Full length article

The spillover effects of management overconfidence on analyst forecasts☆

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ARTICLE INFO	ABSTRACT
	Overconfident CEOs are known to overestimate their ability to generate returns, overpay for target firms, and take excessive risks. We find a CEO's overconfidence can also indirectly affect other market participants, specifically analysts who issue earnings forecasts. First, firms with overconfident CEOs are more likely to have analysts issue earnings forecasts that are optimistic relative to actual earnings; that is, the earnings forecasts more frequently exceed the actual realized earnings than the reverse. Second, firms with overconfident CEOs tend to have less dispersed analyst earnings forecasts. And third, smaller analyst forecast errors are associated with firms that have overconfident CEOs. These findings demonstrate the importance of CEOs' behavioral characteristics in shaping the environment in which analysts and other market participants make important financial decisions, in some cases improving the information environment.

1. Introduction

Management disclosures are an important source of information in financial markets and can affect the level and variability of security prices by influencing the beliefs of market participants. It is well established that management communications can influence the earnings forecasts issued by financial analysts; see, for instance, Richardson et al. (2004). Even subtleties such as managerial tone on earnings conference calls can affect analyst forecasts (Druz et al., 2015). In turn, analyst earnings forecasts are used by investors as a bellwether of firms' future prospects and as an input for almost all models of valuation and cost of capital estima-

tors. Given the importance of management as a source of company information for analysts, and the fact that analyst forecasts are known to be influenced by communications from managers, it is conceivable that management traits may influence the content of managers' information disclosures and that differences in managers' traits may, in turn, influence analysts' beliefs regarding different firms' expected future earnings.

Statements quoted in the popular press support this notion. For example, in an article in the financial press (*Financial Post*, December 16, 2009, "TELUS CEO Puts Money Where His Mouth Is"), TELUS CEO, Darren Entwistle, was quoted providing a strong positive message to the market:

> "I'm confident in the opportunity that our company has in the coming quarters", he said on a guidance call with analysts. "Accordingly, I've recently informed the TELUS board of directors that I'll be taking the entirety of my 2010 annual cash salary net of taxes in TELUS shares".

The same article went on to quote an analyst: "It's a huge vote of confidence on their ability to deliver", said Greg MacDonald at National Bank Financial. In this example, not only is the CEO signaling great confidence about the future performance of his firm through his choice about compensation, the analyst is also expressing confidence in the firm's management.

In this paper, we explore the potential impact of CEO overconfidence on analyst forecasts.[1] An established literature indicates that overconfidence can present itself as both excessive optimism concerning the level of future firm performance and excessive certainty about the precision of their private information.[2] These two manifestations of overconfidence have direct implications for analyst forecasts and provide us with three testable hypotheses. First, overconfident CEOs who overestimate future firm performance are more likely to provide positive information to analysts, thus increasing the likelihood of analysts issuing optimistic earnings forecasts for firms with overconfident CEOs. Second, overconfident CEOs may overestimate the precision of their information and disclose more precise information, which in turn may result in less dispersed analyst forecasts. Finally, managers who exhibit overconfidence show an increased willingness to voluntarily disclose information through management earnings guidance, which may lead to smaller forecast errors relative to managers who are less willing to disclose. We elaborate on these hypotheses in Section 2.3.

We examine a sample of 429 large, publicly traded US firms from 1983 to 1994. The dataset contains 78,493 annual analyst forecast observations from the Institutional Brokers Estimate System (I/B/E/S) with supplementary stock price data from the Center for Research in Security Prices (CRSP). Our primary empirical proxy for overconfidence is a widely used set of measures developed by Malmendier and Tate (2005, 2008) based on the stock-option holding decisions of CEOs. This set of measures exploits the fact that CEOs are often underdiversified.[3] If a particular CEO holds his stock options until the year of expiration even though the options are at least 40% in the money, this behavior can be interpreted as overestimation of future firm performance, and thus the CEO is classified as overconfident. We refer to this set of measures as the portfolio-based measures.

Using the portfolio-based measures of overconfidence, we find statistically significant and economically meaningful support for all three of our hypotheses. We document three main results. First, we find that analyst forecasts for firms with overconfident CEOs are approximately 25% more likely to be optimistic. That is, they are more likely to forecast that earnings will be greater than the earnings the firm eventually realizes. Second, analyst absolute forecast errors are 2.4%–4.3% smaller in magnitude, and thus more accurate, for firms with overconfident CEOs relative to firms without overconfident CEOs. Third, forecast dispersion, as defined by the standard deviation of analyst forecasts for a particular firm, is 3.0%–3.8% smaller for firms with CEOs classified as overconfident using the portfolio-based measures.

We also explore a secondary measure of overconfidence based on how each CEO is described in the press, developed by Malmendier and Tate (2008), which we refer to as the press-based measure. Malmendier and Tate (2008, page 38) emphasize that since the press-based measure is founded on assessments by outsiders, it is "necessarily [a] noisier and less precise" measure of overconfidence than the portfolio-based measures. Consistent with the relatively less precise nature of the press-based overconfidence measure, we find support for the first hypothesis based on this measure, but not the second or third hypotheses. Another possible explanation for the difference in results using the portfolio-based versus press-based overconfidence measures is that some CEOs may display an overconfident persona to encourage optimism about his firm without necessarily providing more or better information, yielding results that do not necessarily align with our hypotheses.

This paper contributes to two main streams of literature. We add to the expanding literature on the influence of behavioral biases on corporate decision-making and the literature on analyst forecasts characteristics which shows that analyst forecasts tend to be optimistic. We add to these literatures by showing that overconfidence can affect the information that CEOs provide to analysts, thereby influencing analyst forecasts and the broader information environment.

The remainder of the paper proceeds as follows. In Section 2, we review the background literature and develop testable hypotheses regarding the influence CEO overconfidence may have on analyst forecast characteristics. We describe the data in Section 3. In Section 4, we describe the CEO overconfidence measures and the analyst forecast data. We present our main results in Section 5, demonstrating the impact that CEO overconfidence has on analyst forecasts. The paper concludes with Section 6.

2. Related literature and hypotheses development

In this section we discuss the literatures on analyst forecasts and management overconfidence. We consider how overconfidence may affect the information that CEOs disclose, which leads to three primary testable hypotheses regarding the impact of CEO overconfidence on analyst forecast optimism, accuracy, and dispersion.

2.1. Analyst forecast literature

Prior research has investigated how analyst forecasts contribute to the information environment. For instance, Brown and Rozeff (1978) show that analyst forecasts tend to be more informative relative to simple time-series estimates, and although there exists some debate, analyst forecasts are generally accepted to be optimistic (see, for instance, Butler and Lang, 1991).[4] Research has also ventured to understand the implications of analyst

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[1] In principle, other behavioral traits may also be influential; we consider overconfidence as an example of one of many possible conduits through which manager traits may influence analysts' beliefs and the information environment. Likewise, the traits of managers other than the CEO may be relevant; we focus on CEOs due to their position of leadership within the firm and because of data availability.

[2] One can differentiate between these two types of overconfidence. See, for instance, Moore and Healy (2008), who refer to overestimation of the level of a variable as 'overestimation' and excessive certainty about the accuracy of a variable as 'overprecision'. These different manifestations of overconfidence are often assumed to result from the same underlying psychological causes (Alba and Hutchinson, 2000; Daniel et al., 1998; Juslin et al., 2000; Moore et al., 1999; Stone, 1994). While these are the two specific manifestations of overconfidence of interest, for brevity, we use the term 'overconfidence' to encompass both the concepts of 'overestimation' and 'overprecision'.

[3] CEOs generally hold large portions of their investment portfolios in stock and options in their firm and are compensated by the same firm. Additionally, their human capital is invested in the same firm.

[4] Many studies have proposed and tested hypotheses to explain the optimism bias. In general, these explanations can be classified as either incentives-based or behavioral-based. Incentives-based explanations generally assume analysts rationally issue optimistic forecasts due to incentive conflicts as a result of underwriting relationships (see Dugar and Nathan, 1995; Lin and McNichols, 1998; Michaely and Womack, 1999) as well as relations with firm management (see Lim, 2001; Das et al., 1998). Richardson et al. (2004) provide evidence that managers manipulate analyst behavior by guiding analysts toward beatable targets so that they or their firms can sell equity on favorable terms after an earnings announcement. Proposed behavioral-based explanations to account for analysts' optimistic bias include overconfidence and cognitive dissonance in analyst earnings forecasts, as explored by Friesen and Weller (2006). Further, some researchers posit that seasonality in the bias can arise due to a form of seasonal depression known as seasonal affective disorder (SAD). For instance, Dolvin et al. (2009) find that analyst forecasts are less optimistic during the fall and winter months, and Lo and Wu (2015) find that analysts appear to be less affected by SAD than investors and so their forecasts may actually help to mitigate the effects of SAD in financial markets.

forecast dispersion, tying dispersion to stock returns (Diether et al., 2002; Abarbanell et al., 1995; Barron et al., 2009), stock return volatility, and financial distress (Avramov et al., 2009). In exploring these relationships, forecast dispersion has been interpreted as a proxy both for differences in opinion (Diether et al., 2002) and information uncertainty (Johnson, 2004; Barron et al., 2009).[5]

2.2. Overconfidence literature

In the psychology literature, studies demonstrate that people tend to be overconfident about the level of their performance, actual ability, level of control, and chances of success (see, for instance, Weinstein, 1980; Svenson, 1981; Taylor and Brown, 1988). The convention is to refer to this type of overconfidence as 'overestimation'. 'Overprecision' is another variety of overconfidence, which Moore and Healy (2008) describe as "excessive certainty regarding the accuracy of one's beliefs (p. 502)". Researchers often assume, either explicitly or implicitly, that these different types of overconfidence result from the same underlying psychological causes (see Alba and Hutchinson, 2000; Juslin et al., 2000). We examine the implications that these two varieties of overconfidence have on the type of information that CEOs provide to analysts, thereby influencing analyst forecasts.

There is a growing behavioral corporate finance literature that examines the influence of behavioral biases on corporate decision-making.[6] Recent studies investigate the effect of CEO overconfidence, captured using the portfolio-based and press-based measures of overconfidence developed by Malmendier and Tate (2005, 2008), on the cash flow sensitivity of investments (Malmendier and Tate, 2005), mergers and acquisitions (Malmendier and Tate, 2008), dividend change announcements (Bouwman, 2009), earnings smoothing (Bouwman, 2014), financial misreporting (Schrand and Zechman, 2012), and management earnings forecasts (Hribar and Yang, 2016; Luo, 2010). Hribar and Yang (2016) find that overconfident managers are more likely to issue management guidance consisting of range forecasts with a relatively narrower width. This indicates that overconfidence affects the precision of discretionary information in the form of management forecasts that CEOs provide. Correspondingly, Ben-David et al. (2013) show that top corporate executives routinely produce confidence intervals that are too narrow when asked to estimate future stock market returns. Consistent with the 'overprecision' type of overconfidence, Ben-David et al. (2013) find that realized market returns are within the 80% confidence intervals provided by executives only 36% of the time. They document that firms with CEOs who exhibit this form of overconfidence invest more, use more leverage, are less likely to pay dividends, and are more likely to repurchase shares.

Recent studies have begun to study the effect of management overconfidence on voluntary disclosures. First, Hribar and Yang (2016) find evidence that a manager who overestimates the precision or quality of his information will disclose *more precise* information. They show that overconfident CEOs issue management guidance with earnings forecasts that have a narrower width than non-overconfident CEOs. Second, Libby and Rennekamp (2012) also examine the relationship between overconfidence and information disclosure. They perform an experiment, the results of which suggest that after an experience of positive performance, managers are more likely to attribute the firm's positive outcome to their own skill. This increases managers' overconfidence in the firm's future positive performance and increases their willingness

to initiate voluntary earnings guidance. Wong and Zhang (2014) study the effect of CEO optimism on analysts' consensus forecasts and revisions and find that actual earnings relative to analyst consensus forecasts are negatively related to the level of CEO optimism, which they measure using net insider buying of company stock.[7] Furthermore, they find that stock price reactions to downward analyst forecast revisions are less negative for firms with optimistic CEOs, thus suggesting that investors understand the implications of optimism for analysts' forecasts and revisions.

2.3. Hypotheses

Overconfident CEOs overestimate the level of their firm's future performance, as well as the precision of their information regarding this underlying performance. We examine whether CEO overconfidence can influence analyst forecasts through the information that they provide to analysts.[8] The existing corporate finance and psychology literatures that examine overconfidence suggest that there are important differences between the information that overconfident versus non-overconfident CEOs provide to analysts. First, an overconfident CEO should provide information that is more positive because he overestimates his firm's future performance. Second, Hribar and Yang (2016) demonstrate that overconfident CEOs are more willing to voluntarily disclose information. Additionally, an overconfident CEO should overestimate the precision of his private information and consequently should disclose more precise information, consistent with Hribar and Yang's (2016) finding that overconfident CEOs issue management guidance with earnings forecasts that have a narrower width than non-overconfident CEOs. The differences in information that an overconfident CEO should provide leads to predictions that we can test using analyst forecast data. We now specify our main hypotheses.

Prediction 1: Forecasts for firms with overconfident CEOs are more likely to be optimistic.

According to our first prediction, overconfident CEOs who overestimate their firm's future performance are more likely to provide positive information to analysts, thus increasing the likelihood of analysts issuing optimistic earnings forecasts for firms with overconfident CEOs.

Prediction 2: Forecasts for firms with overconfident CEOs have smaller absolute errors.

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[5] Additional research examines the influence of cross-sectional variations in specific analyst characteristics on analysts' forecast bias, including studies by Clement (1999) and Clement et al. (2007).

[6] See, for instance, Heaton (2002); Barberis and Thaler (2003); Baker et al. (2006).

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[7] There are several differences between their paper and ours. While we similarly study the impact of CEO characteristics on analyst forecasts, we differ in the proposed mechanism through which CEO characteristics may influence analyst forecasts. Wong and Zhang (2014) posit that analysts rationally issue optimistically biased forecasts to appease optimistic firm management, whereas we propose that overconfidence affects the content of the information that CEOs provide to analysts, which in turn influences analyst forecasts even in absence of analysts' desire to appease management. Both effects may be happening simultaneously; nevertheless, to distinguish these two hypotheses, we investigate the influence of overconfidence on three analyst forecast characteristics unexplored by Wong and Zhang (2014). The influence of CEO overconfidence on these forecast characteristics should help clarify whether differences in analyst forecasts are the result of intentional manipulation of forecasts by analysts or whether instead they arise due to differences in the information disclosed by CEOs.

[8] The setting in which we examine the impact of overconfidence on analyst forecast characteristics is susceptible to both behavioral biases and intentional biases. We assume that the intentional biases that influence analyst forecast characteristics do not vary systematically between analysts who issue forecasts for firms with overconfident CEOs and analysts who issue forecasts for firms with non-overconfident CEOs. In other words, we assume that analysts who suffer from other biases are assigned to issue forecasts for firms that are randomly sorted between having overconfident CEOs and having non-overconfident CEOs. When testing the following predictions, we account for violations in this assumption by using analyst fixed effects to account for analyst specific biases in forecast characteristics as well as firm-level controls that may contribute to these biases.

The second prediction follows from the findings of Verrecchia (1990) and Hribar and Yang (2016). Verrecchia's model implies that a manager who overestimates the precision of his information will disclose more. Hribar and Yang (2016) provide evidence that overconfidence positively correlates with voluntary disclosures. Managers' increased willingness to disclose firm-specific information should help analysts form more accurate forecasts. Thus, all else equal, we expect smaller analyst forecast errors to be associated with an overconfident manager.

Prediction 3: Forecasts for firms with overconfident CEOs are less dispersed across individual analyst forecasts.[9]
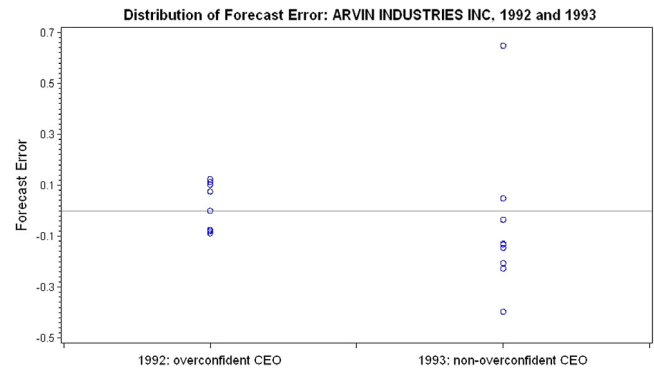
Prediction 3 is based on the notion that overconfident CEOs overestimate the precision of their private information, or equivalently, their perception of the precision of their information is higher than its actual precision. Then, consistent with Hribar and Yang's (2016) findings, overconfident CEOs should be more likely to disclose more precise information. In turn, we expect analyst forecasts for firms with overconfident CEOs to have smaller dispersion, reflecting the more precise information provided by overconfident CEOs. Note that dispersion differs from absolute forecast error in that it measures variability in the cross-section of analyst forecasts for a particular firm. In contrast, absolute forecast error is based on a single forecast and measures the absolute distance between a forecast and actual earnings. Small forecast dispersion does not necessarily imply small absolute forecast error. For example, the cross-section of analyst forecasts for a firm may be tightly clustered far from actual earnings. In this situation, forecast dispersion is small, yet absolute forecast error is large. Interpreting forecast dispersion as a proxy for differences in opinion or information uncertainty, we expect analyst forecasts for firms with overconfident CEOs to exhibit less forecast dispersion, as stated in Prediction 3.[10]

Fig. 1 shows an example of the cross-section of analyst forecasts observed during the tenure of a CEO classified as overconfident as well as the cross-section of analyst forecasts observed during the subsequent tenure of a non-overconfident CEO for the same firm. The firm had a CEO who was classified as overconfident in 1992, and that individual was replaced by a new, non-overconfident CEO in 1993.[11] Each circle in Fig. 1 represents an analyst forecast for Arvin Industries Inc. in either 1992 or 1993. The horizontal line represents the actual earnings of the firm (revealed subsequent to the analysts forming their forecasts); a perfectly accurate analyst forecast would lie on the line and have a forecast error of 0. Comparing the set of analyst forecasts in 1992 with those in 1993, we see that first, a greater proportion of forecasts are optimistic (above the horizontal line) in 1992 (during the tenure of the overconfident CEO) than in 1993 (during the tenure of the non-overconfident CEO). Second, the absolute forecast error of forecasts in 1992 appears to be smaller (closer to the horizontal line), on average, than that of forecasts in 1993. Lastly, the dispersion, or standard deviation, or forecasts is smaller in 1992 than it is in 1993.

Fig. 1. Analysts' Forecasts for Arvin Industries in 1992 and 1993. This figure shows the distribution of analysts' forecasts for Arvin Industries in 1992 and 1993. In this specific example, there was a change of CEO in 1993. The CEO in 1992 was classified as overconfident by the *Longholder* measure and the new CEO in 1993 was not classified as overconfident by *Longholder*. The horizontal line represents the actual earnings of the firm (i.e. a forecast error of 0) and each of the circles represents one analyst's forecast.

By testing the three empirical predictions described above, we can determine whether differences in analyst forecast characteristics between firms with overconfident versus non-overconfident CEOs are the result of differences in the content of the information that overconfident CEOs willingly disclose.

3. Data

Our sample comprises of 429 large, publicly traded US firms and is limited to the sample of firms for which we have measures of CEO overconfidence as described by Malmendier and Tate (2008).[12] Our dataset includes annual CEO overconfidence measures over the years 1983 through 1994 based both on CEOs' option-holding decisions and the way the CEOs are described in the financial press. Data on CEO characteristics such as age, stock ownership, educational background, and whether the CEO is also president and chairman are also available.

We use analyst earnings forecast data from the I/B/E/S Unadjusted Detail History Estimates File and firms' actual realized earnings data from the I/B/E/S Unadjusted Detail History Actual File. As documented by Diether et al. (2002), in the case of stock splits the I/B/E/S Adjusted Details and Actual Files divide historical analyst forecasts by the split adjustment factor, but rounds the adjusted forecast to the nearest penny. The rounding causes a problem because not all pre-split forecasts and earnings per share are perfectly divisible by a penny. For example, earnings forecasts of 14 cents and 6 cents for a stock that undergoes a 10 for 1 split will be divided by 10, rounded to the nearest penny, and recorded as 1 cent by I/B/E/S. If the firm realizes actual earnings per share of 10 cents, I/B/E/S will similarly record the earnings as 1 cent. I/B/E/S then includes an adjustment factor of 10 in the Adjustment File, which when used to "unadjust" the earnings estimates, erroneously results in two 10 cent forecasts and thus zero forecast error for both forecasts. This is also problematic when examining forecast dispersion. For the same stock that splits 10 for 1, both a 6 cent and a 14 cent earnings forecast would be reported as a 1 cent forecast, erroneously resulting in zero forecast dispersion. Thus, we use I/B/E/S unadjusted data and adjust for

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[9] Wong and Zhang (2014) suggest that analysts rationally issue optimistically biased forecasts to appease management. This argument does not imply one should find any difference in forecast dispersion across overconfident versus non-overconfident CEOs.

[10] We note that predictions 2 and 3 are consistent with the positive correlation found between accuracy and confidence interval width in the psychology literature (Henmon, 1911; Moore and Healy, 2008). That is, the distance from the perceived score on a test to the actual score received on the test and the width of the confidence interval provided by the same respondent are positively correlated.

[11] The overconfidence classification is based on the Malmendier and Tate (2008) "*Longholder*" variable, which is based on the CEO's timing of exercising options held in the firm's stock. We discuss this measure more fully in Section 4.

[12] CEO overconfidence measures are available for 477 firms in the sample period, but we were unable to match 48 of these firms analyst forecasts data from the I/B/E/S database. To be included in the sample, a firm must appear on one of *Forbes* magazine's lists of the largest US companies during the sample period. The *Forbes* ranking is described in more detail by Hall and Liebman (1998) and Yermack (1995).

stock splits manually using the CRSP Cumulative Adjustment Split Factor from the CRSP Daily Stock files as it contains more precise information regarding the true split date of a stock than I/B/E/S adjustment factors.

We supplement the I/B/E/S data with CRSP Daily Stock File stock prices on the day prior to the forecast announcement date and stock prices at the end of each firm's previous fiscal year to scale the absolute forecast error and forecast dispersion measures, respectively. We also extract market capitalization and annual returns from the CRSP data to use as firm-level controls. Market capitalization is stock price times the number of shares outstanding on the last trading day of the previous year. (We use the log of this variable when included in regressions.) Annual returns for a given year are the stock price on the last trading day of the year minus the stock price on the last trading day of the previous year, scaled by the stock price on the last trading day of the previous year.

We merge the three databases using a linking table provided by Wharton Research Data Services (WRDS) that links CRSP PERMNOs to the firm's corresponding I/B/E/S ticker.[13] The final dataset contains data for 429 large publicly-traded US firms in the sample period beginning on January 1, 1983 and ending on December 31, 1994. A total of 5,088 distinct analysts issue forecasts for at least one of these 429 firms in the sample period, resulting in 78,493 firm–analyst–year observations.

4. CEO overconfidence and analyst forecasts

In this section, we describe the overconfidence measures and the analyst forecast data.

4.1. Measures of CEO overconfidence

We capture CEO overconfidence based on two sets of measures developed by Malmendier and Tate (2005, 2008). The first set of measures is based on the company-stock-option-holding decisions of CEOs and exploits the fact that CEOs are generally underdiversified. The second set is based on the public opinion of a CEO's level of overconfidence, reflecting the frequency with which CEOs are described as *confident* versus *conservative* in the financial press. Both sets of measures were computed on an annual basis by Malmendier and Tate (2008), and we use one-year lagged values in our regressions for conservatism.

4.1.1. Portfolio-based measures of overconfidence

The first set of measures is based on a CEO's financial decision-making, specifically his decision to hold or exercise executive options in his company's stock. Generally, executive stock options have a lifespan of ten years and are fully exercisable after a four-year vesting period. In each sample year, one observes the number of unexercised options remaining from previous stock option grants that the CEO received in prior years in office. Because CEOs are highly exposed to firm-specific risk, they should exercise their options early if the marginal cost in risk exposure of holding the option exceeds the marginal benefit of the option value when the stock price is sufficiently high.[14] Malmendier and Tate (2008) find that a subset of CEOs consistently fail to exercise highly in-the-money vested options. Given the underdiversification of CEOs,

this failure to exercise can be interpreted as an overestimation of future firm performance, which motivates the CEO to hang on to his option package in hopes of cashing-in in the future.[15][16]

Three indicator variables are constructed to partition the sample of CEOs into "late" and "timely" option exercisers. First, the variable *Longholder* equals 1 if a CEO, at any time during his tenure, held an option to the year of expiration even when the option was at least 40% in the money entering its final year.[17] *Longholder* equals zero otherwise. This measure represents overconfidence as a trait that does not vary over time. If *Longholder* equals 1 for a particular CEO, we occasionally refer to him as a *Longholder*. We adopt a similar convention for other binary variables to be introduced below.

Second, to allow for time-variation in the tendency to exhibit overconfidence, *Longholder* is split into two separate indicator variables, *Pre-Longholder* and *Post-Longholder*. For CEOs classified as *Longholder*, *Post-Longholder* equals 1 starting in the year after the CEO held an option until the year of expiration for the first time and equals 0 otherwise. Correspondingly, *Pre-Longholder* equals 0 for the years *Post-Longholder* equals 1, and equals 1 for the years *Post-Longholder* equals 0. In the analysis below, we include both *Pre-Longholder* and *Post-Longholder* in the same regressions to pick up differential effects in analyst forecast characteristics before and after the event which classifies a CEO as a *Longholder*. If the coefficient estimates for these two variables are similar, this implies that overconfidence is a trait that people either do or do not exhibit. On the other hand, if there are differences in analyst forecast behavior before and after a CEO is classified as overconfident, then perhaps the measure is capturing a feature that is less a trait and more a characteristic that can vary over time.

Lastly, *Holder67* relaxes the stipulation that overconfident CEOs hold their options all the way until expiration. This variable focuses on a CEO's exercise decision in the fifth year prior to expiration since this is the earliest point at which options in the sample become fully vested.[18] This indicator variable equals one after the CEO holds a fully vested option with five years remaining duration on a stock that has increased in price by at least 67% since the option grant date.[19] It is important to note that only CEOs who meet these criteria enter the *Holder67* sample. That is, a CEO enters the *Holder67* sample and is assigned a 0 or 1 only once he has an option with five years remaining duration that is at least 67% in the money. This ensures that every CEO in the *Holder67* subsample had the opportunity to be classified as overconfident and thus, avoids over-proportionally classifying CEOs whose firms' stock has gone up as overconfident. Once a CEO postpones the exercise of such an option, *Holder67* retains a value of 1 for the remainder of his tenure.

4.1.2. Press-based measures of confidence

The press-based measure of confidence gauges the degree to which CEOs are described as *confident* by journalists in *The*

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[13] Four additional firms are matched by hand.

[14] Note that it is illegal for managers to short sell their own firm's stock, but it is legal for them to own put options provided that the amount of the securities underlying the put equivalent position does not exceed the amount of underlying securities otherwise owned. See Section 16 (c), Rule 16c-4 of the Securities and Exchange Act of 1934.

[15] Malmendier and Tate (2005) verify that CEOs who excessively hold onto their stock options do not earn significant abnormal returns over the S&P 500 on average. This rules out the possibility that CEOs generally hold onto their options as a result of inside information.

[16] The use of CEO option holdings to indicate overconfidence may also bear relevance to the CEO compensation literature that examines the negative effects of option-based compensation on earnings management (Bergstresser and Philippon, 2006; Jiang et al., 2010), misreporting (Burns and Kedia, 2006), and firm disclosures (Nagar et al., 2003).

[17] As reported by Malmendier and Tate (2008), the exercise threshold of 40% is calibrated using the model developed by Hall and Murphy (2002).

[18] Option packages which are not fully vested and have five years of remaining duration are dropped from the sample.

[19] As described by Malmendier and Tate (2008), the exercise threshold of 67% is calibrated using the model developed by Hall and Murphy (2002).

New York Times, Business Week, Financial Times, The Economist, and The Wall Street Journal. This proxy is based on the relative frequency with which a CEO is described as "confident" and "optimistic" (*confident*) versus "not confident", "not optimistic", "conservative", "frugal", "cautious", "practical", "reliable", and "steady" (*conservative*). If a CEO is more often described as *confident* than *conservative*, then he is classified as overconfident. We should emphasize that this measure is a noisy measure of overconfidence by its nature. Further, it is arguably a better measure of confidence than overconfidence and relative to the portfolio-based measure, it is certainly more prone to strategic manipulation by a CEO who wishes to create a public impression of confidence even if he lacks true confidence in his firm's future prospects.

TOTALconfident is the press-based measure that corresponds to CEO n in year t. It is a binary variable that equals 1 if the number of times CEO n is described as *confident* exceeds the number of times he is portrayed as *conservative* in all sample years up to year $t - 1$. It is defined as:

$$TOTALconfident_{n,t} = \begin{cases} 1 & \text{if } \sum_{s=1}^{t-1} a_{n,s} > \sum_{s=1}^{t-1} b_{n,s} \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

where $a_{n,s}$ is the number of times CEO n is described as *confident* in year s and $b_{n,s}$ is the number of times CEO n is described as *conservative* in year s. Additionally, *TOTALmentions* is a count variable for CEO n in year t that measures the total number of times CEO n is mentioned using both *confident* and *conservative* descriptors in all sample years up to year $t - 1$. We use this variable to control for how often a CEO is mentioned in the press.[20]

It is important to note that the press coverage measures may potentially suffer from endogeneity since press coverage of a CEO may be affected by analyst forecasts as they are disclosed. If analysts issue particularly high or low earnings forecasts, this may generate more media attention. However, the use of cumulative measures of press coverage, which include press mentions up to and including the year prior to that in which forecasts are issued, helps to mitigate the endogeneity.

4.2. Measures of analyst forecast characteristics

We consider three characteristics of analyst forecasts: forecast optimism, absolute forecast error, and forecast dispersion. Forecast optimism is simply an indicator of whether an earnings forecast is above or below actual earnings. Absolute forecast error measures forecast accuracy and is the absolute distance between a forecast and actual earnings. Forecast dispersion measures the dispersion in the cross-section of analyst forecasts for a particular firm.

4.2.1. Forecast optimism

We define $F_{i,j,t}$ as the dollar earnings per share forecast that was most recently issued by analyst i for firm j between twelve months and 30 days prior to the forecast period end date in year t.[21]

Correspondingly, $A_{j,t}$ is the actual earnings per share realized by firm j in year t. As used by Luo (2010), *ForecastOptimism* explicitly measures whether an analyst's earnings forecast is above or below the firm's actual earnings and is defined as follows:

$$ForecastOptimism_{i,j,t} = \begin{cases} 1 & \text{if } F_{i,j,t} \geq A_{j,t} \\ 0 & \text{if } F_{i,j,t} < A_{j,t}. \end{cases} \quad (2)$$

4.2.2. Absolute forecast error

To explicitly measure how far away a forecast is from actual realized earnings, we employ an absolute forecast error measure used by Lang and Lundholm (1996). *AbsoluteForecastError* is the absolute value of the difference between the forecast and the actual earnings of the firm, scaled by the stock price of firm j on the day prior to the forecast announcement date. Normalizing by stock price facilitates comparison across firms. The measure is defined as follows:

$$AbsoluteForecastError_{i,j,t} = \frac{|F_{i,j,t} - A_{j,t}|}{P_{j,t}}. \quad (3)$$

4.2.3. Analyst forecast dispersion

Using analyst-level data, we employ a measure of the dispersion of forecasts for the cross-section of analysts previously used by Lang and Lundholm (1996) and Zhang (2006). *ForecastDispersion* is calculated as the standard deviation of analyst forecasts for firm j in year t, scaled by the stock price at the end of the previous fiscal year. The dispersion measure is defined as follows:

$$ForecastDispersion_{j,t} = \frac{1}{P_{j,t-1}} \left(\frac{1}{I_{j,t}} \sum_{i=1}^{I_{j,t}} (F_{i,j,t} - \overline{F}_{j,t})^2 \right)^{\frac{1}{2}} \quad (4)$$

where I_j is the number of analysts issuing forecasts for firm j in year t and $\overline{F}_{j,t}$ is the mean analyst forecast for firm j in year t.

4.3. Summary statistics

Table 1 contains summary statistics on analyst forecast characteristics, CEO overconfidence measures, and firm characteristics. Panel A shows univariate statistics for each of three forecast characteristics: *ForecastOptimism*, *AbsoluteForecastError*, and *Forecast-Dispersion*, as well as statistics for *ForecastAge*, which measures the number of days between the forecast announcement and a firm's fiscal year end. Note that we have a total of 78,493 analyst earnings forecasts across all of the years, analysts, and firms in our sample. 53% of those forecasts are optimistic as characterized by the mean of the binary variable *ForecastOptimism*.[22] *AbsoluteForecast-Error* is an absolute measure of the distance between an analyst's earnings forecast and the firm's subsequently realized actual earnings. The average (median) *AbsoluteForecastError* for all forecasts is 5.36% (1.14%). Strikingly, the average (median) optimistic forecast (*ForecastOptimism* = 1) has an *AbsoluteForecastError* that is approximately 4.1% (0.7%) greater than that of the average (median) non-optimistic forecast. The mean (median) *ForecastDispersion* in the sample is 6.08% (1.63%) and the mean (median) *ForecastAge* is 125.84 (94) days, meaning that the average (median) forecast is issued approximately four (three) months before the end of the fiscal

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[20] Results do not significantly differ using non-cumulative measures of *TOTALconfident* and *TOTALmentions* constructed using only the number of relevant measures for the past year.

[21] As pointed out by Clement (1999), analysts whose most recently issued annual earnings forecast is more than one year prior to the actual forecast period end date are not likely to be following the firm very closely. Similarly, analysts issuing forecasts within 30 days of the forecast period end date are more likely to be herding around the consensus forecast and to revise their forecasts downward for management to more easily beat the forecast (in line with the findings of Richardson et al., 2004). We use an analyst's most recent forecast (within the twelve month to 30 days period) as it presumably contains the most information and should be the most accurate. However, our results are qualitatively unchanged using the oldest forecast issued by an analyst between twelve months and six months prior to the forecast period end date. These older forecasts exhibit relatively more variation.

[22] Because we include only an analyst's most recent forecast for a firm in any year, the proportion of optimistic forecasts is less than for the entire sample of analyst forecasts including all revisions. This is consistent with evidence of a "walk-down" in forecasts as the end of the forecast period approaches, as shown by Richardson et al. (2004).

Table 1
Summary statistics.

	Mean	Standard deviation	Min	25th percentile	Median	75th percentile	Max	Obs
Panel A: Analyst forecast characteristics								
ForecastOptimism	0.53	0.50	0	0	1	1	1	78,493
AbsoluteForecastError (%)								
All	5.36	12.50	0	0.33	1.14	4.26	90.62	78,493
ForecastOptimism = 1	7.28	15.85	0	0.43	1.53	5.89	90.62	41,623
ForecastOptimism = 0	3.20	6.34	0	0.24	0.84	2.86	35.54	36,870
ForecastDispersion (%)	6.08	20.00	0	0.60	1.63	4.68	421.73	4,011
ForecastAge (days)	125.84	84.95	31	56	94	174	364	78,493
Panel B: CEO overconfidence measures								
Longholder	0.19	0.39	0	0	0	0	1	3,768
Pre-Longholder	0.10	0.30	0	0	0	0	1	3,768
Post-Longholder	0.09	0.28	0	0	0	0	1	3,768
Holder67	0.51	0.50	0	0	1	1	1	1,956
TOTALconfident	0.23	0.42	0	0	0	0	1	3,664
TOTALmentions	34.68	84.92	0	3	11	35	1,803	3,670
Panel C: Firm characteristics								
#AnalystsCovering	20.36	11.16	1	12	19	28	63	4,093
MarketCap ($000)	2,908,938	5,198,913	4,952	659,447	1,356,271	2,941,884	74,016,501	4,071
Returns (%)	8.64	42.74	−94.51	−14.29	5.52	25.21	950.00	4,029

This table reports summary statistics for forecast characteristics, CEO overconfidence measures, and firm characteristics using observations for 78,493 analyst forecasts, 790 CEOs, and 429 firms. Summary statistics for the forecast characteristics appear in Panel A. The sample is restricted to forecasts issued no more than one year and no less than 30 days prior to the forecast period end date. We employ only the most recent forecast made by an analyst within that period for any particular firm in a fiscal year. *ForecastOptimism* is an indicator variable that equals 1 if the earnings forecast is above actual earnings and equals 0 otherwise. *AbsoluteForecastError* is the absolute value of the distance between the earnings forecast and the actual earnings, scaled by the stock price of the firm on the day prior to announcement date. Statistics for *AbsoluteForecastError* appear for all observations as well as for two subgroups partitioned based on the value of *ForecastOptimism*. *ForecastDispersion* is the standard deviation of the cross-section of analyst forecasts for a particular firm, scaled by the stock price at the beginning of the fiscal year. Consequently, this measure is available for each firm–year. *AbsoluteForecastError* and *ForecastDispersion* are shown as percentages. *ForecastAge* is the number of days from the announcement date of the forecast to the end of the fiscal year for which the forecast was issued. Summary statistics for CEO overconfidence measures appear in Panel B. *Longholder* is an indicator variable that equals 1 for the entire tenure of the CEO if the CEO at some point during his tenure held until the last year before expiration an option package that was at least 40% in the money. *Pre-Longholder* is an indicator variable that equals 1 for the years prior to and including the year the first time the CEO holds an option package to expiration. *Post-Longholder* is an indicator variable that equals 1 for the years *Pre-Longholder* equals 0 and equals 0 for the years *Pre-Longholder* equals 1. *Holder67* is an indicator variable that equals 1 for all CEO-years after the CEO fails for the first time to exercise an option that is 67% in the money with five years remaining duration. *TOTALconfident* is an indicator variable that equals 1 if the number of "confident" and "optimistic" *confident* mentions for a CEO exceeds the number of "not confident", "not optimistic", "reliable", "cautious", "practical", "conservative", "steady", and "frugal" *conservative* mentions in the financial press. *TOTALmentions* is the total number of times the financial press mentions the CEO as either *confident* or *conservative*. Both *TOTALconfident* and *TOTALmentions* are constructed using the cumulative sum of mentions over all sample years up to but not including the year for which the variable is constructed. Summary statistics for firm characteristics appear in Panel C. *#AnalystsCovering* is the number of analysts who have issued at least one forecast for the firm in a particular year. *MarketCap* is the number of shares outstanding multiplied by the firm's share price on the last trading day of the previous year and is reported in millions of dollars. *Returns* for a given year are calculated as the stock price on the last trading day of the year minus the stock price on the last trading day of the previous year, scaled by the stock price on the last trading day of the previous year.

year. (Recall that we base our main analysis on the last forecast issued by each analyst for a given firm in a given year.)

Panel B contains summary statistics on the annual measures of overconfidence for the 790 CEOs in our sample. We see that a small subset of CEOs hold their options until the year of expiration even though the underlying stock is in-the-money. 19% of all CEO-years are classified as *Longholder* = 1 and are, on the whole, evenly split between *Pre-Longholder* and *Post-Longholder* years.[23] That is, the first time that the average *Longholder* CEO holds an option that is at least 40% in the money until the year of expiration is more than halfway into his tenure (based on the slightly higher mean for *Pre-Longholder* than for *Post-Longholder*). The number of observations for *Holder67* is smaller than for the other measures because a CEO enters the *Holder67* sample only once he has an option with five years remaining duration that is at least 67% in the money. 51% of all CEO-years are classified as *Holder67*. Additionally, 23% of CEO-years are classified as *TOTALconfident* = 1 meaning that for these years, the CEO is described in the financial press cumulatively more often as confident than conservative. The average (median) number of *TOTALmentions* is approximately 34.7 (11). Both *TOTALconfident* and *TOTALmentions* are lagged measures, which include press mentions up to the previous year.

Summary statistics on firm characteristics are displayed in Panel C. The sample of firms tends to be large with mean (median) market capitalization of roughly $2.9 billion ($1.4 billion), annual returns of 8.64% (5.52%), and analyst coverage of 20.36 (19). In our regressions reported below, we are unable to control for firm fixed effects, but we include these firm-specific controls and industry fixed effects instead.[24]

4.4. Correlations of CEO overconfidence measures

In Table 2, we report pairwise correlations for the portfolio-based and press-based measures as well as their correlations with firm characteristics. Data in Panel A show that, as expected, *Longholder* is highly correlated with both *Pre-Longholder* and *Post-Longholder*, although it is slightly more correlated with *Pre-Longholder*.[25] *Pre-Longholder* and *Post-Longholder* are slightly negatively correlated. The *Longholder* measures are positively correlated with *Holder67*, as they should be. Additionally, *TOTALconfi-*

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[23] In untabulated results, 11% of all CEOs in the sample, or 87 CEOs, for which we have portfolio holding data are classified as *Longholder* = 1. This means that CEOs who are designated as having held their options too long tend to have a longer tenure than non-*Longholder* CEOs.

[24] In analysis described below, we are unable to control for firm fixed effects because CEO overconfidence measures such as *Longholder* have the same value, either 0 or 1, for the entire tenure of a CEO. In light of the fact that the vast majority of firms in our sample have the same CEO for the full sample period, near-perfect multicollinearity results if we simultaneously include measures of overconfidence and firm fixed effects.

[25] This suggests that there are more CEO-years prior to and including the year in which a CEO holds his option package to maturity than years after and is consistent with the summary statistics for the *Longholder* variables shown in Panel A of Table 1.

Table 2
Correlations of CEO overconfidence measures.

Panel A: Correlations of CEO overconfidence measures						
	Portfolio-based measures				Press-based measures	
	Longholder	Pre-Longholder	Post-Longholder	Holder67	TOTALconfident	TOTALmentions
Longholder	1					
Pre-Longholder	0.70	1				
Post-Longholder	0.64	−0.10	1			
Holder67	0.48	0.25	0.38	1		
TOTALconfident	0.11	0.08	0.07	0.08	1	
TOTALmentions	0.03	0.01	0.04	0.01	0.34	1
Panel B: Correlations of CEO overconfidence measures with firm characteristics						
	Longholder	TOTALconfident	#AnalystsCovering	MarketCap	Returns	
Longholder	1					
TOTALconfident	0.11	1				
#AnalystsCovering	0.06	0.18	1			
MarketCap	0.04	0.18	0.46	1		
Returns	−0.01	−0.03	−0.04	0.00	1	

This table contains the correlations of the CEO overconfidence measures both with one another and with firm characteristics. Panel A contains correlations between the overconfidence measures. All other variables are as defined in Table 1.

dent and *TOTALmentions* are positively correlated with each other, albeit slightly less so.

The correlations between the portfolio-based measures and press-based measure of overconfidence are fairly low, at no more than 0.11, which indicates that not very many CEOs are categorized as confident or overconfident by both sets of measures. That is, that there is little overlap in the set of CEOs who overestimate firm future performance and thus hold on to their options versus the set of CEOs who are portrayed as confident by the financial press. Those CEOs who are described by the press as confident do not tend to be the same CEOs who overestimate firm future performance. This is consistent with Malmendier and Tate (2008)'s observation that the press-based measures are less precise proxies for overconfidence relative to the portfolio-based measures.

Panel B shows the correlation between the *Longholder* and *TO-TALconfident* measures of overconfidence with firm-specific characteristics. *Longholder* does not appear to be highly correlated with any of the firm characteristics. *TOTALconfident* is relatively more highly correlated with both #AnalystsCovering and MarketCap (0.18 in both cases), indicating that CEOs of larger firms with more analyst coverage are more often described in the press as confident.

5. The relationship between CEO overconfidence and analyst forecasts

In this section, we examine the influence of CEO overconfidence on three characteristics of analyst forecasts: forecast optimism, absolute forecast error, and forecast dispersion. We employ a regression framework through which we control for firm characteristics, as well as analyst, industry, and year fixed effects. We test whether forecasts for firms with overconfident CEOs are more likely to be optimistic, are more accurate, and are less dispersed as a result of the more positive and precise information that overconfident CEOs provide, as well as their increased willingness to provide information.

5.1. The effect of CEO overconfidence on forecast optimism

First, we test Prediction 1, which states that forecasts issued for firms with overconfident CEOs have a greater likelihood of being optimistic, using the following regression model:

$Pr(ForecastOptimism_{i,j,t} = 1)$

$$= \Phi \begin{pmatrix} \alpha_0 + \alpha_1 ForecastAge_{i,j,t} \\ + \alpha_2 \#AnalystsCovering_{j,t} \\ + \alpha_3 MarketCap_{j,t-1} \\ + \alpha_4 Returns_{j,t-1} \\ + \alpha_5 ConfidenceMeasure_{j,t} \\ + \beta_i AnalystFixedEffects_i \\ + \gamma_t YearFixedEffects_t \\ + \psi_t IndustryFixedEffects_j \end{pmatrix}. \quad (5)$$

ForecastOptimism_{i,j,t} is a binary variable that equals 1 if analyst *i*'s earnings forecast for firm *j* in year *t* is above firm *j*'s actual earnings in year *t*. *ConfidenceMeasure_{j,t}* refers to the above-described Malmendier and Tate (2005, 2008) measures pertaining to the CEO of firm *j* in year *t*. We assume that Φ is the logistic distribution. We control for the number of days between the forecast announcement date and the fiscal period end (*ForecastAge_{i,j,t}*), the number of analysts covering a particular firm (*#AnalystsCovering_{j,t}*), the natural log of firm market capitalization on the last trading day of the previous year (*MarketCap_{j,t-1}*), and the firm's stock return in the previous year (*Returns_{j,t-1}*).

We estimate Eq. (5) using a conditional logit model, variously including different overconfidence measures, and all including analyst, industry, and year fixed effects.[26] This addresses the incidental parameters problem and allows for consistent estimates of the coefficients of interest while avoiding the estimation of the coefficients of the fixed effects. We cluster standard errors by firm to account for potential correlation in the residuals across years for a given firm.

Table 3 presents the odds ratios of the estimated coefficients from the various regressions, with different columns containing results from models that include different overconfidence measures. *t*-statistics appear in parentheses underneath coefficient estimates. In general, older forecasts, forecasts for larger firms, and forecasts for firms with greater analyst coverage are more likely to be optimistic. Larger firms and firms with positive returns are less likely to have optimistic forecasts.

Consider the coefficients on the variables of primary interest, the portfolio-based and press-based measures, all of which support

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[26] We do not include firm fixed effects since overconfidence measures such as *Longholder* retain a value of either 0 or 1 for a CEO's entire tenure, resulting in near-perfect multicollinearity with firm fixed effects since firms in our sample rarely experience a change in CEO during the sample period. In lieu of firm fixed effects, we include firm-level characteristics to control for potential firm-specific effects.

Table 3
Logit regressions of *ForecastOptimism* on overconfidence measures.

	ForecastOptimism				
	(1)	(2)	(3)	(4)	(5)
ForecastAge	1.0008***	1.0008***	1.0008***	1.0012***	1.0008***
	(4.82)	(4.69)	(4.69)	(4.56)	(4.62)
#AnalystsCovering	1.0085**	1.0090**	1.0090**	1.0044	1.0078**
	(2.29)	(2.25)	(2.25)	(0.73)	(2.00)
MarketCap	1.0356	1.0303	1.0302	1.0890*	1.0348
	(1.20)	(0.93)	(0.92)	(1.75)	(1.08)
Returns (%)	0.9931***	0.9930***	0.9930***	0.9910***	0.9930***
	(−7.04)	(−6.25)	(−6.24)	(−6.02)	(−6.65)
Longholder		1.2558***			
		(2.70)			
Pre-Longholder			1.2469**		
			(2.17)		
Post-Longholder			1.2669**		
			(2.05)		
Holder67				1.1175	
				(1.20)	
TOTALconfident					1.2528***
					(2.69)
TOTALmentions					0.9997
					(−1.03)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Analyst fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
R-squared	0.1297	0.133	0.133	0.182	0.138
Observations	77,570	72,860	72,860	38,349	69,849

This table contains results from fixed-effect logit regressions of *ForecastOptimism* on CEO overconfidence measures and firm-level controls. All regressions include analyst, industry, and year fixed effects. All coefficients are shown as odds ratios. *ForecastOptimism* is an indicator variable that equals 1 if the earnings forecast is above actual earnings and equals 0 otherwise. (Note that we work with the most recent forecast for a given firm, issued no more than twelve months and no less than 30 days prior to the forecast period end date.) All other variables are as defined in Table 1. *t*-statistics are shown in parentheses. Standard errors are clustered by firm.
* Indicate significance at the 10% significance level.
** Indicate significance at the 5% significance level.
*** Indicate significance at the 1% significance level.

Prediction 1. We see odds ratios that are significantly greater than one for the majority of portfolio-based measures of overconfidence (*Longholder*, *Pre-Longholder*, and *Post-Longholder*), as well as on the press-based measure of perceived confidence (*TOTALconfident*). That is, a CEO identified as overconfident (or identified as being publicly perceived as confident) is more likely to have analysts issue optimistic earnings forecasts, even controlling for firm-level features and analyst, industry, and year fixed effects. Results do not differ greatly between the various portfolio-based and press-based measures. Firms with CEOs who hold their options too long, for whom *Longholder* = 1, are roughly 26% more likely to have optimistic analyst forecasts. Firms with CEOs classified as overconfident on the basis of *Pre-Longholder* (or *Post-Longholder*) are about 25% (or 27%) more likely to have optimistic analyst forecasts, and firms with CEOs classified as overconfident based on *Holder67* are also more likely to have optimistic analyst forecasts, but insignificantly so. This is not entirely surprising since the conditions to be classified as *Holder67* are less stringent than the other portfolio-based measures of overconfidence. Additionally, controlling for the influence of *TOTALmentions*, firms with CEOs who are classified as *TOTALconfident* based on their portrayal by the financial press are 25% more likely to have optimistic analyst earnings forecasts. These results are highly economically significant: overconfidence consistently has a greater impact on the likelihood of a forecast being optimistic than any of the other control variables in the regression specification (as reflected by the relative magnitudes of the odds ratios).

5.2. The effect of CEO overconfidence on absolute forecast error

Next we test Prediction 2, which hypothesizes that as a result of overconfident CEOs' increased willingness to voluntarily disclose

information, we should expect higher analyst forecast accuracy and smaller absolute errors in analyst forecasts. We test this prediction using *AbsoluteForecastError* as the dependent variable in the following regression model, estimated using ordinary least squares (OLS):

$$
\begin{aligned}
AbsoluteForecastError_{i,j,t} = {} & \alpha_0 + \alpha_1 ForecastAge_{i,j,t} \\
& + \alpha_2 \#AnalystsCovering_{j,t} \\
& + \alpha_3 MarketCap_{j,t-1} \\
& + \alpha_4 Returns_{j,t-1} \\
& + \alpha_5 ForecastOptimism_{i,j,t} \\
& + \alpha_6 ConfidenceMeasure_{j,t} \\
& + \beta_i AnalystFixedEffects_i \\
& + \gamma_t YearFixedEffects_t \\
& + \psi_t IndustryFixedEffects_j.
\end{aligned} \tag{6}
$$

The explanatory variables used in Eq. (6) are the same as those included in estimating equation (5).[27] Standard errors are clustered by firm. Table 4 reports the results from estimating equation (6). The empirical predictions would permit one-sided hypothesis tests, however we conservatively report the significance of results based on two-tailed tests in all of our models estimated by OLS. As expected, older forecasts tend to have larger absolute errors since less information about future earnings is available for older forecasts than for forecasts issued closer to the end of the

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[27] Regression results are at least as strong for the regressors of interest when *ForecastOptimism* is included as a control variable.

Table 4
OLS regressions of *AbsoluteForecastError* on overconfidence measures.

| | AbsoluteForecastError (%) | | | | |
	(1)	(2)	(3)	(4)	(5)
ForecastAge	0.0223***	0.0200***	0.0200***	0.0179***	0.0209***
	(6.17)	(5.78)	(5.78)	(4.12)	(5.54)
#AnalystsCovering	0.1506**	0.1552**	0.1567**	0.1538*	0.1096
	(2.02)	(2.01)	(2.03)	(1.73)	(1.54)
MarketCap	−6.5409***	−6.5878***	−6.6003***	−4.7723***	−5.9910***
	(−7.03)	(−6.51)	(−6.50)	(−4.62)	(−6.95)
Returns (%)	−0.1073***	−0.1179***	−0.1181***	−0.0832***	−0.0865***
	(−3.46)	(−3.33)	(−3.34)	(−2.84)	(−3.01)
Longholder		−3.4606**			
		(−2.53)			
Pre-Longholder			−4.2809**		
			(−2.49)		
Post-Longholder			−2.4347*		
			(−1.93)		
Holder67				−1.1684	
				(−0.83)	
TOTALconfident					1.7362
					(1.40)
TOTALmentions					0.0073
					(1.53)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Analyst fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
R-squared	0.130	0.133	0.133	0.243	0.136
Observations	77,569	72,859	72,859	38,348	69,848

This table contains coefficient estimates arising from OLS regressions of *AbsoluteForecastError* on CEO overconfidence measures and firm-level controls. All regressions include analyst, industry, and year fixed effects. *AbsoluteForecastError* is the absolute value of the distance between the earnings forecast and the actual earnings, scaled by the stock price of the firm on the day prior to announcement date. *AbsoluteForecastError* is a percentage measure so all coefficients can be interpreted as percentages. (Note that we work with the most recent forecast for a given firm, issued no more than twelve months and no less than 30 days prior to the forecast period end date.) All other variables are as defined in Table 1. *t*-statistics are shown in parentheses. Standard errors are clustered by firm.

  * Indicate significance at the 10% significance level.
  ** Indicate significance at the 5% significance level.
  *** Indicate significance at the 1% significance level.

fiscal year. Surprisingly, forecasts for firms with more analyst coverage also tend to have larger absolute errors. Forecasts for larger firms have smaller absolute forecast errors, which is consistent with the notion that firm size proxies for the quality of the information environment. Additionally, forecasts for firms with higher returns tend to have smaller absolute forecast errors.

Consider the coefficient estimates associated with the primary variables of interest in Table 4. In column (2), we see that firms with CEOs classified as overconfident using *Longholder* have analyst forecasts with absolute errors that are roughly 3.5% smaller than firms with non-Longholder CEOs. Recall from Panel A of Table 1 that the (unconditional) mean *AbsoluteForecastError* is approximately 5.4%. The coefficient estimate on *Longholder* from Table 4 suggests that conditional on having a *Longholder* CEO, the average forecasts error drops to about 1.9%, on average. Moving on to column (3) of Table 4, we see that firms with *Pre-Longholder* and *Post-Longholder* CEOs have absolute forecast errors that are 2.4% and 4.3% smaller, respectively. Firms with overconfident CEOs based on *Holder67* have analyst forecasts with absolute errors that are roughly 1.2% smaller, albeit insignificant, as shown in column (4). On balance, the results for the portfolio-based measure support Prediction 1. CEO confidence as measured using the press-based measure is associated with an insignificant increase in absolute forecast error. A reason for this may be the "necessarily noisier and less precise" nature of this measure, relative to the portfolio-based measures, since it is based on the assessments of outsiders, as emphasized by Malmendier and Tate (2008, page 38).

5.3. The effect of CEO overconfidence on forecast dispersion

In this section, we examine the impact that CEO overconfidence has on forecast dispersion, as defined by the standard deviation of analyst forecasts for a particular firm. Interpreting forecast dispersion as a proxy for differences in opinion or information uncertainty about a stock, we test Prediction 3, which hypothesizes that overconfident CEOs provide more precise information because they overestimate the precision of their information. We estimate the following regression model using OLS, variously including different measures of overconfidence:

$$
\begin{aligned}
ForecastDispersion_{j,t} = {}& \alpha_0 + \alpha_1 \#AnalystsCovering_{j,t} \\
& + \alpha_2 MarketCap_{j,t-1} + \alpha_3 Returns_{j,t-1} \\
& + \alpha_4 ActualEarnings_{j,t} \\
& + \alpha_5 OverconfidenceMeasure_{j,t} \\
& + \gamma_t YearFixedEffects_t \\
& + \psi_t IndustryFixedEffects_j.
\end{aligned} \tag{7}
$$

ForecastDispersion$_{j,t}$ is the standard deviation of the most recent forecasts issued for firm *j* in year *t* (between 12 months and 30 days before the end of the forecast window), scaled by the stock price at the end of the previous fiscal year. Unlike *ForecastOptimism* and *AbsoluteForecastError*, there is only one observation of *ForecastDispersion* for each firm–year because this variable measures the standard deviation across analysts for each firm. Thus, we can only include industry and year fixed effects and firm characteristics as control variables when estimating equation (7). Standard errors are clustered by firm.

Table 5
OLS regressions of *ForecastDispersion* on overconfidence measures.

	ForecastDispersion (%)				
	(1)	(2)	(3)	(4)	(5)
#AnalystsCovering	0.4419*** (6.20)	0.4194*** (5.64)	0.4195*** (5.64)	0.2593*** (4.55)	0.4109*** (5.85)
MarketCap	−6.0523*** (−7.65)	−5.7874*** (−7.26)	−5.7910*** (−7.27)	−4.2667*** (−6.74)	−5.9116*** (−7.86)
Returns (%)	−0.0031 (−0.31)	−0.0021 (−0.15)	−0.0019 (−0.14)	−0.0079 (−0.46)	0.0031 (0.27)
Actual Earnings	−1.2456*** (−3.18)	−1.2656*** (−3.20)	−1.2667*** (−3.20)	−0.7607 (−1.50)	−1.0152** (−2.31)
Longholder		−3.3658*** (−3.29)			
Pre-Longholder			−3.0192** (−2.52)		
Post-Longholder			−3.7719*** (−3.55)		
Holder67				−0.8773 (−0.98)	
TOTALconfident					2.0650** (2.39)
TOTALmentions					0.0090* (1.74)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
R-squared	0.226	0.222	0.223	0.211	0.213
Observations	3,969	3,694	3,694	1,940	3,571

This table reports coefficient estimates for OLS regressions of *ForecastDispersion* on CEO overconfidence measures and firm-level controls. All regressions include industry and year fixed effects. *ForecastDispersion* is the standard deviation of the cross-section (across analysts) of the most recent forecasts issued by analysts for firms in a particular year (issued no more than twelve months and no less than 30 days prior to the forecast period end date), scaled by the stock price at the beginning of the fiscal year. *ForecastDispersion* is shown in percentage form. *ActualEarnings* is the actual earnings realized for the fiscal year which the forecast is issued. All other variables are as defined in Table 1. *t*-statistics are shown in parentheses. Standard errors are clustered by firm.
  * Indicate significance at the 10% significance level.
  ** Indicate significance at the 5% significance level.
  *** Indicate significance at the 1% significance level.

Table 5 contains results from estimating equation (7).[28] In general, forecasts for firms with more analyst coverage tend to be more dispersed. Forecasts for larger firms, and firms with higher returns and higher earnings per share tend to be less dispersed. Turning to the variables of interest, we see that the coefficients on the portfolio-based measures of overconfidence in columns (2) to (4) are negative (and significant for *Longholder*, *Pre-Longholder*, and *Post-Longholder*). Forecasts for firms with CEOs classified as *Longholder* are 3.4% less dispersed and forecasts for with *Pre-Longholder* and *Post-Longholder* CEOs are 3.0% and 3.8% less dispersed, respectively. (Since the mean dispersion is about 6%, this means firms with CEOs identified as overconfident by these measures have forecast errors that are approximately half as dispersed relative to those associated with the firms of non-overconfident CEOs.) These negative coefficients on the overconfidence measures support the argument that a CEO identified as overconfident by the portfolio-based measures overestimates the precision of his information and thus provides more precise information to analysts resulting in less dispersion in the cross-section of analyst forecasts, consistent with Prediction 3.

In column (5), the coefficient estimate on *TOTALconfident* is positive and significant, suggesting that forecasts for firms with CEOs classified as confident using this press-based measure are 2.1% *more* dispersed. As suggested previously, the press-based measures of overconfidence are potentially noisier and less precise than the portfolio-based measures. An alternative explanation

may be that CEOs classified as overconfident using the press-based measure effectively communicate optimism (as shown in Table 3), but lack the innate trait of overconfidence which would cause them to believe their information is more precise and hence convey to analysts information that is more precise. In fact, interpreting forecast dispersion as differences in opinion or information uncertainty, there is *more* disagreement among analysts about the future performance of a firm with a CEO more often described as "confident" and "optimistic" in the press. This is consistent with a story whereby CEOs who strategically convey more confidence than they innately experience may actually increase uncertainty about the true value of their firm.

5.4. Controlling for CEO characteristics

In this section, we examine the effects of overconfidence on *ForecastOptimism*, *AbsoluteForecastError*, and *ForecastDispersion* in a context where we simultaneously control for CEO-specific characteristics. We do this to ensure, to the best of our ability, that the effects we attribute to the overconfidence measures are not arising due to the influence of some other personal characteristic. For brevity, we report results based on only one portfolio-based measure, *Longholder*, but results are similar for *Pre-Longholder*, *Post-Longholder*, and *Holder67*. Since we argue it may capture a different characteristic, we also report results for the press-based measure, *TOTALconfident*.

First, Table 6 shows the pairwise correlations of *Longholder* and *TOTALconfident* with each of the CEO characteristics we consider, including the proportion of firm stock owned by the CEO and his immediate family (as of the end of the year prior to the forecast period), CEO age (in years), whether the CEO is also president and chairman, whether the CEO has had a finance

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[28] Results are similar using *all* analyst forecasts to calculate forecast dispersion, which includes the full set of forecasts (no more than 12 months and no less than 30 days prior to the end of the forecast window) instead of just the most recent forecast that an analyst makes in that window of time for a firm in a particular year.

Table 6
Correlations between overconfidence measures & CEO characteristics.

	Longholder	TOTALconfident	StockOwnership	CEOAge	President&Chairman	FinanceEducation	TechnicalEducation
Longholder	1						
TOTALconfident	0.11	1					
StockOwnership	−0.03	0.06	1				
CEOAge	0.01	0.00	0.04	1			
President&Chairman	−0.02	0.02	−0.02	−0.03	1		
FinanceEducation	0.08	0.05	−0.07	−0.13	−0.04	1	
TechnicalEducation	−0.05	0.00	0.04	−0.01	0.02	−0.11	1
Mean	0.19	0.23	1.97	57.40	0.39	0.38	0.51
Standard deviation	0.39	0.42	6.07	6.73	0.49	0.48	0.50
Observations	3,767	3,663	3,808	4,062	4,050	2,452	2,452

This table contains correlations of the CEO overconfidence measures, *Longholder* and *TOTALconfident*, with CEO characteristics. *Longholder* is an indicator variable that equals 1 for the entire tenure of the CEO with a firm if the CEO at some point during his tenure held until the last year before expiration an option package that was at least 40% in the money. *TOTALconfident* is an indicator variable that equals 1 if the number of "confident" and "optimistic" *confident* mentions for a CEO exceeds the number of "not confident", "not optimistic", "reliable", "cautious", "practical", "conservative", "steady", and "frugal" *conservative* mentions in the financial press. *TOTALconfident* is constructed using the cumulative sum of mentions over all sample years up to but not including the year for which the variable is constructed. *President&Chairman* is binary and equals 1 for CEOs who are also the president and chair. *StockOwnership* is the proportion of company stock owned by the CEO and his immediate family and is measured at the beginning of the year. *FinanceEducation* is binary and equal to 1 for CEOs with an undergraduate or graduate degree in accounting, finance, business (including an MBA), or economics. *TechnicalEducation* is binary and equals 1 for CEOs with an undergraduate or graduate degree in engineering, physics, operations research, chemistry, mathematics, biology, pharmacy, or other applied sciences.

Table 7
OLS regressions of forecast characteristics on overconfidence measures.

	ForecastOptimism		AbsoluteForecastError (%)		ForecastDispersion (%)	
	(1)	(2)	(3)	(4)	(5)	(6)
CEOAge	0.9929	0.9891*	−0.1157	−0.1915*	0.0256	−0.0088
	(−1.16)	(−1.65)	(−1.24)	(−1.79)	(0.37)	(−0.12)
President&Chairman	0.9292	0.9854	−0.6051	−1.0097	−0.4983	−0.6839
	(−0.89)	(−0.17)	(−0.62)	(−0.97)	(−0.90)	(−1.18)
FinanceEducation	1.0768	1.0427	−0.6174	−1.0804	−0.2111	−0.3366
	(0.82)	(0.43)	(−0.46)	(−0.73)	(−0.29)	(−0.46)
TechnicalEducation	0.9730	0.9720	−1.9631	−2.4303*	−0.0095	−0.1342
	(−0.33)	(−0.34)	(−1.59)	(−1.82)	(−0.01)	(−0.18)
StockOwnership (%)	1.0230***	1.0307***	0.1225	0.2682	0.0329	0.0998
	(2.67)	(3.49)	(0.67)	(1.40)	(0.32)	(0.82)
#AnalystsCovering	1.0177***	1.0177***	0.1447	0.1391	0.2995***	0.2905***
	(3.22)	(3.11)	(1.48)	(1.37)	(4.45)	(4.15)
MarketCap	1.0046	1.0150	−5.9007***	−5.8741***	−4.8739***	−4.8865***
	(0.10)	(0.33)	(−5.44)	(−5.31)	(−5.81)	(−5.66)
Returns (%)	0.9937***	0.9929***	−0.0691**	−0.0647*	0.0041	0.0047
	(−4.43)	(−4.96)	(−2.03)	(−1.84)	(0.39)	(0.42)
ForecastAge	1.0006***	1.0007***	0.0170***	0.0176***		
	(2.83)	(2.86)	(5.19)	(5.22)		
Actual Earnings					−0.8053**	−0.7343*
					(−2.24)	(−1.82)
Longholder	1.2394**		−2.4764		−2.1495**	
	(2.07)		(−1.62)		(−2.15)	
TOTALconfident		1.3612***		1.3555		1.4245*
		(3.12)		(1.13)		(1.77)
TOTALmentions		0.9995		0.0062		0.0059
		(−1.52)		(1.36)		(1.29)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Analyst fixed effects	Yes	Yes	Yes	Yes	No	No
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.164	0.173	0.146	0.150	0.237	0.230
Observations	48,463	44,801	48,462	44,800	2,266	2,104

This table contains coefficient estimates for regressions of *ForecastOptimism*, *AbsoluteForecastError*, and *ForecastDispersion* on CEO overconfidence measures. (Note that we work with the most recent forecast for a given firm, issued no more than twelve months and no less than 30 days prior to the forecast period end date.) *ForecastOptimism* is an indicator variable that equals 1 if the earnings forecast is above actual earnings and equals 0 otherwise. *AbsoluteForecastError* is the absolute value of the distance between the earnings forecast and the actual earnings, scaled by the stock price of the firm on the day prior to announcement date. *ForecastDispersion* gis the standard deviation of the cross-section of analyst forecasts for a particular firm, scaled by the stock price at the beginning of the fiscal year. Consequently, this measure is available for each firm–year. *AbsoluteForecastError* and *ForecastDispersion* are shown as percentages. All other variables are as defined in Tables 1 and 6. *t*-statistics are shown in parentheses. Standard errors are clustered by firm.
* Indicate significance at the 10% significance level.
** Indicate significance at the 5% significance level.
*** Indicate significance at the 1% significance level.

education, and whether the CEO has had a technical education.[29]

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[29] Additional data on CEO tenure and vested options are also available; however, CEO tenure is highly correlated with CEO age (0.42) and vested options is highly

correlated with each of the portfolio-based measures of overconfidence since a CEO must hold fully vested options in order to enter the *Longholder* and *Holder67* samples. For this reason, we do not include CEO tenure and vested options in the analyses or regression specifications.

Although the correlations are very small, we see that *Longholder* is positively correlated with CEO age and whether the CEO has had a finance education, and is negatively correlated with stock ownership, whether the CEO is also president and chairman, and whether the CEO has had a technical education. *TOTALconfident* is positively correlated with all CEO characteristic variables. None of the correlations between overconfidence measures and CEO characteristics have a magnitude greater than 0.08.

Table 7 shows the regression results from estimating equations (5) to (7) after controlling for CEO characteristics. Estimates appearing in columns (1) and (2) are odds ratios from estimating logit models to explain *ForecastOptimism* whereas estimates in other columns are standard OLS coefficient estimates associated with the *AbsoluteForecastError* models in columns (3) and (4) and the *ForecastDispersion* models in columns (5) and (6). CEO age is associated with a slightly decreased likelihood of an optimistic forecast and decreased magnitude of *AbsoluteForecastError*, but has little effect on *ForecastDispersion*. The effect of greater CEO stock ownership significantly increases the likelihood of an optimistic forecast, but has little impact on *AbsoluteForecastError* and *ForecastDispersion*. The other CEO characteristics are mostly insignificantly related to the forecast characteristics. Turning our attention to *Longholder*, the estimated coefficients maintain their expected signs for all three of *ForecastOptimism*, *ForecastDispersion*, and *AbsoluteForecastError*. The coefficient estimates remain significant for *ForecastOptimism* and *ForecastDispersion*; the estimate becomes insignificant for *AbsoluteForecastError*. The coefficient estimates on *TOTALconfident* are also similar in magnitude and significance as in the regressions reported in Tables 3 to 5. On balance, our findings are mostly unchanged after having controlled for CEO-specific characteristics.

6. Conclusion

We expect an overconfident CEO should exhibit more optimism about his firm's future performance and should overestimate the precision of his private information resulting in an increased willingness to disclose. These characteristics imply that analyst forecast errors should be more optimistic, more accurate, and more precise for firms with overconfident CEOs.

We find that forecasts for firms with overconfident CEOs have a greater likelihood of being optimistic, perhaps as a result of the more positive information that overconfident CEOs provide. Forecasts for firms with overconfident CEOs also have smaller absolute forecast errors and are less dispersed, suggesting smaller differences in opinion and information uncertainty that arise as a result of higher precision information provided by overconfident CEOs and their increased willingness to disclose. The results using the portfolio-based measure of overconfidence are more mixed, consistent with the press-based measures being noisier and less precise measures, as Malmendier and Tate (2008) describe. We note as well that not all CEOs who portray themselves as confident to the press are necessarily innately confident, and those who are not may not necessarily disclose information more openly. This may help explain the mixed results we find using the press-based measures of overconfidence.

Overall, our findings have implications for market efficiency. A CEO's overconfidence has economically and statistically significantly implications for the quality of analyst forecasts, which in turn has implications for the quality of investor decisions. Further, our findings suggest that the identification of management biases in general may help improve the information environment in which market participants make decisions: analyst forecasts that more accurately represent expected earnings can help to promote a more accurate reflection of firm value in stock prices. If overconfidence can influence the information that CEOs provide to analysts, this opens the door to the possibility that a host of other management characteristics may impact analyst forecast characteristics.

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