistics

Our main variable of interest, *Extraversion*, has a mean value of 6.97 and standard deviation of 0.62 (Table 1). Although we do not have specific hypotheses about the remaining four dimensions of personality, for completeness we report summary statistics and include them in our analyses as controls. Average CEO age for our sample of CEOs is 55.4 years and average tenure is 7.4 years. Approximately 97% of CEOs in our sample are male and sample CEOs hold on average 0.02% of their company's outstanding shares. With respect to firm characteristics, average equity premium for our sample firms is 2.91% for ICC^{HVZ} and 5.03% for ICC^{AN}. The average firm in our sample has total assets of $80 billion, book-to-market ratio of 0.48, long-term debt-to-total-assets ratio of 16.3%, expected long-term growth rate of 17.0%, and four-factor model market beta of 1.06. These numbers indicate that our sample is composed of larger, stable firms, which is not surprising given that our universe is the S&P 1500.

4 | RESULTS

4.1 | CEO extraversion and ICC

We begin our empirical analysis by estimating the following panel regression to test the null hypothesis that CEO extraversion is unrelated to firms' cost of equity capital:

$$\begin{aligned} ICC^{K}_{i,t} = {} & \beta_0 + \beta_1 Extraversion_j + \beta_2 EmotionalStability_j + \beta_3 Openness_j + \beta_4 Agreeableness_j \\ & + \beta_5 Conscientiousness_j + \theta FirmCharacteristics_{i,t} + \gamma CEOCharacteristics_{i,t} + FE_t + FE_i + \varepsilon_{i,t}, \end{aligned} \tag{2}$$

where $ICC^{K}_{i,t}$ is the implied cost of equity risk premium for firm *i* in year *t*; and superscript *K* denotes whether expected earnings are obtained from analyst forecasts or from a cross-sectional model. *Extraversion* is our main variable of interest. *Emotional Stability*, *Openness*, *Agreeableness*, and *Conscientiousness* are the other four Big Five personality traits obtained from linguistic analysis of conference call transcripts. Following Chen et al. (2013), Mishra (2014), and Chen et al. (2016), we control for several firm characteristics that Botosan et al. (2011) find are correlated with the cost of equity, including beta, firm size, book-to-market ratio, leverage, and the forecast of long-term growth rate of earnings. We also include analyst forecast bias to control for the effect of optimism (Easton & Sommers, 2007) and analyst forecast error to control for the potential impact of CEO extraversion on the information environment of the firm. Finally, we control for individual CEO characteristics, including age, gender, tenure, ownership, and overconfidence. These characteristics can affect CEO risk preferences and corporate policies (Graham et al., 2013; Hirshleifer et al., 2012; Malmendier & Tate, 2005, 2008). Definitions of the control variables are in Appendix B. Finally, we include year and industry fixed effects and draw inferences based on

TABLE 1 Descriptive statistics.

Variable	N	Mean	SD	25% pctl	50% pctl	75% pctl
Panel A: CEO characteristics						
Extraversion	8048	6.972	0.620	6.646	7.018	7.358
Emotional Stability	8048	3.080	0.476	2.803	3.123	3.392
Agreeableness	8048	3.282	0.337	3.068	3.286	3.496
Conscientiousness	8048	6.515	0.566	6.168	6.514	6.859
Openness	8048	6.172	0.539	5.804	6.146	6.515
CEO Age	8048	55.352	6.918	51.000	55.000	60.000
CEO Ownership (%)	8048	0.018	0.042	0.001	0.004	0.011
CEO Tenure	8048	7.431	7.065	2.504	5.347	10.006
CEO Gender	8048	0.968	0.175	1	1	1
CEO Overconfidence	8048	0.257	0.437	0	0	1
Panel B: Firm characteristics						
ICC^{AN} (%)	8048	5.034	4.373	2.787	4.594	6.512
ICC^{HVZ} (%)	8048	2.906	3.172	0.806	2.432	4.469
Assets ($billion)	8048	80.3	31.7	6.5	16.6	51.1
B/M	8048	0.478	0.299	0.270	0.416	0.614
Leverage	8048	0.163	0.149	0.006	0.146	0.262
LTG	8048	0.170	0.145	0.102	0.140	0.183
Beta	8048	1.064	0.337	0.842	1.038	1.250
Analyst Bias	8048	-0.005	0.043	-0.004	0.000	0.004
Analyst FERR	8048	0.013	0.046	0.001	0.004	0.011
ROAVOL	8048	0.110	0.050	0.040	0.070	0.100
Net Leverage	8046	0.020	0.310	-0.860	-0.170	0.060

Note: This table presents descriptive statistics of firm and CEO variables for a sample of S&P 1500 firms over 2004–2013. Panel A reports summary statistics for 2333 unique CEOs for whom we can estimate extraversion scores. Panel B reports summary statistics for 1579 unique firms whose CEOs are in our sample. We estimate extraversion using a linguistic technique and a sample of unscripted speech from quarterly conference call transcripts. We obtain conference call transcripts from Thomson Reuters for 2004–2013. The extraversion measure is based on CEO responses during the question-and-answer (Q&A) portion of the call and calculated using the Support Vector Machine method from Mairesse et al. (2007). We require that each CEO speak at least 500 words to be included in our sample. We use company ticker and name and CEO names to match CEOs from conference call transcripts to the ExecuComp database. Implied cost of equity capital (ICC) is an average internal rate of return. ICC^{AN} uses analyst forecasts of expected earnings and ICC^{HVZ} uses a cross-sectional model from Hou et al. (2012) to forecast expected earnings. Variables are defined in Appendix B.

standard errors clustered by firm and year and corrected for heteroskedasticity using the Huber–White adjustment. We calculate the variance inflation factor of each covariant in the main ordinary least squares (OLS) regression models. We find none of the variance inflation factors is greater than 10, which suggests multicollinearity is not a great concern.

TABLE 2 CEO extraversion and firm cost of equity capital.

Variable	OLS models		Fixed-effects models	
	ICC^{AN}	ICC^{HVZ}	ICC^{AN}	ICC^{HVZ}
Extraversion	0.2354**	0.2535**	0.5691**	0.6074***
	(0.104)	(0.097)	(0.230)	(0.173)
Emotional Stability	0.1406	0.1212	−0.0239	0.3628*
	(0.187)	(0.093)	(0.203)	(0.169)
Agreeableness	0.2365	0.0494	−0.0780	−0.0583
	(0.254)	(0.110)	(0.325)	(0.224)
Conscientiousness	−0.0369	−0.1300	−0.4124*	−0.2835
	(0.168)	(0.092)	(0.192)	(0.194)
Openness	−0.1080	−0.1019	−0.0580	−0.1126
	(0.159)	(0.119)	(0.197)	(0.199)
Assets	0.2858***	0.2264***	2.3530***	1.5755***
	(0.056)	(0.066)	(0.380)	(0.372)
B/M	2.8960***	4.4838***	1.9433**	4.3015***
	(0.200)	(0.586)	(0.608)	(0.662)
Leverage	2.7113***	2.3284***	0.0998	0.1433
	(0.459)	(0.486)	(0.701)	(0.572)
LTG	1.6400***	−1.9751***	2.0092***	−1.4592***
	(0.455)	(0.269)	(0.462)	(0.274)
Beta	0.3187***	−0.0096	0.1522	−0.0271
	(0.111)	(0.088)	(0.130)	(0.096)
Analyst Bias	−4.1377	2.1887	−4.7297	−1.3166
	(6.953)	(3.508)	(4.103)	(3.021)
Analyst FERR	39.2390***	4.7245	16.1549**	1.0105
	(7.277)	(2.960)	(5.567)	(2.718)
CEO Age	0.0222**	0.0079	0.0346*	0.0173
	(0.010)	(0.008)	(0.018)	(0.011)
CEO Gender	−0.3562	−0.4318*	−1.2084**	−0.5831
	(0.312)	(0.230)	(0.445)	(0.412)
CEO Ownership	−1.7611	−0.1075	−1.5638	−2.3039
	(1.661)	(0.985)	(1.812)	(2.030)
CEO Tenure	0.0062	−0.0004	0.0125	0.0075
	(0.011)	(0.009)	(0.017)	(0.016)
CEO Overconfidence	−0.4117***	−0.0024	0.0149	−0.0099
	(0.136)	(0.101)	(0.261)	(0.207)

(Continues)

TABLE 2 (Continued)

Variable	OLS models		Fixed-effects models	
	ICC^{AN}	ICC^{HVZ}	ICC^{AN}	ICC^{HVZ}
Constant	−3.5987**	−1.9241	−15.9051***	−13.8692***
	(1.717)	(1.206)	(4.226)	(3.269)
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	No	No
No. observations	8048	8048	7928	7928
No. firms	1274	1274	1154	1154
R^2	0.464	0.391	0.753	0.535

Note: This table reports estimates from a panel regression of implied cost of equity capital (ICC) risk premium on CEO extraversion, the other personality traits, and a set of CEO and firm characteristics. ICC is average internal rate of return estimated using the models of Gebhardt et al. (2001), Easton (2004), and Gordon and Gordon (1997) minus the yield on 10-year Treasury bonds, as detailed in Appendix A. ICC^{AN} uses analyst forecasts of expected earnings and ICC^{HVZ} uses a cross-sectional model from Hou et al. (2012) to forecast expected earnings. We estimate extraversion using a linguistic technique and a sample of unscripted speech from quarterly conference call transcripts. We obtain conference call transcripts from Thomson Reuters for 2004–2013. Extraversion score is based only on CEO responses during the question-and-answer (Q&A) portion of the call and calculated using the Support Vector Machine method from Mairesse et al (2007). We require that each CEO speak at least 500 words to be included in our sample. We use company tickers and names and CEO names to match CEOs from conference call transcripts to the ExecuComp database. Details of the extraversion measure are in Section 3.3. Variables are defined in Appendix B. Standard errors (in parentheses) are clustered for firm and year. In the ordinary least squares (OLS) models, standard errors are also clustered by firm and year.
*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

The first two columns of Table 2 report results from these OLS analyses. Each of the two columns reports results for a different dependent variable: analyst-based ICC (ICC^{AN}) in Column 1 and cross-sectional earnings-based ICC (ICC^{HVZ}) in Column 2. Our OLS models explain between 39.1% and 46.4% of variation in firms' cost of equity capital. The coefficient on *Extraversion* is 0.24 for ICC^{AN} and 0.25 for ICC^{HVZ}. These coefficients indicate that after controlling for other determinants of the cost of equity capital, a 1 SD increase in CEO extraversion (=0.62 in Table 1) is related to 0.15% (0.62 × 0.24% = 0.15%) higher analyst-based (ICC^{AN}) cost of capital for firms in the same industry, or about 3% (=0.15%/5.034%) to 5% (=0.155%/2.91%) of the mean expected cost of capital value for ICC^{AN} and ICC^{HVZ} from Table 1, respectively.

In addition to estimating OLS regressions, following Malmendier and Tate (2005, 2008), we use fixed effects to control for unobserved omitted time-invariant effects.[9] Fixed-effects models, reported in Columns 3 and 4 of Table 2, explain between 53.5% and 75.3% of the variation in firms' cost of capital. We find that the coefficient on *Extraversion* is 0.57 for ICC^{AN} (p-value < 0.05) and 0.61 for ICC^{HVZ} (p-value < 0.01). The coefficient estimates indicate that a 1 SD increase in extraversion is associated with an increase in expected cost of equity capital of 0.35% to 0.38% per year (e.g., 0.62 × 0.57% = 0.35% and 0.62 × 0.61% = 0.38%), which is about 7% (=0.35%/5.034%) to 13% (=0.38%/2.91%) relative to the average expected cost of capital value for ICC^{AN} and ICC^{HVZ},

[9]All of our results are robust to the use of OLS models with year and industry fixed effects and firm and year clustered standard errors. For brevity, we present only firm fixed-effects models in the remainder of this article because firm fixed-effects models are more conservative and control for time-invariant firm characteristics.

respectively. This difference in cost of capital is economically meaningful.[10] The other four personality traits are not consistently significantly associated with cost of equity capital.

Consistent with findings documented in the literature, cost of capital increases significantly with book-to-market ratio and financial leverage. Firms with higher analyst forecast error have higher cost of capital (for the ICC^{AN} measure), which supports the view that (1) analyst forecast errors capture the quality of the firm's information environment and (2) firms with a relatively poor information environment have higher cost of equity capital. Confirming the positive relation between growth and risk, we find that ICC^{AN} increases with firm's projected long-term growth rate. Interestingly, ICC^{HVZ} decreases with firm's projected long-term growth rate, suggesting that the Hou et al. (2012) cross-sectional earnings model may not fully capture growth opportunities. We also find that that the cost of capital increases with firm size (measured by total assets), which is likely driven by our relatively short sample period.[11]

4.2 | Extraverted CEOs' risk taking and ICC

We next conduct three separate analyses to examine whether CEO risk-taking behavior explains the positive relation between extraversion and firms' cost of equity capital documented in Table 2. First, we examine whether CEO extraversion is positively related to measures of firm riskiness. For this analysis, we use a market-based risk measure as well as operating and financing risk measures that are more directly related to CEO decisions. Following Bernile et al. (2017), we use stock return volatility as a market-based measure of risk and firm's financial leverage (*Net Leverage*) as a measure of financial risk. Additionally, following John et al. (2008), we use volatility of firm's ROA (*ROAVOL*) to capture operational risk. We then estimate panel regressions of these risk measures on CEO extraversion, the other four personality traits, and firm and CEO characteristics used in our baseline regressions in Equation (2).

Table 3 presents results for the following dependent variables: subsequent 1-year stock return *Volatility* (in Column 1),[12] *Net Leverage* (debt minus cash in Column 2), and *ROAVOL* (volatility calculated over a 5-year period in Column 3). We find that CEO extraversion is positively and significantly related to each of the three risk measures, consistent with the argument that extraverted CEOs take more risk. A 1 SD increase in CEO extraversion increases a firm's 1-year *Volatility* by 0.22% (=0.62 × 0.0039), *Net Leverage* by 1.09% (=0.62 × 0.0176), and *ROAVOL* by 3.35% (=0.62 × 0.0541). The increase in the market-based risk measure, *Volatility*, is only marginally statistically and economically significant. However, the increases in *Net Leverage* and *ROAVOL* are both statistically and economically significant. Given the average full sample values of 1.95% for *Net Leverage* and 10.61% for *ROAVOL*, our results suggest that 1 SD increase in extraversion is associated with an increase in these measures of between 30% and 50% relative to their sample means. These results are not surprising given that *Net Leverage* and *ROAVOL* are more directly affected by CEOs' risk-taking behavior, whereas *Volatility* measures how the stock market perceives overall company risk taking. Our leverage results are consistent with those of Lartey et al. (2020), who

[10]To illustrate the potential economic effect of this difference, consider two equity-only firms, A and B, that are identical in every regard other than CEO extraversion. Firm A's CEO has extraversion that is 1 SD below the sample mean (i.e., 6.35) and Firm B's CEO has extraversion that is 1 SD above the mean (i.e., 7.59). Furthermore, assume that the two firms have the same project that costs $9,000,000 and generates $1,500,000 per year over its 10-year life and has zero salvage value. Given our estimated effect of extraversion on cost of equity capital, Firm A's project cost of capital is 7.99% (based on ICC^{AN}) and Firm B's is 8.69% (based on ICC^{AN}). The net present values (NPVs) of the project are $1,070,955 for Firm A and only $758,015 for Firm B. This difference in cost of capital due to CEO extraversion translates into 29% lower NPV. The magnitude of difference in NPVs for the same example is 18% for the ICC^{HVZ} measure.

[11]In unreported analyses, we find that ICC is negatively and significantly related to total assets before 2000 but becomes positively related after 2000. We also find that ICC is negatively and significantly related to market capitalization before 2000 and insignificantly related after 2000. Our findings are consistent with studies that document attenuation of the size anomaly (e.g., Chordia et al., 2014).

[12]In unreported analyses, we also consider subsequent 3-year stock return volatility and subsequent 3-year idiosyncratic volatility calculated using the following: capital asset pricing model (CAPM), CAPM augmented with squared excess market returns, Fama–French three-factor model (Fama & French, 1993), and Carhart four-factor model (Carhart, 1997). We find similar results.

TABLE 3 CEO extraversion and firm risk taking.

Variable	*Volatility*	*Net Leverage*	*ROAVOL*
Extraversion	0.0039*	0.0176**	0.0541***
	(0.002)	(0.006)	(0.015)
Emotional Stability	−0.0009	0.0099	−0.0780
	(0.001)	(0.009)	(0.045)
Agreeableness	0.0004	−0.0058	0.1510***
	(0.002)	(0.006)	(0.043)
Conscientiousness	−0.0010	−0.0420***	0.0777**
	(0.002)	(0.007)	(0.031)
Openness	−0.0011	0.0205***	−0.1566***
	(0.001)	(0.006)	(0.035)
Assets	−0.0026	0.1175***	−0.6020***
	(0.005)	(0.011)	(0.065)
B/M	0.0251***	0.0200**	0.0271
	(0.005)	(0.008)	(0.093)
Leverage	0.0372***	—	0.7028***
	(0.007)	—	(0.104)
LTG	0.0003	0.0174	0.1841***
	(0.004)	(0.014)	(0.049)
Analyst Bias	−0.0170	0.3946***	0.3225
	(0.038)	(0.105)	(0.252)
Analyst FERR	0.1149**	0.4733***	0.1694
	(0.047)	(0.138)	(0.250)
CEO Age	−0.0001	−0.0012***	−0.0037
	(0.000)	(0.000)	(0.002)
CEO Gender	0.0040	−0.0325	−0.0496
	(0.002)	(0.018)	(0.058)
CEO Ownership	−0.0173	0.1599	0.5233
	(0.021)	(0.151)	(0.584)
CEO Tenure	−0.0001	0.0012*	−0.0016
	(0.000)	(0.001)	(0.002)
CEO Overconfidence	−0.0015	0.0202**	0.0007
	(0.002)	(0.006)	(0.031)
Constant	0.0772*	−0.7748***	0.8166
	(0.035)	(0.098)	(0.539)
Firm-year fixed effects	Yes	Yes	Yes

TABLE 3 (Continued)

Variable	*Volatility*	*Net Leverage*	*ROAVOL*
No. observations	7928	7926	7928
No. firms	1154	1154	1154
R^2	0.762	0.840	0.700

Note: This table reports estimates from a panel regression of risk measures on CEO extraversion, the other personality traits, and a set of CEO and firm characteristics. Risk measures are total return volatility (*Volatility*) measured over a 1-year period, *Net Leverage* measured over the previous fiscal year, and return on assets volatility (*ROAVOL*) measured over a 5-year period. We estimate extraversion using a linguistic technique and a sample of unscripted speech from quarterly conference call transcripts. We obtain conference call transcripts from Thomson Reuters for 2004–2013. The extraversion measure is based on CEO responses during the question-and-answer (Q&A) portion of the call and is calculated using the Support Vector Machine method from Mairesse et al. (2007). Variables are defined in Appendix B. All specifications include firm and year fixed effects. Standard errors (in parentheses) are clustered by firm and year.
$^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

find that an increase in extraversion is associated with a 51.61% increase in leverage relative to the sample standard deviation for net book leverage.

Next, we split our sample into two high and low subsamples based on the three risk measures: *Volatility*, *Net Leverage*, and *ROAVOL*. We then run the baseline regressions (Equation 2) in each of the six subsamples. If risk taking by extraverted CEOs explains the positive relation between CEO extraversion and ICC, we expect to see the positive relation only in subsamples where extraverted CEOs take higher risk that results in relatively high *Volatility*, *Net Leverage*, and *ROAVOL*. Conversely, if extraverted CEOs do not actively engage in risk-taking activities (possibly because of specific firm or governance constraints), we may not observe a significant link between CEO extraversion and cost of capital. Panels A and B of Table 4 present results with ICC^{AN} and ICC^{HVZ} as the dependent variables, respectively. We find significant support for CEO risk-taking behavior as a potential explanation. The positive relation between CEO extraversion and ICC is significant only in subsamples where firms have high *Volatility*, high *Net Leverage*, or high *ROAVOL*. Taken together, our results support the idea that CEOs' risk-taking behavior contributes to the positive relation between CEO extraversion and firms' cost of equity capital.[13]

4.3 | Do extraverted CEOs self-select to work for risky firms? reverse causality

We interpret our finding of a positive relation between CEO extraversion and ICC as evidence that extraverted CEOs influence firms' cost of capital. An alternative interpretation with the opposite causation is also possible. If extraverted CEOs select to work for firms that undertake riskier projects because these types of firms are a better match for their extraverted personality, we could also observe a positive relation between CEO extraversion and cost of capital. We examine this reverse causality explanation in three ways.

[13]One potential concern with the CEO risk-taking explanation is that we already control for firm risk in the models (i.e., beta). If CEO extraversion affects the cost of equity by increasing firm risk (i.e., beta), we should no longer observe significant explanatory power of CEO extraversion. However, we argue that although we control for beta, the standard beta measure (in the literature and practice) is estimated based on the prior 5 years of stock return data. Given the median CEO tenure in our sample is only 5 years (i.e., about 50% of the CEOs in our sample have tenure less than 5 years), the beta measure can capture a different CEO effect on firm risk, which results in significant noise. Therefore, even though we control for historical beta in our models, it does not rule out the potential mechanism that links CEO extraversion and firm risk in our data. In addition, it is possible that the market may expect higher cost of equity for extraverted CEOs because they are prone to risk taking not yet materialized in current firm risk. Pan et al. (2015) shows that it takes time for market participants to learn about CEO abilities, and they incorporate their learning of CEO abilities into their assessments of firm risk. Based on this study, we believe that market participants also likely learn about CEOs' personality traits over time. Uncertainty about the assessment of CEO personality results in unpriced risk factors in a basic asset pricing model (such as CAPM). Therefore, we observe a significant effect of CEO extraversion on cost of equity even after controlling for concurrent firm risk measures in the models.

TABLE 4 CEO extraversion and cost of equity in high versus low risk-taking firms.

Variable	Low *Volatility*	High *Volatility*	Low *Net Leverage*	High *Net Leverage*	Low *ROAVOL*	High *ROAVOL*
Panel A: Dependent variable: ICC^{AN}						
Extraversion	−0.1232	0.7727**	0.0183	0.5600*	0.1978	0.6283**
	(0.117)	(0.302)	(0.186)	(0.281)	(0.249)	(0.272)
Emotional Stability	−0.1680	0.0020	−0.5206**	0.4689	−0.2220	0.3864
	(0.151)	(0.314)	(0.220)	(0.288)	(0.246)	(0.306)
Agreeableness	0.2401	−0.9827*	0.3158	0.5344	0.2995	−0.7938
	(0.235)	(0.455)	(0.291)	(0.461)	(0.376)	(0.558)
Conscientiousness	−0.0862	−0.1506	−0.0280	−0.1682	−0.3072	−0.3680
	(0.124)	(0.301)	(0.263)	(0.321)	(0.393)	(0.334)
Openness	0.0178	−0.1135	−0.0199	−0.2455	−0.0743	−0.0980
	(0.174)	(0.367)	(0.199)	(0.341)	(0.255)	(0.314)
Assets	0.7452***	1.7979***	0.9179***	2.1663***	3.0894***	1.9245***
	(0.168)	(0.352)	(0.270)	(0.440)	(0.463)	(0.358)
B/M	0.8791***	1.8458***	0.6220*	1.8272***	2.9665***	1.4444**
	(0.231)	(0.523)	(0.312)	(0.520)	(0.711)	(0.543)
Leverage	0.3297	0.1353	0.6157	0.8979	0.6461	−0.3369
	(0.347)	(1.140)	(0.533)	(1.249)	(0.743)	(0.776)
LTG	2.1905***	2.0050***	2.2163***	0.9944	2.4017***	1.8089***
	(0.264)	(0.564)	(0.392)	(0.827)	(0.635)	(0.502)
Beta	0.1188	0.1468	−0.2427	0.4180	−0.1310	0.1146
	(0.158)	(0.298)	(0.205)	(0.364)	(0.265)	(0.245)
Analyst Bias	−8.5353	−3.7062	−3.7305	−6.8555	−11.0197	−4.6170
	(6.261)	(4.038)	(2.813)	(4.620)	(6.313)	(4.168)
Analyst FERR	10.2175	18.2953**	8.5941*	14.3806*	1.5261	17.1814**
	(7.798)	(5.958)	(4.119)	(6.556)	(6.396)	(5.611)
CEO Age	0.0086	0.0346	−0.0065	0.0385	0.0010	0.0425
	(0.009)	(0.028)	(0.015)	(0.024)	(0.018)	(0.027)
CEO Gender	0.1163	−0.3605	0.0148	−1.8678***	−1.0733**	−0.8429*
	(0.229)	(0.831)	(0.327)	(0.571)	(0.431)	(0.390)
CEO Ownership	0.1553	−1.2514	1.6459	2.0619	−2.8217	−1.3447
	(0.988)	(2.871)	(1.105)	(3.084)	(1.848)	(2.521)
CEO Tenure	−0.0065	0.0005	−0.0162*	0.0284	0.0184	0.0175
	(0.006)	(0.029)	(0.009)	(0.026)	(0.017)	(0.025)
CEO Overconfidence	0.0794	0.5011	−0.0525	0.3610	−0.1439	0.2136
	(0.131)	(0.413)	(0.199)	(0.378)	(0.240)	(0.364)

TABLE 4 (Continued)

Variable	Low *Volatility*	High *Volatility*	Low *Net Leverage*	High *Net Leverage*	Low *ROAVOL*	High *ROAVOL*
Constant	−3.5362*	−11.4708*	−2.8110	−19.1702***	−20.1067***	−11.4227**
	(1.826)	(5.743)	(3.339)	(5.309)	(3.981)	(4.860)
Firm-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
No. observations	3828	3882	3868	3914	3847	3853
No. firms	739	875	702	696	713	820
R^2	0.860	0.791	0.820	0.786	0.795	0.774
Panel B: Dependent variable: ICC^{HVZ}						
Extraversion	0.0211	0.8719**	0.2382	0.5192**	0.1613	0.7756***
	(0.082)	(0.316)	(0.165)	(0.208)	(0.114)	(0.202)
Emotional Stability	−0.0431	0.7698**	0.2324	0.6287**	0.0548	0.6188*
	(0.164)	(0.312)	(0.176)	(0.256)	(0.141)	(0.284)
Agreeableness	0.1017	−0.5427	−0.1526	0.7534*	0.0386	−0.4057
	(0.190)	(0.380)	(0.321)	(0.336)	(0.184)	(0.438)
Conscientiousness	0.1868	−0.7083*	0.0586	−0.0256	0.2352	−0.3459
	(0.110)	(0.345)	(0.305)	(0.324)	(0.135)	(0.305)
Openness	−0.1786	0.3944	−0.0547	−0.3468	−0.1532	−0.1596
	(0.138)	(0.352)	(0.271)	(0.258)	(0.141)	(0.284)
Assets	0.0722	1.6123***	0.7880***	1.3215**	0.2160	1.4539***
	(0.156)	(0.336)	(0.223)	(0.427)	(0.241)	(0.375)
B/M	3.2681***	4.1712***	2.5887***	4.4303***	3.5191***	3.6419***
	(0.493)	(0.534)	(0.548)	(0.526)	(0.345)	(0.695)
Leverage	1.5839***	−0.6404	0.3690	2.3679*	2.2187***	−1.5915*
	(0.450)	(0.879)	(0.774)	(1.239)	(0.611)	(0.734)
LTG	−0.6910*	−1.458***	−0.8870**	−2.0029***	−1.3208**	−1.0427**
	(0.367)	(0.390)	(0.321)	(0.527)	(0.423)	(0.415)
Beta	−0.5868*	−0.3402	−0.4805*	−0.3347	−0.3817	−0.7249**
	(0.292)	(0.386)	(0.230)	(0.476)	(0.348)	(0.267)
Analyst Bias	−5.0423	−0.0308	−5.6515**	−2.1572	−3.1434	−2.4075
	(4.302)	(3.576)	(2.463)	(4.071)	(3.374)	(3.430)
Analyst FERR	−6.8673	2.6961	−2.1681	1.6289	4.3599	−0.4385
	(5.438)	(3.838)	(3.098)	(3.598)	(2.677)	(3.353)
CEO Age	0.0102	0.0253	0.0039	0.0118	−0.0022	0.0396*
	(0.012)	(0.023)	(0.016)	(0.022)	(0.017)	(0.019)

(Continues)

TABLE 4 (Continued)

Variable	Low *Volatility*	High *Volatility*	Low *Net Leverage*	High *Net Leverage*	Low *ROAVOL*	High *ROAVOL*
CEO Gender	0.6790*	−0.7461	−0.3284	−0.1427	0.2147	−0.2201
	(0.368)	(1.105)	(0.563)	(0.515)	(0.194)	(0.824)
CEO Ownership	−0.0850	−1.3029	−0.1176	1.5771	−0.3869	−2.4947
	(1.762)	(2.069)	(1.595)	(3.672)	(1.514)	(1.889)
CEO Tenure	−0.0163	−0.0035	−0.0183	0.0301	0.0004	−0.0011
	(0.010)	(0.022)	(0.011)	(0.028)	(0.013)	(0.024)
CEO Overconfidence	0.0607	0.3025	0.0881	0.0718	0.2597*	−0.2308
	(0.101)	(0.309)	(0.163)	(0.300)	(0.139)	(0.314)
Constant	−1.3482	−15.143**	−6.3460***	−15.8054***	−3.4638	−12.6795***
	(1.964)	(4.737)	(1.850)	(4.532)	(2.422)	(3.265)
Firm-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
No. observations	3828	3882	3868	3914	3847	3853
No. firms	739	875	702	696	713	820
R^2	0.725	0.554	0.638	0.532	0.726	0.562

Note: This table reports estimates from a panel regression of implied cost of equity capital (ICC) on CEO extraversion, the other personality traits, and a set of CEO and firm characteristics in subsamples of firms based on three risk measures: stock return volatility over a 12-month period (*Volatility*), *Net Leverage*, and return on assets volatility (*ROAVOL*) measured over a 5-year period. We split the sample based on median values of *Volatility*, *Net Leverage*, and *ROAVOL*. ICC is the average internal rate of return estimated using the models of Gebhardt et al (2001), Easton (2004) and Gordon and Gordon (1997) minus the yield on 10-year Treasury bonds, as detailed in Appendix A. ICC^{AN} (Panel A) uses analyst forecasts of expected earnings. ICC^{HVZ} (Panel B) uses a cross-sectional model from Hou et al. (2012) to forecast expected earnings. We estimate extraversion using a linguistic technique and a sample of unscripted speech from quarterly conference call transcripts. We obtain conference call transcripts from Thomson Reuters for 2004–2013. The extraversion measure is based on CEO responses during the question-and-answer (Q&A) portion of the call and calculated using the Support Vector Machine method from Mairesse et al (2007). We require that each CEO speak at least 500 words to be included in our sample. We use company tickers and names and CEO names to match the CEOs from conference call transcripts to the ExecuComp database. Variables are defined in Appendix B. All specifications include firm and year fixed effects. Standard errors (in parentheses) are clustered by firm and year.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

First, we use propensity score matching to select a control group of firms to compare to our treatment group of firms that are run by extraverted CEOs. Specifically, we use the sample median value of extraversion to split the firm-year sample into high-CEO-extraversion observations (treatment sample) and low-CEO-extraversion observations (control sample). To implement propensity score matching, for each treatment firm-year observation, we select a matching comparison firm-year observation using the one-to-one nearest neighbor matching technique of propensity scores (1) with replacement and (2) without replacement of a comparison firm. To estimate the propensity scores, we use a probit model that includes firm size (log assets), book-to-market ratio, firm age, and 5-year ROA volatility. As reported in Table 5, we have 3695 matching pairs for one-to-one nearest neighbor propensity score matching without replacement. We find that the mean value of ICC is higher in the treatment sample than in the comparison sample for both measures. Specifically, the differences in ICC are 0.13% (for ICC^{AN}) and 0.73% (for ICC^{HVZ}). The difference is statistically significant at the 1% level for ICC^{HVZ} but not significant at

TABLE 5 Reverse causality, propensity score matching.

Nearest neighbor propensity score matching		*N*	Treatment sample (more extraverted CEOs)	Control sample (less extraverted CEOs)	Differences in ICC	Standard errors	*t*-stats
ICC^{AN}	1-to-1 matching without replacement	3695	5.97	4.84	0.13	0.09	1.34
	1-to-1 matching with replacement	4004	5.04	4.78	0.26	0.12	2.21**
ICC^{HVZ}	1-to-1 matching without replacement	3695	3.05	2.68	0.37	0.11	5.03***
	1-to-1 matching with replacement	4004	3.12	2.79	0.42	0.15	4.58***

Note: This table presents univariate tests comparing implied cost of equity capital (ICC) between the firms with extraverted CEOs and a matched sample of firms with less extraverted CEOs using propensity score matching techniques. We use the sample median extraversion score to define extraverted CEOs (treatment sample, where the extraversion scores are higher than the median) and less extraverted CEOs (control sample, where the scores are lower than the median). The matching sample of less extraverted CEOs are selected using the nearest neighbor propensity score matching technique using a probit model with the following independent variables: firm size (log assets), book-to-market ratio, firm age, 5-year return on assets volatility, and each firm's Fama–French 48-industry classsification. The results using one-to-one nearest neighbor propensity score matching both with and without replacement are reported. We report the matched sample size, mean value of ICC measures in the treatment sample (with extraverted CEOs) and the control sample (with less extraverted CEOs), difference of the mean values, standard errors, and *t*-statistics of the mean difference. The first two rows present the results for ICC^{AN}, and the second two rows present the results for ICC^{HVZ}.

**$p < 0.05$; ***$p < 0.01$.

conventional levels for ICC^{AN} (p-value = 0.18, two-tailed). As a robustness check, we also use a one-to-one nearest neighbor matching technique with replacement of control firms, which results in 4004 matching pairs. These results are statistically significant at the 5% level or better for both ICC measures and are inconsistent with the reverse causality explanation.

Second, for firms that have more than one CEO during our sample period, we examine the intraclass correlation coefficient between extraversion measures of different CEOs within the same firm. If firms tend to prefer and select CEOs with a certain level of extraversion, this intraclass correlation coefficient should be high. In contrast, in untabulated results, we find that the average intraclass correlation coefficient within each company is 0.168. This correlation coefficient suggests that companies do not systematically select CEOs with similar levels of extraversion.

Third, we examine changes in ICC around CEO turnover events. Specifically, following Green et al. (2019), we regress change in ICC on an indicator variable for increase in CEO extraversion and increase in other CEO characteristics and levels of firm control variables used in the baseline regressions (Equation 2). If the positive relation between CEO extraversion and ICC is driven by extraverted CEOs simply being attracted to high-risk firms, we should observe an insignificant relation between change in the ICC measures and an increase in CEO extraversion. In contrast, our results in Panel A of Table 6 report a positive and statistically and economically significant relation between an increase in CEO extraversion and change in ICC. Firms that hired a new CEO who is more extraverted than their departing CEO experience an average increase in ICC of between 0.68% and 1.08% over the subsequent year, depending on the measure of ICC. These estimates are likely to be conservative as Figure 1 shows that ICC increases over CEOs' tenure for more extraverted (but not less extraverted) CEOs, indicating that it may take some time for an extraverted new CEO to undertake risky projects and for the market to learn about this increased risk. Regardless, this result is inconsistent with the reverse causality explanation. We also conduct a placebo test (untabulated) using the years before CEO turnover, and we do not find a significant change

TABLE 6 Effect of CEO turnover on ICC.

Panel A: All CEO turnover events		
	Change in ICC^{AN}	Change in ICC^{HVZ}
Variable	**(1)**	**(2)**
Increase in Extraversion	0.7780*	0.7434**
	(0.411)	(0.345)
Increase in Emotional Stability	−0.2066	0.6151*
	(0.305)	(0.347)
Increase in Agreeableness	−0.4403	0.4029
	(0.387)	(0.354)
Increase in Conscientiousness	−0.8682*	−0.4948
	(0.515)	(0.364)
Increase in Openness	0.0938	−0.2918
	(0.415)	(0.354)
Assets	−0.0256	−0.2187**
	(0.163)	(0.109)
B/M	−0.4369	1.3322**
	(0.788)	(0.671)
Leverage	−2.6063	0.2225
	(2.310)	(1.311)
LTG	0.0684	−1.9411*
	(2.483)	(1.174)
Beta	−0.5106	−0.3462
	(0.403)	(0.290)
Analyst Bias	−9.7713	−4.9386
	(14.595)	(9.650)
Analyst FERR	9.0830	0.7746
	(13.329)	(8.857)
Increase in CEO Age	0.0444	−0.0141
	(0.438)	(0.438)
Change in CEO Gender	0.1266	0.0095
	(0.321)	(0.379)
Increase in CEO Ownership	−0.5776	−1.0648*
	(0.523)	(0.631)
Increase in CEO Tenure	1.0765	−0.1219
	(0.840)	(0.835)
Change in CEO Overconfidence	0.2347	0.3186
	(0.407)	(0.351)

TABLE 6 (Continued)

Panel A: All CEO turnover events		
Variable	**Change in ICC^{AN} (1)**	**Change in ICC^{HVZ} (2)**
Constant	1.5169	1.4036
	(1.887)	(0.978)
Year-industry fixed effects	Yes	Yes
No. observations	541	541
No. firms	463	463
R^2	6.70%	6.80%

Panel B: Voluntary versus forced CEO turnover				
	ICC^{AN}		ICC^{HVZ}	
Variable	**Forced CEO turnover**	**Voluntary CEO turnover**	**Forced CEO turnover**	**Voluntary CEO turnover**
Increase in Extraversion	0.6444	0.4553*	0.3408	0.8548**
	(0.666)	(0.264)	(0.950)	(0.358)
Increase in Emotional Stability	0.2386	−0.0301	1.1401	0.5853*
	(0.727)	(0.259)	(1.142)	(0.352)
Increase in Agreeableness	0.2406	0.0033	1.8193	0.1089
	(0.740)	(0.262)	(1.166)	(0.352)
Increase in Conscientiousness	−0.6780	−0.6213**	−0.8870	−0.2834
	(0.782)	(0.300)	(0.969)	(0.364)
Increase in Openness	0.3992	−0.1625	−0.6593	−0.3131
	(0.666)	(0.300)	(1.296)	(0.361)
Assets	−0.2808	0.0069	−0.4333*	−0.1581
	(0.222)	(0.095)	(0.243)	(0.118)
B/M	−3.2012**	0.1245	2.0879	0.9658
	(1.254)	(0.368)	(1.589)	(0.702)
Leverage	−4.6126**	1.0097	−2.2400	0.3629
	(2.112)	(0.888)	(3.628)	(1.231)
LTG	−4.2691**	3.7773***	−6.4760***	−0.5807
	(1.941)	(0.803)	(1.866)	(1.395)
Beta	−0.3069	−0.3495	0.2424	−0.4222
	(0.537)	(0.221)	(0.730)	(0.313)
Analyst Bias	−22.5662	−3.7124	−40.3880**	1.3328
	(21.082)	(5.259)	(18.676)	(9.725)
Analyst FERR	4.5395	7.6969	6.2012	4.2673
	(22.145)	(4.819)	(18.139)	(8.965)

(Continues)

TABLE 6 (Continued)

Panel B: Voluntary versus forced CEO turnover				
	ICC^{AN}		ICC^{HVZ}	
Variable	Forced CEO turnover	Voluntary CEO turnover	Forced CEO turnover	Voluntary CEO turnover
Increase in CEO Age	0.7514	−0.3880	0.8845	−0.5374
	(0.765)	(0.330)	(1.108)	(0.527)
Change in CEO Gender	−0.9122	0.0660	0.5928	−0.2572
	(0.709)	(0.278)	(1.069)	(0.404)
Increase in CEO Ownership	−2.7980***	−0.5906	−2.6507*	−0.5632
	(0.949)	(0.504)	(1.448)	(0.723)
Increase in CEO Tenure	0.5378	1.0484*	−0.5491	0.1209
	(1.219)	(0.630)	(2.180)	(0.863)
Change in CEO Overconfidence	1.0515	0.4146	0.5312	0.5406
	(0.819)	(0.277)	(1.189)	(0.372)
Constant	5.5805***	−0.2112	2.8522	0.8739
	(1.929)	(0.862)	(2.091)	(1.090)
Year-industry fixed effects	Yes	Yes	Yes	Yes
No. observations	87	454	87	454
R^2	0.305	0.143	0.323	0.057

Note: This table examines the impact of CEO turnover on the change in implied cost of equity capital (ICC) around the turnover year. We collect 541 CEO turnover events from the ExecuComp database. We remove turnover of interim CEOs whose tenures are less than 2 years. We measure the changes in ICC by subtracting the ICC in the last year of the departing CEO from the ICC in the first year of the newly appointed CEO. If the new CEO has higher extraversion scores (or other four personality scores), we code *Increase in Extraversion* (or other four personality scores) as 1, and 0 otherwise. We also compare the other CEO characteristics, such as age, gender, ownership, tenure, and overconfidence and use dummy variables to capture the changes. We control for the same firm characteristics as controlled in the other tables. In Panel B, we split the sample into forced and voluntary turnover, following the methodology of Fee et al (2013). All specifications include year and industry fixed effects. Standard errors (in parentheses) are clustered by firm and year.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

in cost of capital. Taken together, these results suggest that rather than CEO self-selection, it is the behavior of extraverted CEOs that is associated with higher cost of equity capital.

Our interpretation is that boards are content with their firms' level of risk, and if they hire more extraverted CEOs, these CEOs take on more risk because of their personality and style (which we label *CEO Style*). However, our analyses so far do not rule out the possibility that firms endogenously select extraverted CEOs when they desire a change in direction. For example, firms that want to change strategy and take on riskier projects may put more importance on hiring an extraverted CEO (which we label *Endogenous Matching*). To examine whether *Endogenous Matching* could be driving our results, we perform two additional tests.

First, we expand the CEO turnover analysis to explore voluntary (exogenous) versus forced (endogenous) turnover events. Under the *Endogenous Matching* view, the impact of a change in CEO extraversion on a firm's cost of capital should be more pronounced for the forced turnover subsample and insignificant in the voluntary turnover subsample where the board presumably has less or no incentive to change the firm's strategy. To classify CEO

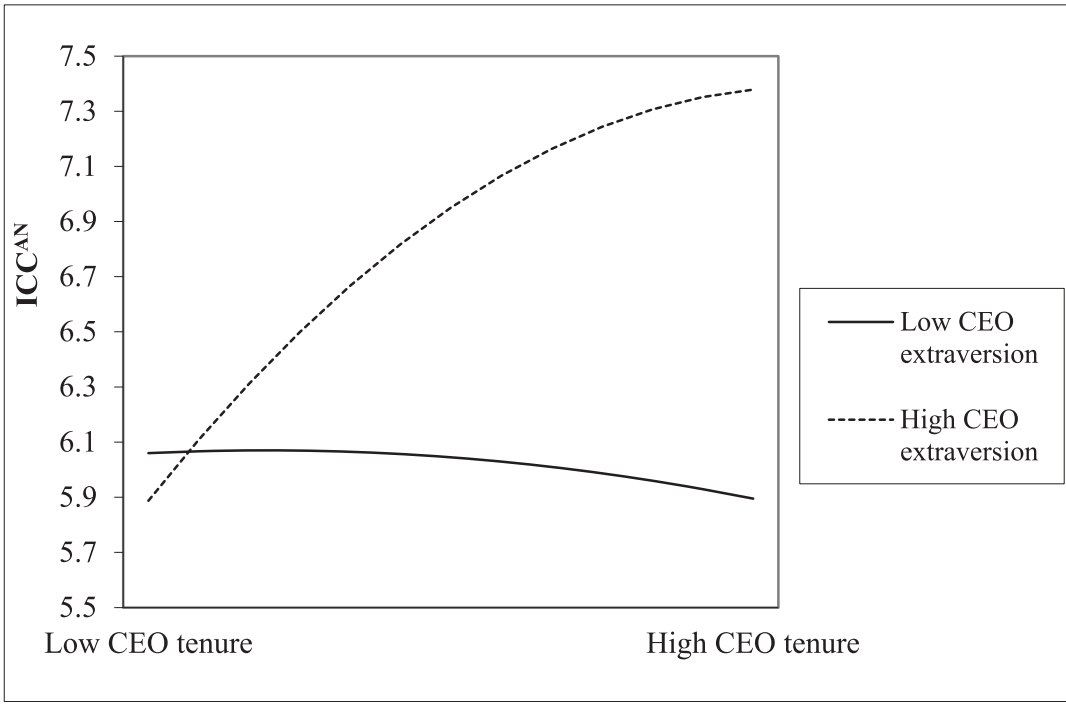

FIGURE 1 CEO extraversion and cost of capital evolution over CEO's tenure. This figure shows the interaction between CEO tenure and CEO extraversion and its effect on the implied cost of equity capital risk premia (ICC). ICC^{AN} uses analyst forecasts of expected earnings and is the average internal rate of return estimated using models of Gebhardt et al (2001), Easton (2004) and Gordon and Gordon (1997) minus the yield on 10-year Treasury bonds, as detailed in Appendix A. Low (high) CEO tenure is measured as 1 SD below (above) the average CEO tenure in the sample. Low (high) CEO extraversion indicates when the CEO is below (above) the median in CEO extraversion, measured using a linguistic technique and a sample of unscripted speech from quarterly conference call transcripts. We obtain conference call transcripts from Thomson Reuters for 2004–2013. The extraversion measure is based on CEO responses during the question-and-answer (Q&A) portion of the call and calculated using the Mairesse et al. (2007) Support Vector Machine method. We require that each CEO speak at least 500 words to be included in our sample. We reestimate the fixed-effects model in Column 3 of Table 2 by adding (1) a squared CEO tenure term, (2) an interaction term between CEO tenure and high (low) CEO extraversion, and (3) an interaction term between CEO tenure-squared and high (low) CEO extraversion. This additional analysis is available from the authors. To create this figure, we use the coefficients on CEO tenure and CEO tenure squared as well as their respective interactions with high (low) CEO extraversion scores.

turnover events as voluntary or forced, we follow the methodology used by Fee et al. (2013) and hand collect news articles related to CEO departure for each CEO turnover event in our sample. We remove interim CEOs (where the incoming CEO was in the position for less than 2 years) and CEO turnovers that are difficult to classify. The final sample for this analysis contains 87 forced CEO turnovers and 454 voluntary CEO turnovers. We repeat the turnover analysis from Panel A of Table 6 on the subsamples of voluntary and forced turnovers.

The results in Panel B of Table 6 do not support the *Endogenous Matching* view. The magnitude of extraversion coefficients is similar in both subsamples for ICC^{AN} and much larger in the voluntary turnover subsample for ICC^{HVZ}. Moreover, the effect of an increase in CEO extraversion on cost of capital is significant only in the voluntary turnover sample. Although the lack of significance in the forced turnover sample could be due to small sample size, the magnitudes of the coefficients do not support *Endogenous Matching*.

Second, we examine how the relation between CEO extraversion and cost of capital varies with CEO power. Under the *CEO Style* interpretation, we expect to see a stronger relation between CEO extraversion and cost of capital for subsamples of firms with more powerful CEOs. In contrast, under *Endogenous Matching*, CEO power should not be related to the strength of relation between CEO extraversion and cost of capital. We measure CEO power in two ways. First, following Adams et al. (2005), we classify CEO as powerful if the CEO: (1) is a founder, (2) is the only insider on the board, or (3) accumulates titles (i.e., the CEO is also the chairman and/or president). Second, we use an exogenous measure of CEO power—industry competition. Giroud and Mueller (2011) argue that industry competition serves as an external governance mechanism that may limit managerial discretion and thereby the influence of CEO personality traits on corporate decisions. We measure industry competition using the Herfindahl–Hirschman index.

Table 7 reports the results of these analyses. We find that CEO extraversion is positively and significantly related to a firm's cost of capital only in the subsample of powerful CEOs and the subsample of less competitive industries (i.e., cases where managerial discretion is likely to be higher). These findings are consistent with our interpretation that *CEO Style* is behind the positive relation between CEO extraversion and cost of capital. Although we cannot rule out *Endogenous Matching*, these results suggest that it is not likely to be the main driver of our findings.[14]

4.4 | Look-ahead bias?

Given that extraversion is a stable personality trait, we follow prior studies (e.g., Green et al., 2019; Malhotra et al., 2018) and pool all conference calls from a given CEO to increase the power of our algorithm to detect extraversion. Although it is standard in the literature, this procedure may cause a concern that our measure includes information that may not be known to the market at the time, that is, look-ahead bias. To mitigate this concern, we construct an annual extraversion measure using only conference call transcripts in a given calendar year. We then regress implied equity cost of capital in year *t* on an annual extraversion measure averaged across all years that the CEO is in the sample before year *t*. The results of this analysis are similar to our main results reported in Table 2. Using an extraversion measure based on data available before the measurement of cost of capital, we find that CEO extraversion has a positive and significant relation with firms' cost of equity capital. Specifically, as reported in Table S1 of the Online Appendix, coefficients on extraversion are 0.63 for ICC^{AN} and 0.66 for ICC^{HVZ}, significant at the 1% and 5% levels, respectively, and nearly identical to the results reported in Table 2. Additionally, we find that individual CEO's annual extraversion measures are highly correlated at 89%. Together, these results indicate that extraversion is indeed a stable trait, and potential look-ahead bias does not affect our findings.

However, these analyses do not address the possibility that our annual extraversion measure varies with firm fundamentals. It is plausible that executives that have recently engaged in greater amounts of risky investments might need to talk longer on calls to explain such investments, leading to reverse causality from risk to our extraversion measure. To explore this possibility, we regress within-CEO changes in annual extraversion measures on changes in firm risk and other fundamentals. The results reported in Table S2 of the Online Appendix do not

[14]We adopt the firm fixed-effects model as our main model specification because it allows us to control for any time-invariant firm characteristics and focus on within-firm correlation between CEO extraversion and cost of equity. Because our measure of CEO extraversion is constant for each CEO in the sample, the firm fixed-effects model picks up within-firm variation in CEO extraversion only when there is CEO turnover. There may be concern that CEO turnover is rare or that firms may tend to hire CEOs with similar personalities, which could make the CEO extraversion measure sticky. However, if this is the case, we should observe very little explanatory power of CEO extraversion in the firm fixed-effects model because there is not enough variation in the independent variable (Zhou, 2001). Given that our main results are consistently significant in all firm fixed-effects models, we feel the potential sticky measure problem does not cause a significant endogeneity issue. In addition, our analyses of the conditional effect of CEO extraversion on cost of equity (Table 7) suggests that CEO extraversion affects cost of equity in situations where CEOs have more power and discretionary control over the firm. It is difficult to believe that other confounding variables or omitted variables coincide with this conditional effect in the same manner.

TABLE 7 CEO extraversion and cost of equity in high- versus low-CEO-power firms.

Panel A: Powerful CEOs				
	ICC^{AN}		ICC^{HVZ}	
Variable	More powerful CEOs	Less powerful CEOs	More powerful CEOs	Less powerful CEOs
Extraversion	0.6863**	0.4144	0.7243***	0.4188
	(0.270)	(0.236)	(0.211)	(0.258)
Emotional Stability	−0.3766	0.9669**	0.1683	1.1455*
	(0.312)	(0.403)	(0.223)	(0.549)
Agreeableness	−0.3742	0.5133	0.1027	−0.2077
	(0.519)	(0.585)	(0.393)	(0.511)
Conscientiousness	−0.6527*	−0.6006	0.0342	−0.7208
	(0.339)	(0.510)	(0.285)	(0.518)
Openness	−0.2351	0.3897	−0.6390*	1.0069
	(0.334)	(0.442)	(0.320)	(0.578)
Assets	2.2346***	1.7098***	1.6337***	1.1622**
	(0.327)	(0.505)	(0.353)	(0.396)
B/M	1.8564**	2.3214***	4.1740***	4.0577***
	(0.586)	(0.657)	(0.672)	(0.371)
Leverage	0.2517	0.3428	0.0440	−0.8588
	(0.843)	(0.984)	(0.640)	(1.020)
LTG	1.9125**	2.1081**	−1.4789***	−0.9200*
	(0.601)	(0.657)	(0.394)	(0.435)
Beta	0.1476	0.1159	−0.1335	0.2960
	(0.150)	(0.218)	(0.097)	(0.185)
Analyst Bias	−3.2391	−8.5798	0.0357	−9.0008*
	(4.650)	(6.587)	(3.258)	(4.277)
Analyst FERR	13.8150*	15.7918**	0.9394	0.9603
	(6.280)	(6.297)	(3.067)	(2.889)
CEO Age	0.0424	0.0228	0.0246	−0.0163
	(0.027)	(0.026)	(0.019)	(0.023)
CEO Gender	−1.3936**	−1.1763*	−1.2920*	−0.8683
	(0.593)	(0.618)	(0.612)	(0.856)
CEO Ownership	1.2758	−9.0665*	−0.0986	−11.1102**
	(2.278)	(4.361)	(1.603)	(4.176)
CEO Tenure	0.0163	0.0389	−0.0031	0.0664**
	(0.024)	(0.025)	(0.021)	(0.025)

(Continues)

TABLE 7 (Continued)

Panel A: Powerful CEOs				
	ICC^{AN}		ICC^{HVZ}	
Variable	More powerful CEOs	Less powerful CEOs	More powerful CEOs	Less powerful CEOs
CEO Overconfidence	0.0734	−0.5731	0.2002	−0.5764
	(0.227)	(0.412)	(0.213)	(0.373)
Constant	−11.2191**	−16.2128**	−13.3940***	−13.4280**
	(3.701)	(5.946)	(3.073)	(5.931)
Firm-year fixed effects	Yes	Yes	Yes	Yes
No. observations	5467	2257	5467	2257
No. firms	967	497	967	497
R^2	0.783	0.787	0.542	0.619
Panel B: Industry competition				
	ICC^{AN}		ICC^{HVZ}	
Variable	Less competitive industry	More competitive industry	Less competitive industry	More competitive industry
Extraversion	0.4773**	0.0643	0.3082**	−0.0039
	(0.209)	(0.236)	(0.125)	(0.156)
Emotional Stability	−0.1389	−0.3435	0.1595	0.0916
	(0.329)	(0.222)	(0.207)	(0.219)
Agreeableness	0.1215	0.0823	0.1572	−0.1467
	(0.501)	(0.321)	(0.299)	(0.340)
Conscientiousness	−0.0130	−0.0564	−0.1866	0.2935
	(0.298)	(0.186)	(0.198)	(0.217)
Openness	−0.2917	0.1621	−0.1306	0.0089
	(0.336)	(0.243)	(0.231)	(0.271)
Assets	2.3939***	0.8047***	0.4475**	0.9940***
	(0.237)	(0.233)	(0.184)	(0.191)
B/M	1.9452***	0.3524	2.3349***	3.0654***
	(0.307)	(0.311)	(0.331)	(0.292)
Leverage	0.0558	−0.1707	−0.0272	−0.6066
	(1.037)	(0.618)	(0.703)	(0.631)
LTG	2.4002***	1.6794***	−1.1802**	−1.8982***
	(0.633)	(0.504)	(0.487)	(0.391)
Beta	0.0792	0.2762**	−0.0199	−0.1552
	(0.159)	(0.109)	(0.104)	(0.113)
Analyst Bias	0.7825	−13.7213***	−7.2924*	−6.9951**
	(3.578)	(4.868)	(4.173)	(3.064)

TABLE 7 (Continued)

Panel B: Industry competition				
	ICC^{AN}		ICC^{HVZ}	
Variable	Less competitive industry	More competitive industry	Less competitive industry	More competitive industry
Analyst FERR	20.9147***	9.1389	−5.1228	−0.5002
	(5.548)	(6.327)	(4.010)	(2.839)
CEO Age	0.0315	0.0016	0.0201	−0.0101
	(0.022)	(0.015)	(0.013)	(0.016)
CEO Gender	−1.0397**	−0.1032	0.2392	−0.0334
	(0.406)	(0.403)	(0.309)	(0.595)
CEO Ownership	−1.2849	0.5284	−0.7475	0.7263
	(2.334)	(1.769)	(2.096)	(1.515)
CEO Tenure	0.0130	0.0055	−0.0099	−0.0072
	(0.020)	(0.013)	(0.013)	(0.015)
CEO Overconfidence	−0.2602	0.5075*	0.1034	0.2649
	(0.281)	(0.275)	(0.161)	(0.218)
Constant	−17.0023***	−3.7959	−4.7805**	−7.2632***
	(3.040)	(2.408)	(1.995)	(2.290)
Firm-year fixed effects	Yes	Yes	Yes	Yes
No. observations	3949	3894	3949	3894
No. firms	635	683	635	683
R^2	0.713	0.868	0.635	0.666

Note: This table reports estimates from a panel regression of implied cost of equity capital (ICC) on CEO extraversion, the other personality traits, and a set of CEO and firm characteristics in subsamples of firms based on two measures of CEO power: internal and external. For the internal measure (Panel A), following Adams et al. (2005), we classify the CEO as powerful if: (1) CEO is a founder, (2) CEO is the only insider on the board, or (3) CEO concentrates titles. For the external measure (Panel B), we use industry concentration measured using the Herfindahl–Hirschman index. ICC is the average internal rate of return estimated using the models of Gebhardt et al. (2001), Easton (2004), and Gordon and Gordon (1997) minus the yield on 10-year Treasury bonds, as detailed in Appendix A. ICC^{AN} uses analyst forecasts of expected earnings. ICC^{HVZ} uses a cross-sectional model from Hou et al. (2012) to forecast expected earnings. We estimate extraversion using a linguistic technique and a sample of unscripted speech from quarterly conference call transcripts. We obtain conference call transcripts from Thomson Reuters for 2004–2013. The extraversion measure is based on CEO responses during the question-and-answer (Q&A) portion of the call and calculated using the Support Vector Machine method from Mairesse et al (2007). We require that each CEO speak at least 500 words to be included in our sample. We use company tickers and names and CEO names to match the CEOs from conference call transcripts to the ExecuComp database. Variables are defined in Appendix B. All specifications include firm and year fixed effects. Standard errors (in parentheses) are clustered by firm and year.
*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

support this reverse causality conjecture. Specifically, changes in stock volatility, changes in ROA volatility, undertaking of an M&A transaction, and increase in cost of capital are not significantly related to changes in annual extraversion as measured, whereas change in *Net Leverage* is negatively and marginally related to the change in CEO extraversion.

4.5 | Effects of CEO extraversion on firm performance, valuation, and new equity issuance

To examine the economic implications of the positive relation between CEO extraversion and ICC, we next examine the effect of extraversion on firm performance, valuation, and new equity issuance. Ex ante, the relation between extraversion and firm performance and valuation is ambiguous. If the riskier projects that extraverted CEOs undertake generate on average larger cash flows and help the firm grow faster, we might expect higher operating cash flows, ROA, sales growth, or market share. However, if the extra risk does not pay off, performance may be negatively affected. Similar arguments may be made for valuation and equity issuance. Finally, in an efficient labor market, we expect optimal matching between managers and firms; as a result, there may be no observed relation between CEO characteristics and performance (e.g., Custodio et al., 2013).

Following Green et al. (2019), we consider the following measures of performance: *Sales Growth*, *ROA*, *OCF*, *Market Share*, *Stock Return*, *Profit Margin* and *Firm Efficiency*. We use Tobin's Q as a measure of valuation, and net stock issues and external equity issues as measures of equity issuance. All variables are defined in Appendix B.

We examine three panel models and present results in Table 8. For brevity we report only the coefficient on extraversion (or change in extraversion for Column 3), but we employ the same set of explanatory variables as in all our main regressions (i.e., Equation 2). Additionally, we include an indicator variable for firms that repurchase shares, as this affects the calculation of shares outstanding and book value of equity in the dependent variables, net stock issues (*NS*, Fama & French, 2008), and external equity issuance (*EI*, Baker et al., 2003). Column 1 uses the full sample panel with level dependent variables and firm and year fixed effects. Column 2 uses the full sample panel with industry-adjusted level dependent variables and year fixed effects. Column 3 uses a subsample of firms that experience CEO turnover and examines changes in industry-adjusted dependent variables around each turnover event. Consistent with Green et al. (2019), we find some evidence that extraversion has a positive and marginal relation to sales growth. However, we also find that when a more extraverted CEO replaces less extraverted CEO, there is a drop in firm efficiency.[15] Although we find no significant evidence that CEO extraversion affects firm valuation, we find some evidence of a negative relation between CEO extraversion and equity issuance in the full sample but no statistically significant reduction in equity issuance around CEO turnovers. Overall, the results on the impact of CEO extraversion on performance, valuation, and financing are mixed and mostly insignificant, which is consistent with efficient market outcomes.

4.6 | Additional tests

4.6.1 | Credit ratings

To further examine the effect of CEO extraversion on cost of capital, we collect and analyze firms' credit ratings. Credit ratings are a transparent market-driven measure of firm risk with respect to debt financing and have a strong association with firms' cost of debt capital. We collect long-term credit ratings for our sample firms from the Compustat database. The ratings range from AAA to D (default) and SD (selective default). We assign a numerical value to each credit rating where a higher value stands for better crediting rating (i.e., lower risk and lower cost of borrowing). We regress the credit rating values on the CEO extraversion scores and a similar set of firm control variables used in Equation (2). We use both OLS and firm fixed-effects regressions. Because the credit rating data are available only for a subset of firms in our sample, we end up with 3960 firm-year observations in the analysis.

[15]We note that our sample and sample period are slightly different from those of Green et al. (2018), which may explain some of different signs on insignificant coefficients.

TABLE 8 Effects of CEO extraversion on firm performance, valuation, and equity issuance.

Variable	Level dependent variables with firm-year fixed effects (1)	Industry-adjusted level dependent variables with year fixed effects (2)	Change in industry-adjusted dependent variables around CEO turnover (3)
Panel A: Firm performance and valuation			
Sales Growth	0.0137*	0.0111**	0.0102
	(0.007)	(0.005)	(0.011)
ROA	0.0057	0.0035*	−0.0024
	(0.003)	(0.002)	(0.004)
OCF	0.0005	0.0004	−0.0018
	(0.001)	(0.001)	(0.001)
Market Share	−0.0014	0.0027	0.0017
	(0.002)	(0.003)	(0.001)
Stock Return	0.0140	0.0200***	−0.0100
	(0.013)	(0.006)	(0.023)
Profit Margin	0.0035	−0.0011	−0.0007
	(0.002)	(0.003)	(0.003)
Firm Efficiency	−0.0060	−0.0031	−0.0173**
	(0.004)	(0.006)	(0.007)
Tobin's Q	−0.0384	0.0079	−0.0006
	(0.037)	(0.036)	(0.034)
Panel B: Equity issuance			
EI	−0.0113*	−0.0090*	−0.0050
	(0.005)	(0.005)	(0.007)
NS	−0.0049*	−0.0036	−0.0002
	(0.003)	(0.002)	(0.005)

Note: This table reports coefficients on extraversion from panel regressions of firm performance, valuation, and equity issuance on CEO extraversion, the other personality traits, and a set of CEO and firm characteristics. Model 1 uses level dependent variables and firm and year fixed effects. Model 2 uses industry-adjusted values of dependent variables and year fixed effects. Model 3 uses a subsample of firms that experienced CEO turnover and employs industry-adjusted changes in dependent variables. We measure firm performance using sales growth, return on assets, operating cash flows, market share, stock return, profit margin, and firm efficiency. Firm valuation is measured using Tobin's Q and equity issuance is measured using net stock issues (*NS*, Fama & French, 2008) and external equity issues (*EI*; Baker et al., 2003). We estimate extraversion using a linguistic technique and a sample of unscripted speech from quarterly conference call transcripts. We obtain conference call transcripts from Thomson Reuters for 2004–2013. The extraversion measure is based on CEO responses during the question-and-answer (Q&A) portion of the call and calculated using the Support Vector Machine method from Mairesse et al. (2007). Variables are defined in Appendix B. Standard errors (in parentheses) are clustered by firm and year.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

In Table S3 in the Online Appendix, we find a negative and significant association between CEO extraversion and credit ratings of long-term debt. A 1 SD increase in CEO extraversion reduces the credit rating by approximately 0.17. Given the average credit rating in the sample is 12.4, the economic effect is about 1.4% relative to the sample mean. These results support our prior findings on cost of equity capital and provide further evidence that CEO extraversion has a significant association with firm risk and cost of debt financing.

4.6.2 | Individual ICC measures

As discussed earlier, we use averages of three underlying measures of ICC^{AN} and ICC^{HVZ}, respectively. In Table S4 in the Online Appendix, we find that extraversion is also positive and statistically significant for each of the individual underlying ICC measures.

4.6.3 | Financial crisis

Our sample spans 2004–2013, which includes the important global financial crisis in 2007–2009. We investigate whether our results vary during the financial crisis. We conduct a split-sample analysis by separating our sample into financial-crisis (2007–2009) and nonfinancial-crisis years. We find that CEO extraversion does not have a significant effect on cost of capital during the financial crisis. This could be because (1) cost of capital increased with much noise during financial crisis and (2) CEO personality plays a less important role in "stronger" situations (Malhotra et al., 2018), that is, in situations where CEOs have less discretion, say, because of the pressure and constraints caused by the financial crisis. We present the results of this additional analysis in Table S5 in the Online Appendix.

4.6.4 | More parsimonious models

Having both firm and year fixed effects and many firm-level control variables may be overkill in our model. To verify that our results are also robust in a more parsimonious model, we control for only firm size, book-to-market ratio, and Big Five CEO personality traits (in addition to removing firm fixed effects). We present the parsimonious model in Table S6 in the Online Appendix. Our main conclusion remains the same: CEO extraversion is positively associated with firms' cost of equity.

4.7 | Other alternative explanations

Our ICC measures are essentially the internal rate of return that equates the current stock price to the present value of expected future earnings. A major input of expected future earnings is based on analysts' forecasts. An alternative interpretation of our results could be that analysts have a stronger reaction to extraversion than do other market participants, as they interact more with CEOs, for example, in analyst conference calls. This may result in relatively more optimistic earnings forecasts relative to stock price in the market, which leads to higher ICC estimates and causes a mechanical positive association between CEO extraversion and firm ICC observed in our regression models.

We attempt to rule out this alternative explanation using two approaches. First, we focus on expected earnings. Our results are not solely dependent on analysts' earnings forecasts, as we also adopt the cross-sectional model-based ICC measure, which should be less contaminated by analysts' forecast biases.

In addition, we control analyst bias and optimism in all regression models, and our main results remain robust. We also consider the interaction between analyst bias and CEO extraversion (see Table S7 in the Online Appendix) to further rule out the possibility that analysts are too optimistic for firms headed by extraverted CEOs, and our results remain the same.

Second, we focus on the stock price in estimating the ICC measures. We use two tests to see whether market prices underreact to CEO extraversion, which may cause inflated ICC estimates. We first replace the market price with analysts' target price in the ICC estimation. By doing this, we match expected future earnings with stock prices forecasted by the same analyst so that it reduces the potential bias caused by different perceptions of CEO personality by different market participants (i.e., general market participants may underreact to CEO personality information compared to analysts). We obtain 6706 observations of ICC estimates using both analysts' target prices and expected future earnings. We compare this ICC measure with the market-price-based ICC measure but find no statistical differences (see Table S8 in the Online Appendix). In addition, we regress the target-price-based ICC measure on CEO extraversion and still find a positive and significant association (see Table S9 in the Online Appendix). This result suggests that analysts' reaction to CEO personality information is in line with the general market reaction; that is, the stock market does not systematically underreact to CEO personality information.[16]

We further examine the stock returns of firms managed by extraverted CEOs. If market prices initially underreact to CEO extraversion, we expect positive abnormal stock returns going forward for firms managed by extraverted CEOs. We use realized stock returns based on both calendar date and event date approaches to measure abnormal stock returns. More specifically, for the calendar date approach, in June of each year t, we sort all sample firms into quintiles based on CEO extraversion. We construct a portfolio that is long in high-extraversion firms (top quintile) and short in low-extraversion firms (bottom quintile). We hold this portfolio from July of year t through the end of June of year $t + 1$. In Table S10 in the Online Appendix, we do not find consistent evidence that the high-extraversion portfolio outperforms the low-extraversion portfolio. Whereas the difference in returns is 0.35% (t-statistic = 2.52) per month for equal-weighted raw returns, it is only 0.08% (t-statistic = 0.52) per month for value-weighted raw returns. Alphas from the Fama–French (2016) five-factor model, which adjusts for market beta, size, value, profitability, and investment factors, yield even less evidence that the high-extraversion portfolio outperforms the low-extraversion portfolio. Although high-extraversion firms realize positive and significant five-factor alphas and low-extraversion firms realize insignificant alphas, the difference in five-factor alphas between the two groups is not statistically significant for either the equal- or value-weighted portfolios. Therefore, there is no consistent evidence that the market underreacts to CEO extraversion.

We also use an event date approach by extracting realized stock returns after each appointment of a CEO during the sample period. We calculate long-term buy-and-hold-abnormal returns (BHARs) for each CEO turnover event using the value-weighted CRSP market index as the benchmark. We then sort each CEO turnover event by newly appointed CEOs' extraversion scores. We take the top quintile of the most extraverted CEOs and compare with the bottom quintile of the least extraverted CEOs in terms of BHAR values after each appointment. To check the robustness of our results, we choose multiple time windows (ranging from 6 months to 5 years after each CEO appointment) to calculate BHARs. In this analysis, we analyze 340 new CEO appointments with monthly stock returns available up to 5 years after each appointment. There are 68 appointments of relatively more extraverted CEOs (top quintile) and 68 appointments of relatively less extraverted CEOs (bottom quintile). Sample sizes vary in different time windows because of missing stock return data.

[16]Although the coefficients on CEO extraversion are smaller in the regression models of target-price-based ICC compared to the models of market-price-based ICC (i.e., see Table 2), we do not find the difference between these coefficients to be statistically different. For example, comparing the coefficient of 0.141 in Model 1 of Table S9 with the coefficient of 0.2354 in Model 1 of Table 2, the z-statistic for the coefficient difference is 1.23, which is not significant at conventional levels. In addition, regressing CEO extraversion on the ratio of analysts' target price to the stock market price of the firm, we do not find any significant association. This evidence does not support the alternative explanation that financial analysts systematically adjust their target price upward in response to CEO extraversion, which, if true, could cause a mechanical positive association between CEO extraversion and ICC.

We compare the BHAR measures for the two samples of CEO appointments and report the results in Table S11 in the Online Appendix. We find that the long-term stock returns of firms appointing more extraverted CEOs are not statistically different from firms appointing less extraverted CEOs. The *t*-statistics for the BHAR values measured in various time windows are not significant at any conventional level. These results again suggest that overall, the stock market correctly prices CEO information in the appointment of an extraverted CEO as there is not significant correction to long-term stock returns after CEO appointments.

After analyzing both expected earnings and stock prices in detail, we believe our results are not explained by analysts' forecast bias or market underreaction to CEO personality information. We rule out the alternative explanation that the positive association between CEO extraversion and ICC is mechanical because of the analyst-based ICC measure we use in the study.[17]

5 | CONCLUSION

We examine whether CEO extraversion influences firms' expected cost of equity capital. We measure extraversion by using a linguistic algorithm on CEOs' speech patterns during the relatively unscripted Q&A portion of analysts' conference calls. We find that firms managed by extraverted CEOs have higher cost of equity capital and lower credit ratings than otherwise similar firms run by less extraverted CEOs. Our results capture the incremental association between CEO extraversion and cost of capital after controlling for several other CEO and firm-specific variables, including CEO overconfidence, traditional firm risk measures, and firm fixed effects. In exploring potential sources of this association, we find that firms with extraverted CEOs appear to be more prone to risk taking, a behavior that should translate into higher cost of equity capital. CEO turnover events associated with an increase in extraversion exhibit a statistically and economically significant increase in ICC, suggesting that extraverted CEOs do not simply select riskier firms.

Our evidence adds to the literature by suggesting that CEO extraversion, a stable personality trait associated with risk taking and leadership, has significant implications for the cost of equity capital and credit ratings. Despite increased cost of capital, we find only marginal evidence that CEO extraversion affects firm performance. CEO extraversion is positively and marginally related to sales growth and market share, but negatively and marginally related to firm efficiency and equity issuance.

Although we do not directly address broad economywide policy and regulatory issues, our findings may inform individual companies and their policies around capital budgeting and hiring and retaining CEOs. When evaluating investment opportunities, firms may want to consider the effect of their CEO's extraversion on the firm's discount rate. In addition, our findings have implications for boards' CEO hiring practices. Khurana (2002) finds that some companies irrationally focus on finding "charismatic" leaders. For example, in CEO searches *"most important was to find a CEO who could reinvigorate and revitalize the company. Someone who could harness the energy of its employees and inspire them to excellence"* (Khurana, 2002, p. 60). To the extent that extraversion and charisma are correlated among individual CEOs, our findings suggest that in hiring decisions, boards should weigh the benefits of CEO extraversion against the potential costs. Finally, boards should consider not only direct costs to shareholders (e.g., CEO's pay and benefits package) but also indirect costs that stem from potentially higher risk taking and cost of capital.

[17]Although we argue that analysts react to CEO extraversion by increasing ICC because of higher perceived firm risk, it is also possible that analysts may lower expected future earnings to match the discounted market price caused by market perceptions of increased firm risk. According to Jylha and Ungeheuer (2021), financial analysts tend to adjust growth expectations to fit their target valuation with market valuations. However, in our additional analysis (see Table S12 in the Online Appendix), we do not find a significant association between analysts' long-term growth rate forecasts and CEO extraversion, which suggests that analysts do not systematically adjust growth forecasts based on CEO personality information. Furthermore, as we control analysts' long-term growth rate forecasts in our main models, the association between CEO extraversion and ICC is less likely to be driven by analysts' intentional adjustment of growth rate forecasts.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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APPENDIX A: Details of implied cost of equity capital estimates.

ICC Estimate	Source	Formula and assumptions
Individual ICC measures		
ICC_{GLS}	Gebhardt et al. (2001)	$P_t = B_t + \sum_{i=1}^{11} \frac{FROE_{t+i} - ICC_{GLS}}{(1+ICC_{GLS})^i} B_{t+i-1} + \frac{FROE_{t+12} - ICC_{GLS}}{ICC_{GLS}(1+ICC_{GLS})^{11}} B_{t+11}$, where P_t is market price per share in year t, B_t is book value of equity per share in year t, ICC_{GLS} is the implied cost of capital estimate, and FROE is expected return on equity (ROE) in year $t+i$ based on the information in year t. We estimate FROE in years $t+1$ to $t+3$ using either analysts' earnings forecasts from Institutional Brokers' Estimate System (IBES) or model-based earnings forecasts (Hou et al. (2012); Li & Mohanram (2014)). Beyond year 3, we assume that each firm's ROE fades linearly to its Fama–French 48-industry median by year 12. Following Gebhardt et al. (2001), we exclude firms with loses when calculating Fama–French 48-industry median ROE. We forecast book values of equity per share (B_t) using earnings forecasts (FEPS, from either analysts or the cross-sectional model) and dividend payout (dp) in the following manner: $B_{t+i+1} = B_{t+i} + FEPS_{t+i+1}(1 - dp)$. We estimate dividend payout by dividing actual dividends (Compustat item DVT) from the most recent fiscal year by the earnings over the same period (Compustat item NI). For firms with negative earnings, we follow Gebhardt et al. (2001) and divide the actual dividends by 6% of total assets, to compute payout.
ICC_{MPEG}	Easton (2004)	$P_t = \frac{FEPS_{t+2} + ICC_{MPEG} \times FD_{t+1} - FEPS_{t+1}}{ICC^2_{MPEG}}$, where P_t is market price per share in year t, ICC_{MPEG} is the implied cost of capital estimate, FD is expected dividend in year $t+1$, and FEPS is expected earnings per share in year $t+i$ based on the information in year t. We estimate FEPS in years $t+1$ and $t+2$ using either analysts' earnings forecasts from IBES or model-based earnings forecasts (Hou et al. (2012); Li & Mohanram (2014)). We estimate FD by multiplying dividend payout ratio by FEPS in year $t+1$. We estimate dividend payout by dividing actual dividends (Compustat item DVT) from the most recent fiscal year by the earnings over the same period (Compustat item NI). For firms with negative NI, we divide the actual dividends by 6% of total assets, to compute payout. If FEPS for year $t+1$ is negative, we multiply the payout ratio by 6% of total assets.

(Continues)

ICC Estimate	Source	Formula and assumptions
ICC_{Gordon}	Gordon and Gordon (1997)	$P_t = \frac{FEPS_{t+1}}{ICC_{Gordon}}$, where P_t is market price per share in year t, ICC_{Gordon} is the implied cost of capital estimate, and FEPS is expected earnings per share in year t+1 based on the information in year t. We estimate the FEPS in year t+1 using either analysts' earnings forecasts from IBES or model-based earnings forecasts (Hou et al. (2012); Li & Mohanram (2014)). This is a special case of the Gordon growth model with zero-growth assumption.
Aggregate ICC measures		
ICC^{I} (i.e., ICC^{AN} or ICC^{HVZ})		$ICC^{I}_{i,t} = \frac{SUM(Nonmissing(ICC_{GLS,i,t}, ICC_{MPEG,i,t}, ICC_{Gordon,i,t})}{COUNT(Nonmissing(ICC_{GLS,i,t}, ICC_{MPEG,i,t}, ICC_{Gordon,i,t})} - y_{10}^{GOVT}$, where $ICC^{I}_{i,t}$ is either ICC^{AN} or ICC^{HVZ} for firm i in year t, depending on whether we use analyst earnings forecasts or cross-sectional model to predict future earnings. To obtain ICC^{I}, we calculate the average of the three individual ICC measures and subtract the yield on 10-year Treasury bonds. To preserve the number of observations, we do not require that all three measures of ICC are available when computing the average.

APPENDIX B: Variable definitions.

Variable	Definition
Extraversion	Aggregate extraversion score estimated from CEO responses during the question-and-answer (Q&A) portion of conference calls and calculated using the Mairesse et al. (2007) Support Vector Machine linguistic method. We require that each CEO speak at least 500 words to be included in our sample. We collect conference calls from Thomson Reuters. Details of the linguistic procedure and measure construction are available in Section 3.3
Emotional Stability	Aggregate emotional stability score estimated from CEO responses during the Q&A portion of conference calls and calculated using the Mairesse et al. (2007) Support Vector Machine linguistic method. We require that each CEO speak at least 500 words to be included in our sample. We collect conference calls from Thomson Reuters. Details of the linguistic procedure and measure construction are available in Section 3.3
Openness	Aggregate openness score estimated from CEO responses during the Q&A portion of conference calls and calculated using the Mairesse et al. (2007) Support Vector Machine linguistic method. We require that each CEO speak at least 500 words to be included in our sample. We collect conference calls from Thomson Reuters. Details of the linguistic procedure and measure construction are available in Section 3.3
Conscientiousness	Aggregate conscientiousness score estimated from CEO responses during the Q&A portion of conference calls and calculated using the Mairesse et al. (2007) Support Vector Machine linguistic method. We require that each CEO speak at least 500 words to be included in our sample. We collect conference calls from Thomson Reuters. Details of the linguistic procedure and measure construction are available in Section 3.3
Agreeableness	Aggregate agreeableness score estimated from CEO responses during the Q&A portion of conference calls and calculated using the Mairesse et al. (2007) Support Vector Machine linguistic method. We require that each CEO speak at least 500 words to be included in our sample. We collect conference calls from Thomson Reuters. Details of the linguistic procedure and measure construction are available in Section 3.3

Variable	Definition
ICC^{AN}	Equal-weighted average of three individual implied cost of equity capital (ICC) measures less the yield on 10-year Treasury bonds, where at least one measure is nonmissing. Expected earnings are estimated based on analyst forecasts from Institutional Brokers' Estimate System (IBES). Winsorized at the 1st and 99th percentiles
ICC^{HVZ}	Equal-weighted average of three individual ICC measures less the yield on 10-year Treasury bonds, where at least one measure is nonmissing. Expected earnings are estimated based on a cross-sectional model of Hou et al. (2012) using past data from Compustat. Winsorized at the 1st and 99th percentiles
Tobin's Q	Market value of equity (CSHO × PRCC_F) plus book value of debt (DLTT + DLC) divided by the book value of assets (AT)
Assets	Logarithm of total assets (AT)
B/M	Ratio of book value of equity to market value of equity at the fiscal year-end (CEQ/(CSHO × PRCC_F)). Winsorized at the 1st and 99th percentiles
Leverage	Ratio of book value of long-term debt (DLTT) divided by book value of total assets (AT). Winsorized at the 1st and 99th percentiles
Firm Age	Number of years since the firm first appears in Compustat annual database
LTG	Average analyst forecast of the long-term growth rate, item LTG from the IBES summary file. Winsorized at the 1st and 99th percentiles
Volatility	Standard deviation of monthly returns from Center for Research in Security Prices (CRSP) estimated over subsequent 12 months
Beta	Coefficient on excess market return from four-factor model estimated using monthly returns from CRSP over the past 60 months, requiring at least 24 nonmissing monthly observations
NS	Net stock issues: Natural log of the ratio of the split-adjusted shares outstanding at the fiscal year-end in year *t* divided by the split adjusted shares outstanding at the fiscal year-end in year $t-1$, computed using Compustat data, as defined in Fama and French (2008)
EI	External equity issues: Change in book equity minus change in retained earnings scaled by total assets as in Baker et al. (2003)
ROAVOL	Standard deviation of return on assets (ROA) estimated over subsequent 5 years. ROA is defined as earnings before interest and taxes divided by total assets (EBIT/AT). Winsorized at the 1st and 99th percentiles
Net Leverage	Ratio of the difference between long-term debt (DLTT) and cash and marketable securities (CHE) divided by book value of total assets (AT). Winsorized at the 1st and 99th percentiles
Analyst Bias	Actual earnings from the IBES actuals file minus the median earnings estimate from the IBES summary file, scaled by the median earnings estimate from the IBES summary file
Analyst FERR	Absolute value of the difference between actual earnings from the IBES actuals file minus the median earnings estimate from the IBES summary file, scaled by the median earnings estimate from the IBES summary file
CEO Age	Age of the CEO from ExecuComp
CEO Gender	Indicator variable that equals 1 if the CEO is male, and 0 otherwise. CEO gender is from ExecuComp
CEO Tenure	Number of years that CEO has been in the CEO position at the firm. Start date is from ExecuComp

(Continues)

Variable	Definition
CEO Ownership	Number of shares owned excluding options from ExecuComp, divided by the number of shares outstanding from Compustat
CEO Overconfidence	Indicator variable equal to 1 if the CEO is classified as overconfident, and 0 otherwise. We classify the CEO as overconfident if they hold unexercised excisable options that are 67% or more in the money at least twice over the period in the ExecuComp database, and 0 otherwise. CEO is defined as overconfident from the first moment they hold unexercised exercisable options that are at least 67% in the money. Details of the calculation can be found in Campbell et al. (2011)
CEO Pay Slice	Total compensation of the CEO scaled by the total compensation of the five highest paid executives in the firm as defined in Bebchuk et al (2011). Compensation data are from ExecuComp. Winsorized at the 1st and 99th percentiles
Credit Rating	Credit rating of long-term debt is collected from the Compustat database. The ratings have 21 levels ranging from AAA to D and SD (selective default). We assign a ranked value to each credit rating (e.g., 21 for AAA and 1 for D and SD)
Sales Growth	Percentage change from last year's sales to this year's sales from Compustat. Winsorized at the 1st and 99th percentiles
Market Share	Percentage of revenues earned by the firm within its Fama–French (1997) 48-industry classification using Compustat data
Firm Efficiency	Measure of how efficient a firm is at generating revenue for a given set of inputs, as described in greater detail in Demerjian et al. (2012) (Source: http://faculty.washington.edu/pdemerj/data.html)
OCF	Profitability: Annual cash flows from operations scaled by assets as of the end of the prior fiscal year, from Compustat. Winsorized at the 1st and 99th percentiles
Profit Margin	Net income divided by sales, from Compustat. Winsorized at the 1st and 99th percentiles
Stock Return	Annual stock returns, from CRSP. Winsorized at the 1st and 99th percentiles
Industry Concentration	Herfindahl–Hirschman index (*H*), which is calculated as $H = \sum_{i=1}^{N} S_i^2$, where *Si* is the market share of firm *i* and *N* is the number of firms in the industry (based on the Standard Industrial Classification [SIC] four-digit code)
Forced Turnover	Following Fee et al. (2013) methodology, we identify every outgoing CEO and search Factiva for all articles in a 3-year period centered on the turnover year that include the CEO's surname, firm's name at the time of the turnover event, and any of the following key words (with indicated wild cards): fire*, oust*, force*, remove*, pressure*, terminat*, dismiss*, or shake up. If the articles suggest that the turnover was involuntary, we assign the turnover to the overtly forced category
Powerful CEO	Following Adams et al. (2005), we classify CEO as powerful if: (1) CEO is a founder, (2) CEO is the only insider the board, or (3) CEO concentrates titles