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ABSTRACT

We use detailed assessments of CEO personalities to explore the option-based measure of CEO overconfidence, Longholder, introduced by Malmendier and Tate (2005a) and widely used in the behavioral corporate finance and economics literatures. Longholder is significantly related to several specific characteristics and is negatively related to general ability. These relations also hold for overconfidence measures derived from CEOs' earnings guidance. Investment-cash flow sensitivities are larger for both Longholder and less able CEOs. Overall, Longholder CEOs have many of the same characteristics traditionally associated with overconfident individuals, including lower general ability, supporting the interpretation of this measure as reflecting overconfidence.

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1. Introduction

Academics and practitioners increasingly believe that CEO personalities, abilities, and characteristics matter for corporate performance.[1] CEO overconfidence has received particular attention in corporate finance and economics research because it might lead to suboptimal corporate decisions. Malmendier and Tate (2005a) find that investments by firms led by overconfident CEOs are significantly more sensitive to their cash flows, which is often interpreted as a sign of managerial myopia. Malmendier and Tate (2008) find that overconfident CEOs are more likely to make value-destroying mergers, particularly diversifying ones.[2]

In their survey of CEO and managerial overconfidence, Malmendier and Tate (2015) note that "the most common approach to measuring CEO overconfidence has been to use decisions that the executive makes on his or her personal portfolio of company stock options." The variable, named *Longholder* by Malmendier and Tate (2005a), classifies CEOs as overconfident when they hold vested options that are at least 40% in the money until the year the options expire. The intuition is that risk averse CEOs would exercise deep in-the-money options well before expiration to reduce their exposure to company-specific risks and to obtain the benefits of diversification, and that leaving such options outstanding therefore signals overconfidence about the prospects of their firms. Many subsequent papers have used this measure of overconfidence.[3]

There may be other reasons, however, for CEOs not to exercise in-the-money options. For example: (1) Risk-neutral or less risk averse CEOs may choose to take advantage of the tax deferral in options. (2) CEOs can hedge the value of their equity holdings rather than engage in an outright sale of shares or exercise of options. (3) CEOs may believe or know the company stock is undervalued, and rationally do not exercise. (4) CEOs may not be

[1] For example, see Bertrand and Schoar (2003), Bloom and Van Reenen (2007), and Kaplan et al. (2012).

[2] Malmendier and Tate (2015) survey the literature on CEO (and managerial) overconfidence. See also Guenzel and Malmendier (2020) who survey the behavioral corporate finance literature on CEOs.

[3] See Bettis et al. (2001), Jagolinzer et al. (2007), and Bettis et al. (2015).

able to exercise options because the board precludes them from doing so.[4]

Given these alternative motivations for not exercising options, we use detailed assessments of executives who become public company CEOs to understand which managerial characteristics are related to *Longholder*. This, in turn, allows us to consider whether the *Longholder* measure can be interpreted as reflecting CEO overconfidence.

We obtain personality assessments for more than 2,600 candidates for management positions. The assessments are based on four-hour structured interviews performed by ghSMART, primarily between 2001 and 2012.[5] After each interview, ghSMART produces a detailed description of the candidate's background and characteristics. The assessments also rate each candidate for 30 specific characteristics and abilities that capture different aspects of the executive's personality.[6] The assessed executives are typically candidates for CEO, CFO, COO, and other top management positions. The firms requesting the assessments are governed under a variety of different ownership forms, including venture capital, private equity-owned, other privately owned, and publicly traded firms.

We track each candidate's subsequent career to determine which candidates subsequently become a CEO of a public company and identify 67 such candidates. Of these 67 CEOs, nine (13%) are *Longholders*. This approach allows us to compare the personalities of CEOs classified as *Longholders* and *Non-Longholders*.

We find that *Longholder* CEOs have significantly lower scores on a number of characteristics: having a strong network, being organized and calm under pressure, moving fast, sticking to commitments, having strong analytical skills, being creative, having a strong work ethic, having good listening skills, and being open to criticism. Personalities of CEOs identified as overconfident by the *Longholder* measure thus exhibit these characteristics to a lesser extent than other CEOs.

This evidence is consistent with the typical characteristics of overconfident individuals

[4]Some firms adopt "hold to retirement" or "hold past retirement" requirements for equity awards (Larcker and Tayan 2016).

[5]Botelho and Powell (2018) and Botelho et al. (2017) also analyze the ghSMART data.

[6]See Table A-1 in Kaplan and Sorensen (2019).

identified in the psychology literature. Overconfident individuals have been found to have weaker networks (Burt 1997; Klayman et al. 1999; Hayward et al. 2006; Gudmundsson and Lechner 2013), to be too optimistic with organization, planning, and commitments (Larwood and Whittaker 1977; Vallone et al. 1990), to have lower analytical skills and cognitive ability (Stango et al. 2017; Chapman et al. 2018), and to be worse listeners and feedback seekers (Tost et al. 2012; Meikle et al. 2016). Given that *Longholder* CEOs exhibit similar characteristics, our evidence is consistent with the interpretation of *Longholder* as measuring overconfidence.

Because the specific characteristics are highly correlated, Kaplan and Sorensen (2019) use factor analysis to reduce the dimensionality and identify the main variation in the data. In the sample of 2,600 executives, they identify four factors that explain 54% of the variation across characteristics. They interpret these factors as (1) general talent, (2) execution (vs. interpersonal), (3) charisma (vs. analytical), and (4) strategic (vs. managerial). Interestingly, *Longholder* is significantly negatively related to the first factor, suggesting that overconfident CEOs tend to have less general talent or ability. This finding is consistent with the classic study (in psychology) by Kruger and Dunning (1999) who show that lower-ability individuals tend to be more overconfident.

We perform three robustness analyses. First, we confirm that firms with *Longholder* CEOs are similar to firms with non-*Longholder* CEOs. Second, it is possible that non-*Longholders* never have a chance to become *Longholders*, because their options are never sufficiently in-the-money. But we find that the average moneyness of non-*Longholders'* options is not statistically different from that of *Longholders*. Third, in addition to the *Longholder* measure, we explore two alternative measures of overconfidence, namely, the extent to which CEOs provide optimistic earnings guidance and the extent to which earnings guidance is overly precise. We find the former measure, overly optimistic earnings guidance, is also negatively correlated with many individual characteristics and with our measure of CEO ability.

Finally, we estimate the investment-cash flow regressions from Malmendier and Tate (2005a, 2015) using our sample. We confirm that investments by firms with *Longholder* CEOs are significantly more sensitive to cash flows. Moreover, we find investments by firm with less talented CEOs are also significantly more sensitive to cash flows. The sensitivity to *Longholder* remains when we include both variables in a regression.

Combined, then, our findings are consistent with overconfidence being associated with lower general ability, but with *Longholder* capturing an aspect of overconfidence over and above lower general ability.

One limitation of this study is the small sample. Although we obtain statistically significant results for the main relationships, we are unable to include additional explanatory variables. Another limitation is that ghSMART does not explicitly rate the candidates' overconfidence, and we are not able to relate the *Longholder* measure to a more direct assessment of each candidate's overconfidence. Despite these limitations, we believe our study is useful, given that our data contain unusually, if not uniquely, rich information about the personalities of public company CEOs.

The paper proceeds as follows. Section 2 describes our data, the assessments, and the measurement of overconfidence. Section 3 explores the correlation between the Longholder measure, measures based on earnings guidance and the assessments. Section 4 explores the correlation with Kaplan and Sorensen (2019) factors. Section 5 considers the relation of investment to cash flow and its correlation with *Longholder* and the assessment factors. Section 6 concludes.

2. Data

2.1 Assessments

Our main data are a proprietary set of detailed personality assessments of candidates for top management positions (see also Kaplan et al. 2012; Kaplan and Sorensen 2019). The

assessments are performed by ghSMART, a consulting firm that is engaged by investors, company boards, and company management teams to assess candidates for management positions. Importantly, ghSMART is not an executive recruiting firm, and it does not suggest which candidate(s) to consider for a given position. ghSMART does not receive a fee contingent on whether a candidate is hired, and has no apparent incentives to deliver biased assessments. According to ghSMART, its main concern is to provide accurate assessments to maintain its reputation and generate repeat business. Note that the assessments are performed ex ante, typically before the candidate becomes CEO, which by itself could influence the candidate's personality and overconfidence.

ghSMART's assessments are based on extensive structured interviews. During the interview, the interviewer[7] asks for specific examples of the candidate's actions and behavior at previous jobs and life stages, starting with the candidate's childhood and progressing through the candidate's education and subsequent career path. The candidate's history and behavior is summarized in a 20- to 40-page report, which is effectively a mini-biography of the candidate.

In addition to the narrative part, each report also includes ratings for 30 specific characteristics across five general areas, which are classified by ghSMART as Leadership, Personal, Intellectual, Motivational, and Interpersonal. Table A-1 in Kaplan and Sorensen (2019) shows an excerpt from ghSMART's internal guidelines that describe the 30 characteristics along with the behaviors that determine their scoring.[8] Appendix A in this paper lists the 30 characteristics and five general areas. In many of the assessments, the ratings for oral and written communications are absent. Accordingly, we do not include these two characteristics in our analyses. The reports sometimes include ratings for other characteristics that are specific to a particular firm or situation, but because these characteristics are

[7]The ghSMART interviewers generally hold doctoral degrees or degrees from top MBA programs, and have worked at consulting firms (e.g., McKinsey & Co., Bain, and Boston Consulting Group). ghSMART reports a high degree of consistency of assessments across interviewers.

[8]Smart and Street (2008) provide additional information and detail about ghSMART's interviewing methodology.

not consistently reported across candidates, we do not include them in our analysis.

An important concern is whether the candidates can "game" or "fake" the interviews by providing answers they believe will help them be hired, even if they do not reflect their actual personalities. The ghSMART assessments and ratings appear to be reliable for a number of reasons. The assessments are formed using best practices from organizational psychology, including using external interviewers not self-assessments, and using extensive structured interviews rather than questionnaires. In organizational psychology, these practices have been found to produce assessments that are consistent across tests and robust to gaming and faking by the test subjects. ghSMART charges more than $20,000 per assessment and has seen its business grow substantially, suggesting that ghSMART's customers find the assessments useful.[9] Finally, it is difficult to reconcile the empirical results with significant faking. If the assessments were uninformative, we would not see the statistical relationships between the assessed characteristics and various outcomes that are documented in Kaplan et al. (2012), Kaplan and Sorensen (2019) and this paper. For example, Kaplan and Sorensen (2019) find that the scores predict which candidates later become CEOs and CFOs, suggesting that the assessed characteristics are, at least somewhat, persistent and reflect the candidates' personalities as perceived in other hiring and recruiting situations that do not involve ghSMART.

It should be noted that at the time of the assessments, ghSMART and the candidates would not have been aware of the factor structure and other results we report.

2.2 Factors

The assessments grade the executives on the 28 specific characteristics we use, with a rating from D (lowest) to A+ (highest), reflecting the extent to which the candidate's

[9] Additionally, albeit anecdotally, several PE firms told us they do not make any investments without a CEO assessment of the type ghSMART provides. Although economic theory suggests it may be rational for candidates to attempt to misrepresent their types, economic theory also prescribes that it would be irrational for investors to rely on such assessments if they were uninformative. Assessments also are costly: in addition to the fee charged by ghSMART, assessments require at least four hours of a candidate's time.

personality exhibit the specific characteristic. We convert these letter grades to numerical scores by coding all grades of B or below as 1 (we combine these grades because we have relatively few of them). We code grades of B+ as 2 and grades of A- as 3. We code grades of A and A+ as 4, because we find relatively few A+'s. The results are not sensitive to the coding scheme.

The ratings for the characteristics are highly correlated, making it difficult to infer the effects of individual characteristics in a multivariate analysis. Kaplan and Sorensen (2019) use factor analysis to identify four factors with eigenvalues above one, which combined capture most of the variation in the candidates' characteristics. The loadings of the individual characteristics on the four factors are shown in Appendix B, and these loadings lend themselves to natural interpretations of the factors. The first factor has positive loadings on all the specific characteristics, and this factor can be interpreted as a CEO's general ability in the spirit of Rosen (1981). This structure of this first factor is common in factor analysis, dating back to Spearman's *g*-factor (Spearman 1904), and it reflects the general tendency of characteristics to move together.

The second factor loads on two distinct sets of characteristics. The more positive loadings, in decreasing order, are for Respect, Open to criticism, Listening skills, and Teamwork. These characteristics capture a candidate's communication and interpersonal skills. By contrast, the more negative loadings are for Aggressive, Fast, Proactive, Holds people accountable, and Removes underperformers. These characteristics arguably reflect a candidate's execution ability. The second factor therefore sorts candidates into those with better interpersonal skills versus those with greater execution ability. Those with greater interpersonal skills have positive scores, and those with greater execution ability have negative scores.

The third factor has the most negative loadings for Enthusiasm, Persuasion, Aggressive, Proactive, and Fast. These characteristics appear to describe more charismatic candidates. By contrast, the most positive loadings are for Analytical skills, Attention to detail, Orga-

nization, and Brainpower, which describe candidates with more analytical personalities. The third factor can therefore be interpreted as sorting candidates into those with more charismatic personalities, who have negative scores on this factor, versus candidates with more analytical skills, who have positive scores on this factor.

Finally, the fourth factor has the most positive loadings for Strategic vision, Brainpower, Analytical skills, and Creative. These characteristics arguably describe candidates with more high-level and strategic perspectives. It has the more negative loadings on Holds people accountable, Efficiency, Attention to detail, and Organization, which are associated with more managerial and detail-oriented personalities. The fourth factor thus differentiates between candidates with a higher-level and strategic perspective, who have positive scores on this factor, versus those with a managerial and detail-oriented personality, who have negative scores.

Kaplan and Sorensen (2019) compare the scores for CEO and CFO candidates. CEO candidates score higher on the first factor (more general talent), more negatively on the second factor (more execution), more negatively on the third factor (more charismatic), and more positively on the fourth factor (more strategic). By contrast, the scores of CFO candidates tend to have the opposite signs. CFOs tend to score lower on the first factor (less general talent), higher on the second factor (more interpersonal), substantially higher on the third factor (more analytical), and lower on the fourth factor (more detail-oriented and managerial).

2.3 Overconfidence measures

Managerial overconfidence has traditionally been defined in two ways (Malmendier and Tate 2015; Bénabou and Tirole 2016): (a) as optimism, that is, overestimation of one's absolute performance (overestimation) or relative performance (overplacement) (e.g., Heaton 2002; Malmendier and Tate 2005a; Ben-David et al. 2013); and (b) as overprecision,

that is, excessive precision in one's beliefs (e.g., Hackbarth 2008; Ben-David et al. 2013).[10]

Because managerial overconfidence is difficult to measure directly outside of a survey setting (as in Ben-David et al. 2013; Graham et al. 2013), the literature has used several indirect measures. Overconfidence in terms of optimism—overestimation of the mean outcome—has been measured using the option-based approach (e.g., Malmendier and Tate 2005a,b, 2008), the earnings-forecast-based approach (e.g., Huang and Kisgen 2013; Otto 2014), and the press-based approach (e.g., Malmendier and Tate 2008; Hirshleifer et al. 2012).[11] The press-based approach requires an extensive search of media coverage for each individual executive. By contrast, the option-based measures use executives' option holdings data, and the earnings-forecast-based measures use firms' reported earnings and earnings guidance data, which are available for public firms. The option-based *Longholder* measure is probably the most widely used measure of overconfidence (Malmendier 2018).

For overprecision, Ben-David et al. (2013) use a quarterly survey of CFOs' forecasts of the S&P 500. Moreover, firms can specify a range forecast or a point estimate when disclosing their earnings guidance, and more confident CEOs might provide a narrower forecast range or a point estimate. Indeed, about two-thirds of firms provide a range forecast (e.g., Otto 2014), and Huang and Kisgen (2013) suggest that the width of this range reflects the confidence in the forecast.

2.3.1. Longholder measure

To relate the CEOs' assessed personalities to measures of overconfidence, we manually augment the assessment data with information about each candidate's subsequent career, using LinkedIn, Bloomberg, and other web searches. We identify 67 individuals who eventually become public company CEOs. Figure 1 shows the industries of the 78 firms that these candidates worked for. Most of the firms are in information technology, health care, consumer discretionary, and industrials.

[10] Moore and Healy (2008) reconciles these definitions of overconfidence.
[11] Malmendier (2018) discusses these measures in detail.

For the candidates identified as public company CEOs, we obtain their equity and option portfolio holdings from DEF 14A filings in the SEC EDGAR database, which enables us to compute the *Longholder* measure from Malmendier and Tate (2015). *Longholder* is an indicator that equals 1 for CEOs who hold an option to the last year before expiration, provided it was at least 40% in-the-money entering the final year. Nine of the 67 CEOs (13%) are *Longholders*.

2.3.2. Measures based on earnings guidance

We collect earnings (EPS) forecasts and realizations from IBES. Our sample contains 31 CEOs with multiple quarters per CEO, providing a total of 216 CEO-quarter observations. We create two additional measures of overconfidence from these observations. As in Otto (2014), we create an indicator variable, *High Forecast*, that equals 1 when a firm's EPS forecast exceeds realized EPS. If a firm provides an EPS range forecast rather than a point estimate, *High Forecast* equals 1 if the lower bound of the range exceeds the realized EPS. *High Forecast* therefore provides a measure of a CEO being optimistic about earnings.

We also follow Huang and Kisgen (2013) and create another indicator, called *Point Estimate*, that equals 1 when a firm provides a point EPS forecast, and equals 0 when it provides a range EPS forecast.

2.4 Endogeneity of longholders

A concern is that *Longholder* firms and *Longholder* CEOs are endogenously matched, and that differences between *Longholder* and other CEOs may partly be due to differences in their firms rather than differences in their overconfidence. In Table 1, we compare firm characteristics of *Longholder* and non-*Longholder* firms. The table shows that the two sets of firms do not differ statistically on firm characteristics—including market value, sales, ROA, Q, investment, and leverage.

The only exception is that *Longholder* CEOs hold a greater fraction of equity in their

firms both in stock and vested options, consistent with the interpretation that *Longholder* reflects overconfidence. Indeed, the model in Gervais et al. (2011) shows that an overconfident manager is more likely to accept a highly convex compensation contract because the manager is more likely to overvalue it. Humphery-Jenner et al. (2016) provide supportive empirical evidence by finding that overconfident CEOs are more likely to receive incentive-based pay that relies on stock options.

Another concern is whether non-*Longholder* CEOs actually have an opportunity to exercise in-the-money options and choose not to do so. The *Longholder* measure would be noisier if the options of CEOs classified as non-*Longholder* were never actually in-the-money. Accordingly, Table 2 reports the vested options and their average moneyness for both groups of CEOs. *Longholder* CEOs have less vested option holdings, in terms of both their Black-Scholes and intrinsic values. However, the average moneyness of non-*Longholders* options is not statistically different from that of *Longholders*, even for the vested options that are at least 40% in-the-money. Hence, non-*Longholders* did have a chance to become *Longholders*. Moreover, the dollar value of option tranches that *Longholders* hold for too long is not negligible. For the vested options at least 40% in-the-money in the last year before expiration, the mean (median) Black-Scholes values is \$1.29 (\$1.15) million and the intrinsic value is \$2.08 (\$1.24) million.

3. Individual characteristics

In this section, we consider how the *Longholder* measure and other measures of overconfidence relate to individual characteristics and aspects of personalities. Table 3 compares ratings on the characteristics for *Longholder* and non-*Longholder* CEOs. We see that *Longholder* is negatively related to most of the specific characteristics. The differences are significant for having a strong network, being organized, calm under pressure, moving fast, sticking to commitments, having strong analytical skills, being creative, having a strong work ethic, good listening skills, and being open to criticism. *Longholder* CEOs therefore

exhibit these characteristics to a lesser extent than non-*Longholder* CEOs.

3.1 Characteristics and behavior of overconfident individuals

An extensive psychology literature examines the typical characteristics and behavior of overconfident individuals. Below, we review this literature. Appendix A lists the expected relations between overconfidence and the specific characteristics in our assessments.

Overconfident individuals tend to search too little for ideas and information (Haran et al. 2013; Moore et al. 2015). They have more "constrained" social networks that are smaller and more interconnected with weaker connections to outsiders (Burt 1997; Klayman et al. 1999; Hayward et al. 2006; Gudmundsson and Lechner 2013), which can reinforce overconfident leaders being less likely to see flaws and having inflated expectations of positive outcomes (Shipman and Mumford 2011). Consistent with this literature, we find that overconfident CEOs are less likely to have a strong network.

Overconfident individuals also tend to be less organized, to plan less, and to be less likely to stick to commitments. Their limited ability to see deficiencies and to expect positive outcomes can lead to less time and effort invested in learning and planning (Shipman and Mumford 2011). Indeed, Vancouver and Kendall (2006) find that high self-efficacy—one's belief in his or her capacity to perform—has a negative effect on preparation. Similar negative effects of overconfidence on organization and planning are also found elsewhere (Larwood and Whittaker 1977; Vallone et al. 1990). For instance, Larwood and Whittaker (1977) find that the general belief among managers that their own firms would possess unusually high growth rates led to overly optimistic planning. Our findings are consistent with this literature.

Despite overly optimistic planning, overconfident individuals score high on social potency, which includes being forceful and decisive, and low on stress reaction (Burks et al. 2013). This finding suggests that overconfident CEOs should score high on being calm under pressure and moving fast. We do not find these positive associations.

Overconfident individuals tend to rank lower on analytical skills and cognitive ability. Pallier et al. (2002) suggest that higher intelligence is associated with less overconfidence. Supporting this result, Chapman et al. (2018) find a negative correlation between IQ (and cognitive ability) and overconfidence; and Stango et al. (2017) find a positive correlation with math biases, such as non-belief in the law of large numbers (Benjamin et al. 2013), gambler's fallacy/hot-hand fallacy (Benjamin et al. 2013), exponential-growth bias (Stango and Zinman 2009; Banks and Oldfield 2007), and overconfidence. Consistent with this literature, we find overconfident CEOs rank lower on analytical skills.

Although overconfidence is found to be negatively correlated with analytical skills and cognitive ability, the evidence for creativity (Hirshleifer et al. 2012; Stock et al. 2019) and a strong work ethic (Bénabou and Tirole 2002; Heidhues et al. 2018) is mixed. Overconfidence has been found to be related to proactiveness (Pallier et al. 2002) and extraversion (Schaefer et al. 2004). These traits are arguably related to enthusiasm and optimistic expectations. In studying entrepreneurship, Hayward et al. (2006) argue that greater overconfidence provides venture founders with the bravado to persist. Indeed, overconfident individuals with high self-esteem tend to persist for too long even when this persistence is not productive (McFarlin et al. 1984). This persistence can be supported by working harder. For instance, theoretical work on overconfidence has emphasized that if ability and effort are complements, overconfidence can lead to higher effort (Bénabou and Tirole 2002; Gervais et al. 2011). By contrast, a model by Heidhues et al. (2018) suggests that if the complementarity between ability and effort is low or ability and effort have separable effects, overconfidence can lead to lower effort. We find a negative association for both creativity and work ethic.

The literature has also found robust evidence for overconfidence being negatively related to listening skills and being open to criticism. Overconfident individuals tend to underinvest in information acquisition, such as seeking advice, and often blame failures on uncontrollable factors (Meikle et al. 2016). Moreover, a feeling of power leads them to discount advice and exacerbates the feelings of higher optimism, control, and over-

confidence (Tost et al. 2012). To the extent that research findings for narcissism apply to overconfidence,[12] these individuals dismiss advice because they think others are incompetent and because they fail to reduce their self-enhancement when expecting to be assessed (Kausel et al. 2015; Littrell et al. 2019). Consistent with this literature, we find a negative relation between overconfidence and listening skills.

3.2 Earnings forecasts and individual characteristics

Table 4 reports regression results of the two EPS-based measures of overconfidence against the specific characteristics. Because this sample contains several quarterly observations for each CEO, we cluster standard errors by CEO. Similar to *Longholder*, *High Forecast* is negatively related to most of the individual characteristics and significantly so to several of them. Sticking to commitments, brainpower, and being creative are significantly negative for both *Longholder* and *High Forecast*, consistent with Larwood and Whittaker (1977), Vallone et al. (1990), Stango et al. (2017), Chapman et al. (2018), and Stock et al. (2019).

Unlike *Longholder*, *Point Estimate* is sometimes positively and negatively related to the individual characteristics.

Overall, this evidence suggests that the notion of overconfidence that is captured by *Longholder* is closer to that of *High Forecast*. They both appear to differ markedly from the overprecision captured by *Point Estimate*.

4. Overconfidence and general ability

As mentioned earlier, Kaplan and Sorensen (2019) show that the variation in the specific characteristics can be summarized by four factors. Table 5 reports the means and distributions for the four factors for all CEOs, and for non-*Longholder* and *Longholder* CEOs. Table 6 reports the correlations between *Longholder* and the four factors.

[12]For example, see Campbell et al. (2004), Shipman and Mumford (2011), Macenczak et al. (2016), and Littrell et al. (2019).

Both in univariate and multivariate regressions, *Longholder* is negatively related to all four factors, but is significantly negatively correlated with only the first factor. The first factor has positive loadings on all specific characteristics. Kaplan et al. (2012) interpret it as a measure of general talent or ability. They also find that it is correlated with subsequent CEO success.

Interestingly, this finding that overconfident CEOs (as measured by *Longholder*) have lower general ability is consistent with the well-known Dunning-Kruger effect in psychology. Kruger and Dunning (1999) document that less competent people tend to overestimate their abilities more than those who are more skilled.[13] The stronger overestimation by less competent people can occur because their lack of competence deprives them of the metacognitive ability to realize they make mistakes. As Kruger and Dunning (1999) write, "When people are incompetent in the strategies they adopt to achieve success and satisfaction, they suffer a dual burden: Not only do they reach erroneous conclusions and make unfortunate choices, but their incompetence robs them of the ability to realize it" (p. 1121). This positive relation between overconfidence and the lack of skill persists even when people receive accurate feedback on their performance (Simons 2013) and are held accountable for their self-assessments (Ehrlinger et al. 2008). The Dunning-Kruger effect has been found not only among students and laymen, but also among professionals with specialized knowledge. For instance, high-performing medical doctors significantly underestimate their performance, whereas low-performing medical doctors significantly overestimate their performance (Hodges et al. 2001; Davis et al. 2006; Mehdizadeh et al. 2014). Our results suggest that this effect holds for CEOs as well.

In Table 7, *High Forecast*, like *Longholder*, is significantly negatively related to Factor 1 both in univariate and multivariate regressions, suggesting, again, that overconfidence is related to lower overall ability (Kruger and Dunning 1999). *High Forecast* is significantly negatively related to Factor 3 (positively related to charisma), but this relation is

[13] Dunning (2011) reviews research on the Dunning-Kruger effect.

insignificant in a multivariate regression. In the multivariate regression, *High Forecast* is marginally significantly related to Factor 2 (lower execution skills) and Factor 4 (greater creative / strategic). The result for Factor 2 is consistent with overconfidence being related to lower execution ability.

5. Investment-cash flow sensitivities

The relationships we document between managerial overconfidence—as captured by *Longholder* and *High Forecast*—and executive characteristics are consistent with two different interpretations of the empirically documented behavior of *Longholder* CEOs. *Longholder* is related to variables that are associated with overconfidence, and it may capture behavior of overconfident CEOs, as it is typically interpreted. At the same time, *Longholder* and overconfidence are also related to lower general ability, so *Longholder* may also capture behavior of less able CEOs.

Although our limited data make this part of our analysis somewhat tentative and suggestive, we try to distinguish between these two interpretations by revisiting the empirical findings on investment-cash flow sensitivities from Malmendier and Tate (2005a) and Malmendier and Tate (2015). Following their analyses, we collect information about investment and cash flow, along with a number of other accounting variables, for the public firms with CEOs in our sample. Descriptive statistics for these variables are in Table 8. Table 9 reports the estimates of the investment-cash flow regression (used in the Malmendier and Tate papers) for our sample.

The first column of Table 9 shows that, despite the small sample, we replicate the main *Longholder* results, and we confirm that investments in companies with *Longholder* CEOs are significantly more sensitive to their cash flows, although the significance is only at the 10% level. In the second column of Table 9, we see that investments are less sensitive to cash flows when CEOs have greater general talent (higher Factor 1), which suggests that investments are more sensitive to cash flow when CEOs have less general talent and

ability. Columns three to five in Table 9 estimate the investment-cash flow sensitivities for the remaining three factors individually. Interestingly, the results indicate that the investment-cash flow sensitivities are also greater for firms with more analytical CEOs (positive Factor 3) and with more operational and managerial CEOs (negative Factor 4).

In the multivariate specification, only the third factor remains statistically significant. Importantly, however, the coefficient for *Longholder* also remains significant even when the other factors are included. This result suggests that the empirical effect of *Longholder* is not merely an artifact of this variable being related to other aspects of managerial personalities, as captured by the four factors, but that *Longholder* captures a distinct aspect of individual overconfidence as it is usually interpreted in the literature.

6. Conclusion

We use detailed assessments of CEOs to explore the nature of *Longholder*, the option-based measure of CEO overconfidence introduced by Malmendier and Tate (2005a) and now commonly used in the corporate finance and economics literatures. We document a pattern of correlations between the *Longholder* measure and individual characteristics that prior literature has found to be related to overconfidence. *Longholder* CEOs are less likely to have strong networks (e.g., Burt 1997; Klayman et al. 1999; Hayward et al. 2006). They are less likely to be well organized and to honor commitments (e.g., Larwood and Whittaker 1977; Vallone et al. 1990). They tend to have lower analytical skills and cognitive ability (e.g., Stango et al. 2017; Chapman et al. 2018), and tend not to be good listeners or feedback seekers (e.g., Tost et al. 2012; Meikle et al. 2016). Finally, *Longholder* and a measure of overconfidence based on high earnings forecasts are negatively related to overall CEO ability/talent; that is, less talented CEOs appear to be more overconfident (Kruger and Dunning 1999).

These results provide solid evidence that *Longholder* measures a quality that is related to overconfidence and adds to our understanding of the nature of that overconfidence.

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A. Individual characteristics and overconfidence

This table summarizes predictions for individual ghSMART characteristics and overconfidence discussed in section 3. Individual characteristics are from Table A-1 in Kaplan and Sorensen (2019).

Characteristics	Description	Predicted association with overconfidence	References for the association
Leadership			
Hires A players	Sources, recruits, and hires A players.	Negative	Haran et al. (2013), Moore et al. (2015)
Develops people	Coaches people in their current roles to improve performance, and prepares them for future roles.	Negative	Haran et al. (2013), Moore et al. (2015)
Removes underperformers	Removes C players within 180 days. Achieves this through coaching-out, re-deployment, demotion, or termination.	Negative	Haran et al. (2013), Moore et al. (2015)
Respect	Values others, treating them fairly and showing concern for their views and feelings.	Negative	Schaefer et al. (2004), Macenczak et al. (2016)
Efficiency	Able to produce significant output with minimal wasted effort.	Negative	Shipman and Mumford (2011), Haran et al. (2013), Moore et al. (2015)
Network	Possesses a large network of talented people.	Negative	Burt (1997), Klayman et al. (1999), Hayward et al. (2006), Gudmundsson and Lechner (2013)
Flexible	Adjusts quickly to changing priorities and conditions. Copes with complexity and change.	Negative	Haran et al. (2013), Moore et al. (2015)
Personal			
Integrity	Does not cut corners ethically. Earns trust and maintains confidences.	Negative	Schrand and Zechman (2012), O'Reilly III et al. (2018), O'Reilly III and Doerr (2020)
Organization	Plans, organizes, schedules, and budgets in an efficient, productive manner.	Negative	Larwood and Whittaker (1977), Vallone et al. (1990), Shipman and Mumford (2011), Vancouver and Kendall (2006)
Calm	Maintains stable performance when under heavy pressure or stress.	Positive	Burks et al. (2013)

Aggressive	Moves quickly and takes a forceful stand without being overly abrasive.	Positive	Vallone et al. (1990), Burks et al. (2013)
Fast	Takes action quickly without getting bogged down by obstacles.	Positive	Vallone et al. (1990), Burks et al. (2013)
Commitments	Lives up to verbal and written agreements, regardless of personal cost.	Negative	Larwood and Whittaker (1977), Vallone et al. (1990), Shipman and Mumford (2011), Vancouver and Kendall (2006)
Intellectual			
Brainpower	Learns quickly. Demonstrates ability to quickly understand and absorb new info.	Negative	Pallier et al. (2002), Chapman et al. (2018)
Analytical skills	Structures and processes qualitative or quantitative data and draws conclusions.	Negative	Stango et al. (2017)
Strategic vision	Able to see and communicate the big picture in an inspiring way.	Positive	Shipman and Mumford (2011)
Creative	Generates new and innovative approaches to problems.	Ambiguous	Hirshleifer et al. (2012), Tang et al. (2015), Stock et al. (2019)
Attention to detail	Does not let important details slip through the cracks or derail a project.	Negative	Shipman and Mumford (2011)
Motivational			
Enthusiasm	Exhibits passion and excitement over work. Has a "can do" attitude.	Positive	Schaefer et al. (2004)
Persistence	Demonstrates tenacity and willingness to go the distance to get something done.	Positive	McFarlin et al. (1984), Hayward et al. (2006)
Proactive	Acts without being told what to do. Brings new ideas to company.	Positive	Pallier et al. (2002)
Work ethic	Possesses a strong willingness to work hard and long hours to get the job done.	Ambiguous	Bénabou and Tirole (2002), Gervais et al. (2011), Heidhues et al. (2018)
High standards	Expects personal performance and team performance to be the best.	Positive	Shipman and Mumford (2011)
Interpersonal			
Listening skills	Lets others speak and seeks to understand their viewpoints.	Negative	Meikle et al. (2016), Tost et al. (2012), Kausel et al. (2015), Littrell et al. (2019)
Open to criticism	Often solicits feedback and reacts calmly to receiving criticism.	Negative	Meikle et al. (2016), Tost et al. (2012), Kausel et al. (2015), Littrell et al. (2019)
Written communication	Writes clearly and articulately using correct grammar.	Not considered	

Oral communication	Speaks clearly and articulately without being overly verbose or talkative.	Not considered	
Teamwork	Reaches out to peers and cooperates with supervisors to establish relationship.	Ambiguous	Yin et al. (2019)
Persuasion	Able to convince others to pursue a course of action.	Positive	Shipman and Mumford (2011), Smith et al. (2017), Schwardmann and Van der Weele (2019), Solda et al. (2019)
Holds people accountable	Sets goals for team and follows up to ensure progress toward completion.	Positive	Shipman and Mumford (2011)

B. Kaplan and Sorensen (2019) factor loadings

This appendix shows Table 5 (Panel A) from Kaplan and Sorensen (2019) with factor loadings for the first four factors. Loadings with an absolute value less than 0.15 are left blank.

	Factor 1	Factor 2	Factor 3	Factor 4
Hires A Players	0.59			
Develops People	0.56	0.25		
Removes Underperformers	0.53	-0.17		-0.22
Respect	0.31	0.73		
Efficiency	0.71			-0.22
Network	0.64			
Flexible	0.54	0.38		
Integrity	0.30	0.31		
Organization	0.50		0.44	-0.23
Calm	0.44	0.33		
Aggressive	0.68	-0.43	-0.26	
Fast	0.69	-0.37	-0.18	
Commitments	0.70			-0.21
Brainpower	0.52		0.33	0.43
Analytical Skills	0.54		0.56	0.25
Strategic Vision	0.58	-0.16		0.46
Creative	0.52			0.39
Attention to Detail	0.40		0.46	-0.27
Enthusiasm	0.55	0.24	-0.44	
Persistence	0.66	-0.16		
Proactive	0.74	-0.26	-0.20	
Work Ethic	0.57			
High Standards	0.73	-0.17		
Listening Skill	0.39	0.62		
Open to Criticism	0.41	0.65		
Oral Communication	0.49	0.16	-0.16	0.19
Teamwork	0.48	0.61		
Persuasion	0.60		-0.37	0.18
Holds People Accountable	0.66	-0.21		-0.27

Figure 1: **Distribution across industries**

This figure depicts the distribution of 78 firms by industrial sectors according to the Global Industry Classification Standard (GICS) by MSCI.

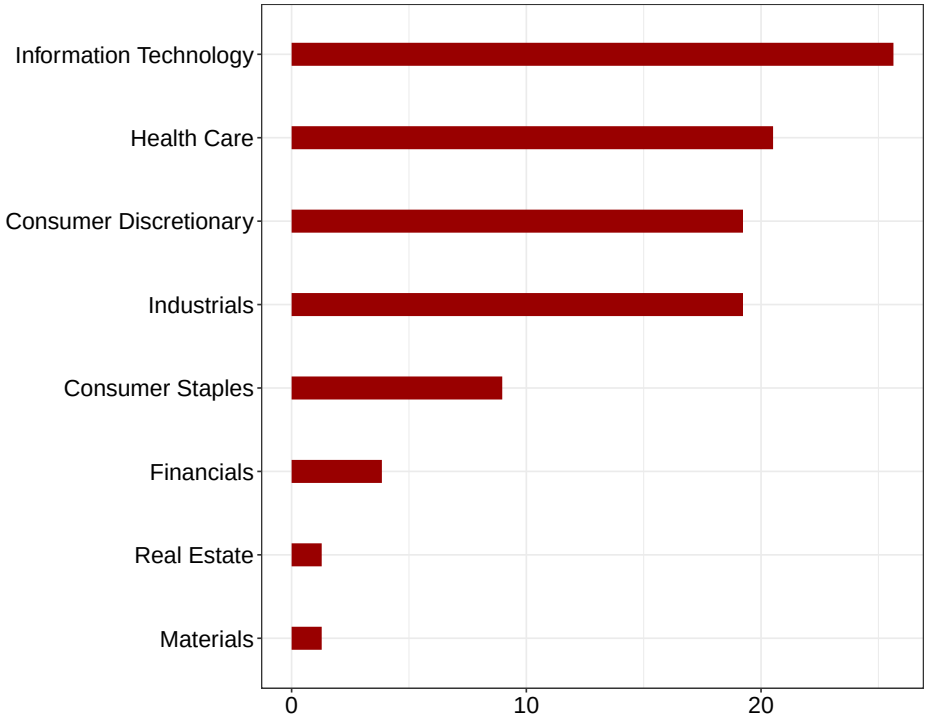

Table 1:
Firm characteristics

This table presents descriptive statistics for firm characteristics. The sample is based on ghSMART, Equilar, CRSP, Compustat, and form DEF14A filings from the SEC EDGAR database. The sample covers the period from 2001 to 2016. Firm characteristics are from Compustat. Compustat data codes are in parentheses. *Longholder* is an indicator variable equal to 1 if the CEO held an option to the last year before expiration, provided it was at least 40% in-the-money entering the final year as in Malmendier and Tate (2015). *Market value ($bn)* is computed as the product of common shares outstanding (CSHO) and fiscal-year closing price (PRCC_F). *Assets ($bn)* is total assets (AT). *Sales ($bn)* is sales (SALE). *ROA* is computed as operating income before depreciation (OIBDP) divided by lagged total assets (AT). *Return, 12-month* is the annual return from CRSP. *Q* is Tobin's Q defined as the market value of assets divided by total assets (AT). The market value of assets is defined as the book value of assets (AT) plus market value minus the book value of equity. The book value of equity is defined as stockholders' equity (SEQ or, if missing, CEQ + PSTK, or, if missing, AT - LT) minus preferred stock (PSTKL or, if missing, PSTKRV, or, if missing, PSTK) plus deferred taxes and investment tax credit (TXDITC or, if missing, 0). *Investment* is capital expenditures (CAPX) divided by the lag of net property plants and equipment (PPENT). *Leverage* is computed as the total debt (DD1 + DLTT) divided by total assetes (AT). *Volatility, 12-month* is the annualized volatility of returns from CRSP. *Stock ownership (%)* is the percentage of company stock held by a CEO. *Vested options (%)* is the percentage of vested options held by a CEO as the number of common shares outstanding. The t-test is for the difference in means between *Longholder* and non-*Longholder* executives calculated using robust standard errors clustered by executive. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Full Sample				Longholder = 0				Longholder = 1				
	Obs.	Mean	Median	Std.Dev	Obs.	Mean	Median	Std.Dev	Obs.	Mean	Median	Std.Dev	t-test
Market value ($bn)	362	2.229	0.869	3.547	284	2.246	0.903	3.491	78	2.168	0.760	3.767	-0.072
Assets ($bn)	398	3.758	0.682	8.519	317	4.025	0.606	9.156	81	2.711	0.816	5.254	-0.580
Sales ($bn)	388	2.431	0.555	5.540	307	2.738	0.591	6.091	81	1.269	0.481	2.195	-1.381
ROA	382	0.057	0.109	0.295	303	0.037	0.107	0.318	79	0.132	0.119	0.167	1.573
Return, 12-month	330	0.210	0.117	0.665	257	0.183	0.111	0.644	73	0.305	0.190	0.731	1.605
Q	362	2.069	1.622	1.270	284	2.064	1.657	1.261	78	2.086	1.545	1.307	0.058
Investment	393	0.359	0.237	0.365	314	0.356	0.249	0.349	79	0.369	0.176	0.427	0.118
Leverage	398	0.223	0.163	0.229	317	0.214	0.139	0.230	81	0.261	0.245	0.224	0.747
Volatility, 12-month	330	0.486	0.410	0.258	257	0.487	0.411	0.261	73	0.484	0.407	0.248	-0.046
Stock ownership (%)	353	2.373	0.301	6.102	275	0.989	0.248	2.931	78	7.250	0.581	10.427	2.003**
Vested options (%)	354	0.678	0.291	0.904	276	0.524	0.241	0.768	78	1.221	0.993	1.121	2.223**

Table 2:
Vested options

This table presents descriptive statistics for vested option holdings. The sample is based on ghSMART, Equilar, CRSP, and form DEF14A filings from the SEC EDGAR database. Each observation corresponds to a vested option tranche as reported annually in DEF14A. *Longholder* is an indicator variable equal to 1 if the CEO held an option to the last year before expiration, provided it was at least 40% in-the-money entering the final year as in Malmendier and Tate (2015). *Black-Scholes value ($mn)* is the Black-Scholes value of an option tranche at the end of the fiscal year. *Intrinsic value ($mn)* is the intrinsic value of an option tranche at the end of the fiscal year. *Moneyness* is option tranche moneyness computed as the difference between the stock price and the exercise price scaled by the exercise price at the end of the fiscal year. The t-test is for the difference in means between *Longholder* and non-*Longholder* executives calculated using robust standard errors clustered by executive. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Full Sample				Longholder = 0				Longholder = 1				
	Obs.	Mean	Median	Std.Dev	Obs.	Mean	Median	Std.Dev	Obs.	Mean	Median	Std.Dev	t-test
Vested options													
Black-Scholes value ($mn)	290	2.589	1.021	5.563	115	4.578	1.213	8.274	175	1.281	1.016	1.490	-1.716*
Intrinsic value ($mn)	411	2.208	0.606	4.913	141	3.740	0.178	7.773	270	1.408	0.754	1.863	-1.358
Moneyness	411	8.665	1.370	25.841	141	4.608	0.576	17.869	270	10.784	1.497	28.956	0.863
Vested options, in-the-money													
Black-Scholes value ($mn)	240	3.103	1.253	5.990	92	5.699	2.216	8.911	148	1.488	1.159	1.531	-1.810*
Intrinsic value ($mn)	328	2.767	1.160	5.359	94	5.610	2.134	8.964	234	1.625	1.125	1.912	-1.720*
Moneyness	328	11.000	1.854	28.463	94	7.223	1.760	21.445	234	12.517	1.854	30.747	0.623
Vested options, at least 40% in-the-money													
Black-Scholes value ($mn)	219	3.367	1.384	6.207	77	6.730	2.611	9.404	142	1.544	1.198	1.539	-2.036**
Intrinsic value ($mn)	305	2.963	1.188	5.507	77	6.804	2.589	9.504	228	1.666	1.147	1.920	-1.985**
Moneyness	305	11.814	1.961	29.359	77	8.765	2.896	23.440	228	12.844	1.928	31.083	0.450
Vested options, at least 40% in-the-money in the last year before expiration													
Black-Scholes value ($mn)	12	1.294	1.147	0.943	0				12	1.294	1.147	0.943	
Intrinsic value ($mn)	16	2.075	1.235	2.078	0				16	2.075	1.235	2.078	
Moneyness	16	7.487	1.201	10.751	0				16	7.487	1.201	10.751	

Table 3:
Individual characteristics

This table presents descriptive statistics for CEO traits. The sample is based on ghSMART, Equilar, CRSP, and form DEF14A filings from the SEC EDGAR database. *Longholder* is an indicator variable equal to 1 if the CEO held an option to the last year before expiration, provided it was at least 40% in-the-money entering the final year as in Malmendier and Tate (2015). The ghSMART characteristics are defined in Kaplan and Sorensen (2019), Table A-1. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively, under the assumption of a single test.

	Full Sample				Longholder = 0				Longholder = 1				
	Obs.	Mean	Median	Std.Dev	Obs.	Mean	Median	Std.Dev	Obs.	Mean	Median	Std.Dev	t-test
Hires A players	67	3.405	3.300	0.442	58	3.415	3.300	0.445	9	3.344	3.300	0.445	-0.441
Develops people	67	3.358	3.300	0.445	58	3.357	3.300	0.456	9	3.367	3.300	0.391	0.061
Removes underperformers	66	3.330	3.300	0.547	57	3.354	3.300	0.554	9	3.178	3.300	0.507	-0.894
Respect	67	3.602	3.700	0.420	58	3.613	3.700	0.423	9	3.533	3.700	0.418	-0.526
Efficiency	64	3.695	3.700	0.402	55	3.723	3.850	0.386	9	3.522	3.700	0.474	-1.398
Network	65	3.578	3.700	0.475	56	3.642	3.700	0.420	9	3.178	3.300	0.620	-2.870***
Flexibile	65	3.540	3.700	0.419	56	3.568	3.700	0.415	9	3.367	3.300	0.427	-1.346
Integrity	67	3.914	4.000	0.227	58	3.918	4.000	0.209	9	3.889	4.000	0.333	-0.361
Organization	65	3.564	3.700	0.445	56	3.624	3.700	0.398	9	3.189	3.300	0.560	-2.871***
Calm	67	3.656	3.700	0.388	58	3.696	3.775	0.373	9	3.400	3.300	0.406	-2.189**
Aggressive	65	3.745	4.000	0.339	56	3.763	4.000	0.324	9	3.633	3.700	0.427	-1.070
Fast	65	3.684	3.850	0.409	56	3.727	4.000	0.386	9	3.411	3.300	0.465	-2.221**
Commitments	67	3.850	4.000	0.276	58	3.889	4.000	0.208	9	3.600	3.700	0.490	-3.107***
Brainpower	66	3.716	3.700	0.354	57	3.746	3.700	0.315	9	3.522	3.700	0.526	-1.794*
Analytical skills	67	3.615	3.700	0.380	58	3.661	3.700	0.332	9	3.322	3.300	0.538	-2.597**
Strategic vision	66	3.505	3.700	0.419	57	3.542	3.700	0.395	9	3.267	3.000	0.515	-1.866*
Creative	67	3.590	3.700	0.431	58	3.629	3.700	0.384	9	3.333	3.300	0.628	-1.957*
Attention to detail	65	3.496	3.700	0.477	56	3.533	3.700	0.457	9	3.267	3.300	0.559	-1.573
Enthusiasm	67	3.545	3.700	0.494	58	3.560	3.700	0.503	9	3.444	3.300	0.442	-0.653
Persistent	67	3.813	4.000	0.329	58	3.824	4.000	0.325	9	3.744	4.000	0.368	-0.673
Proactive	67	3.792	4.000	0.376	58	3.816	4.000	0.350	9	3.633	4.000	0.507	-1.369
Work ethic	67	3.928	4.000	0.226	58	3.954	4.000	0.170	9	3.756	4.000	0.422	-2.551**
High standards	67	3.747	4.000	0.391	58	3.747	4.000	0.398	9	3.744	4.000	0.368	-0.021
Listening skills	65	3.447	3.300	0.472	56	3.508	3.700	0.448	9	3.067	3.000	0.464	-2.731***
Open to criticism	67	3.411	3.300	0.479	58	3.454	3.300	0.462	9	3.133	3.300	0.524	-1.905*
Teamwork	67	3.605	3.700	0.388	58	3.635	3.700	0.370	9	3.411	3.300	0.465	-1.636
Persuasion	65	3.543	3.700	0.425	56	3.571	3.700	0.409	9	3.367	3.300	0.502	-1.351
Holds people accountable	65	3.631	3.700	0.404	56	3.648	3.700	0.394	9	3.522	3.700	0.474	-0.866

Table 4:
Individual characteristics and EPS forecasts

Each entry presents a linear regression of the CEO overconfidence measure—*Longholder*, *High Forecast*, or *Point Estimate*—on the specified characteristic. We present regression results for *Longholder* for comparability. *High Forecast* is an indicator variable that equals 1 when a firm's EPS forecat exceeds the realized EPS as in Otto (2014). If a firm provides an EPS range forecast, this indicator variable is 1 when the lower bound of the range exceeds the realized EPS. *Point Estimate* is an indicator variable that equals 1 when a firm provides a point EPS forecast, and 0 when it provides a range EPS forecast. EPS forecasts and realizations are from IBES. Beta is the coefficient on the characteristic. The p-value is the statistical significance of this coefficient calculated using robust standard errors clustered by executive. The number of observations in each regression is indicated in square brackets. The ghSMART characteristics are defined in Kaplan and Sorensen (2019), Table A-1. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively, under the assumption of a single test.

	Longholder			High Forecast			Point Estimate		
	Beta	Obs	p-val	Beta	Obs	p-val	Beta	Obs	p-val
Hires A players	−0.042	[67]	0.661	−0.093	[216]	0.072*	−0.021	[216]	0.788
Develops people	0.006	[67]	0.952	−0.043	[212]	0.447	−0.051	[212]	0.614
Removes underperformers	−0.070	[66]	0.375	−0.115	[216]	0.004***	0.057	[216]	0.416
Respect	−0.053	[67]	0.600	0.004	[212]	0.935	−0.057	[212]	0.384
Efficiency	−0.152	[64]	0.167	−0.220	[216]	0.000***	0.054	[216]	0.594
Network	−0.249	[65]	0.006***	−0.058	[216]	0.397	0.104	[216]	0.378
Flexibile	−0.139	[65]	0.183	−0.058	[216]	0.188	−0.006	[216]	0.927
Integrity	−0.068	[67]	0.719	−0.122	[216]	0.464	−0.087	[216]	0.575
Organization	−0.266	[65]	0.006***	−0.080	[216]	0.133	−0.073	[216]	0.496
Calm	−0.232	[67]	0.032**	−0.010	[216]	0.896	0.068	[216]	0.411
Aggressive	−0.137	[65]	0.289	−0.159	[216]	0.121	0.064	[216]	0.640
Fast	−0.230	[65]	0.030**	−0.037	[216]	0.632	0.262	[216]	0.002***
Commitments	−0.448	[67]	0.003***	−0.327	[216]	0.065*	0.224	[216]	0.240
Brainpower	−0.213	[66]	0.078*	−0.240	[216]	0.000***	−0.038	[216]	0.784
Analytical skills	−0.277	[67]	0.012**	−0.094	[216]	0.340	0.006	[216]	0.970
Strategic vision	−0.187	[66]	0.067*	−0.035	[216]	0.566	0.186	[216]	0.033**
Creative	−0.188	[67]	0.055*	−0.251	[216]	0.006***	−0.129	[216]	0.387
Attention to detail	−0.142	[65]	0.121	−0.192	[216]	0.000***	−0.057	[216]	0.618
Enthusiasm	−0.056	[67]	0.516	0.006	[212]	0.932	0.064	[212]	0.485
Persistent	−0.087	[67]	0.504	−0.291	[216]	0.010***	−0.050	[216]	0.707
Proactive	−0.153	[67]	0.176	−0.347	[216]	0.000***	−0.190	[216]	0.288
Work ethic	−0.458	[67]	0.013**	−0.503	[216]	0.154	0.317	[216]	0.043**
High standards	−0.002	[67]	0.983	−0.571	[216]	0.000***	−0.388	[216]	0.059*
Listening skills	−0.240	[65]	0.008***	0.018	[212]	0.658	0.010	[212]	0.873
Open to criticism	−0.165	[67]	0.061*	0.005	[216]	0.918	−0.012	[216]	0.863
Teamwork	−0.176	[67]	0.107	0.005	[216]	0.938	0.027	[216]	0.761
Persuasion	−0.138	[65]	0.181	−0.027	[216]	0.756	0.163	[216]	0.106
Holds people accountable	−0.093	[65]	0.390	−0.231	[212]	0.001***	−0.221	[212]	0.073*

Table 5:
Kaplan and Sorensen (2019) factors

This table presents descriptive statistics for Kaplan and Sorensen (2019) factors for CEOs. The sample is based on ghSMART, Equilar, CRSP, and form DEF14A filings from the SEC EDGAR database. *Longholder* is an indicator variable equal to 1 if the CEO held an option to the last year before expiration, provided it was at least 40% in-the-money entering the final year as in Malmendier and Tate (2015). *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Full Sample				Longholder = 0				Longholder = 1				
	Obs.	Mean	Median	Std.Dev	Obs.	Mean	Median	Std.Dev	Obs.	Mean	Median	Std.Dev	t-test
Factor 1	64	0.417	0.618	0.824	55	0.523	0.633	0.682	9	-0.229	-0.247	1.290	-2.655**
Factor 2	64	-0.143	-0.082	0.790	55	-0.103	0.014	0.806	9	-0.389	-0.331	0.670	-1.005
Factor 3	64	-0.016	0.156	0.746	55	0.030	0.168	0.732	9	-0.296	-0.155	0.810	-1.219
Factor 4	64	0.049	0.143	0.783	55	0.085	0.175	0.821	9	-0.171	-0.229	0.466	-0.910

Table 6:
CEO overconfidence and Kaplan and Sorensen (2019) factors

This table reports estimates of the linear regressions of CEO overconfidence on Kaplan and Sorensen (2019) factors. The variables are defined in Table 3. Robust standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Longholder				
	(1)	(2)	(3)	(4)	(5)
Factor 1	−0.136**				−0.125**
	(0.051)				(0.052)
Factor 2		−0.056			−0.043
		(0.056)			(0.054)
Factor 3			−0.072		−0.054
			(0.059)		(0.057)
Factor 4				−0.051	−0.051
				(0.056)	(0.054)
R^2	0.102	0.016	0.023	0.013	0.137
Obs.	64	64	64	64	64

Table 7:
Forecasting EPS and Kaplan and Sorensen (2019) factors

This table reports estimates of the linear regressions of CEO forecasting EPS behavior on Kaplan and Sorensen (2019) factors. The variables are defined in Table 4. Robust standard errors clustered by executive are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	High Forecast					Point Estimate				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Factor 1	−0.137***				−0.129***	0.025				0.051
	(0.039)				(0.047)	(0.062)				(0.059)
Factor 2		0.027			0.059*		−0.012			0.035
		(0.027)			(0.032)		(0.036)			(0.039)
Factor 3			−0.056**		−0.023			−0.061		−0.056
			(0.028)		(0.025)			(0.047)		(0.043)
Factor 4				0.059	0.117*				0.168**	0.229**
				(0.056)	(0.065)				(0.076)	(0.097)
R^2	0.062	0.007	0.014	0.006	0.090	0.002	0.001	0.018	0.050	0.084
Obs.	212	212	212	212	212	212	212	212	212	212

Table 8:
Summary statistics for investment sensitivity analyses

This table presents descriptive statistics for the investment-cash flow sensitivity analyses. The sample is based on ghSMART, Equilar, CRSP, Compustat, and form DEF14A filings from SEC EDGAR database. The sample covers the period from 2001 to 2016. Firm characteristics are from Compustat. Compustat data codes are in parentheses. The top panel reports average firm characteristics. *Obs. per firm* is the number of observations by firm. *Avg. Market value ($bn)* is the average market capitalization by firm computed as the product of common shares outstanding (CSHO) and fiscal-year closing price (PRCC_F). *Avg. Leverage* is the average leverage by firm computed as the total debt (DD1 + DLTT) divided by total assetes (AT). *Avg. ROA* is the average return on assets by firm computed as operating income before depreciation (OIBDP) divided by lagged total assets (AT). *Longholder* and *Factor 1–4* are defined in Table 3. The investment-cash flow sensitivity analyses variables are defined as in Malmendier and Tate (2015). *Investment* is capital expenditures (CAPX) divided by the lag of net property plants and equipment (PPENT). *Q* is Tobin's Q defined as the market value of assets divided by total assets (AT). The market value of assets is defined as the book value of assets (AT) plus market value minus the book value of equity. The book value of equity is defined as stockholders' equity (SEQ or, if missing, CEQ + PSTK, or, if missing, AT - LT) minus preferred stock (PSTKL or, if missing, PSTKRV, or, if missing, PSTK) plus deferred taxes and investment tax credit (TXDITC or, if missing, 0). *Size* is the logarithm of total assets (AT). *Cash flow* is the sum of earnings (IB) and depreciation (DP) divided by the lag of net property plants and equipment (PPENT). *Stock ownership* is the fraction of company stock held by a CEO. *Vested options* is the number of vested options held by a CEO divided by the number of common shares outstanding. *Efficient board size* is an indicator variable equal to 1 if the board has between 4 and 12 members. *Investment*, *Q*, *Size*, *Cash flow*, *Stock ownership*, *Vested options* are winsorized at the 1st and 99th percentiles.

	Obs.	Mean	Std.Dev	p5	p25	p50	p75	p95
Average firm characteristics								
Obs. per firm	78	4.500	3.194	1.000	2.000	4.000	6.000	10.150
Avg. Market value ($bn)	78	1.808	2.803	0.030	0.230	0.656	2.013	6.033
Avg. Leverage	78	0.247	0.237	0.000	0.043	0.216	0.361	0.719
Avg. ROA	78	0.053	0.314	-0.480	0.057	0.114	0.182	0.303
Summary statistics for investment-cash flow sensitivity analyses								
Longholder	317	0.237	0.426	0.000	0.000	0.000	0.000	1.000
Factor 1	351	0.333	0.837	-1.188	-0.218	0.517	1.018	1.485
Factor 2	351	-0.123	0.911	-1.379	-0.814	-0.079	0.603	1.337
Factor 3	351	-0.163	0.818	-1.399	-0.642	-0.155	0.413	0.995
Factor 4	351	0.184	0.866	-0.993	-0.227	0.236	0.502	1.559
Investment	351	0.407	0.364	0.037	0.141	0.290	0.598	1.131
Q	351	2.098	1.212	0.942	1.206	1.677	2.620	4.641
Size	351	6.436	1.727	3.226	5.347	6.374	7.527	9.270
Cash flow	351	0.460	4.965	-5.405	0.144	0.779	1.699	4.931
Stock ownership	351	0.036	0.076	0.000	0.001	0.004	0.016	0.244
Vested options	351	0.006	0.010	0.000	0.000	0.002	0.008	0.024
Efficient board size	335	1.000	0.000	1.000	1.000	1.000	1.000	1.000

Table 9:
The sensitivity of investment to cash flow and Kaplan and Sorensen (2019) factors

This table reports estimates of the linear regressions of investment on cash flow, CEO traits, cash flow interacted with CEO traits, control variables, control variables interacted with cash flow, year fixed effects, and year fixed effects interacted with cash flow. The variables are defined in Tables 3 and 8. Robust standard errors clustered by firm are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Investment					
	(1)	(2)	(3)	(4)	(5)	(6)
Q	0.054*	0.051*	0.049*	0.045*	0.045	0.037
	(0.029)	(0.026)	(0.028)	(0.025)	(0.029)	(0.030)
Size	−0.065**	−0.074***	−0.070***	−0.073***	−0.066***	−0.058*
	(0.026)	(0.023)	(0.022)	(0.024)	(0.022)	(0.030)
Stock ownership	0.064	−0.441	−0.436	−0.393	−0.413	0.258
	(0.592)	(0.373)	(0.371)	(0.448)	(0.373)	(0.653)
Vested options	−2.569	−2.390	−3.061	−2.658	−3.962	−3.272
	(3.820)	(3.924)	(3.806)	(3.699)	(4.035)	(3.195)
Cash flow	−0.011	0.126	0.116	0.134	0.186**	0.104
	(0.044)	(0.083)	(0.097)	(0.092)	(0.085)	(0.090)
Longholder	−0.095					−0.127
	(0.093)					(0.104)
Longholder × Cash flow	0.039*					0.046**
	(0.021)					(0.023)
Factor 1		−0.004				−0.066
		(0.034)				(0.048)
Factor 1 × Cash flow		−0.015***				0.010
		(0.005)				(0.009)
Factor 2			0.002			0.015
			(0.029)			(0.039)
Factor 2 × Cash flow			0.007			−0.000
			(0.009)			(0.013)
Factor 3				−0.010		0.001
				(0.040)		(0.051)
Factor 3 × Cash flow				0.017***		0.027**
				(0.006)		(0.012)
Factor 4					0.056*	0.058
					(0.030)	(0.045)
Factor 4 × Cash flow					−0.026***	−0.027
					(0.010)	(0.017)
Controls × Cash flow	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE × Cash flow	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.358	0.351	0.333	0.344	0.346	0.398
Obs.	317	351	351	351	351	317