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ABSTRACT

I study the effect of chief executive officer (CEO) optimism on CEO compensation. Using data on compensation in US firms, I provide evidence that CEOs whose option exercise behavior and earnings forecasts are indicative of optimistic beliefs receive smaller stock option grants, fewer bonus payments, and less total compensation than their peers. These findings add to our understanding of the interplay between managerial biases and remuneration and show how sophisticated principals can take advantage of optimistic agents by appropriately adjusting their compensation contracts.

1. Introduction

Are optimistic CEOs paid differently? Bertrand and Schoar (2003) and Graham, Li, and Qiu (2012) show that a significant fraction of the variation in corporate practices and executive compensation can be explained by manager fixed effects. The authors interpret these findings as evidence that managerial "style" and latent individual characteristics affect corporate policies, actions, and outcomes. Two latent characteristics that are well documented in the psychology literature (see, e.g., Taylor and Brown, 1988) and have received much attention in economics and finance in the recent past are overconfidence and optimism. A rapidly growing literature has provided ample evidence for their impact on corporate behavior.[1] Ben-David, Graham, and Harvey (2013), for example, find that financial executives are both overconfident and optimistic, and that a firm's investment is increasing in both biases. Landier and Thesmar (2009) show how entrepreneurial optimism affects the choice of debt maturity, and

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[1] Explanations for corporate actions that are based on managerial optimism or overconfidence, of course, go back at least as far as Roll's (1986) hubris hypothesis of corporate takeovers. The distinction between overconfidence and optimism, however, is sometimes blurred in the literature. In this paper, an agent is considered optimistic if he believes that good outcomes are more likely than they really are. An agent is considered overconfident if he believes that information he possesses is more precise than it really is.

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Malmendier and Tate (2005a,b, 2008) and Malmendier, Tate, and Yan (2011) provide evidence that overconfident CEOs display higher investment-cash flow sensitivities, are more acquisitive, and are less likely to rely on equity financing than their peers. Given these findings, a natural question to ask is whether and how such biases in beliefs are reflected in compensation arrangements and incentive schemes: Are optimists paid differently? Do principals design compensation contracts that take advantage of the agents' optimism—and if so, how?

I address these questions by studying the effect of CEO optimism on CEO compensation. I focus on CEOs because their compensation contracts are more likely to be tailored to their individual characteristics than the compensation plans offered to rank-and-file employees. CEO compensation contracts thus provide a laboratory in which the effects of optimism on contract design can be examined.[2] I estimate the effect of optimism on compensation by comparing the remuneration of CEOs who work for the same firm but display different levels of optimism, controlling for differences in the employment period as well as time-varying firm and CEO characteristics. Following this approach and using data on compensation in US firms, I provide evidence that CEOs whose behavior is indicative of optimistic beliefs receive smaller stock option grants, fewer bonus payments, and lower total compensation than their peers. These findings are consistent with the implications of a model in which an unbiased principal can compensate an optimistic agent with fewer incentive claims because an optimist overestimates the claims' future payoffs.

I assess each CEO's optimism with two different measures. The first measure is based on the CEO's option exercise decisions and follows the rationale proposed by Malmendier and Tate (2005a,b, 2008) and Malmendier, Tate, and Yan (2011). Exercises during the final year before the options' expiration date—despite the fact that the options were already deep in the money at the end of the previous year—are classified as “late” and taken as an indication for optimistic beliefs about the company's prospects. The fraction of late option exercises is then used as a proxy for the CEO's optimism. The second measure is based on the earnings forecasts that are voluntarily released by each firm. A forecast that exceeds the ex post realized earnings or, alternatively, the analyst consensus forecast, is classified as “optimistic.” The fraction of forecasts that are classified as optimistic is then used as a proxy for the CEO's optimism. The rationale behind this approach is that optimistic CEOs overestimate their firms' future performance and should thus be more likely than their peers to release inflated earnings forecasts.

The empirical findings presented in this paper are robust to controlling for various CEO- and firm-level characteristics, as well as firm and year fixed effects, and are confirmed in multiple robustness tests. Furthermore, I entertain several alternative explanations and show that they are not sufficient to explain the results. In particular, to address the concern that the CEOs are appointed based on each firm's individual target level of optimism, I model the preferred level of optimism for each firm as the sum of two components: a time-invariant, unobservable base level and a time-varying, linear combination of observable firm characteristics. Controlling for this specification, I do not find any evidence that the empirical findings are explained by differences in firm characteristics, which may be related to both the decision to employ an optimistic CEO as well as to his compensation. Similarly, controlling for differences in firm performance and board characteristics does not change the results. Neither do I find any evidence that the late exercising of in-the-money options can be explained by differences in the CEOs' portfolios of company stock and options, inside information, or procrastination.

Regarding the optimism measure based on the CEOs' forecasting behavior, robustness tests based on analyst consensus estimates confirm that the smaller option grants of optimists are not merely the result of missing a given earnings target. CEOs whose earnings forecasts systematically exceed the contemporaneous analyst estimates receive lower-valued option grants than their peers. Furthermore, controlling for whether or not the realized earnings exceed two salient benchmarks—the prior year's earnings and the analyst consensus forecast—does not change the results. Neither do I find any evidence for a sample selection bias due to the fact that firms choose whether or not to release voluntary earnings per share (EPS) forecasts.

Examining the compensation of CEOs whose earnings forecasts are systematically too low—i.e., too pessimistic—reveals that the results are not driven by the CEOs' inability to produce accurate earnings estimates. Only the CEOs who habitually overestimate their firms' future earnings, i.e., the overly optimistic CEOs, receive fewer incentives and lower total pay than their unbiased counterparts. Pessimistic CEOs, to the contrary, are found to receive larger option and restricted stock grants and more bonus payments than their peers. This suggests that inaccurate forecasts per se are not a sign of lower talent, which in turn causes lower compensation. Moreover, controlling for the confidence that the CEOs place in their own forecasts as measured by the widths of the forecast ranges has no material effect on the results.

Finally, I provide empirical evidence for a negative association between the utilized measures of CEO optimism and the fraction of incentives in the CEOs' total compensation. If the systematic late exercising of in-the-money options and the persistent issuing of inflated earnings forecasts were not driven by optimism but instead by a higher risk-tolerance of the CEOs, then one would expect the opposite result (see, e.g., Bellemare and Shearer, 2010; Grund and Sliwka, 2010; Dohmen and Falk, 2011, Graham, Harvey, and Puri, 2013). The negative association between the optimism measures and the percentage of incentives in the CEOs' total compensation thus suggests that the findings are not explained by a higher risk-tolerance of the CEOs.

The paper contributes to the existing literature on managerial biases and CEO compensation by providing

[2] Whether and how employee optimism may explain the provision of broad-based option plans to employees below the top-management level is examined, for example, by Oyer and Schaefer (2005) and Bergman and Jenter (2007).

empirical evidence that CEO optimism is reflected in CEO compensation. CEOs whose option exercise behavior and earnings forecasts are indicative of optimistic beliefs receive smaller stock option grants, fewer bonus payments, and less total compensation than their peers. These results show how sophisticated principals can take advantage of optimistic agents by optimally adjusting their compensation contracts and highlight the potential benefits of hiring such agents. This finding is consistent with Heaton (2002, p. 34), who notes that "the interests of principals may be served best by the design of mechanisms that exploit managerial irrationality rather than squash it. For example, principals may design incentive mechanisms that underpay irrational agents by exploiting the agents' incorrect assessments of their ability or the firm's risk." The paper thus adds to our understanding of the interplay between managerial beliefs and compensation, which may ultimately help reconcile some of the unexplained heterogeneity in the remuneration of observationally similar individuals.

Finally, the results of my analyses have potentially important implications for empirical studies that aim to assess the effect of compensation and incentive schemes on corporate practices such as investment and capital structure decisions. Managerial optimism affects both corporate actions and remuneration and may thus be an important control variable when estimating the effect of compensation schemes on these actions.

In addition to the new empirical results, the paper also makes two methodological contributions. First, I show how to construct a measure of managerial optimism that follows the rationale proposed by Malmendier and Tate (2005a,b, 2008) and Malmendier, Tate, and Yan (2011) using information from insider trading filings. Second, I propose a new measure of managerial optimism, which is based on a firm's earnings forecasts. Both measures can be constructed using publicly available information from the Thomson Reuters insider filings database and the First Call Historical Database.

Within the existing theoretical literature, the paper is most closely related to the work of Gervais, Heaton, and Odean (2011). In their model, the authors consider an agent who is overconfident and therefore overestimates the precision of a privately available signal regarding the quality of an investment opportunity. If the principal optimally adjusts the agent's pay to this bias, mildly overconfident agents are compensated with less convex contracts than their peers, whereas extremely overconfident agents are compensated with more convex contracts. This paper differs in that I focus on managerial optimism rather than overconfidence. That is, I consider an agent who believes that his projects are intrinsically better than they really are rather than an agent who overestimates the precision of some signal regarding the project's quality.

In the empirical literature, Graham, Harvey, and Puri (2013) is the most closely related work. Using data obtained from psychometric tests, the authors show, among other findings, that CEOs with a higher risk-aversion are less likely to be compensated with performance-based pay, and that CEOs with a higher rate of time preference are more likely to be paid in salary. Other related papers on the effects of managerial biases and personal characteristics on corporate decisions and outcomes include Brown and Sarma (2007) and Doukas and Petmezas (2007) on the impact on acquisitions, and Hribar and Yang (2013) on the impact on forecast behavior and earnings management. Hirshleifer, Low, and Teoh (2012) provide evidence that overconfident CEOs invest more in innovation. Hilary, Hsu, and Segal (2013) show that CEOs become more optimistic after a series of past successes and that more optimistic CEOs appear to exert greater effort. Campbell, Gallmeyer, Johnson, Rutherford, and Stanley (2011) provide evidence regarding the influence on CEO turnover, and Hackbarth (2008, 2009) examines the implications for capital structure decisions. Keiber (2005) considers a setting in which both the principal and the agent are overconfident, and Gervais and Goldstein (2007) show how agents who overestimate the marginal productivity of their effort can ameliorate free-rider and effort coordination problems. Kaplan, Klebanov, and Sorensen (2012) investigate which CEO characteristics are related to hiring decisions, investment decisions, and firm performance.

Potential explanations concerning why agents with biased beliefs may rise to the rank of CEO in the first place are provided, for example, by Englmaier (2007, 2010, 2011) and Goel and Thakor (2008). Furthermore, a large literature in psychology documents a widespread tendency in all humans to be overly optimistic regarding their abilities and their future. As Taylor and Brown (1988, p. 197) summarize: "A great deal of research in social, personality, clinical, and developmental psychology documents that normal individuals possess unrealistically positive views of themselves, an exaggerated belief in their ability to control the environment, and a view of the future that maintains that their future will be far better than the average person's." Evidence that such biases extend to management students, entrepreneurs, and corporate presidents is provided, for example, by Camerer and Lovallo (1999), Cooper, Woo, and Dunkelberg (1988), and Larwood and Whittaker (1977).

2. Hypotheses and data

2.1. Hypotheses

The following section briefly lays out the predicted effect of CEO optimism on CEO compensation. A principal–agent model that formally derives the hypotheses is presented in Appendix A. The intuition is as follows: An optimistic CEO believes good outcomes to be more likely than they really are and thus overestimates the probability of success and the firm's future prospects. It follows that an optimistic CEO overestimates the value of compensation claims that are contingent on successful outcomes because he overestimates the probability that these outcomes will be realized.[3] Fewer incentive claims that are contingent on such outcomes will therefore be sufficient to satisfy the CEO's participation and incentive compatibility constraints. As a consequence, compared to an unbiased

[3] Empirical evidence that optimistic mangers indeed overestimate the value of their stock options is provided, for example, by Sautner, Weber, and Glaser (2010).

CEO, an optimist is willing to accept a compensation contract that specifies fewer incentive claims. Furthermore, using unbiased beliefs to value the claims, the total compensation of an optimistic CEO will be lower than that of his peers.

As a simple example, consider the following setup. Suppose that the CEO accepts only compensation packages that he values at at least $100. Otherwise, he prefers his outside option. Moreover, suppose that at least $36 of the $100 must be provided in the form of incentive pay. Otherwise, the CEO does not exert any effort. Finally, assume that only two compensation instruments are available: dollar bills and incentive claims. Dollar bills are valued equally by the firm's owners and the CEO at $1 each. Incentive claims are valued by the firm's owners at their expected payoff, say at $10 per claim. The risk-averse CEO, however, values incentive claims at less than their expected payoff, say at $6. Thus, the optimal compensation package comprises $64 in cash and six incentive claims. Consider now an optimistic CEO who overestimates the probability that the incentive claims will pay off. This CEO values each incentive claim at more than $6, say at $9. It follows that the optimal compensation package for the optimist comprises $64 in cash and four incentive claims. An optimistic CEO thus receives fewer incentive claims and—valuing claims using unbiased beliefs—lower total compensation than an unbiased CEO.[4] Hypotheses 1 and 2 summarize these predictions:

H1: Lower incentive compensation. More optimistic CEOs receive lower incentive compensation than less optimistic CEOs.

H2: Lower total compensation. More optimistic CEOs receive lower total compensation than less optimistic CEOs.

2.2. Data

To test Hypotheses 1 and 2, I examine the empirical relation between optimism and compensation for CEOs of US firms. I assess a given CEO's optimism with two separate measures. The first measure is based on the CEO's option exercise decisions and follows the rationale proposed by Malmendier and Tate (2005a,b, 2008) and Malmendier, Tate, and Yan (2011). The measure identifies a CEO as optimistic if he holds on to his stock options longer than is expected from a CEO with unbiased beliefs.[5] The intuition behind this approach is that a risk-averse CEO is expected to reduce his exposure to company-specific risk by exercising his stock options early if they are sufficiently deep in the money (see, e.g., Hall and Murphy, 2002; Huddart and Lang, 1996). Thus, holding on to an option until late in the option's life—despite the fact that the option is already deep in the money—is considered evidence for optimistic beliefs about the company's prospects. This rationale is consistent with the principal–agent model presented in Appendix A, in which the delayed exercising of incentive claims arises endogenously as the outcome of an optimist's utility maximization. Hence, the use of delayed option exercises as a proxy for a CEO's optimism provides a close link between the empirical analysis and the theory from which the hypotheses regarding an optimist's compensation are derived.

The second measure is based on the comparison between the earnings per share (EPS) that were forecast by the firm during the CEO's tenure and the EPS that were actually realized. The idea behind this approach is that optimistic CEOs overestimate their firm's future performance and should thus be more likely than their peers to release forecasts that exceed the EPS that are realized ex post. Note that an EPS forecast released by the firm is likely to reflect the CEO's beliefs even though he may not personally compute or announce it: It is unlikely that the CEO would tolerate a forecast with which he strongly disagrees. This intuition is consistent with the findings of Hribar and Yang (2013), who provide evidence that firms run by CEOs who are described as being optimistic in the financial press are indeed more likely to issue forecasts that exceed the earnings that are eventually realized.

I compute both optimism measures for each CEO-firm combination based on each CEO's average behavior during his tenure in a given firm. That is, I aim to capture the CEO's average optimism with respect to the firm. There are two reasons for this approach. First, the proposed measures almost certainly contain some noise that is unrelated to the CEO's optimism. Averaging across all years helps mitigate the influence of such noise on the measures. Second, fluctuations of a CEO's optimism over short horizons are less likely to have an effect on the structure of his compensation than the CEO's average optimism, which is more stable over time.

I use three main data sources for my empirical analysis: information on the CEOs' compensation from Execucomp, information on the CEOs' option exercises from the Thomson Reuters insider filings database, and information on EPS forecasts, analyst consensus estimates, and realized

[4] The example assumes that an optimistic CEO values incentive claims less ($9) than the firm's owners ($10). In other words, the CEO's optimism does not completely undo the effect of his risk-aversion. This is the maintained assumption both in the formal model and in the empirical analysis. A consequence of this assumption is that the CEO's incentive compatibility constraint holds with equality when evaluated at the optimal contract—exactly $36 are provided to the CEO in the form of incentive claims. This is a sufficient condition for a negative effect of the CEO's optimism on the amount of his incentive compensation. If, however, the CEO's incentive compatibility constraint holds with slack, then the amount of incentive pay is not, in general, a monotone function of the CEO's optimism. To illustrate, consider two examples: a very optimistic CEO who values incentive claims at $12.50, and an extremely optimistic CEO who values incentive claims at $50. At the optimum, the first CEO receives eight incentive claims, and the second CEO receives two incentive claims. Thus, neither CEO's incentive compatibility constraint is binding. However, the very optimistic CEO receives more incentive claims than an unbiased CEO, while the extremely optimistic CEO receives less. A formal analysis of the case in which the agent's incentive compatibility constraint is not binding as well as an empirical investigation of a potentially non-monotonic effect of optimism on compensation are presented in Appendix B.

[5] Note that this measure is indeed a measure of optimism in the sense of an overestimation of the firm's mean future cash flows (Malmendier, Tate, and Yan, 2011). Despite differences in terminology—the overestimation of a firm's future prospects, to which I refer as optimism, is sometimes referred to as overconfidence in the literature—the measure is not a measure of overconfidence in the sense of an underestimation of variance.

earnings from the First Call Historical Database. All data on compensation, option exercises, and earnings forecasts are obtained for the years between 1996 and 2005.[6] Furthermore, I obtain financial information from the Center for Research in Security Prices (CRSP) and Compustat as well as data on the firms' board characteristics from RiskMetrics.

2.2.1. Optimism measure based on option exercise decisions ("LongHolder")

The first measure for a CEO's optimism is based on the CEOs' option exercise decisions and follows the rationale proposed by Malmendier and Tate (2005a,b, 2008) and Malmendier, Tate, and Yan (2011). Information on the CEOs' option exercises is obtained from the Thomson Reuters insider filings database. The data files are designed to capture all insider activity as reported on the Securities and Exchange Commission (SEC) Forms 3, 4, 5, and 144, and include additional information concerning the accuracy of the reported data in the form of a cleanse indicator that denotes the overall level of confidence in each record. Corporate insiders—individuals who have access to non-public, material, insider information, including the CEO, are required to file Forms 3, 4, and 5 for transactions involving their companies' stock. For my analysis, Form 4 is the relevant source of information as it indicates changes in an insider's ownership position. This could be a purchase, sale, option grant or exercise, or any other transaction that causes a change in the ownership position.

I start with all Form 4 observations between January 1996 and December 2005 and only keep observations that pertain to exercises of incentive stock options by CEOs and that have cleanse indicators R, H, C, L, or I, indicating a reasonable level of confidence in the accuracy of the data. A description of the different cleanse indicators is provided in Appendix C. Furthermore, I discard observations if the following items are missing: the person ID that uniquely identifies each CEO, the transaction date, the expiration date of the options or information on the number of securities exchanged in the transaction, the transaction price adjusted for stock splits, or the share price on the transaction date. As a final check, I make use of the fact that option exercises are recorded in two separate tables and keep only those observations that are listed in both tables with the same transaction price. After these steps, I am left with a "clean" list of all exercises of incentive stock options.

For all exercise observations, I first calculate the time to expiration at the time of exercise as the difference between the expiration date of the options and the transaction date. During this process, I drop an additional 20 observations with a reported expiration date before the transaction date and four observations with an implied time to expiration of more than 200 years, as these are clearly data entry errors. Each observation in the sample is then matched with the annual closing price of the underlying stock at the end of the preceding calendar year, which I obtain from the CRSP database.[7] I keep only those observations for which price information is available and calculate the moneyness of the options at the end of the previous year as the difference between the closing price of the preceding calendar year and the exercise price divided by the exercise price. All prices are adjusted for stock splits, and observations where the exercise price is zero are dropped.

Then, for each observation, I assign an optimism dummy that takes the value one if the options were exercised within one year of their expiration date and at least 40% in the money at the end of the preceding year. Otherwise, the dummy takes the value zero. My analyses are not sensitive to this cut-off. Consistent with the findings of Malmendier and Tate (2008), the results are similar if I use 20% or 60% instead of 40%.

Finally, I average the value of the optimism dummy for each CEO across all observations that pertain to that CEO within a given firm, weighting each exercise observation by the number of options that were exercised. Weighting observations by the profit that was realized in the transaction—calculated as the product of the number of shares exchanged in the transaction and the difference between the share price on the transaction date and the exercise price—or giving equal weight to all observations, yields similar results. This procedure leads to the variable LongHolder, which can take on values between zero and one—with higher values indicating more optimistic beliefs.

2.2.2. Optimism measure based on EPS forecasts ("HighForecast")

The second measure for a CEO's optimism is based on the comparison of the EPS forecasts released by the firm with the EPS that were eventually realized. More than 70% of all firms in the Execucomp database provide such forecasts during the sample period despite the fact that they are not legally obliged to do so. This finding is consistent with the survey results presented by Graham, Harvey, and Rajgopal (2005): Executives consider EPS the most important performance measure to be communicated to outsiders. The prime motive for voluntarily disclosing such information, according to the survey respondents, is promoting a reputation for transparent and accurate reporting.

I begin my analysis with all company-issued EPS forecasts in the First Call Historical Database that were announced between January 1996 and December 2005. I keep only forecasts for the common stock of each firm and drop observations if the announcement date falls on or after the end of the fiscal period for which the announcement was made, or on or after the date on which

[6] Information on the CEOs' option exercises as recorded in the table pertaining to derivative transactions in the Thomson Reuters insider filings database is available only from 1996 onwards. Information on the Black-Scholes values of the CEOs' option grants is available from the Execucomp database only until 2005 due to changes in the reporting requirements for equity-based compensation (Financial Accounting Standards Board (FASB) 123). A benefit of this data restriction is that the results of the empirical analyses are not confounded by the recent financial crisis.

[7] Matching observations with the stock price as of 12 months before the expiration date of the options as in Malmendier and Tate (2005a,b, 2008) and Malmendier, Tate, and Yan (2011) would lead to a significant drop in the percentage of matched observations (68% versus 92%).

the actual EPS were announced. Furthermore, I drop observations if any of these three dates is missing, or if information on the EPS that were eventually realized is not available. If a firm updates a prior forecast, I only keep the update.

For each forecast and realization pair, I then assign a dummy that indicates whether or not the forecast was "optimistic," relative to the ex post realized EPS. If the forecast was issued in the form of an EPS range (62% of all forecasts), then the dummy variable takes the value one if the lower bound of the range exceeds the EPS that were eventually realized. If the forecast was a point estimate (38% of all forecasts), then the dummy variable takes the value one if this point estimate exceeds the ex post realized EPS. Thereafter, for each year and each firm, I average the dummies across all forecast-realization pairs, thus calculating the fraction of forecasts within each year that were higher than the actual EPS. For each CEO-firm combination, I then calculate the equally weighted average of these fractions across all years. The intuition behind this two-step procedure is to first measure a CEO's optimism on a yearly basis and to then compute the average optimism across all years. I denote the resulting variable HighForecast, which can take on values between zero and one. HighForecast is equal to zero if all EPS forecasts are lower than the EPS that are eventually realized. It is equal to one if all forecasts are higher than the actual EPS. Thus, higher values of the variable HighForecast are indicative of more optimistic beliefs, as higher values denote a larger fraction of forecasts that appear to be too high ex post.

In addition to the optimism measure HighForecast, I construct two additional variables for each CEO-firm combination that are based on the forecasting behavior of the CEOs. The first additional variable, denoted ForecastLead, measures the average number of days between the date on which a forecast was issued and the end date of the relevant fiscal period. On average, the final forecast (or last update) is announced 91 days before the end of the fiscal period. However, forecasts that ex post exceed the realized EPS tend to be issued earlier (on average, 112 days before the fiscal period end date) than forecasts that ex post do not exceed the realized EPS (issued on average 72 days before the end of the fiscal period). To account for such differences in the timing of EPS forecasts, I include ForecastLead as a control variable in all regression analyses that use the optimism measure HighForecast.

The second additional variable, denoted ForecastWidth, measures the average width of the EPS ranges that are forecast by the CEOs. I calculate the relative width of each forecast range as the difference between the upper and the lower bound of the forecast, divided by the midpoint of the range. If the forecast is a point estimate, I set the relative width to zero. Finally, to remove the effect of outliers, I winsorize the variable ForecastWidth at the 1% level.

I control for the average width of the forecast ranges in all regressions that use the optimism measure HighForecast for two reasons. First, range forecasts are classified as optimistic if the lower bound of the forecast exceeds the ex post realized EPS. Thus, all else equal, forecasts that specify a wider range are less likely to be classified as optimistic. Second, the average width of the EPS forecasts can be interpreted as a measure of the CEO's confidence in the forecasts: A more confident CEO should be more likely to issue a narrower forecast range or even a point estimate. Thus, lower values of ForecastWidth are indicative of more confidence. Controlling for each CEO's confidence may be important, because the optimal compensation arrangement may not only be influenced by the CEO's optimism but also by his (over-)confidence as shown, for example, in Gervais, Heaton, and Odean (2011).[8] In addition to ForecastWidth, I also include its squared value in the regression specifications because the results of Gervais, Heaton, and Odean (2011) suggest that the effect of overconfidence on compensation is non-monotonic.

Interestingly, the correlation coefficient between ForecastWidth and HighForecast across all CEO-firm combinations is −0.134 and significant at the 1% level. This is evidence for a positive correlation between optimism and (over-)confidence: More optimistic CEOs are also more confident in their earnings forecasts. The correlation coefficient between ForecastWidth and LongHolder, is −0.072 and significant at the 5% level.

2.2.3. Option characteristics for optimistic and non-optimistic CEOs

Table 1 presents a first glance at the option compensation of optimistic and non-optimistic CEOs. Using information obtained from the Execucomp database, I compute the average Black-Scholes value of the option grants as well as the average number of options awarded per grant for each CEO-firm combination in the sample. Furthermore, I compute the average maturity and moneyness of the options, weighting each grant observation by the number of options that were awarded. Maturity is calculated as the difference in years between the year in which the options were granted and the year in which they expire. Moneyness is the difference between the firm's share price on the grant date and the exercise price divided by the exercise price. To remove the effect of outliers, I winsorize Moneyness at the 1% level.

In addition, using the insider filings data obtained from Thomson Reuters, I compute the average number of years between the vesting date of the options and their expiration date (Exercise window) as well as the average number of years that the CEO waited after the vesting date before exercising his options (Waited until exercised). As before, observations are weighted by the number of exercised options.

The CEOs in the sample are classified based on the optimism measure LongHolder in Panel A and based on HighForecast in Panel B. As can be seen from the first two rows in both panels, the average option grant awarded to an optimist has a lower Black-Scholes value and contains fewer options than the average grant awarded to a non-optimist. Both findings are consistent with Hypothesis 1: More optimistic CEOs receive lower incentive compensation than less optimistic CEOs. The differences

[8] As mentioned in the Introduction, the distinction between overconfidence and optimism is sometimes blurred in the literature. In this paper, an agent is considered overconfident if he believes that information he possesses is more precise than it really is. An optimist, however, simply believes that good outcomes are more likely than they really are.

Table 1

Option characteristics for optimistic and non-optimistic CEOs.

This table presents descriptive statistics for the options that are granted to CEOs who are optimistic and to CEOs who are not optimistic. CEOs are classified based on the optimism measure LongHolder in Panel A and based on HighForecast in Panel B. The sample period is 1996 to 2005. Ln(Black-Scholes value) is the natural logarithm of the average Black-Scholes value of option grants (in $′000). Number of options per grant is the average number of options per grant (in '000). Maturity of granted options is the average difference in years between the year in which the options were granted and the year in which they expire. Moneyness at grant date is the average difference between the share price on the grant date and the exercise price divided by the exercise price. Exercise window is the average number of years between the options' vesting and expiration dates. Waited until exercised is the average number of years the CEO waited until exercising after the options' vesting date. The unit of observation is a CEO-firm combination. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively, for a two-tailed *t*-test of the null hypothesis of equal means against the alternative of unequal means.

Panel A

	Non-optimistic CEOs (LongHolder =0)		Optimistic CEOs (LongHolder =1)		
	N	Mean (Std. dev.)	*N*	Mean (Std. dev.)	Difference (Std. err.)
Ln(Black-Scholes value)	757	7.07	230	6.85	−0.22**
		(*1.20*)		(*1.27*)	(*0.09*)
Number of options per grant	757	196.5	230	158.8	−37.6**
		(*320.9*)		(*202.0*)	(*17.7*)
Maturity of granted options	757	9.42	230	9.05	−0.37***
		(*1.19*)		(*1.74*)	(*0.12*)
Moneyness at grant date (in %)	757	−0.11	230	−0.35	−0.25
		(*2.24*)		(*2.79*)	(*0.20*)
Exercise window	534	7.58	173	6.32	−1.26*
		(*8.95*)		(*7.70*)	(*0.70*)
Waited until exercised	534	3.58	173	6.10	2.52***
		(*8.69*)		(*7.72*)	(*0.70*)

Panel B

	Non-optimistic CEOs (HighForecast =0)		Optimistic CEOs (HighForecast =1)		
	N	Mean (Std. dev.)	*N*	Mean (Std. dev.)	Difference (Std. err.)
Ln(Black-Scholes value)	541	7.07	537	6.95	−0.11
		(*1.25*)		(*1.24*)	(*0.08*)
Number of options per grant	541	243.1	537	198.6	−44.5
		(*567.5*)		(*433.3*)	(*30.7*)
Maturity of granted options	541	9.43	537	9.29	−0.14
		(*1.49*)		(*1.49*)	(*0.09*)
Moneyness at grant date (in %)	541	−0.13	537	−0.08	0.05
		(*2.66*)		(*1.94*)	(*0.14*)
Exercise window	147	6.15	187	7.52	1.37*
		(*3.08*)		(*10.03*)	(*0.78*)
Waited until exercised	147	3.40	187	4.84	1.44*
		(*2.72*)		(*10.10*)	(*0.77*)

in the average Black-Scholes value and in the average number of options per grant are significant at the 5% level in Panel A. In Panel B, the differences are not statistically significant.[9]

On average, the granted options have a maturity that exceeds nine years and are slightly out of the money on the day of the grant. While I do not find any evidence for a statistically significant difference in the average moneyness of the options granted to non-optimists and optimists, Panel A shows that the average maturity of the non-optimists' options is larger than the average maturity of the optimists' options. The difference, however, is economically small. Using a stock price of $33, an annual volatility of 45%, a risk-free rate of 4.9%, a dividend yield of 2.7%, and assuming that the option was granted at the money, the Black-Scholes value of a call option with 9.4 years to maturity is $14.34. The value of an option with 9.1 years to maturity is $14.24. Thus, the difference in maturity translates into a difference in value of $0.10 or 0.7%.[10]

[9] The differences in the average Black-Scholes value and in the average number of options per grant reported in Panel B are significant at the 10% level in a one-sided *t*-test against the alternative that optimists receive lower-valued grants and fewer options per grant than non-optimists.

[10] $33, 45%, and 2.7% are the average stock price, volatility, and dividend yield in the sample. The average risk-free rate used by Execucomp to compute Black-Scholes values during the sample period is 4.9%.

The difference in the average maturity reported in Panel B is even smaller and not statistically significant.

The average time-span between the vesting date of the options and their expiration date is longer than six years for both optimistic and non-optimistic CEOs. Nonetheless, optimistic CEOs wait significantly longer before exercising their options than non-optimistic CEOs. This holds both for CEOs who are classified based on their exercise behavior (Panel A) as well as for CEOs who are classified based on their forecast behavior (Panel B). On average, non-optimists wait about three and a half years before exercising their options (3.6 years in Panel A and 3.4 years in Panel B), while optimists, on average, wait around five to six years, depending on which measure is used to classify CEOs as either optimistic or non-optimistic.

Overall, the results of this analysis suggest that while the maturity and moneyness of the awarded options are comparable for non-optimistic and optimistic CEOs, optimists on average receive smaller and lower-valued grants. Moreover, while on average both non-optimists and optimists are free to exercise their options during a period of at least six years, optimistic CEOs decide to wait significantly longer than non-optimistic CEOs to do so.

2.2.4. Compensation and CEO and firm characteristics

Information on the CEOs' compensation as well as on their holdings of company stock and options is obtained from the Execucomp database and matched with the information on the CEOs' optimism. I keep only observations for which at least one of the optimism measures is available. In addition to the compensation data, I obtain financial and balance sheet information as well as information on the firms' board composition from the CRSP, Compustat, and RiskMetrics databases. For each firm and in each year, I calculate the firm's market capitalization, leverage, market-to-book ratio, and return on assets, as well as the firm's cash holdings and research and development (R&D) and capital expenditures (Capex) scaled by total assets. Leverage is calculated as total long-term debt divided by total assets. The market-to-book ratio is calculated as the sum of the firm's market capitalization and total long-term debt divided by total assets. Return on assets is calculated as earnings before interest and taxes (EBIT) divided by total assets. In addition, I compute the firm's yearly stock returns as well as the standard deviation of the monthly returns over the previous five years. Finally, I calculate the total number of directors and the fraction of independent directors on the firm's board.

I drop observations if there is no information on the CEO's total compensation, salary, or bonus, the Black-Scholes value of option awards or value of restricted stock grants, or if the indicated value of the CEO's total compensation is zero. I also drop one observation for which the sum of the CEO's bonus payments and option and stock grants exceeds the indicated value of his total compensation. Furthermore, I drop observations if information on the CEO's tenure, age, or gender is not available, or if the indicated values of tenure or age are negative. If the variable "age" is missing in the Execucomp data but can be recovered using information from prior or subsequent years, I do not drop the observation.

One assumption of the model used to derive the hypotheses regarding the effect of optimism on compensation is that contingent claims are necessary to incentivize the CEO. This assumption is important because the CEO's optimism affects his compensation through the overvaluation of such claims. To focus on cases that are more consistent with the assumptions of the model, I thus drop observations if the CEO has neither received any incentive stock options during the current year nor in any preceding sample year. In that case, an optimistic CEO cannot hold on to his options or overestimate their value as is implied by my model.[11] After this step, I am left with a final sample of 11,477 observations, covering 2,559 CEOs and 1,889 firms. A total of 601 of these firms change CEOs at least once during the sample period. However, of the 2,559 CEOs, I observe only 27 as CEO in more than one firm.

3. Empirical analysis and results

3.1. Summary statistics

Table 2 presents summary statistics for the final sample of 11,477 observations.[12] Information on the CEOs' compensation is presented in Panel A, and information on the CEOs' tenure, age, and gender, as well as on the two optimism measures LongHolder and HighForecast, is presented in Panel B. The average total compensation per year is about $5.7 million. The standard deviation is large ($11.9 million), and the maximum exceeds $600 million. The mean salary, bonus, and value of restricted stock grants are $0.67, $0.85, and $0.56 million per year, respectively, and the average Black-Scholes value of option grants is $3.1 million. The average fraction of incentive pay—bonus, restricted stock, and stock options—in the CEOs' total compensation is 65%.

The average tenure and age of the CEOs is seven and 55 years, respectively, and 98% of the observations pertain to male CEOs. The mean value of the optimism measure LongHolder across all observations is 0.32. The average value of the variable HighForecast across all observations is 0.49, indicating that on average, the CEOs meet or beat their own earnings forecasts slightly more often than they miss them.

The standard deviation of the variable LongHolder across all observations is 0.41, and the standard deviation of HighForecast is 0.37. The standard deviation of LongHolder between firms is 0.39, and the within-firm standard

(*footnote continued*)
The summary statistics presented in Table 1 suggest that virtually all options are granted at the money.

[11] If I keep these observations, the empirical results are weaker, but qualitatively unchanged.

[12] The sample size for the optimism measure LongHolder (6,955) is smaller than for HighForecast (10,147) because I can match fewer CEOs in the Execucomp database with CEOs in the Thomson Reuters insider filings database than I can match firms in Execucomp with firms in the First Call Historical Database.

Table 2
Summary statistics.

This table presents summary statistics for the final sample of 11,477 observations. The sample period is 1996 to 2005. The variables are as follows: Total compensation is the CEO's total compensation (Execucomp item TDC1). Salary is the CEO's salary. Bonus is the amount of bonus payments. Restricted stock is the dollar value of restricted stock grants. Options is the Black-Scholes value of option awards. Incentives/Total compensation is the sum of Bonus, Restricted stock, and Options divided by Total compensation. Tenure is the number of years since the CEO has been appointed. Age is the CEO's age during the year of the observation. Male is a dummy variable that takes the value one if the CEO is male. LongHolder is the measure of CEO optimism that is based on the CEOs' option exercise decisions. HighForecast is the measure of CEO optimism that is based on the discrepancy between the firms' EPS forecasts and the eventually realized EPS. Compensation variables are reported in $'000.

Panel A

Variable	Observations	Mean	Median	Std. dev.	Min	Max
Total compensation	11,477	5,664	2,914	11,938	0	600,347
Salary	11,477	670	619	351	0	5,807
Bonus	11,477	846	450	1,538	0	43,512
Restricted stock	11,477	560	0	2,284	0	74,750
Options	11,477	3,087	1,042	10,654	0	600,347
Incentives/Total compensation	11,477	0.65	0.71	0.24	0.00	1.00

Panel B

Variable	Observations	Mean	Median	Std. dev.	Min	Max
Tenure	11,477	7.0	5.0	6.8	0.0	52.0
Age	11,477	55.1	55.0	7.0	29.0	86.0
Male	11,477	0.98	1.00	0.12	0.00	1.00
LongHolder	6,955	0.32	0.00	0.41	0.00	1.00
HighForecast	10,147	0.49	0.47	0.37	0.00	1.00

Panel C

Exercise observations per CEO-firm combination		Fraction of CEO-firm combinations	
Mean	8.0		
Median	4.0	LongHolder $=0$	55%
Std. dev.	13.1	LongHolder $\in (0,1)$	28%
Min	1.0	LongHolder $=1$	17%
Max	161.0		

Panel D

Forecast observations per CEO-firm combination		Fraction of CEO-firm combinations	
Mean	6.7		
Median	4.0	HighForecast $=0$	24%
Std. dev.	6.5	HighForecast $\in (0,1)$	52%
Min	1.0	HighForecast $=1$	24%
Max	35.0		

deviation is 0.11. For the variable HighForecast, the standard deviation between firms is 0.34, and the within-firm standard deviation is 0.15. The correlation coefficient between LongHolder and HighForecast is 0.05 and significant at the 1% level. Thus, the CEOs' behavior displays a certain degree of consistency: Those CEOs who are more prone to making forecasts that are too high are also more likely to hold on longer to their in-the-money options.

Panel C presents summary statistics for the number of exercise observations for each CEO-firm combination as well as information on the distribution of the optimism measure LongHolder. On average, there are eight exercise decisions for each CEO-firm combination in the sample. The maximum is as high as 161. For 55% of all CEO-firm combinations, the value of LongHolder is zero, i.e., none of the options exercised by the CEO were exercised within one year of their expiration date and were at least 40% in the money at the end of the preceding year. For 17% of all CEO-firm combinations, the value of LongHolder is one, i.e., all options were exercised within one year of their expiration date, and all of them were at least 40% in the money at the end of the year that precedes the exercise date. Thus, for 72% of all CEO-firm combinations, the CEO exercises either always late or never late. Changes in the exercise behavior of a given CEO in a given firm are observed for only 28% of all CEO-firm pairs.

Summary statistics for the number of forecast observations as well as information on the distribution of the optimism measure HighForecast are presented in Panel D. The mean number of EPS forecast observations per CEO-firm combination is 6.7, and the maximum is 35. For 24% of all CEO-firm combinations, the forecast EPS are always lower than or equal to the EPS that were eventually realized (HighForecast $=0$). For another 24% of all CEO-firm combinations, the forecast earnings always exceed the actual earnings (HighForecast $=1$). For the majority of CEO-firm combinations (52%), the forecast EPS are sometimes too high and sometimes too low ($0<$ HighForecast <1).

3.2. Regression analyses

3.2.1. CEO selection and firm characteristics

This section presents the results of regression analyses concerning the effect of a CEO's optimism on the different components of his compensation as well as on his total compensation. A natural concern regarding these analyses is that optimistic CEOs are not randomly assigned to the companies for which they work. Different firms may have different levels of "preferred optimism" and appoint their CEOs accordingly.

A growing literature in finance and economics has documented various effects that biased managers may have on corporate policies, and the trade-off between the costs and benefits of hiring an optimistic CEO may vary from firm to firm. In particular, firms may differ in the amount of damage that an optimistic CEO may cause by implementing "bad projects." Little damage may be caused, for example, if good projects can be easily distinguished from bad ones and if powerful control mechanisms can be put in place to validate project proposals. However, if a lot of discretion must be left to the CEO, and if choosing between projects is particularly difficult, the firm's owners may prefer not to appoint an optimist if selecting the wrong project would cause a lot of damage. This reasoning suggests that differences in firm characteristics may help explain why some firms employ more optimistic CEOs than others.

Table 3, Panel A, displays a comparison of firm characteristics for companies that hire optimistic or non-optimistic CEOs. Panel B compares the characteristics of firms that hire a new CEO who is more optimistic than the firm's previous CEO and the characteristics of firms that change to a CEO who is less optimistic than the previous CEO. All firm characteristics are measured at the end of the year preceding the (new) CEO's appointment.[13]

Panel A reveals that firms that hire optimistic CEOs on average have a lower market-to-book ratio, a lower standard deviation of stock returns, hold less cash (scaled by total assets), and have lower R&D expenditures (scaled by total assets) than firms that hire non-optimistic CEOs.[14] To the extent that more R&D-intensive firms, firms with more growth opportunities, and firms with more volatile stock returns are firms for which project selection is particularly important while distinguishing between good and bad projects is particularly difficult, these results are consistent with the intuition outlined above. Such firms may prefer a lower level of optimism and may thus be less likely to appoint optimistic CEOs. Furthermore, CEOs in firms with larger cash holdings may have more discretion in implementing projects without the approval of the providers of outside financing. This is consistent with the finding that firms with larger cash holdings appear to be less likely to hire optimists.

Panel B focuses on firms that change to a new CEO. The data reveal that the differences in firm characteristics are much less pronounced between firms that change to a new CEO who is more optimistic than the previous CEO and firms that change to a less optimistic CEO. The average market-to-book ratios and cash holdings are not significantly different between the two groups of firms. The differences in the standard deviations of the monthly stock returns and the firms' R&D expenditures remain significant—but only at the 10% level. The differences in all other characteristics are not statistically significant.

Overall, Panel A provides some evidence that firm characteristics that may be related to the ability to limit the damage that a biased manager can cause by implementing value-decreasing projects may be associated with the likelihood of hiring a more or a less optimistic CEO. Panel B, however, reveals that there are only a few and weakly significant differences between the companies that hire a CEO who is more optimistic than his predecessor and those that hire a less optimistic CEO. Nevertheless, to address the concern that each firm employs its CEO according to its preferred level of optimism, I include a dummy variable for each firm as well as the natural logarithm of the firm's market capitalization, the standard deviation of the monthly stock returns during the previous five years, and the firm's leverage, market-to-book ratio, cash holdings, and R&D expenditures as control variables in the compensation regressions. Untabulated robustness tests confirm that using the "historical" values of the firm characteristics—measured at the end of the year that precedes the CEO's appointment—instead of the contemporaneous values does not change my findings.

Note that the regression specification models each firm's preferred level of optimism as the sum of two components: a time-invariant, unobservable base level and a time-varying component that can be expressed as a linear function of the included firm characteristics. The crucial identification assumption for my analyses is

[13] In Panel A, CEOs for which the optimism measure LongHolder or HighForecast is equal to 1 (0) are classified as optimistic (non-optimistic). CEOs for which LongHolder is equal to 1 (0) but HighForecast is equal to 0 (1) are dropped from the sample. In Panel B, new CEOs are classified as more (less) optimistic than the previous CEO if the value of LongHolder or HighForecast is higher (lower) than for the previous CEO. Cases with an increase (decrease) in LongHolder but a decrease (increase) in HighForecast are dropped from the sample.

[14] The variable "R&D expenditures divided by total assets" is missing for 53% of the observations in the sample. To avoid dropping such a large fraction of the data, I set missing values equal to zero. Replacing missing values instead with the average R&D intensity of all firms within the

(*footnote continued*)
same industry (based on the first two digits of the standard industrial classification (SIC) code and calculated on a yearly basis) or dropping observations for which the R&D intensity is missing does not change the finding that firms that hire optimistic CEOs have lower R&D intensities than firms that hire non-optimistic CEOs. In the compensation regressions presented in Section 3.2.4, the dummy variable "R&D missing" takes the value one if the variable "R&D expenditures divided by total assets" has been set to zero due to a missing value.

Table 3
Firm characteristics.
This table presents summary statistics for various firm characteristics. The sample period is 1996 to 2005. In Panel A, CEOs for which the optimism measure LongHolder or HighForecast is equal to 1 (0) are classified as optimistic (non-optimistic). CEOs for which LongHolder is equal to 1 (0) but HighForecast is equal to 0 (1) are dropped from the sample. In Panel B, new CEOs are classified as more (less) optimistic than the previous CEO if the value of LongHolder or HighForecast is higher (lower) than for the previous CEO. Cases with an increase (decrease) in LongHolder but a decrease (increase) in HighForecast are dropped from the sample. All characteristics are measured at the end of the year that precedes the year in which the (new) CEO was appointed. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively, for a two-tailed *t*-test of the null hypothesis of equal means against the alternative of unequal means.

Panel A: Firms with non-optimistic or optimistic CEOs

	CEO is non-optimistic		CEO is optimistic		
	N	Mean (Std. dev.)	*N*	Mean (Std. dev.)	Difference (Std. err.)
MktCap	791	5,881	437	6,584	702
		(*18,822*)		(*27,683*)	(*1,484*)
Assets	880	8,677	475	9,910	1,232
		(*41,582*)		(*35,101*)	(*2,135*)
Sales	876	4,095	475	4,646	550
		(*11,624*)		(*11,424*)	(*655*)
Leverage	874	0.19	472	0.18	−0.01
		(*0.20*)		(*0.17*)	(*0.01*)
MtB	784	1.64	435	1.38	−0.26***
		(*1.87*)		(*1.46*)	(*0.10*)
Return	750	0.07	414	0.05	−0.01
		(*0.71*)		(*0.48*)	(*0.04*)
Std.return	772	0.13	426	0.11	−0.02***
		(*0.07*)		(*0.05*)	(*0.004*)
Cash/Assets	847	0.08	443	0.07	−0.01**
		(*0.11*)		(*0.10*)	(*0.006*)
R&D/Assets	880	0.04	475	0.03	−0.02***
		(*0.16*)		(*0.06*)	(*0.006*)
Capex/Assets	819	0.06	444	0.07	0.001
		(*0.06*)		(*0.06*)	(*0.003*)
EBIT/Assets	859	0.08	468	0.08	0.00
		(*0.16*)		(*0.17*)	(*0.01*)

Panel B: Firms that change their CEO

	New CEO is less optimistic		New CEO is more optimistic		
	N	Mean (Std. dev.)	*N*	Mean (Std. dev.)	Difference (Std. err.)
MktCap	290	15,170	133	9,650	−5,520
		(*40,706*)		(*27,554*)	(*3,380*)
Assets	290	16,060	133	20,922	4,863
		(*58,291*)		(*106,100*)	(*9,816*)
Sales	290	8,886	133	6,324	−2,562
		(*22,041*)		(*12,601*)	(*1,694*)
Leverage	287	0.19	132	0.18	−0.01
		(*0.15*)		(*0.15*)	(*0.02*)
MtB	287	1.90	132	1.74	−0.16
		(*2.15*)		(*2.68*)	(*0.27*)
Return	287	0.02	133	−0.02	−0.03
		(*0.59*)		(*0.55*)	(*0.06*)
Std.return	288	0.13	133	0.14	0.01*
		(*0.06*)		(*0.07*)	(*0.01*)
Cash/Assets	282	0.08	131	0.09	0.01
		(*0.09*)		(*0.12*)	(*0.012*)
R&D/Assets	290	0.04	133	0.03	−0.01*
		(*0.06*)		(*0.04*)	(*0.005*)
Capex/Assets	280	0.05	130	0.06	0.003
		(*0.04*)		(*0.05*)	(*0.005*)
EBIT/Assets	290	0.09	133	0.09	0.00
		(*0.12*)		(*0.08*)	(*0.01*)

therefore that the difference between a CEO's actual level of optimism and a firm's preferred level of optimism—modeled as described—is as good as randomly assigned (conditional on covariates).

An alternative way to address the concern that optimistic CEOs are not randomly assigned would be to estimate a “Heckman style” treatment effects model. However, several aspects render this approach unappealing in my setup. First, the measures of CEO optimism are continuous, and using a binary variable for optimistic CEOs instead would lead to a significant loss of information. Second, an incidental parameters problem would prevent me from including firm dummies in the first stage of the selection model. This is particularly unfortunate, as unobserved firm characteristics are probably the prime reason for any selection concern in the first place. Third, in the absence of an instrument for CEO optimism, the control function derived from the selection model would amount to nothing more than a nonlinear combination of the control variables that are already included in my specification. For these reasons, I opt to address the selection concern instead by modeling each firm's target level of optimism as described above.

3.2.2. Corporate governance and firm performance

A further concern one may have is that differences in governance and firm performance are systematically related to the CEO's option exercise and forecast behavior as well as to his compensation. A powerful board of directors may influence both the CEO's decisions to exercise his stock options and the firm's EPS forecasts. Moreover, some CEOs may receive less compensation than their peers because of their firm's poor performance. To address these concerns, I include the size of each firm's board, the percentage of independent directors, and the CEO's tenure, as well as each firm's stock return during the fiscal year and return on assets (EBIT divided by total assets) as additional control variables in the regressions. Finally, I include control variables for the CEO's gender and age as well as dummy variables for each sample year.[15]

3.2.3. Regression specification

In summary, I estimate regressions of the following form:

$$\begin{aligned}\text{Ln}(y_{ijt}+1) = {} & \alpha+\beta \cdot OptimismMeasure_{ij} \\ & +\gamma' FirmCharacteristics_{ijt}+\delta' CEOCharacteristics_{ijt} \\ & +\zeta' Firm_j+\eta' Year_t+\varepsilon_{ijt}, \end{aligned} \tag{1}$$

where i, j, and t denote CEOs, firms, and years. That is, I estimate the effect of optimism on pay by comparing the compensation of CEOs who work for the same firm but display different levels of optimism, controlling for time-varying firm and CEO characteristics as well as differences in the employment period.

Using $\text{Ln}(y+1)$ as the dependent variable, where y denotes the compensation variable of interest (in \$′000), allows me to include observations where the value of the compensation variable is equal to zero. Untabulated regressions using $\text{Ln}(y)$ for $y>0$ as the dependent variable confirm my main findings. Furthermore, regressions in which I replace the dependent variable with a dummy that takes the value one if $y>0$ provide some evidence that optimistic CEOs are less likely than their peers to receive option grants and bonus payments.

OptimismMeasure is the measure of CEO optimism (either LongHolder or HighForecast). *FirmCharacteristics* is a vector of time-varying firm characteristics. *CEOCharacteristics* is a vector of dummy variables for the CEO's gender, age, and tenure. I include age and tenure dummies rather than linear and quadratic terms to allow for a more general relation between these variables and the CEO's compensation.[16] The estimation results, however, are not sensitive to this choice of specification. Finally, to account for heterogeneity and correlation of the error terms across observations that pertain to the same firm, I calculate heterogeneity-robust standard errors that allow for clustering at the firm level in all specifications.

3.2.4. The effect of CEO optimism on CEO compensation

Table 4 presents the results regarding the effect of a CEO's optimism on the different components of his compensation as well as on his total compensation. The sample sizes reported in Table 4 are smaller than those reported in Table 2 due to the limited availability of some of the control variables.

Panel A displays the results for the regressions using the optimism measure LongHolder. Panel B displays the results using HighForecast. The first column in both panels reveals a negative and substantial association between the CEO's optimism and the Black-Scholes value of his option grants. The coefficient estimate on LongHolder is −0.752, and the estimate for HighForecast is −0.514. Both are significant at the 5% level. These results can be interpreted as evidence that CEOs who are more prone to holding on to their stock options despite the fact that the options are already deep in the money and CEOs who are more likely to announce EPS forecasts that prove to be too high ex post indeed receive lower-valued option grants than their peers. The coefficient estimates imply that an increase in the value of LongHolder (HighForecast) by one within-firm standard deviation leads to a decrease of about 8% (7%) in the Black-Scholes value of the CEO's option grants. Thus, the regression results are supportive of Hypothesis 1 and indicative of a negative relation between a CEO's optimism and the value of his option awards that is both statistically and economically significant.

Regarding the value of restricted stock grants, neither Panel A nor Panel B provide evidence for a significant effect of the CEO's optimism. The coefficient estimate on

[15] Using earnings before interest, taxes, depreciation, and amortization (EBITDA) instead of EBIT to compute a firm's return on assets yields very similar results. Untabulated regressions furthermore reveal that additionally including the G-Index of Gompers, Ishii, and Metrick, (2003), the E-Index of Bebchuk, Cohen, and Ferrell (2009), or the number of years since the firm's initial public offering (IPO) ("firm age") has virtually no effect on the estimation results. Similarly, untabulated regressions that include interaction terms between the measures of CEO optimism and the size of the board, the percentage of independent directors, and the CEO's tenure provide very little systematic evidence that the effect of optimism on compensation varies with a firm's board characteristics or the CEO's tenure.

[16] The first age dummy takes the value one if the CEO's age is 40 years, the second takes the value one if the CEO's age is 41 years, and so on. Finally, the 32nd dummy takes the value one if the CEO's age is above 70 years (1.5% of all observations). I do not include a dummy for CEOs who are younger than 40 years of age (1.2% of all observations). The first tenure dummy takes the value one if the CEO's tenure is one year, the second takes the value one if the CEO's tenure is two years, and so on. Finally, the 21st dummy takes the value one if the CEO's tenure is more than 20 years (4.9% of all observations in my sample). I do not include a dummy for the year in which the CEO is appointed (tenure=0).

Table 4
Effect of CEO optimism on CEO compensation.

This table presents the regression results regarding the effect of CEO optimism on CEO compensation. The sample period is 1996 to 2005. LongHolder is the optimism measure based on the CEO's option exercise behavior. HighForecast is the optimism measure based on the EPS forecast behavior. ForecastLead is the average number of days between the date on which a forecast was issued and the end date of the fiscal period for which the forecast was made. ForecastWidth is the average width of the range of forecast EPS scaled by the midpoint of the range. Options is the Black-Scholes value of option awards. Rst.stock is the value of restricted stock grants. Bonus, Salary, and Total are the CEO's bonus payments, salary, and total compensation. MktCap is the firm's market capitalization. Std.return is the standard deviation of stock returns during the prior 60 months. Leverage is the ratio of total long-term debt to total assets. MtB is the ratio of the sum of the firm's market capitalization and total long-term debt to total assets. Cash/Assets is the firm's cash holdings scaled by total assets. R&D/Assets is the firm's R&D expenditures scaled by total assets. R&D missing is a dummy variable for observations for which R&D/Assets is set to zero due to missing values. Boardsize is the number of directors on the firm's board, and Independent is the percentage of independent directors. Return is the firm's stock return during the current fiscal year. EBIT/Assets is the firm's EBIT divided by total assets. Heterogeneity-robust standard errors that allow for clustering at the firm level are reported in parentheses. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Panel A

	Ln(Options+1)	Ln(Rst.stock+1)	Ln(Bonus+1)	Ln(Salary+1)	Ln(Total+1)
LongHolder	−0.752**	0.521	−0.783***	−0.213	−0.201**
	(*0.330*)	(*0.492*)	(*0.268*)	(*0.133*)	(*0.085*)
Ln(MktCap)	0.635***	0.244**	0.980***	0.073	0.457***
	(*0.099*)	(*0.100*)	(*0.100*)	(*0.045*)	(*0.027*)
Std.return	−0.338	−0.377	4.126***	−0.585	0.287
	(*1.134*)	(*1.178*)	(*0.941*)	(*0.468*)	(*0.315*)
Leverage	−0.588	0.274	0.216	0.087	0.019
	(*0.504*)	(*0.475*)	(*0.469*)	(*0.073*)	(*0.117*)
MtB	0.014	−0.002	−0.072***	0.000	0.005
	(*0.019*)	(*0.024*)	(*0.022*)	(*0.011*)	(*0.008*)
Cash/Assets	−0.122	0.382	0.673	−0.167	0.283
	(*0.743*)	(*0.673*)	(*0.641*)	(*0.171*)	(*0.200*)
R&D/Assets	0.043	2.785*	3.819**	0.417	0.206
	(*1.213*)	(*1.423*)	(*1.860*)	(*0.333*)	(*0.403*)
R&D missing	0.309	−0.340	0.324	−0.169	−0.005
	(*0.503*)	(*0.380*)	(*0.314*)	(*0.119*)	(*0.093*)
Boardsize	0.034	−0.032	−0.064**	0.013	−0.001
	(*0.033*)	(*0.040*)	(*0.029*)	(*0.012*)	(*0.007*)
Independent	0.130	0.757	−0.044	0.204*	0.065
	(*0.428*)	(*0.481*)	(*0.365*)	(*0.109*)	(*0.103*)
Return	−0.096	0.069**	0.185	−0.007	−0.047
	(*0.069*)	(*0.029*)	(*0.138*)	(*0.009*)	(*0.029*)
EBIT/Assets	−0.055	0.769	7.166***	0.327*	0.423*
	(*0.821*)	(*0.630*)	(*0.842*)	(*0.199*)	(*0.251*)
Firm, year, tenure, age, and gender dummies	Yes	Yes	Yes	Yes	Yes
R^2	0.482	0.582	0.533	0.672	0.766
N	5,777	5,777	5,777	5,777	5,777

Panel B

	Ln(Options+1)	Ln(Rst.stock+1)	Ln(Bonus+1)	Ln(Salary+1)	Ln(Total+1)
HighForecast	−0.514**	−0.213	−0.638***	−0.071	−0.143*
	(*0.255*)	(*0.312*)	(*0.224*)	(*0.090*)	(*0.074*)
ForecastLead	0.002**	0.000	0.001	0.000	0.000
	(*0.001*)	(*0.001*)	(*0.001*)	(*0.001*)	(*0.000*)
ForecastWidth	0.272	−0.170	−1.125	−0.338	0.015
	(*1.383*)	(*1.966*)	(*1.489*)	(*0.838*)	(*0.501*)
ForecastWidth^2	−0.468	−0.628	1.175	0.346	0.144
	(*1.506*)	(*2.008*)	(*1.616*)	(*0.805*)	(*0.551*)
Ln(MktCap)	0.691***	0.116	0.856***	0.091***	0.427***
	(*0.086*)	(*0.085*)	(*0.092*)	(*0.031*)	(*0.025*)
Std.return	−1.529	1.575	3.007**	−0.613	0.098
	(*1.382*)	(*1.275*)	(*1.281*)	(*0.423*)	(*0.351*)
Leverage	−0.620	0.934**	−0.207	0.052	−0.001
	(*0.422*)	(*0.417*)	(*0.400*)	(*0.105*)	(*0.103*)
MtB	0.003	−0.007	−0.064***	−0.008	0.001
	(*0.019*)	(*0.021*)	(*0.021*)	(*0.007*)	(*0.010*)

Table 4 (*continued*)

Panel B

	Ln(Options+1)	Ln(Rst.stock+1)	Ln(Bonus+1)	Ln(Salary+1)	Ln(Total+1)
Cash/Assets	0.612	−0.258	1.501***	−0.165	0.251
	(0.667)	(0.600)	(0.551)	(0.120)	(0.181)
R&D/Assets	−0.197	2.552*	3.333**	0.660	0.385
	(1.450)	(1.471)	(1.536)	(0.469)	(0.538)
R&D missing	0.032	−0.557	0.122	−0.087	−0.119
	(0.352)	(0.364)	(0.259)	(0.069)	(0.074)
Boardsize	0.016	−0.023	−0.062**	0.026*	−0.010
	(0.027)	(0.035)	(0.028)	(0.013)	(0.007)
Independent	0.155	0.320	0.100	0.222**	−0.072
	(0.378)	(0.402)	(0.302)	(0.105)	(0.093)
Return	−0.114*	0.123***	0.297	−0.009	−0.048*
	(0.068)	(0.028)	(0.186)	(0.008)	(0.026)
EBIT/Assets	0.346	0.417	8.558***	0.047	0.595**
	(0.680)	(0.575)	(0.771)	(0.174)	(0.239)
Firm, year, tenure, age, and gender dummies	Yes	Yes	Yes	Yes	Yes
R^2	0.447	0.534	0.519	0.732	0.723
N	8,238	8,238	8,238	8,238	8,238

the optimism measure LongHolder in the second column of Panel A is 0.521. The estimate for HighForecast in Panel B is −0.213. Neither estimate is statistically significant at any conventional level. However, for more than 70% of the observations in the sample, the CEO does not receive any restricted stock grants at all. Untabulated regressions in which I replace $\text{Ln}(y+1)$ with $\text{Ln}(y)$ for $y>0$ provide some evidence that, conditional on receiving restricted stock grants, the value of these grants tends to be lower for optimistic CEOs than for their peers.

The third column of Table 4 presents the results for the regressions regarding the amount of bonus payments that the CEO receives. Both panels provide further evidence in support of Hypothesis 1. The coefficient estimates on the optimism measures are negative and significant at the 1% level in Panels A and B, resembling the results for the value of the options that are granted to the CEO. The point estimate of −0.783 (−0.638) for the coefficient on LongHolder (HighForecast) in Panel A (B) implies a reduction of around 8% (9%) in the amount of bonus payments for an increase in the value of LongHolder (HighForecast) by one within-firm standard deviation. This indicates an economically significant effect of optimism on the amount of bonus payments that the CEO receives.

The fourth column shows the results for the effect on the CEO's salary. The coefficient estimates on the optimism measures LongHolder in Panel A and HighForecast in Panel B are negative, but not significantly different from zero. Thus, these regressions do not provide significant evidence for a negative relation between a CEO's optimism and his yearly salary.

Finally, column 5 presents the results for the effect on the CEO's total compensation. Both panels reveal negative and significant coefficient estimates for the optimism measures LongHolder (Panel A) and HighForecast (Panel B). The point estimate for LongHolder is −0.201 and significant at the 5% level. This implies a reduction in the CEO's total compensation of around 2% for an increase in the variable LongHolder by one within-firm standard deviation. The coefficient estimate on HighForecast is −0.143, significant at the 10% level, and also implies a reduction by about 2% for an increase in the optimism measure by one within-firm standard deviation. Thus, both panels provide evidence for a negative effect of a CEO's optimism on his total compensation and are supportive of Hypothesis 2. The negative association between a CEO's optimism and his total compensation is of course not entirely surprising, given the results regarding the negative impact of optimism on the value of the option grants and bonus payments.

3.2.5. The effect of CEO optimism on discretionary cash bonuses

In the model that is used to derive the predictions regarding the effect of optimism on compensation, the different compensation claims are specified ex ante so that the CEO's participation and incentive compatibility constraints are satisfied. The CEO's optimism affects these constraints and, through this channel, the compensation claims. Compensation components, however, that are not specified to satisfy these constraints (but chosen for any other reason) will not be affected: If the optimal amount of such payments does not depend on the participation and incentive compatibility constraints, then it does not depend on the CEO's optimism either.

A case in point are discretionary cash bonuses. In the model, such bonuses are not part of the optimal contract. Instead, all bonuses are specified ex ante and contingent on verifiable performance targets. In the data, however, some bonuses may be awarded ex post and at the discretion of the board. To the extent that the amount of these bonuses does not depend on the CEO's participation and incentive compatibility constraints, there should be no relation between the realized bonuses and the CEO's optimism. To test this prediction, I examine whether the effect of CEO optimism on the amount of bonus payments is weaker if the total bonuses I observe are more likely to contain a larger fraction of discretionary bonuses.

De Angelis and Grinstein (2012) hand-collect information on CEO compensation in Standard & Poor's (S&P) 500 firms from the 2007 proxy statements. They find that during the fiscal year 2007, cash bonuses that the firms reported as "non-equity-awards" were more likely to be awarded for achieving pre-specified performance targets, while cash bonuses that the firms reported as "annual cash bonuses" were more likely to be awarded at the discretion of the board. Building on this finding, I use the fraction of presumably discretionary bonuses that are reported during the fiscal year 2007 as a proxy for the fraction of discretionary bonuses during my sample period. That is, for each firm in my sample, I define

$$D_{2007} \equiv \frac{\textit{Annual cash bonuses in } 2007}{\textit{Annual cash bonuses in } 2007 + \textit{Non-equity-awards in } 2007} \tag{2}$$

and include the interaction between D_{2007} and the measures of CEO optimism as an additional variable in the regressions relating the amount of total bonus payments to the CEO's optimism.[17]

Table 5 presents the results.[18] The coefficient estimates on the optimism measures are negative and significant at the 1% level. The coefficient estimates on the interaction terms with D_{2007} are positive and significant at the 5% level. Further, unreported hypothesis tests reveal that the sum of the coefficients on the optimism measures and the interaction terms is not statistically different from zero. That is, the null hypothesis that CEO optimism does not affect the bonuses in firms that only report presumably discretionary bonuses in 2007 cannot be rejected.

The empirical results presented in Tables 4 and 5 thus provide evidence that, on average, CEO optimism has a negative effect on the amount of bonus payments that the CEO receives. This finding is consistent with the predictions of my model if the bonuses are largely the result of compensation schemes that were designed to satisfy the CEO's participation and incentive compatibility constraints ex ante.[19] Indeed, De Angelis and Grinstein (2012) find that 86% of the firms in their sample use pre-specified performance awards while only 20% use discretionary bonuses. The finding that the effect of CEO optimism is weaker if the bonuses are more likely to be discretionary is consistent with my model to the extent that the amount of such bonuses is determined ex post, at the discretion of the board, and independent of the CEO's participation and incentive compatibility constraints ex ante.

4. Alternative explanations and robustness checks

4.1. Alternative explanations for the late exercising of in-the-money options

A potential concern one may have is that the optimism measure LongHolder is confounded by variables other than optimism that influence the CEO's exercise behavior.[20] Low dividend yields, board pressure, or inside information, for example, may cause some CEOs to exercise their options later than their peers. Moreover, some CEOs may simply procrastinate and therefore exercise their options at the last moment before they expire.

However, while such circumstances may influence the exercise behavior of the CEOs, it is not clear that they will bias the results of the subsequent analyses. To the extent that dividend yields, board pressure, and the access to inside information are time-invariant firm-level characteristics, they will be absorbed by the firm fixed effects in the compensation regressions. Moreover, in unreported conditional logit models with firm fixed effects, I do not find any evidence that a firm's dividend yield or the size of the board and the percentage of inside directors have a significant influence on the decision to hold in-the-money options until the last year before expiration. Unreported regressions furthermore confirm that including a firm's dividend yield (dividends paid in year t divided by the stock price at the end of year $t-1$) in the compensation regressions does not change the results.

Regarding the effect of inside information, Malmendier and Tate (2005a,b, 2008) and Malmendier, Tate, and Yan (2011) show that, on average, the CEOs do not profit from holding on to their options and would have been better off by exercising earlier and investing the proceeds in the stock market. This finding is inconsistent with an alternative story that explains the decision to hold on to the options with inside information. Consistent with these results, I find that in my sample, the options that were exercised "late" by the CEOs were on average deeper in the money at the end of the preceding year than on the exercise date. Thus, the CEOs would have been better off by exercising earlier than by holding on to the options, which is inconsistent with an explanation based on inside information. Both findings are consistent with the results of Jenter (2005), who uses insider trading patterns to identify divergences in top managers' perceptions of fundamental value and market valuations and finds little evidence that the use of inside information can explain the trading behavior.

Concerning procrastination as an alternative explanation for the late exercising of the options, I examine whether or not the CEOs have filed any other insider

[17] The sample average of D_{2007} is 0.16. For 75% (12%) of the observations in my sample, D_{2007} is equal to zero (one). I do not include D_{2007} itself because I include firm fixed effects in each regression.

[18] The reported sample sizes are smaller than in Table 4 because I cannot obtain information on the amount of bonuses reported as "annual cash bonuses" and "non-equity-awards" in 2007 for all firms in my sample.

[19] The intuition is that an optimistic CEO believes ex ante that the contingencies under which he will receive the bonus payments (e.g., that a certain performance target will be met) are more likely than they really are. Thus, for a given performance target, an optimistic CEO will agree ex ante to a lower promised bonus than his peers. Or, alternatively, for a given promised bonus, an optimist will agree ex ante to a higher performance target. The lower promised bonuses that were sufficient to satisfy the optimistic CEO's incentive compatibility and participation constraints ex ante will then translate into lower realized bonuses ex post. This effect occurs on average as well as conditional on realized performance, consistent with the empirical finding that the bonuses of optimistic CEOs are lower even after controlling for firm performance.

[20] Malmendier and Tate (2005a, 2008), and Malmendier, Tate, and Yan (2011) provide a detailed discussion.

Table 5
Effect of CEO optimism on discretionary cash bonuses.

This table presents regression results regarding the effect of CEO optimism on bonus payments in firms that are more likely to use a larger fraction of discretionary bonuses. The sample period is 1996 to 2005. D_{2007} is the ratio of bonuses reported as "annual cash bonuses" to the sum of bonuses reported as "annual cash bonuses" and bonuses reported as "non-equity-awards" during the fiscal year 2007. All other variables are defined as in Table 4. Heterogeneity-robust standard errors that allow for clustering at the firm level are reported in parentheses. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	Ln(Bonus+1)	Ln(Bonus+1)
LongHolder	−0.997***	
	(0.337)	
LongHolder x D_{2007}	2.319**	
	(1.134)	
HighForecast		−0.988***
		(0.268)
HighForecast x D_{2007}		1.859**
		(0.744)
ForecastLead		0.001
		(0.001)
ForecastWidth		−2.555
		(1.880)
ForecastWidth^2		2.758
		(2.093)
Ln(MktCap)	0.851***	0.833***
	(0.128)	(0.104)
Std.return	3.208***	2.905***
	(1.222)	(1.112)
Leverage	0.293	−0.241
	(0.570)	(0.467)
MtB	−0.090*	−0.080**
	(0.054)	(0.039)
Cash/Assets	−0.233	0.986
	(0.773)	(0.659)
R&D/Assets	1.999	3.026
	(2.518)	(2.230)
R&D missing	0.090	0.268
	(0.335)	(0.332)
Boardsize	−0.063*	−0.033
	(0.035)	(0.034)
Independent	0.096	0.026
	(0.428)	(0.350)
Return	0.120	0.190
	(0.111)	(0.149)
EBIT/Assets	8.198***	8.796***
	(1.242)	(1.061)
Firm, year, tenure, age, and gender dummies	Yes	Yes
R^2	0.503	0.493
N	4,022	5,685

transactions in the year (the two years) prior to the exercise observations. In 73% (82%) of all cases in which an option exercise satisfies the LongHolder criteria, the CEO filed at least one other transaction in the prior year (the two prior years). This result resembles the findings in Malmendier and Tate (2008). Moreover, these percentages are the same for exercise observations that do not fulfill the LongHolder criteria. Thus, there does not appear to be any evidence that the CEOs simply procrastinate when it comes to exercising their options.

Finally, one may be concerned that some CEOs may be more risk-tolerant or more diversified than others and therefore hold on longer to their in-the-money options. These concerns are particularly hard to tackle, as I have little means to directly assess a given CEO's risk-aversion, nor do I observe the CEO's entire wealth portfolio. However, additional analyses based on the CEOs' holdings of company stock and options and the fraction of incentives in the CEOs' total compensation that are presented in Section 4.5 provide evidence that the empirical findings are unlikely to be explained by systematic differences in the CEOs' diversification or risk-tolerance.

4.2. EPS forecasting and sample selection

A potential concern regarding the previous analyses using the optimism measure HighForecast is that this variable can only be constructed for CEO-firm combinations for which at least one EPS forecast is available. Firms, however, are not obliged to provide such forecasts and decide whether or not to do so voluntarily. If the determinants of the decision to provide EPS forecasts—and thus, whether or not to enter into my sample—are correlated with the determinants of the CEO's compensation, then the previous analyses may suffer from a sample selection bias. This section provides empirical evidence that alleviates these concerns.

Table 6 provides summary statistics for all firms in the Execucomp database that do issue EPS forecasts during my sample period and those that do not. In addition to the firm characteristics already examined in Section 3, Table 6 also shows summary statistics for the variable ForecastIssued, which indicates whether or not a firm has issued at least one EPS forecast during a given year. Furthermore, the table presents summary statistics for five additional variables that have been shown in the literature (e.g., Hribar and Yang, 2013) to be associated with the decision to issue EPS forecasts: #Analysts is the number of analysts that provide EPS forecasts for the firm. Equity issue is a dummy variable indicating whether or not the firm has issued equity during the year. Debt issue is a dummy variable indicating whether or not the firm has issued debt during the year. Earnings volatility is the standard deviation of each firm's income before extraordinary items scaled by total assets (computed over the prior five years). Inst. ownership is the fraction of institutional owners among the firm's shareholders. Information on the number of analysts that follow a firm comes from the First Call Historical Database. Data on equity issuance are obtained from Thomson One, and data on debt issuance come from Compustat. Information on each firm's institutional ownership is obtained from Thomson-Reuters 13F data.

Several results emerge from the comparison of firm characteristics. First, more than 70% of all firms issue EPS forecasts. Second, the firms that do issue forecasts do not do so every year: The conditional mean of the variable ForecastIssued is 0.56, indicating that the firms issue EPS forecasts about every other year. Third, firms issuing EPS forecasts differ from firms not issuing forecasts. In

Table 6
Forecast issuers and non-issuers.

This table presents summary statistics for various firm characteristics. The sample period is 1996 to 2005. The unit of observation is a firm. For each firm, each characteristic is averaged across all sample years. ForecastIssued is a dummy variable indicating whether or not a firm has issued at least one EPS forecast during a given year. #Analysts is the number of analysts that provide EPS forecasts for the firm. Equity issue is a dummy variable indicating whether or not the firm has issued equity during the year. Debt issue is a dummy variable indicating whether or not the firm has issued debt during the year. Earnings volatility is the standard deviation of each firm's income before extraordinary items scaled by total assets (computed over the prior five years). Inst. ownership is the fraction of institutional owners among the firm's shareholders. All other variables are defined as in Table 4. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively, for a two-tailed *t*-test of the null hypothesis of equal means against the alternative of unequal means.

	Firms issuing EPS forecasts		Firms not issuing EPS forecasts		
	N	Mean (Std. dev.)	*N*	Mean (Std. dev.)	Difference (Std. err.)
ForecastIssued	1,923	0.56	770	0.00	−0.56***
		(*0.26*)		(*0.00*)	(*0.01*)
MktCap	1,922	5,876	761	3,562	−2,313***
		(*18,617*)		(*11,942*)	(*606*)
Assets	1,923	9,710	767	8,519	−1,191
		(*47,203*)		(*32,015*)	(*1,580*)
Sales	1,923	3,950	767	2,428	−1,521***
		(*10,682*)		(*8,612*)	(*395*)
Leverage	1,921	0.19	767	0.21	0.02***
		(*0.15*)		(*0.19*)	(*0.01*)
MtB	1,920	1.88	760	1.58	−0.30***
		(*1.91*)		(*1.93*)	(*0.08*)
Return	1,920	0.15	753	0.15	0.00
		(*0.32*)		(*0.53*)	(*0.02*)
Std.return	1,918	0.14	749	0.12	−0.02***
		(*0.07*)		(*0.07*)	(*0.003*)
Cash/Assets	1,908	0.09	760	0.09	−0.01
		(*0.10*)		(*0.11*)	(*0.005*)
R&D/Assets	1,923	0.03	767	0.03	0.00
		(*0.06*)		(*0.11*)	(*0.004*)
Capex/Assets	1,900	0.056	718	0.062	0.006*
		(*0.05*)		(*0.08*)	(*0.003*)
EBIT/Assets	1,905	0.09	714	0.00	−0.08**
		(*0.10*)		(*0.97*)	(*0.04*)
#Analysts	1,923	9.7	770	4.9	−4.7***
		(*6.19*)		(*5.86*)	(*0.25*)
Equity issue	1,923	0.42	770	0.28	−0.14***
		(*0.49*)		(*0.45*)	(*0.02*)
Debt issue	1,923	0.88	770	0.76	−0.12***
		(*0.33*)		(*0.43*)	(*0.02*)
Earnings volatility	1,922	0.07	765	0.15	0.08
		(*0.16*)		(*2.20*)	(*0.08*)
Inst. ownership	1,702	0.62	615	0.51	−0.11***
		(*0.18*)		(*0.21*)	(*0.01*)

particular, forecast issuers are on average larger, have lower leverage, a higher market-to-book ratio, and more volatile stock returns. They also have lower capital expenditures and a higher return on assets. Finally, firms that issue EPS forecasts are followed by more analysts, more likely to issue equity and debt in a given year, and have higher institutional ownership.

Given these findings, I conduct two analyses in order to alleviate the concern that the differences in firm characteristics lead to biased estimates of the effect of CEO optimism on CEO compensation. First, I show that controlling for each firm's analyst following, earnings volatility, and institutional ownership, as well as the decision to issue equity or debt, does not change the results. Second, I estimate a Heckman selection model whose results corroborate my previous findings.

Table 7 presents the results from regressions that include the variables #Analysts, Equity issue, Debt issue, Earnings volatility, and Inst. ownership as additional controls. The coefficient estimate on the optimism measure HighForecast in the regression pertaining to the CEO's option grants is −0.630 and significant at the 5% level (column 1). For the CEO's bonus payments, the coefficient estimate is −0.672 and significant at the 1% level (column 3). For the CEO's total compensation, the estimate is −0.169 and significant at the 10% level (column 5). Regarding the amount of restricted stock that the CEO receives and his salary, the coefficient estimates on HighForecast are negative, but not statistically significant.

Overall, the negative and significant coefficient estimates on the optimism measure HighForecast in columns 1, 3, and 5 confirm the results of the previous analyses. Controlling for known determinants of the decision to issue an EPS forecast does not change the finding that optimistic CEOs receive fewer incentives and lower total compensation than their peers.

Table 7
Controlling for known determinants of the decision to issue EPS forecasts.

This table presents regression results after including known determinants of the decision to issue an EPS forecast as additional control variables. The sample period is 1996 to 2005. All variables are defined as in Tables 4 and 6. Heterogeneity-robust standard errors that allow for clustering at the firm level are reported in parentheses. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	Ln(Options+1)	Ln(Rst.stock+1)	Ln(Bonus+1)	Ln(Salary+1)	Ln(Total+1)
HighForecast	−0.630**	−0.448	−0.672***	−0.098	−0.169*
	(0.267)	(0.328)	(0.258)	(0.089)	(0.087)
ForecastLead	0.003**	0.000	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
ForecastWidth	0.995	−0.061	−0.511	0.386	0.098
	(1.549)	(1.883)	(1.594)	(0.710)	(0.569)
ForecastWidth^2	−1.274	−0.379	0.586	−0.398	0.060
	(1.648)	(1.979)	(1.712)	(0.655)	(0.605)
Ln(MktCap)	0.572***	0.197*	0.898***	0.051**	0.426***
	(0.097)	(0.101)	(0.110)	(0.022)	(0.030)
Std.return	−1.553	1.159	3.234**	−0.354	0.146
	(1.473)	(1.168)	(1.278)	(0.348)	(0.356)
Leverage	−0.346	0.837*	−0.191	0.125	0.030
	(0.461)	(0.446)	(0.432)	(0.108)	(0.109)
MtB	0.016	−0.013	−0.072***	−0.002	0.001
	(0.018)	(0.022)	(0.023)	(0.005)	(0.010)
Cash/Assets	0.566	−0.746	1.344**	−0.096	0.217
	(0.706)	(0.607)	(0.572)	(0.118)	(0.189)
R&D/Assets	0.872	2.022	2.954*	0.688	0.474
	(1.500)	(1.486)	(1.561)	(0.493)	(0.561)
R&D missing	0.122	−0.460	0.160	−0.011	−0.082
	(0.386)	(0.333)	(0.286)	(0.032)	(0.075)
Boardsize	0.009	−0.015	−0.060**	0.023***	−0.010
	(0.030)	(0.039)	(0.026)	(0.007)	(0.007)
Independent	−0.011	0.415	0.116	0.162	−0.099
	(0.408)	(0.411)	(0.321)	(0.106)	(0.101)
Return	−0.099	0.095***	0.258	−0.003	−0.049*
	(0.065)	(0.025)	(0.181)	(0.007)	(0.027)
EBIT/Assets	0.511	−0.012	8.388***	0.112	0.542**
	(0.731)	(0.613)	(0.814)	(0.182)	(0.264)
#Analysts	0.034**	−0.017	−0.043***	0.002	0.000
	(0.013)	(0.013)	(0.013)	(0.003)	(0.004)
Equity issue	−0.104	−0.261**	0.187*	0.034	0.035
	(0.140)	(0.124)	(0.105)	(0.025)	(0.034)
Debt issue	−0.118	−0.078	−0.188**	0.004	−0.033
	(0.093)	(0.088)	(0.076)	(0.013)	(0.025)
Earnings volatility	−0.252	0.313	−0.385	−0.080	−0.355**
	(0.510)	(0.388)	(0.545)	(0.152)	(0.179)
Inst. ownership	0.718	0.182	0.715*	0.075	0.097
	(0.496)	(0.472)	(0.434)	(0.113)	(0.120)
Firm, year, tenure, age, and gender dummies	Yes	Yes	Yes	Yes	Yes
R^2	0.449	0.543	0.519	0.769	0.716
N	7,125	7,125	7,125	7,125	7,125

Table 8 presents the results of a Heckman selection model. The first column shows the first-stage probit regression which models the selection into the sample. CEO-firm combinations enter the sample if at least one EPS forecast is released during the CEO's tenure. Thus, whether or not a CEO-firm combination appears in the sample during a given year depends on the determinants of the decision to issue a forecast during all sample years. For that reason, I model the selection indicator InSample for each CEO-firm combination in the Execucomp database as a function of the average values of #Analysts, Equity issue, Debt issue, Earnings volatility, and Inst. ownership during the CEO's tenure. In addition, I include the CEO and firm characteristics that are used in the compensation regressions as well as dummies for the different sample years. The variables ForecastLead and ForecastWidth can only be constructed if at least one EPS forecast is available. Thus, they can only be included in the second-stage regressions, but not in the first-stage. Finally, to avoid an incidental parameters problem in the probit specification, I include industry dummies based on the first three digits of each firm's SIC code instead of dummies for each firm.

Columns 2 to 6 present the results of the second stages. As in the previous compensation regressions, all specifications include the variables HighForecast, ForecastLead, ForecastWidth, and ForecastWidth^2, as well as CEO and

Table 8
Heckman selection model for the decision to issue an EPS forecast.

This table presents regression results from a Heckman selection model. The sample period is 1996 to 2005. The first column shows the results from the first-stage probit specification. Columns 2 to 6 present the results from the second-stage regressions. All variables are defined as in Tables 4 and 6. Avg. #analysts, Avg.equity issue, Avg.debt issue, Avg.earn.vol., and Avg.inst.own. denote the average values of the corresponding variables (computed across all sample years for each CEO-firm combination). Inverse Mills' ratio is the inverse Mills' ratio (computed using the first-stage results). Industry dummies are formed based on the first three digits of the firms' SIC codes. Heterogeneity-robust standard errors that allow for clustering at the firm level are reported in parentheses in columns 2 to 6. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	InSample	Ln(Opt.+1)	Ln(Rst.st.+1)	Ln(Bon.+1)	Ln(Sal.+1)	Ln(Total+1)
HighForecast		−0.604**	−0.475	−0.755***	−0.090	−0.174**
		(0.268)	(0.324)	(0.253)	(0.090)	(0.086)
ForecastLead		0.003**	0.000	0.001	0.000	0.000
		(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
ForecastWidth		1.048	−0.170	−0.370	0.366	0.087
		(1.593)	(1.910)	(1.601)	(0.725)	(0.575)
ForecastWidth^2		−1.379	−0.261	0.305	−0.390	0.030
		(1.709)	(2.072)	(1.733)	(0.686)	(0.620)
Ln(MktCap)	−0.112***	0.656***	0.161	0.876***	0.061***	0.436***
	(0.021)	(0.094)	(0.098)	(0.095)	(0.022)	(0.029)
Std.return	−0.737*	−1.524	1.153	2.976**	−0.329	0.065
	(0.378)	(1.424)	(1.176)	(1.294)	(0.356)	(0.351)
Leverage	−0.046	−0.524	0.594	−0.255	0.124	−0.012
	(0.131)	(0.447)	(0.433)	(0.418)	(0.101)	(0.107)
MtB	−0.021**	0.009	0.003	−0.060***	−0.001	0.003
	(0.009)	(0.020)	(0.022)	(0.021)	(0.006)	(0.011)
Cash/Assets	−0.480**	0.441	−0.473	1.497***	−0.087	0.222
	(0.211)	(0.705)	(0.602)	(0.573)	(0.116)	(0.191)
R&D/Assets	−2.208***	0.408	2.808*	3.398**	0.756*	0.534
	(0.441)	(1.586)	(1.589)	(1.621)	(0.417)	(0.556)
R&D missing	−0.190***	0.107	−0.449	0.205	−0.010	−0.078
	(0.064)	(0.387)	(0.332)	(0.286)	(0.031)	(0.076)
Boardsize	0.038***	0.011	−0.023	−0.068**	0.021***	−0.011
	(0.008)	(0.030)	(0.039)	(0.027)	(0.007)	(0.007)
Independent	0.533***	0.072	0.297	0.120	0.139	−0.109
	(0.115)	(0.433)	(0.443)	(0.327)	(0.109)	(0.104)
Return	0.006	−0.117	0.104***	0.279	−0.004	−0.050*
	(0.024)	(0.072)	(0.024)	(0.182)	(0.006)	(0.027)
EBIT/Assets	0.830***	0.511	−0.049	8.480***	0.079	0.529*
	(0.203)	(0.762)	(0.649)	(0.821)	(0.184)	(0.273)
Avg.#analysts	0.073***	0.026	−0.012	−0.052*	0.005	0.004
	(0.004)	(0.030)	(0.037)	(0.030)	(0.011)	(0.010)
Avg.equity issue	0.315***	−0.215	−0.125	−0.006	0.152	0.189
	(0.118)	(0.532)	(0.576)	(0.481)	(0.190)	(0.177)
Avg.debt issue	0.233***	0.123	0.850***	−0.653**	0.031	0.042
	(0.063)	(0.256)	(0.326)	(0.300)	(0.080)	(0.079)
Avg.earn.vol.	−0.018	0.351	1.449**	0.371	−0.010	0.205
	(0.249)	(0.649)	(0.729)	(1.049)	(0.277)	(0.251)
Avg.inst.own.	0.658***					
	(0.122)					
Inverse Mills' ratio		0.126	−0.682	−0.335	−0.118	−0.040
		(0.632)	(0.699)	(0.575)	(0.193)	(0.183)
Industry dummies	Yes	No	No	No	No	No
Firm dummies	No	Yes	Yes	Yes	Yes	Yes
Year, tenure, age, and gender dummies	Yes	Yes	Yes	Yes	Yes	Yes
R^2	–	0.447	0.542	0.517	0.769	0.717
N	9,188	7,153	7,153	7,153	7,153	7,153

firm characteristics and dummies for each year and each firm. In addition, I include the variables Avg.#analysts, Avg. earn.vol., Avg.equity issue, and Avg.debt issue. I assume that the average institutional ownership during a CEO's tenure satisfies the exclusion restriction. Thus, the variable Avg.inst.own. is not included in the second-stage regressions. Untabulated specifications, however, that include Avg.inst.own. also in the second-stage lead to very similar results. Finally, I include the inverse Mills' ratio obtained from the first-stage probit model. The standard errors of the coefficient estimates are clustered at the firm level, as before.

Two main results can be obtained from the second-stage regressions. First, the coefficient estimates on the optimism measure HighForecast are negative and significant in the regressions pertaining to the CEO's option grants (column 2), bonus payments (column 4), and total compensation (column 6). Furthermore, the magnitudes of the estimates are similar to the magnitudes presented in Tables 4 and 7. If anything, the estimated effect of optimism on the different compensation components is slightly larger. Second, the estimated coefficients on the inverse Mills' ratio are not statistically significant in any of the regressions. Together, these findings confirm the previous results and suggest that the estimated effects of CEO optimism on the various compensation variables do not suffer from a serious sample selection bias driven by each firm's decision on whether or not to provide EPS forecasts.

4.3. Earnings targets, EPS forecasts, and earnings management

Regarding the evidence for a negative relation between the fraction of EPS forecasts that exceed the EPS that are eventually realized and the CEO's compensation, one may be concerned that it is precisely because a forecast was not met that the CEO receives lower pay as some form of punishment. This explanation is consistent with a negative effect of the CEO's optimism on his compensation if his optimism leads the CEO to agree to performance targets ex ante that prove to be too high ex post. However, the same result may arise if the CEO's compensation in a given year depends on whether or not the firm meets its own earnings forecast, and all CEOs are unbiased and randomly miss or meet their forecasts with equal probability. In such a setting, in each year, some CEOs would miss their forecasts and therefore receive lower pay—and ex post, they would appear to be optimistic.

The fact that the variable HighForecast is not the fraction of earnings forecasts that were too high during the year under consideration, but a weighted average of the fraction of exceedingly high forecasts across all years, mitigates this concern. If the CEOs truly miss or meet their EPS forecasts with equal probability, then the value of HighForecast would tend towards 0.5 for all CEOs. While the CEOs' compensation in each year would be negatively related to the fraction of missed forecasts in that particular year, it would be unrelated to the variable HighForecast, which measures the average fraction of forecasts that proved to be too high across all years. Nonetheless, the nature of my data allows for several additional analyses.

4.3.1. Beating salient earnings benchmarks

One way to address the aforementioned concern that some CEOs receive less compensation because the realized earnings fall short of the firms' earnings targets is to construct control variables that indicate whether or not the firms' EPS exceed various EPS benchmarks. Two salient benchmarks are the EPS that were realized during the prior year and the analyst consensus forecast for the firm's earnings (see, e.g., Graham, Harvey, and Rajgopal, 2005; Matsunaga and Park, 2001).

For each firm and fiscal period, I construct the analyst consensus forecast as follows: First, I obtain all analyst forecasts from the First Call Historical Database that were issued during the sample period. As for the forecasts issued by the firms, I then keep only analyst forecasts for the common stock of each firm and drop observations if the forecast date falls on or after the end of the fiscal period for which the forecast was made or if either date is missing. In case a broker issues multiple forecasts for the same fiscal period—i.e., a broker updates his forecast—I keep only the latest forecast. Furthermore, I drop observations if the broker ID that uniquely identifies each forecast issuer is missing, and I keep only forecasts that were issued at least 30 days before the end of the fiscal period and require that at least three analyst forecasts are available. I apply a 30-day cut-off to ensure that a firm has sufficient time before the end of the fiscal period to update its own forecast in response to the analysts' forecasts. If a firm chooses not to update its own forecast after observing the analysts' forecasts, I interpret this behavior as a sign that the firm is content with its original forecast. Finally, I calculate the analyst consensus estimate as the median analyst forecast for each firm and fiscal period combination. Defining the consensus as the equally weighted average analyst forecast leads to very similar results.

Using the analyst consensus estimate and the EPS of the prior year as benchmarks, I now construct two variables to control for each firm's EPS performance in the regressions. I first define dummy variables that take the value one if the EPS in a given quarter exceed the EPS that were realized during the same quarter of the prior year. Similarly, I define dummy variables that take the value one if the realized EPS in a given quarter exceed the analyst consensus forecast for this quarter. For each firm and in each year, I then compute the average of the dummy variables that indicate whether or not the EPS exceed the previous year's EPS as well as the average of the dummy variables that indicate whether or not the EPS exceed the analyst consensus forecast. I denote these averages BeatLastYearEPS and BeatConsensusEstimate, respectively.

Table 9 displays the results of regressions in which BeatLastYearEPS and BeatConsensusEstimate have been added as additional control variables. Panel A displays the results using the optimism measure LongHolder, and Panel B displays the results for the optimism measure HighForecast. As before, the coefficient estimates on the optimism measures in both panels are negative and significant in the regressions pertaining to the CEOs' option grants and bonus payments. Regarding the CEOs' total compensation, the coefficient estimate on LongHolder (Panel A) is negative and significant at the 10% level. The coefficient estimate on HighForecast (Panel B) remains negative but is no longer significant.

Overall, these results show that including the variables BeatLastYearEPS and BeatConsensusEstimate to control for whether or not a firm's realized earnings exceed salient EPS benchmarks does not drive out the negative and significant association between the measures of CEO optimism and the CEOs' compensation. This finding suggests that the lower pay of CEOs who systematically issue optimistic EPS forecasts is not purely driven by negative shocks to the firms' earnings that make the forecasts look optimistic ex post and also lead to lower compensation.

Table 9
Controlling for whether or not the realized EPS exceed salient benchmarks.

This table presents regression results after including BeatLastYearEPS and BeatConsensusEstimate as additional control variables. All other variables are defined as in Table 4. The sample period is 1996 to 2005. Heterogeneity-robust standard errors that allow for clustering at the firm level are reported in parentheses. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Panel A

	Ln(Options+1)	Ln(Rst.stock+1)	Ln(Bonus+1)	Ln(Salary+1)	Ln(Total+1)
LongHolder	−0.704**	0.668	−0.554**	−0.214	−0.147*
	(0.323)	(0.498)	(0.276)	(0.139)	(0.079)
Ln(MktCap)	0.638***	0.168	0.673***	0.073	0.427***
	(0.103)	(0.107)	(0.103)	(0.051)	(0.029)
Std.return	−0.370	0.097	2.812***	−0.673	0.078
	(1.208)	(1.134)	(1.031)	(0.546)	(0.341)
Leverage	−0.879*	0.250	0.226	0.082	−0.045
	(0.524)	(0.512)	(0.471)	(0.079)	(0.125)
MtB	0.020	−0.013	−0.069***	0.001	0.007
	(0.020)	(0.018)	(0.023)	(0.011)	(0.009)
Cash/Assets	−0.178	0.252	0.156	−0.169	0.267
	(0.794)	(0.713)	(0.636)	(0.184)	(0.213)
R&D/Assets	0.258	2.067	2.165	0.469	0.087
	(1.309)	(1.388)	(1.535)	(0.378)	(0.437)
R&D missing	0.239	−0.242	0.657**	−0.186	0.052
	(0.542)	(0.405)	(0.307)	(0.134)	(0.099)
Boardsize	0.010	−0.028	−0.053*	0.014	−0.002
	(0.034)	(0.042)	(0.028)	(0.013)	(0.008)
Independent	0.174	0.805	−0.222	0.219*	0.060
	(0.450)	(0.512)	(0.346)	(0.120)	(0.107)
Return	−0.084	0.081***	0.111	−0.005	−0.047
	(0.066)	(0.026)	(0.097)	(0.008)	(0.030)
EBIT/Assets	0.134	0.706	4.307***	0.336	0.180
	(0.902)	(0.701)	(0.745)	(0.232)	(0.281)
BeatLast-YearEPS	−0.032	0.093	1.840***	0.019	0.127***
	(0.131)	(0.125)	(0.122)	(0.037)	(0.034)
BeatConsensus-Estimate	−0.164	0.099	0.616**	−0.037	0.038
	(0.132)	(0.128)	(0.119)	(0.039)	(0.035)
Firm, year, tenure, age, and gender dummies	Yes	Yes	Yes	Yes	Yes
R^2	0.476	0.579	0.584	0.667	0.762
N	5,409	5,409	5,409	5,409	5,409

Panel B

	Ln(Options+1)	Ln(Rst.stock+1)	Ln(Bonus+1)	Ln(Salary+1)	Ln(Total+1)
HighForecast	−0.494*	−0.100	−0.423**	−0.065	−0.116
	(0.263)	(0.315)	(0.213)	(0.094)	(0.075)
ForecastLead	0.002*	0.000	0.001	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
ForecastWidth	0.819	−0.401	−1.002	−0.377	0.228
	(1.439)	(1.977)	(1.457)	(0.885)	(0.489)
ForecastWidth^2	−0.915	−0.590	0.693	0.341	−0.123
	(1.599)	(1.943)	(1.614)	(0.849)	(0.527)
Ln(MktCap)	0.719***	0.068	0.583***	0.084**	0.407***
	(0.089)	(0.089)	(0.086)	(0.034)	(0.026)
Std.return	−1.022	1.855	1.264	−0.696	−0.015
	(1.337)	(1.322)	(1.355)	(0.471)	(0.372)
Leverage	−0.681	0.978**	0.071	0.049	−0.005
	(0.434)	(0.435)	(0.392)	(0.111)	(0.108)
MtB	0.004	−0.019	−0.063***	−0.007	0.002
	(0.019)	(0.019)	(0.020)	(0.007)	(0.011)
Cash/Assets	0.619	−0.417	0.656	−0.195	0.212
	(0.700)	(0.628)	(0.533)	(0.129)	(0.189)
R&D/Assets	−0.470	2.798*	2.343	0.734	0.291
	(1.603)	(1.576)	(1.440)	(0.523)	(0.590)
R&D missing	0.059	−0.444	0.297	−0.089	−0.101

Table 9 (*continued*)

Panel B

	Ln(Options+1)	Ln(Rst.stock+1)	Ln(Bonus+1)	Ln(Salary+1)	Ln(Total+1)
	(*0.365*)	(*0.371*)	(*0.255*)	(*0.072*)	(*0.076*)
Boardsize	0.005	−0.034	−0.044	0.027*	−0.011
	(*0.028*)	(*0.035*)	(*0.027*)	(*0.014*)	(*0.007*)
Independent	0.246	0.487	−0.003	0.245**	−0.070
	(*0.388*)	(*0.415*)	(*0.288*)	(*0.112*)	(*0.096*)
Return	−0.102	0.127***	0.187	−0.008	−0.052*
	(*0.064*)	(*0.029*)	(*0.131*)	(*0.008*)	(*0.029*)
EBIT/Assets	0.327	0.268	4.874***	0.025	0.316
	(*0.757*)	(*0.630*)	(*0.716*)	(*0.199*)	(*0.258*)
BeatLast-YearEPS	−0.004	0.131	1.899***	0.032	0.109***
	(*0.111*)	(*0.110*)	(*0.107*)	(*0.027*)	(*0.027*)
BeatConsensus-Estimate	−0.159	0.122	0.738***	−0.028	0.053*
	(*0.114*)	(*0.108*)	(*0.100*)	(*0.024*)	(*0.029*)
Firm, year, tenure, age, and gender dummies	Yes	Yes	Yes	Yes	Yes
R^2	0.445	0.537	0.570	0.726	0.720
N	7,913	7,913	7,913	7,913	7,913

4.3.2. *Optimism measure based on analyst consensus estimates*

A second possibility to address the concern that some CEOs receive less compensation because the realized earnings fall short of the forecast earnings is to construct an alternative optimism measure. The optimism measure HighForecast is based on the comparison of the EPS forecasts that were issued by a firm and the EPS that were eventually realized. Alternatively, I can construct an optimism measure by comparing the earnings that were forecast by the firm with the corresponding analyst consensus forecast. That is, when determining whether or not a forecast issued by a firm was optimistic, instead of examining if the forecast was higher or lower than the ex post realized EPS, I examine whether or not the firm's forecast was higher or lower than the median analyst forecast. The merit of this procedure is that it identifies those CEOs as optimistic who systematically issue forecasts that are higher than the corresponding analyst consensus forecasts. Thus, the measure does not rely on the ex post comparison of forecasts and realizations, but rather upon the comparison of different forecasts that were issued before the actual earnings were realized.[21]

To construct this measure, I first merge the analyst consensus forecasts with the corresponding EPS forecasts issued by each firm and assign a dummy that takes the value one if the forecast issued by the firm exceeds the analyst consensus forecast. As for the optimism measure HighForecast, if the firm's forecast was an EPS range, I compare the lower bound of that range with the analyst consensus forecast. If the firm's forecast was a point estimate, I compare the point estimate with the analyst consensus forecast. Unreported analyses reveal that the average difference between the midpoints of forecasts issued by the firms and the ex post realized EPS is larger than the average difference between the analyst consensus forecasts and the ex post realized EPS. This suggests that EPS forecasts that exceed the analyst consensus forecast are not simply the result of positive inside information which is available to the CEO but not to the analysts.

In the second step, for each firm and for each year, I average the dummies indicating whether a forecast issued by the firm exceeds the analyst consensus forecast across all consensus and firm forecast pairs. For each firm-year combination, this procedure results in the fraction of EPS forecasts issued by the firm that were higher than the corresponding analyst consensus forecast. Finally, for each CEO-firm combination, I calculate the equally weighted average of these fractions across all years. The resulting variable, denoted ExceedConsensus, can take on values between zero and one. ExceedConsensus is equal to zero if all company-issued forecasts were lower than the corresponding analyst consensus forecast. It is equal to one if all forecasts issued by the firm exceed the corresponding analyst consensus forecast. Thus, higher values of the variable ExceedConsensus are indicative of more optimistic beliefs.

Table 10 displays the results of regressions in which the variable HighForecast has been replaced by the variable ExceedConsensus. The first column reveals a negative and significant coefficient estimate on the optimism measure ExceedConsensus in the regression regarding the CEO's option grants. Similar to the results presented in Table 9, this finding suggests that the smaller option grants that optimistic CEOs receive are not simply driven by unexpected, negative shocks to a firm's earnings that cause the realized EPS to fall short of the forecast EPS. Unlike in Table 9, however, the coefficient estimates in the remaining columns are not statistically significant.

[21] The correlation coefficient between HighForecast and the new measure, ExceedConsensus, is 0.77 and significant at the 1% level.

Table 10
Optimism measure based on the comparison with analyst consensus estimates.
This table presents the results for regressions using the optimism measure ExceedConsensus, which is based on the difference between the firm's EPS forecasts and the corresponding analyst consensus forecasts. All other variables are defined as in Table 4. The sample period is 1996 to 2005. Heterogeneity-robust standard errors that allow for clustering at the firm level are reported in parentheses. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	Ln(Options+1)	Ln(Rst.stock+1)	Ln(Bonus+1)	Ln(Salary+1)	Ln(Total+1)
ExceedConsensus	−0.466*	0.245	−0.233	−0.025	0.003
	(0.244)	(0.330)	(0.240)	(0.087)	(0.077)
ForecastLead	0.002**	0.000	0.001	0.000	0.000
	(0.001)	(0.002)	(0.001)	(0.001)	(0.000)
ForecastWidth	0.294	0.599	−0.915	−0.294	0.329
	(1.578)	(2.248)	(1.702)	(1.019)	(0.597)
ForecastWidth^2	−0.332	−1.443	0.740	0.336	−0.152
	(1.693)	(2.301)	(1.763)	(0.971)	(0.641)
Ln(MktCap)	0.683***	0.127	0.882***	0.085***	0.421***
	(0.089)	(0.090)	(0.097)	(0.032)	(0.027)
Std.return	−2.638	2.585	2.077	−1.104**	−0.045
	(1.890)	(1.907)	(2.041)	(0.549)	(0.591)
Leverage	−0.666	0.980**	−0.256	0.027	−0.021
	(0.443)	(0.439)	(0.419)	(0.112)	(0.107)
MtB	−0.001	−0.006	−0.064***	−0.008	0.001
	(0.020)	(0.022)	(0.020)	(0.007)	(0.010)
Cash/Assets	0.749	−0.285	1.690***	−0.161	0.304
	(0.715)	(0.631)	(0.568)	(0.129)	(0.194)
R&D/Assets	−0.202	2.093	4.007**	0.689	0.460
	(1.591)	(1.533)	(1.661)	(0.530)	(0.587)
R&D missing	0.044	−0.528	0.178	−0.091	−0.119
	(0.362)	(0.358)	(0.272)	(0.072)	(0.075)
Boardsize	0.011	−0.026	−0.074***	0.027*	−0.012*
	(0.028)	(0.037)	(0.028)	(0.014)	(0.007)
Independent	0.183	0.314	0.144	0.220*	−0.042
	(0.398)	(0.423)	(0.318)	(0.113)	(0.098)
Return	−0.104	0.125***	0.285	−0.006	−0.044*
	(0.067)	(0.029)	(0.187)	(0.007)	(0.025)
EBIT/Assets	0.676	0.263	8.305***	0.062	0.619**
	(0.729)	(0.603)	(0.802)	(0.190)	(0.255)
Firm, year, tenure, age, and gender dummies	Yes	Yes	Yes	Yes	Yes
R^2	0.439	0.534	0.503	0.711	0.706
N	7,584	7,584	7,584	7,584	7,584

4.3.3. *Earnings management*

Related to the concern that the lower compensation of some CEOs is the result of missing a given earnings target is the concern that some CEOs may manage their firms' earnings in order to meet previously announced forecasts. One may thus be concerned that the variable HighForecast reflects differences in earnings management rather than optimism: CEOs who successfully manage their earnings to meet or beat their own EPS forecasts would appear to be less optimistic, and CEOs who are not able to manage their earnings sufficiently upwards would appear to be more optimistic. This concern is mitigated to the extent that the firm fixed effects and time-varying control variables in the compensation regressions capture a firm's ability to manipulate its earnings. Moreover, this concern does not apply to the optimism measure ExceedConsensus. ExceedConsensus is based on a comparison between the EPS forecasts provided by the firms and the corresponding analyst consensus forecasts—neither of which is affected by any subsequent earnings management. The negative and significant coefficient estimate for the optimism measure ExceedConsensus in the regression pertaining to the CEOs' option grants presented in Table 10 thus suggests that the results are not merely driven by differences in the firms' abilities to manage their earnings.

4.4. *CEO pessimism*

The evidence that optimistic CEOs appear to receive less compensation than their peers naturally leads to the following question: What about pessimistic CEOs? Should we expect that pessimists receive higher compensation than their peers, or are biased beliefs in either direction associated with lower pay? In fact, one may be concerned that biased beliefs in general are a sign of lower talent and may therefore lead to lower compensation.

To address this concern, I define a new dummy variable, Pessimist, that takes the value one for the 25% “most

Table 11
CEO pessimism.

This table presents regression results for pessimistic CEOs. The sample period is 1996 to 2005. Pessimist is a dummy variable for the 25% most pessimistic CEOs in the sample. All other variables are defined as in Table 4. Heterogeneity-robust standard errors that allow for clustering at the firm level are reported in parentheses. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	Ln(Options+1)	Ln(Rst.stock+1)	Ln(Bonus+1)	Ln(Salary+1)	Ln(Total+1)
Pessimist	0.527***	0.356*	0.332**	0.025	0.080
	(0.186)	(0.194)	(0.156)	(0.070)	(0.054)
ForecastLead	0.002*	0.000	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
ForecastWidth	0.820	0.153	−0.669	−0.296	0.121
	(1.391)	(1.955)	(1.502)	(0.859)	(0.517)
ForecastWidth^2	−0.877	−0.862	0.820	0.312	0.061
	(1.493)	(2.003)	(1.627)	(0.821)	(0.561)
Ln(MktCap)	0.696***	0.117	0.866***	0.092***	0.429***
	(0.086)	(0.085)	(0.092)	(0.031)	(0.026)
Std.return	−1.574	1.534	3.002**	−0.612	0.096
	(1.387)	(1.268)	(1.282)	(0.421)	(0.350)
Leverage	−0.599	0.953**	−0.203	0.052	0.001
	(0.422)	(0.417)	(0.401)	(0.105)	(0.103)
MtB	0.001	−0.007	−0.067***	−0.009	0.001
	(0.019)	(0.021)	(0.021)	(0.006)	(0.010)
Cash/Assets	0.584	−0.274	1.476***	−0.167	0.246
	(0.667)	(0.598)	(0.550)	(0.120)	(0.182)
R&D/Assets	−0.279	2.482*	3.317**	0.662	0.380
	(1.449)	(1.472)	(1.536)	(0.467)	(0.535)
R&D missing	0.031	−0.558	0.122	−0.087	−0.119
	(0.344)	(0.365)	(0.262)	(0.069)	(0.074)
Boardsize	0.017	−0.022	−0.062**	0.026*	−0.010
	(0.027)	(0.035)	(0.028)	(0.013)	(0.006)
Independent	0.134	0.308	0.083	0.220**	−0.076
	(0.378)	(0.402)	(0.301)	(0.106)	(0.094)
Return	−0.114*	0.122***	0.297	−0.009	−0.048*
	(0.068)	(0.028)	(0.186)	(0.008)	(0.026)
EBIT/Assets	0.345	0.405	8.585***	0.051	0.601**
	(0.678)	(0.574)	(0.769)	(0.174)	(0.238)
Firm, year, tenure, age, and gender dummies	Yes	Yes	Yes	Yes	Yes
R^2	0.447	0.534	0.518	0.732	0.723
N	8,238	8,238	8,238	8,238	8,238

pessimistic" CEOs in my sample. First, for each CEO-firm combination, I compute the fraction of forecasts that were pessimistic[22]: If a forecast was issued in the form of an EPS range, I consider it pessimistic if the upper bound of the range is lower than the EPS that were eventually realized. If a forecast was a point estimate, I consider it pessimistic if this point estimate is lower than the ex post realized EPS. I then compute the 75th percentile of the distribution of the fraction of pessimistic forecasts across all CEO-firm combinations in my sample. Finally, I assign the dummy variable Pessimist as follows. Pessimist takes the value one if the fraction of pessimistic forecasts that the CEO has made is larger than the 75th percentile of the distribution across all CEO-firm combinations. Pessimist thus designates the 25% "most pessimistic" CEOs in the sample.

I now re-estimate the regressions reported in Section 3.2, replacing the variable HighForecast with the dummy variable Pessimist. Table 11 displays the results. The coefficient estimates on Pessimist provide empirical evidence that biased beliefs are not generally associated with lower compensation. To the contrary, the coefficient estimates on Pessimist are positive and significant in the regressions regarding the CEO's option grants, restricted stock grants, and bonus payments. The coefficient estimates in the regressions for the CEO's salary and total compensation are positive, but not statistically significant. Thus, CEOs with downward biased beliefs, i.e., pessimistic CEOs, receive higher incentive compensation than their peers. This finding is consistent with pessimists underestimating the value of their incentive claims, so that more claims must be granted to meet the CEO's participation and incentive compatibility constraints. The results are at odds with an alternative explanation in which biases per se, i.e., both optimism and pessimism, are a sign of lower talent which, in turn, leads to lower compensation.

[22] As for the optimism measure HighForecast, I first compute the average for each year and then the equally weighted average across all years.

Table 12
Controlling for the CEO's portfolio of company stock and options.

This table presents regression results after including the natural logarithm of the total value (in $′000) of the CEO's portfolio of company stock and options at the beginning of the fiscal year, Ln(CEO invest.), as an additional control variable. All other variables are defined as in Table 4. The sample period is 1996 to 2005. Heteregeneity-robust standard errors that allow for clustering at the firm level are reported in parentheses. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Panel A

	Ln(Options+1)	Ln(Rst.stock+1)	Ln(Bonus+1)	Ln(Salary+1)	Ln(Total+1)
LongHolder	−0.768**	0.624	−0.767***	−0.182	−0.186**
	(0.331)	(0.472)	(0.266)	(0.117)	(0.082)
Ln(MktCap)	0.519***	0.269**	1.125***	0.090*	0.402***
	(0.107)	(0.107)	(0.118)	(0.048)	(0.029)
Std.return	−0.335	−0.220	4.158***	−0.555	0.196
	(1.166)	(1.183)	(0.956)	(0.443)	(0.337)
Leverage	−0.400	0.387	0.185	0.056	0.064
	(0.521)	(0.485)	(0.490)	(0.067)	(0.121)
MtB	0.017	−0.002	−0.080***	−0.008	0.009
	(0.020)	(0.025)	(0.025)	(0.008)	(0.009)
Cash/Assets	−0.139	0.578	0.865	−0.125	0.249
	(0.772)	(0.703)	(0.674)	(0.174)	(0.206)
R&D/Assets	−0.087	2.534*	4.355**	0.156	0.155
	(1.211)	(1.432)	(1.922)	(0.218)	(0.412)
R&D missing	0.388	−0.247	0.350	−0.075	0.008
	(0.537)	(0.393)	(0.341)	(0.054)	(0.090)
Boardsize	0.029	−0.028	−0.067**	0.017	0.001
	(0.035)	(0.042)	(0.029)	(0.012)	(0.008)
Independent	0.131	0.715	−0.067	0.215*	0.071
	(0.439)	(0.491)	(0.378)	(0.112)	(0.105)
Return	−0.038	0.047	0.132	−0.014	−0.023
	(0.047)	(0.037)	(0.119)	(0.013)	(0.018)
EBIT/Assets	−0.066	0.894	7.392***	0.238	0.521**
	(0.869)	(0.659)	(0.900)	(0.185)	(0.254)
Ln(CEO invest.)	0.137**	−0.055	−0.196***	−0.029	0.057***
	(0.056)	(0.056)	(0.064)	(0.020)	(0.015)
Firm, year, tenure, age, and gender dummies	Yes	Yes	Yes	Yes	Yes
R^2	0.489	0.587	0.540	0.694	0.774
N	5,514	5,514	5,514	5,514	5,514

Panel B

	Ln(Options+1)	Ln(Rst.stock+1)	Ln(Bonus+1)	Ln(Salary+1)	Ln(Total+1)
HighForecast	−0.502*	−0.128	−0.624***	−0.033	−0.126*
	(0.287)	(0.328)	(0.230)	(0.088)	(0.073)
ForecastLead	0.002*	0.000	0.000	0.000	0.000
	(0.001)	(0.002)	(0.001)	(0.001)	(0.000)
ForecastWidth	0.470	0.406	−0.869	−0.781	−0.011
	(1.591)	(2.000)	(1.504)	(0.825)	(0.476)
ForecastWidth^2	−0.810	−1.585	0.940	0.755	0.086
	(1.741)	(1.922)	(1.653)	(0.783)	(0.486)
Ln(MktCap)	0.607***	0.150	1.069***	0.110***	0.400***
	(0.101)	(0.094)	(0.110)	(0.034)	(0.029)
Std.return	−1.492	1.674	2.904**	−0.602	0.032
	(1.441)	(1.288)	(1.296)	(0.401)	(0.363)
Leverage	−0.412	0.917**	−0.292	0.048	0.056
	(0.437)	(0.427)	(0.415)	(0.088)	(0.107)
MtB	0.009	−0.006	−0.071***	−0.011*	0.004
	(0.021)	(0.022)	(0.022)	(0.007)	(0.011)
Cash/Assets	0.627	−0.237	1.381**	−0.192	0.238
	(0.697)	(0.625)	(0.577)	(0.130)	(0.190)
R&D/Assets	−0.371	1.839	3.931**	0.569	0.328
	(1.515)	(1.467)	(1.611)	(0.457)	(0.549)
R&D missing	0.058	−0.702*	0.098	−0.056	−0.126*
	(0.375)	(0.379)	(0.286)	(0.037)	(0.075)

Table 12 (*continued*)

Panel B

	Ln(Options + 1)	Ln(Rst.stock + 1)	Ln(Bonus + 1)	Ln(Salary + 1)	Ln(Total + 1)
Boardsize	0.026	−0.018	−0.076***	0.025*	−0.005
	(*0.029*)	(*0.036*)	(*0.027*)	(*0.013*)	(*0.007*)
Independent	0.219	0.331	0.131	0.231**	−0.026
	(*0.404*)	(*0.414*)	(*0.314*)	(*0.097*)	(*0.103*)
Return	−0.073	0.087***	0.207	−0.020	−0.040
	(*0.057*)	(*0.027*)	(*0.156*)	(*0.014*)	(*0.027*)
EBIT/Assets	0.463	0.761	9.370***	0.092	0.779***
	(*0.734*)	(*0.600*)	(*0.836*)	(*0.150*)	(*0.243*)
Ln(CEO invest.)	0.092*	−0.049	−0.250***	−0.031**	0.017
	(*0.049*)	(*0.045*)	(*0.059*)	(*0.014*)	(*0.024*)
Firm, year, tenure, age, and gender dummies	Yes	Yes	Yes	Yes	Yes
R^2	0.456	0.546	0.533	0.754	0.733
N	7,754	7,754	7,754	7,754	7,754

4.5. *Portfolio diversification and risk-tolerance*

A further concern one may have is that the estimation results are driven by differences in risk-aversion or portfolio diversification. Some CEOs may be more risk-tolerant than others and therefore hold on to their in-the-money options longer, or they may have invested less of their personal wealth in the firm and therefore benefit less from exercising their options early and diversifying. Finally, some CEOs may use hedging instruments such as zero-cost collars, equity swaps, or forward contracts to reduce their exposure to firm-specific risk.

These concerns are particularly hard to tackle because I have little means to directly assess a given CEO's risk-aversion, nor do I observe the CEO's entire wealth portfolio. However, in unreported conditional logit models with firm fixed effects, I do not find any evidence that the total value of the CEO's portfolio of company stocks and options explains his exercise behavior. This result is consistent with the findings of Sautner and Weber (2009), who use survey data to assess the relation between individual characteristics and option exercise decisions and find no evidence that differences in diversification or risk-aversion can explain the observed differences in exercise behavior.

Furthermore, including the natural logarithm of the total value (in $′000) of the CEO's portfolio of company stock and options at the beginning of the fiscal year as an additional control variable in the compensation regressions has no material effect on the estimation results.[23] Table 12 presents the results of these regressions. The coefficient estimates for both optimism measures LongHolder (Panel A) and HighForecast (Panel B) remain negative and statistically significant in the regressions pertaining to the CEO's option grants, bonus payments, and total compensation. In fact, even the magnitudes of the point estimates remain similar after adding the additional control variable.

Regarding the use of hedging instruments, Gao (2010) provides evidence that CEOs who face lower hedging costs receive higher-powered incentive contracts. Thus, if holding on longer to exercisable in-the-money options were driven entirely by the better hedging opportunities faced by some CEOs, one would expect a positive association between the optimism measure LongHolder and the CEOs' incentive compensation. I, however, document a negative association. Moreover, according to the firms' SEC filings, such hedging transactions are very rare (see, e.g., Bettis, Bizjak, and Lemmon, 2001; Gao, 2010).

Finally, to further examine whether or not the CEOs whom I classify as optimistic are simply more risk-tolerant than their peers, I examine the relation between the utilized measures of optimism and the percentage of incentive pay in the CEOs' total compensation. To do so, I regress the sum of the CEO's bonus payments and restricted stock and option grants divided by his total compensation on the same set of explanatory variables as before. The results are presented in Table 13. The coefficient estimates on the optimism measure LongHolder are negative and statistically significant at the 10% level in both columns 1 and 2. The coefficient estimate for HighForecast is negative and significant at the 5% level in column 3. The coefficient estimate in column 4 is negative, but not statistically significant. These results imply a negative relation between the measures of CEO optimism and the percentage of incentives in the CEOs' total compensation. Graham, Harvey, and Puri (2013), however, provide evidence that CEOs who are more risk-tolerant are more likely to receive proportionally larger compensation in the form of stocks, options, and bonus payments. Similarly, Grund and Sliwka (2010) find that an employee's risk-tolerance has a positive and substantial impact on the likelihood of receiving

[23] The total value of a CEO's investment is calculated as the total value of all unvested and vested stock options and all restricted and unrestricted shares that the CEO owns. The median total investment in the sample is $14 million, and the mean is $85 million. Unreported regressions in which the total value of the CEO's investment is scaled by the firm's market capitalization yield similar results.

Table 13
Effect of optimism on the fraction of incentives in the CEO's total compensation.

This table presents regression results regarding the fraction of incentive pay in the CEO's total compensation. Incentive/Total is the sum of Bonus, Restricted stock, and Options divided by Total compensation. All other variables are defined as in Tables 4 and 12. The sample period is 1996 to 2005. Heterogeneity-robust standard errors that allow for clustering at the firm level are reported in parentheses. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	Incentive/ Total	Incentive/ Total	Incentive/ Total	Incentive/ Total
LongHolder	−0.056*	−0.056*		
	(0.029)	(0.029)		
HighForecast			−0.035**	−0.030
			(0.018)	(0.018)
ForecastLead			0.000	0.000
			(0.000)	(0.000)
ForecastWidth			−0.063	−0.017
			(0.115)	(0.123)
ForecastWidth^2			0.045	(0.007)
			(0.116)	(0.126)
Ln(MktCap)	0.071***	0.067***	0.073***	0.071***
	(0.008)	(0.009)	(0.007)	(0.007)
Std.return	0.127	0.119	0.124	0.144
	(0.101)	(0.102)	(0.094)	(0.094)
Leverage	−0.023	−0.011	−0.007	0.012
	(0.037)	(0.038)	(0.032)	(0.033)
MtB	0.000	0.000	−0.001	−0.001
	(0.002)	(0.002)	(0.001)	(0.001)
Cash/Assets	0.003	−0.002	0.093*	0.094*
	(0.052)	(0.053)	(0.048)	(0.049)
R&D/Assets	0.105	0.115	0.014	0.001
	(0.100)	(0.098)	(0.126)	(0.127)
R&D missing	0.008	0.002	−0.033	−0.037
	(0.026)	(0.028)	(0.022)	(0.023)
Boardsize	−0.002	−0.003	−0.004**	−0.003*
	(0.002)	(0.002)	(0.002)	(0.002)
Independent	0.003	0.004	−0.018	−0.015
	(0.030)	(0.031)	(0.026)	(0.028)
Return	−0.004	−0.002	−0.001	0.002
	(0.003)	(0.002)	(0.002)	(0.003)
EBIT/Assets	0.193***	0.195***	0.269***	0.293***
	(0.070)	(0.075)	(0.059)	(0.064)
Ln(CEO invest.)		0.004		0.004
		(0.004)		(0.003)
Firm, year, tenure, age, and gender dummies	Yes	Yes	Yes	Yes
R^2	0.577	0.587	0.544	0.554
N	5,777	5,514	8,238	7,754

performance-contingent wages. Thus, the empirical findings in this and other papers suggest that differences in risk-tolerance alone do not explain the results.[24]

[24] Additional evidence that the late exercising of in-the-money options captures optimism rather than risk-tolerance is provided, for example, by Malmendier and Tate (2005a, 2008), Malmendier, Tate, and Yan (2011), and Campbell, Gallmeyer, Johnson, Rutherford, and Stanley (2011). Further evidence on the positive association between risk-tolerance and incentive pay is provided by Bellemare and Shearer (2010) and Dohmen and Falk (2011).

5. Conclusion

The psychology literature documents a widespread tendency in all humans to be overly optimistic regarding their abilities and their future. Moreover, a growing literature in economics and finance provides evidence that these biases extend to firms' senior executives and CEOs and have an economically significant effect on corporate decisions, actions, and outcomes. Whether or not firms purposefully choose to hire and promote such managers, their biases have implications for the design of organizational structures, compensation and incentive schemes, governance mechanisms, and regulation. Taking the existence of optimistic CEOs as given, this paper has focused on how their optimism affects their compensation.

Using data on compensation in US firms, I have shown that CEOs whose option exercise behavior and earnings forecasts are indicative of optimistic beliefs receive smaller stock option grants, fewer bonus payments, and less total compensation than their peers. This new empirical evidence suggests that corporate boards take a CEO's optimism regarding the future prospects of the firm into account when setting the CEO's compensation. These findings do not imply, however, that all firms should hire optimistic CEOs. While optimists may be “cheaper,” they may also have potentially costly effects on corporate policies, as has been documented by several authors. The precise nature of the trade-off between the costs and benefits of hiring an optimistic manager is beyond the scope of this paper and remains an important topic for future research.

Appendix A. Framework for the effect of optimism on compensation

A.1. Setup

This appendix introduces a model that is used as a framework to study the effect of an agent's optimism on the optimal compensation contract. Fig. 1 depicts an overview. I consider a principal that employs an agent to implement and thereafter work on a two-period project. The principal is risk-neutral with utility function $V(\pi)=\pi$, where π denotes the principal's final net payoff. The agent is risk-averse with utility function $U(w,c)=u(w)-c$, where w denotes the agent's total wealth at the end of the second period, and c denotes the agent's total effort costs. I assume that $u(w)$ satisfies $u'(w)>0$, $\lim_{w\to 0}u'(w)=\infty$, $u''(w)<0$, and $-u''(w)/u'(w)=\gamma/w>0$, i.e., $u(w)$ satisfies constant relative risk-aversion. Furthermore, I assume that the agent has zero wealth at the beginning of the first period and access to some alternative employment offer that provides utility Ω_t at time t if accepted. The discount rate is normalized to zero.

The agent's task is to implement the project at time $t=1$ and later on, at time $t=2$, to improve the project if this is feasible. Implementing and improving the project costs the agent private costs $c_1>0$ and $c_2>0$, respectively, but there are no direct costs to the firm. The objective probability that the project is successful is $p\in(0,1)$ if it is not improved and $p+\Delta$, with $\Delta\in(0,1-p)$, if the agent improves the project. ex ante, improvement is possible with probability $\delta\in(0,1)$. The agent believes the

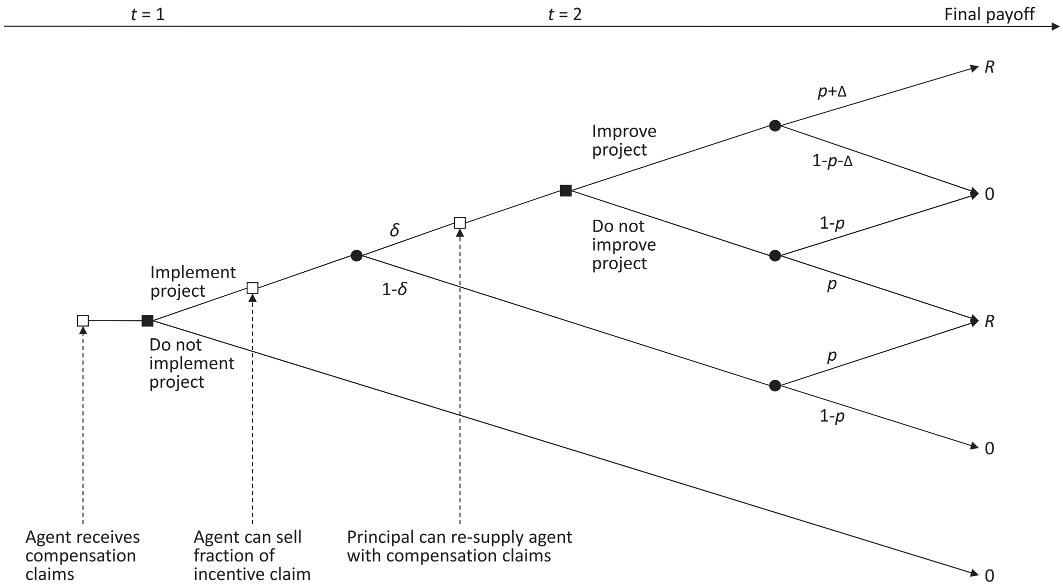

Fig. 1. Model overview. This figure shows an overview of the model described in Appendix A. The sequence of events is as follows. Just before $t=1$, the agent receives his compensation claims. At $t=1$, the agent chooses whether to implement the project. Thereafter, he can sell a fraction of his incentive claims. Just before $t=2$, the principal can re-supply the agent with compensation claims. At $t=2$, the agent chooses whether to improve the project if this is feasible. Improvement is feasible with probability δ. At the end of the second period, the project's final payoff—either R or zero—is realized, and all compensation claims are paid. The project succeeds with probability $p+\Delta$ (p) if it has (not) been improved.

$t=1$				$t=2$		
Agent is granted original compensation claims	Agent decides whether or not to implement the project (observable)	Agent decides what fraction of his incentive claim to sell (observable)	Whether or not the project can be improved becomes common knowledge	Principal can re-supply the agent with compensation claims	Agent decides whether or not to improve the project (if feasible)	Project pays off R if successful and 0 otherwise (verifiable)

Fig. 2. Timing of events and decisions. This figure shows the timing of the events and decisions in the model described in Appendix A.

probability of success to be $\hat{p} \in [p, 1-\Delta)$ if it has not been improved and $\hat{p}+\Delta$ if it has been improved. Thus, the agent can be either unbiased ($\hat{p}=p$) or optimistic ($p<\hat{p}<1-\Delta$).[25] However, I will assume that an agent's optimism is not so extreme as to entirely undo the effects of his risk-aversion in the second period.[26] The principal is assumed to have unbiased beliefs. Furthermore, I assume that the principal knows the agent's beliefs, and that the timing of the decisions and events, as well as the different model parameters, are common knowledge.

In case of success, the project has payoff $R>0$ at the end of the second period. The payoff is zero if the project fails. By assumption, the payoff in case of success is "large enough" so that it is always optimal for the principal to induce the agent to implement and improve the project. In order to compensate the agent, the principal can promise payments to the agent that are contingent on the project's final payoff—the only verifiable information. Note that in this setting, the optimal contract can be expressed as a fixed salary that is independent of the project's outcome and an additional incentive payment, which is contingent on the project's success.[27] Furthermore, I assume that after implementing the project, but before it becomes known whether or not the project can be improved, the agent can sell a fraction $\alpha \in [0, 1]$ of the incentive claim he received in the first period to a risk-neutral, competitive outside investor with unbiased beliefs. The agent cannot commit not to sell, but both implementing the project and selling the incentive claim are

[25] In this setup, an optimistic agent thus overestimates the expected benefits of implementing the project and will therefore be more willing to exert effort. This is consistent with the results of Bénabou and Tirole (2002), who show how higher confidence can improve an agent's motivation to undertake projects, and with the findings of Puri and Robinson (2007), who show that optimistic people (except for extreme optimists) work harder.

[26] See the derivation of the optimal contract for a formal statement of this assumption. Appendix B examines the optimal contract in case this assumption is violated.

[27] A generic contract in the two-outcome setting specifies two payments $\omega(R)$ and $\omega(0)$. Without loss of generality, we can express this contract as a fixed payment $s=\omega(0)$ that is independent of the project's outcome and an incentive claim that pays $b=\omega(R)-\omega(0)$ in case the project succeeds.

observable. These assumptions allow me to study the effect of optimism on the agent's decision to retain his incentive claims and further generate implications on how optimists can be identified empirically. Finally, I assume that the principal has all the bargaining power.

In sum, the sequence of events and decisions is as follows: Just before $t=1$, the principal offers the agent an unconditional salary s_1 and an incentive claim with payoff b_1 in case the project succeeds. The agent can either accept or decline the proposed contract. At $t=1$, if the agent has accepted the contract, he can either implement the project at a private cost c_1 or not. After implementation, the agent can sell a fraction $\alpha \in [0,1]$ of his incentive claim to an outside investor. Just before $t=2$—after observing the agent's implementation and selling decisions and knowing whether or not the project can be improved—the principal can offer the agent an additional fixed payment of s_2 and an additional incentive claim with payoff b_2, conditional on the project's success. Thereafter, at $t=2$, the agent chooses whether or not to improve the project at private cost c_2 in case improvement is feasible. Finally, at the end of the second period, the project's final payoff is realized, and all compensation claims are paid. This sequence of events and decisions is depicted on a time-line in Fig. 2.

A.2. Derivation of the optimal contract by backward induction

A.2.1. Period 2: subgame in which the project can be improved

Let $\alpha \in [0,1]$ denote the fraction of the agent's original incentive claim that he has sold to an outside investor, and let θ denote the price that the agent received per unit of his claim. The agent's incentive compatibility constraint at $t=2$ can then be written as

$$\begin{aligned}&(\widehat{p}+\Delta)u[\alpha\theta+s_1+s_2+(1-\alpha)b_1+b_2]\\&+(1-\widehat{p}-\Delta)u[\alpha\theta+s_1+s_2]-c_1-c_2\end{aligned} \geq \begin{aligned}&\widehat{p}\cdot u[\alpha\theta+s_1+s_2+(1-\alpha)b_1+b_2]\\&+(1-\widehat{p})u[\alpha\theta+s_1+s_2]-c_1,\end{aligned} \tag{3}$$

and the agent's participation constraint is

$$\begin{aligned}&(\widehat{p}+\Delta)u[\alpha\theta+s_1+s_2+(1-\alpha)b_1+b_2]\\&+(1-\widehat{p}-\Delta)u[\alpha\theta+s_1+s_2]-c_1-c_2\end{aligned} \geq \begin{aligned}&\widehat{p}\cdot u[\alpha\theta+s_1+(1-\alpha)b_1]\\&+(1-\widehat{p})u[\alpha\theta+s_1]+\Omega_2-c_1.\end{aligned} \tag{4}$$

The agent's participation constraint will be binding when evaluated at the optimal contract because the principal is assumed to have all the bargaining power. Furthermore, it follows from the first-order conditions of the principal's profit maximization problem that the agent's incentive compatibility constraint will be binding at the optimum as long as the following assumption holds:

Assumption 1. An agent's optimism does not entirely undo the effects of his risk-aversion at $t=2$, i.e.,

$$\frac{u'[\alpha^*\theta+s_1^*+s_2^*+(1-\alpha^*)b_1^*+b_2^*]}{u'[\alpha^*\theta+s_1^*+s_2^*]}<\frac{(p+\Delta)(1-\widehat{p}-\Delta)}{(\widehat{p}+\Delta)(1-p-\Delta)}. \tag{5}$$

Thus, under Assumption 1, we obtain for s_2^* and b_2^*

$$\begin{aligned}s_2^*=u^{-1}\Big\{&\widehat{p}\cdot u\big[\alpha\theta+s_1+(1-\alpha)b_1\big]+\big(1-\widehat{p}\big)\cdot u[\alpha\theta+s_1]\\&+\Omega_2-\widehat{p}\frac{c_2}{\Delta}\Big\}-a\theta-s_1\end{aligned} \tag{6}$$

and

$$\begin{aligned}b_2^*=u^{-1}\Big\{&\widehat{p}\cdot u\big[\alpha\theta+s_1+(1-\alpha)b_1\big]+\big(1-\widehat{p}\big)\cdot u[\alpha\theta+s_1]\\&+\Omega_2+\big(1-\widehat{p}\big)\frac{c_2}{\Delta}\Big\}-u^{-1}\Big\{\widehat{p}\cdot u\big[\alpha\theta+s_1+(1-\alpha)b_1\big]\\&+\big(1-\widehat{p}\big)\cdot u[\alpha\theta+s_1]+\Omega_2-\widehat{p}\frac{c_2}{\Delta}\Big\}-(1-\alpha)b_1.\end{aligned} \tag{7}$$

Furthermore, the agent's expected utility in case the project can be improved is

$$\begin{aligned}U^1\equiv\;&\widehat{p}\cdot u[\alpha\theta+s_1+(1-\alpha)b_1]+(1-\widehat{p})\cdot u[\alpha\theta+s_1]\\&+\Omega_2-c_1.\end{aligned} \tag{8}$$

A.2.2. Period 2: subgame in which the project cannot be improved

If the project cannot be improved, there is no need for the principal to offer any new compensation claims to the agent, i.e., $s_2^*=b_2^*=0$. In that case, the agent's expected utility is

$$\begin{aligned}U^0\equiv\;&\widehat{p}\cdot u[\alpha\theta+s_1+(1-\alpha)b_1]+(1-\widehat{p})\cdot u[\alpha\theta+s_1]\\&+\Omega_2-c_1.\end{aligned} \tag{9}$$

A.2.3. The agent's choice of α

After the agent has implemented the project, he maximizes his expected utility by choosing the fraction α of his original incentive claim that he sells to the outside investor:

$$U^*\equiv\max_{\alpha\in[0,1]}\{\delta\cdot U^1+(1-\delta)\cdot U^0\} \tag{10}$$

$$\begin{aligned}=\max_{\alpha\in[0,1]}\{&\widehat{p}\cdot u[\alpha\theta+s_1+(1-\alpha)b_1]+(1-\widehat{p})\cdot u[\alpha\theta+s_1]\\&+\Omega_2-c_1\},\end{aligned} \tag{11}$$

with first-order condition[28]

$$\begin{aligned}&\widehat{p}\cdot u'[\alpha^*\theta+s_1+(1-\alpha^*)b_1]\cdot(\theta-b_1)\\&+(1-\widehat{p})\cdot u'[\alpha^*\theta+s_1]\cdot\theta=0.\end{aligned} \tag{12}$$

Risk-neutral, competitive outside investors with unbiased beliefs will offer a price

$$\theta=(p+\delta\Delta)b_1, \tag{13}$$

so for $b_1>0$, the first-order condition implies

$$\frac{u'[\alpha^*\theta+s_1]}{u'[\alpha^*\theta+s_1+(1-\alpha^*)b_1]}=\frac{\widehat{p}\cdot(1-p-\delta\Delta)}{(1-\widehat{p})\cdot(p+\delta\Delta)}. \tag{14}$$

Denoting the left-hand-side of this equation by $g(\alpha^*)$ and the right-hand-side by $h(\widehat{p})$, we have

$$\begin{aligned}\frac{\partial g(\alpha^*)}{\partial\alpha^*}=&\frac{u''[\alpha^*\theta+s_1]\cdot u'[\alpha^*\theta+s_1+(1-\alpha^*)b_1]\cdot\theta}{(u'[\alpha^*\theta+s_1+(1-\alpha^*)b_1])^2}\\&+\frac{u''[\alpha^*\theta+s_1+(1-\alpha^*)b_1]\cdot(b_1-\theta)\cdot u'[\alpha^*\theta+s_1]}{(u'[\alpha^*\theta+s_1+(1-\alpha^*)b_1])^2}\\&<0\end{aligned} \tag{15}$$

$$\overline{g}\equiv g(0)=\frac{u'(s_1)}{u'(s_1+b_1)}>1 \tag{16}$$

[28] Note that the second-order condition for a maximum, $\widehat{p}\cdot u''[\alpha^*\theta+s_1+(1-\alpha^*)b_1]\cdot(\theta-b_1)^2+(1-\widehat{p})\cdot u''[\alpha^*\theta+s_1]\cdot\theta^2<0$, is satisfied as well because $u(w)$ is assumed to be concave.

$$\underline{g} \equiv g(1) = \frac{u'(\theta+s_1)}{u'(\theta+s_1)} = 1. \tag{17}$$

For $h(\widehat{p})$ we obtain

$$\frac{\partial h(\widehat{p})}{\partial \widehat{p}} = \frac{1}{(1-\widehat{p})^2} \cdot \frac{1-p-\delta\Delta}{p+\delta\Delta} > 0 \tag{18}$$

and

$$h(p+\delta\Delta) = 1. \tag{19}$$

Thus, we obtain $\alpha^* = 1$ for $\widehat{p} \le p+\delta\Delta$ and $\alpha^* < 1$ for $\widehat{p} > p+\delta\Delta$. The optimal claims granted to the agent in case the project can be improved in the second period can now be expressed as

$$s_2^* = u^{-1}\left\{U^* + c_1 - \widehat{p}\frac{c_2}{\Delta}\right\} - \alpha^*\theta - s_1 \tag{20}$$

and

$$b_2^* = u^{-1}\left\{U^* + c_1 + (1-\widehat{p})\frac{c_2}{\Delta}\right\} - u^{-1}\left\{U^* + c_1 - \widehat{p}\frac{c_2}{\Delta}\right\} - (1-\alpha^*)b_1. \tag{21}$$

A.2.4. Period 1

Just before the first period, the principal can offer the agent a fixed salary s_1 and an incentive claim that pays out b_1 in case the project succeeds. Because the agent can sell this incentive claim to an outside investor after the project has been implemented, he can turn the incentive claim into a safe payment. Thus, there is no benefit from insuring the agent with a fixed salary, as any fixed payment can be equally provided to the agent by increasing his incentive claim by an amount that will fetch a price equal to the fixed payment when sold to the outside investor. From here on, I will therefore assume that the principal sets $s_1^* = 0$.[29] Thus, the agent's expected utility from implementing the project simplifies to

$$U^* \equiv \max_{\alpha \in [0,1]} \{\widehat{p} \cdot u[\alpha\theta + (1-\alpha)b_1] + (1-\widehat{p}) \cdot u[\alpha\theta] + \Omega_2 - c_1\}. \tag{22}$$

The agent's participation constraint at $t=1$ can be written as

$$U^*(\alpha^*, \widehat{p}, b_1) \ge \Omega_1 + \Omega_2, \tag{23}$$

and his incentive compatibility constraint as

$$U^*(\alpha^*, \widehat{p}, b_1) \ge u[s_1] + \Omega_2. \tag{24}$$

Under the assumption that $u[s_1^* = 0] \le \Omega_1$, the incentive compatibility constraint is always satisfied as long as the agent's participation constraint holds. Furthermore, the agent's participation constraint must be binding at the optimum because the principal has all the bargaining power. Thus, we obtain[30]

$$U^*(\alpha^*, \widehat{p}, b_1^*) = \Omega_1 + \Omega_2. \tag{25}$$

This in turn implies that for s_2^* and b_2^*, we have

$$s_2^* = u^{-1}\left\{\Omega_1 + \Omega_2 + c_1 - \widehat{p}\frac{c_2}{\Delta}\right\} - \alpha^*(p+\delta\Delta)b_1^* \tag{26}$$

and

$$b_2^* = u^{-1}\left\{\Omega_1 + \Omega_2 + c_1 + (1-\widehat{p})\frac{c_2}{\Delta}\right\} - u^{-1}\left\{\Omega_1 + \Omega_2 + c_1 - \widehat{p}\frac{c_2}{\Delta}\right\} - (1-\alpha^*)b_1^* \tag{27}$$

in case the project can be improved at $t=2$. Otherwise, we have $s_2^* = b_2^* = 0$.

Regarding the optimal incentive claim granted to the agent at the beginning of the first period, the principal chooses b_1^* so that

$$U^*(\alpha^*, \widehat{p}, b_1^*) = \Omega_1 + \Omega_2. \tag{28}$$

Thus, b_1^* is determined by simultaneously satisfying

$$\widehat{p} \cdot u[\alpha^*(p+\delta\Delta)b_1 + (1-\alpha^*)b_1] + (1-\widehat{p}) \cdot u[\alpha^*(p+\delta\Delta)b_1] - \Omega_1 - c_1 = 0 \tag{29}$$

and

$$\alpha^* \in \arg\max_{\alpha \in [0,1]} \{\widehat{p} \cdot u[\alpha\theta + (1-\alpha)b_1^*] + (1-\widehat{p}) \cdot u[\alpha\theta] + \Omega_2 - c_1\}. \tag{30}$$

A.2.5. Optimal contract

Proposition 1. Optimal contract. The optimal contract in case the project can be improved at $t=2$ is

$$s_1^* = 0 \tag{31}$$

$$b_1^* \in \left\{ \begin{array}{l} b_1 : \widehat{p} \cdot u[\alpha^*(p+\delta\Delta)b_1 + (1-\alpha^*)b_1] \\ \quad + (1-\widehat{p}) \cdot u[\alpha^*(p+\delta\Delta)b_1] - \Omega_1 - c_1 = 0 \end{array} \right\} \tag{32}$$

$$s_2^* = u^{-1}\left\{\Omega_1 + \Omega_2 + c_1 - \widehat{p}\frac{c_2}{\Delta}\right\} - \alpha^*(p+\delta\Delta)b_1^* \tag{33}$$

$$b_2^* = u^{-1}\left\{\Omega_1 + \Omega_2 + c_1 + (1-\widehat{p})\frac{c_2}{\Delta}\right\} - u^{-1}\left\{\Omega_1 + \Omega_2 + c_1 - \widehat{p}\frac{c_2}{\Delta}\right\} - (1-\alpha^*)b_1^* \tag{34}$$

with $\alpha^* = 1$ for $\widehat{p} \le p+\delta\Delta$ and

$$\alpha^* \in \arg\max_{\alpha \in [0,1]} \left\{ \begin{array}{l} \widehat{p} \cdot u[\alpha(p+\delta\Delta)b_1^* + (1-\alpha)b_1^*] \\ \quad + (1-\widehat{p}) \cdot u[\alpha(p+\delta\Delta)b_1^*] + \Omega_2 - c_1 \end{array} \right\} \tag{35}$$

for $\widehat{p} > p+\delta\Delta$. In case the project cannot be improved at $t=2$, s_1^* and b_1^* are unchanged, and $s_2^* = b_2^* = 0$.

A.3. Comparative statics

A.3.1. Comparative statics for b_1^* and α^*

For $\widehat{p} \le p+\delta\Delta$, we have $\alpha^* = 1$ and

$$b_1^* = \frac{u^{-1}\{\Omega_1 + c_1\}}{p+\delta\Delta}. \tag{36}$$

Thus, we obtain

$$\frac{db_1^*}{d\widehat{p}} = \frac{d\alpha^*}{d\widehat{p}} = 0. \tag{37}$$

[29] Note that $s_1^* = 0$ implies $\alpha^* \in (0,1)$ for $\widehat{p} > p+\delta\Delta$ because $\lim_{w \to 0} u'(w) = \infty$. That is, the agent never keeps all of his incentive claim ($\alpha^* = 0$) and always sells some of it to the outside investor.

[30] Note that the agent foresees what price the outside investors will be willing to pay for his original incentive claim as well as his optimal response α^*.

For $\hat{p} > p+\delta\Delta$, we have $\alpha^* \in (0,1)$, and b_1^* is determined by simultaneously satisfying the two equations

$$F(\alpha^*, b_1^*, \hat{p}) = \frac{u'[\alpha^*\theta]}{u'[\alpha^*\theta+(1-\alpha^*)b_1^*]} - \frac{\hat{p}\cdot(1-p-\delta\Delta)}{(1-\hat{p})\cdot(p+\delta\Delta)} = 0 \tag{38}$$

and

$$G(\alpha^*, b_1^*, \hat{p}) = \hat{p}\cdot u[\alpha^*\theta+(1-\alpha^*)b_1^*] + (1-\hat{p})\cdot u[\alpha^*\theta] - \Omega_1 - c_1 = 0. \tag{39}$$

In that case, using the total derivatives of $F(\alpha^*, b_1^*, \hat{p})$ and $G(\alpha^*, b_1^*, \hat{p})$, we can derive the following two expressions:

$$\frac{db_1^*}{d\hat{p}} = \frac{\frac{\partial G}{\partial \alpha^*}\cdot\frac{\partial F}{\partial \hat{p}} - \frac{\partial G}{\partial \hat{p}}\cdot\frac{\partial F}{\partial \alpha^*}}{\frac{\partial G}{\partial b_1^*}\cdot\frac{\partial F}{\partial \alpha^*} - \frac{\partial G}{\partial \alpha^*}\cdot\frac{\partial F}{\partial b_1^*}} \tag{40}$$

and

$$\frac{d\alpha^*}{d\hat{p}} = \frac{\frac{\partial G}{\partial b_1^*}\cdot\frac{\partial F}{\partial \hat{p}} - \frac{\partial G}{\partial \hat{p}}\cdot\frac{\partial F}{\partial b_1^*}}{\frac{\partial G}{\partial \alpha^*}\cdot\frac{\partial F}{\partial b_1^*} - \frac{\partial G}{\partial b_1^*}\cdot\frac{\partial F}{\partial \alpha^*}}. \tag{41}$$

Taking partial derivatives of F and G with respect to α^*, b_1^*, and $\hat{p}$, we obtain after some simplifying algebra

$$\frac{db_1^*}{d\hat{p}} = -\frac{u[\alpha^*\theta+(1-\alpha^*)b_1^*] - u[\alpha^*\theta]}{\hat{p}\cdot u'[\alpha^*\theta+(1-\alpha^*)b_1^*]} < 0 \tag{42}$$

and

$$\frac{d\alpha^*}{d\hat{p}} = -\frac{\alpha^*[1-\alpha^*(1-p-\delta\Delta)]}{\hat{p}(1-\hat{p})\gamma} < 0. \tag{43}$$

A.3.2. Comparative statics for s_2^* and b_2^*

Taking derivatives of s_2^* and b_2^* with respect to $\hat{p}$, we obtain for $\hat{p} \le p+\delta\Delta$

$$\frac{ds_2^*}{d\hat{p}} = -\frac{\frac{c_2}{\Delta}}{u'\left[u^{-1}\left\{\Omega_1+\Omega_2-c_1-\hat{p}\frac{c_2}{\Delta}\right\}\right]} < 0 \tag{44}$$

and

$$\frac{db_2^*}{d\hat{p}} = -\frac{\frac{c_2}{\Delta}}{u'\left[u^{-1}\left\{\Omega_1+\Omega_2+c_1+(1-\hat{p})\frac{c_2}{\Delta}\right\}\right]} + \frac{\frac{c_2}{\Delta}}{u'\left[u^{-1}\left\{\Omega_1+\Omega_2+c_1-\hat{p}\frac{c_2}{\Delta}\right\}\right]} < 0. \tag{45}$$

For $\hat{p} > p+\delta\Delta$, we have

$$\frac{ds_2^*}{d\hat{p}} = \underbrace{-\frac{\frac{c_2}{\Delta}}{u'\left[u^{-1}\left\{\Omega_1+\Omega_2+c_1-\hat{p}\frac{c_2}{\Delta}\right\}\right]}}_{(-)} \underbrace{-(p+\delta\Delta)\alpha^*\frac{db_1^*}{d\hat{p}}}_{(+)} \underbrace{-(p+\delta\Delta)\frac{da^*}{d\hat{p}}b_1^*}_{(+)} \tag{46}$$

and

$$\frac{db_2^*}{d\hat{p}} = \underbrace{-\frac{\frac{c_2}{\Delta}}{u'\left[u^{-1}\left\{\Omega_1+\Omega_2+c_1+(1-\hat{p})\frac{c_2}{\Delta}\right\}\right]} + \frac{\frac{c_2}{\Delta}}{u'\left[u^{-1}\left\{\Omega_1+\Omega_2+c_1-\hat{p}\frac{c_2}{\Delta}\right\}\right]}}_{(-)} \underbrace{-(1-\alpha^*)\frac{db_1^*}{d\hat{p}}}_{(+)} \underbrace{+\frac{da^*}{d\hat{p}}b_1^*}_{(-)}. \tag{47}$$

A.3.3. Empirical predictions

In order to derive testable implications, I focus on the average effect of an agent's optimism regarding his compensation. Specifically, I define the probability weighted average effect of an agent's optimism on his incentive compensation as

$$\Upsilon \equiv \frac{1}{1+\delta}\cdot\frac{db_1^*}{d\hat{p}} + \frac{\delta}{1+\delta}\cdot\frac{db_2^*}{d\hat{p}}, \tag{48}$$

and the probability weighted average effect on his total compensation as

$$\Psi \equiv \frac{1}{1+\delta}\cdot\left(\frac{db_1^*}{d\hat{p}} + \frac{ds_1^*}{d\hat{p}}\right) + \frac{\delta}{1+\delta}\cdot\left(\frac{db_2^*}{d\hat{p}} + \frac{ds_2^*}{d\hat{p}}\right). \tag{49}$$

For $\hat{p} \le p+\delta\Delta$, we obtain

$$\Upsilon = \frac{\delta}{1+\delta}\left(-\frac{\frac{c_2}{\Delta}}{u'\left[u^{-1}\left\{\Omega_1+\Omega_2+c_1+(1-\hat{p})\frac{c_2}{\Delta}\right\}\right]} + \frac{\frac{c_2}{\Delta}}{u'\left[u^{-1}\left\{\Omega_1+\Omega_2+c_1-\hat{p}\frac{c_2}{\Delta}\right\}\right]}\right) < 0 \tag{50}$$

and

$$\Psi = \frac{\delta}{1+\delta}\left(-\frac{\frac{c_2}{\Delta}}{u'\left[u^{-1}\left\{\Omega_1+\Omega_2+c_1+(1-\hat{p})\frac{c_2}{\Delta}\right\}\right]}\right) < 0. \tag{51}$$

For $\hat{p} > p+\delta\Delta$, we have

$$\Upsilon = \frac{\delta}{1+\delta}\left(-\frac{\frac{c_2}{\Delta}}{u'\left[u^{-1}\left\{\Omega_1+\Omega_2+c_1+(1-\hat{p})\frac{c_2}{\Delta}\right\}\right]} + \frac{\frac{c_2}{\Delta}}{u'\left[u^{-1}\left\{\Omega_1+\Omega_2+c_1-\hat{p}\frac{c_2}{\Delta}\right\}\right]}\right) + \frac{\delta}{1+\delta}\cdot\frac{da^*}{d\hat{p}}b_1^* + \frac{1}{1+\delta}\cdot\frac{db_1^*}{d\hat{p}}\left[1-\delta(1-\alpha^*)\right] < 0 \tag{52}$$

and

$$\Psi = \frac{\delta}{1+\delta}\left(-\frac{\frac{c_2}{\Delta}}{u'\left[u^{-1}\left\{\Omega_1+\Omega_2+c_1+(1-\hat{p})\frac{c_2}{\Delta}\right\}\right]} + \frac{da^*}{d\hat{p}}b_1^*(1-p-\delta\Delta)\right) + \frac{1}{1+\delta}\cdot\frac{db_1^*}{d\hat{p}}\{1-\delta[1-\alpha^*(1-p-\delta\Delta)]\} < 0. \tag{53}$$

Thus, the average effect of an agent's optimism on his incentive compensation as well as on his total compensation is strictly negative.

Appendix B. Effect of optimism on compensation if the agent's incentive compatibility constraint is not binding at the optimum

This extension examines the effect of an agent's optimism on his compensation in case the agent's incentive compatibility constraint is not binding at the optimum. For ease of exposition, I focus on a one-period version of the model. An example that demonstrates the effect in the two-period case is presented at the end, together with an empirical analysis.

Consider a principal who employs an agent to implement a one-period project. Implementing the project costs the agent private effort cost c. The project pays off R with probability p and zero otherwise. Only the final payoff is verifiable. The risk-neutral principal has all the bargaining power. The risk-averse agent has utility function $u(\cdot)$, outside option Ω, and believes the probability of success to be $\hat{p}$. As before, I assume that $u(\cdot)$ satisfies $u'(w)>0$, $\lim_{w\to 0}u'(w)=\infty$, $u''(w)<0$, and $-u''(w)/u'(w)=\gamma/w>0$.

To induce the agent to implement the project, the principal promises to the agent a fixed payment s and a variable payment b that is contingent on the project's success. The agent's incentive compatibility constraint can be written as

$$u(s+b)-u(s)\geq \frac{c}{\hat{p}}, \tag{54}$$

and the agent's participation constraint as

$$u(s)+\hat{p}\cdot[u(s+b)-u(s)]-c\geq \Omega. \tag{55}$$

The principal's objective function is

$$\max_{s,b}\ pR-s-pb \tag{56}$$

subject to the agent's incentive compatibility and participation constraints.

The Lagrangian to the principal's problem is

$$\begin{aligned} L=&\,p\cdot R-s-p\cdot b\\ &+\mu\cdot\left\{u(s+b)-u(s)-\frac{c}{\hat{p}}\right\}\\ &+\lambda\cdot\{u(s)+\hat{p}\cdot[u(s+b)-u(s)]-c-\Omega\}. \end{aligned} \tag{57}$$

The first-order conditions are

$$\begin{aligned}\frac{\partial L}{\partial s}=&-1+\mu^*\cdot\{u'(s^*+b^*)-u'(s^*)\}\\ &+\lambda^*\cdot\{u'(s^*)+\hat{p}\cdot[u'(s^*+b^*)-u'(s^*)]\}=0,\end{aligned} \tag{58}$$

$$\frac{\partial L}{\partial b}=-p+\mu^*\cdot u'(s^*+b^*)+\lambda^*\cdot\hat{p}\cdot u'(s^*+b^*)=0, \tag{59}$$

and

$$\mu^*\cdot\left\{u(s^*+b^*)-u(s^*)-\frac{c}{\hat{p}}\right\}=0, \tag{60}$$

$$\lambda^*\cdot\{u(s^*)+\hat{p}\cdot[u(s^*+b^*)-u(s^*)]-c-\Omega\}=0, \tag{61}$$

$$u(s+b)-u(s)\geq \frac{c}{\hat{p}}, \tag{62}$$

$$u(s)+\hat{p}\cdot[u(s+b)-u(s)]-c\geq \Omega, \tag{63}$$

$$\mu^*\geq 0, \tag{64}$$

$$\lambda^*\geq 0. \tag{65}$$

From these, we obtain

$$\lambda^*=\frac{1-p}{u'(s^*)}+\frac{p}{u'(s^*+b^*)}>0 \tag{66}$$

and

$$\mu^*=\frac{p(1-\hat{p})}{u'(s^*+b^*)}-\frac{(1-p)\hat{p}}{u'(s^*)}. \tag{67}$$

Thus, the agent's participation constraint is always binding at the optimum. The agent's incentive compatibility constraint is binding as long as

$$\frac{p(1-\hat{p})}{u'(s^*+b^*)}-\frac{(1-p)\hat{p}}{u'(s^*)}>0\Leftrightarrow\frac{u'(s^*+b^*)}{u'(s^*)}<\frac{p(1-\hat{p})}{\hat{p}(1-p)}. \tag{68}$$

This is the equivalent to Assumption 1 in the two-period version of the model. If this condition is satisfied, we obtain $s^*=u^{-1}\{\Omega\}$ and $b^*=u^{-1}\{\Omega+c/\hat{p}\}-u^{-1}\{\Omega\}$.

If instead we have

$$\frac{u'(s^*+b^*)}{u'(s^*)}=\frac{p(1-\hat{p})}{\hat{p}(1-p)}, \tag{69}$$

then the agent's incentive compatibility constraint is not binding at the optimum. In that case, the optimal compensation claims s^* and b^* are determined by simultaneously satisfying

$$F\equiv u(s^*)+\hat{p}\cdot[u(s^*+b^*)-u(s^*)]-c=\Omega \tag{70}$$

and

$$G\equiv\frac{u'(s^*+b^*)}{u'(s^*)}-\frac{p(1-\hat{p})}{\hat{p}(1-p)}=0. \tag{71}$$

Taking partial derivatives, we obtain

$$\frac{\partial F}{\partial\hat{p}}=u\left(s^*+b^*\right)-u\left(s^*\right)>0 \tag{72}$$

$$\frac{\partial F}{\partial b^*}=\hat{p}\cdot u'\left(s^*+b^*\right)>0 \tag{73}$$

$$\frac{\partial F}{\partial s^*}=u'\left(s^*\right)\cdot\left(1-\hat{p}\right)+u'\left(s^*+b^*\right)\cdot\hat{p}>0 \tag{74}$$

$$\frac{\partial G}{\partial\hat{p}}=\frac{p}{\hat{p}^2(1-p)}>0 \tag{75}$$

$$\frac{\partial G}{\partial b^*}=\frac{u''(s^*+b^*)}{u'(s^*)}<0 \tag{76}$$

$$\frac{\partial G}{\partial s^*}=\frac{u'(s^*)u''(s^*+b^*)-u''(s^*)\cdot u'(s^*+b^*)}{u'(s^*)^2}>0, \tag{77}$$

where the last inequality is implied by $b^*>0$ and $-u''(w)/u'(w)=\gamma/w>0$.

Using

$$dF = \frac{\partial F}{\partial s^*} ds^* + \frac{\partial F}{\partial b^*} db^* + \frac{\partial F}{\partial \widehat{p}} d\widehat{p} = 0 \tag{78}$$

and

$$dG = \frac{\partial G}{\partial s^*} ds^* + \frac{\partial G}{\partial b^*} db^* + \frac{\partial G}{\partial \widehat{p}} d\widehat{p} = 0, \tag{79}$$

we derive

$$\frac{ds^*}{d\widehat{p}} = \frac{\overset{(-)}{\frac{\partial G}{\partial b^*}} \cdot \overset{(+)}{\frac{\partial F}{\partial \widehat{p}}} - \overset{(+)}{\frac{\partial G}{\partial \widehat{p}}} \cdot \overset{(+)}{\frac{\partial F}{\partial b^*}}}{\underset{(+)}{\frac{\partial G}{\partial s^*}} \cdot \underset{(+)}{\frac{\partial F}{\partial b^*}} - \underset{(-)}{\frac{\partial G}{\partial b^*}} \cdot \underset{(+)}{\frac{\partial F}{\partial s^*}}} < 0. \tag{80}$$

Thus, the optimal salary is decreasing in the agent's optimism if the agent's incentive compatibility constraint is not binding at the optimum.

The optimal amount of incentive pay in that case, however, is not in general monotone in the agent's optimism. We have

$$\frac{db^*}{d\widehat{p}} = \frac{\overset{(+)}{\frac{\partial G}{\partial s^*}} \cdot \overset{(+)}{\frac{\partial F}{\partial \widehat{p}}} - \overset{(+)}{\frac{\partial G}{\partial \widehat{p}}} \cdot \overset{(+)}{\frac{\partial F}{\partial s^*}}}{\underset{(-)}{\frac{\partial G}{\partial b^*}} \cdot \underset{(+)}{\frac{\partial F}{\partial s^*}} - \underset{(+)}{\frac{\partial G}{\partial s^*}} \cdot \underset{(+)}{\frac{\partial F}{\partial b^*}}} < 0, \tag{81}$$

if and only if

$$\frac{\partial G}{\partial s^*} \cdot \frac{\partial F}{\partial \widehat{p}} > \frac{\partial G}{\partial \widehat{p}} \cdot \frac{\partial F}{\partial s^*}. \tag{82}$$

This condition, however, is neither always satisfied nor always violated.

B.1. The two-period case: an example

The finding that the agent's incentive pay is not necessarily monotone in his optimism in case the incentive compatibility constraint is not binding extends to the two-period version of the model as the following example demonstrates. Assume that we have $u(w) = \ln(w)$ with $u'(w) = 1/w$ and $u''(w) = -1/w^2$. In that case, using

$$\frac{u'[\alpha^*\theta]}{u'[\alpha^*\theta + (1-\alpha^*)b_1]} = \frac{\widehat{p} \cdot (1-p-\delta\Delta)}{(1-\widehat{p}) \cdot (p+\delta\Delta)} \tag{83}$$

we obtain

$$\alpha^* = \begin{cases} 1 & \text{for} \quad \widehat{p} \le p+\delta\Delta \\ \dfrac{1-\widehat{p}}{1-p-\delta\Delta} & \text{for} \quad \widehat{p} > p+\delta\Delta \end{cases} \tag{84}$$

and using

$$\widehat{p}u[\alpha^*(p+\delta\Delta)b_1^* + (1-\alpha^*)b_1^*] + (1-\widehat{p})u[\alpha^*(p+\delta\Delta)b_1^*] - \Omega_1 - c_1 = 0 \tag{85}$$

we obtain

$$b_1^* = \begin{cases} \dfrac{\exp\{\Omega_1 + c_1\}}{p+\delta\Delta} & \text{for} \quad \widehat{p} \le p+\delta\Delta \\ \exp\left\{\Omega_1 + c_1 - \widehat{p}\ln[\widehat{p}] - (1-\widehat{p})\ln\left[(1-\widehat{p})\dfrac{p+\delta\Delta}{1-p-\delta\Delta}\right]\right\} & \text{for} \quad \widehat{p} > p+\delta\Delta. \end{cases} \tag{86}$$

As before, we have $s_1^* = 0$, $\partial\alpha^*/\partial\widehat{p} \le 0$, and $\partial b_1^*/\partial\widehat{p} \le 0$.

In case the project can be improved in the second period and assuming that Assumption 1 is violated, s_2^* and b_2^* are determined by simultaneously satisfying

$$\frac{u'[\alpha^*\theta + s_2^* + (1-\alpha^*)b_1^* + b_2^*]}{u'[\alpha^*\theta + s_2^*]} = \frac{(p+\Delta)(1-\widehat{p}-\Delta)}{(\widehat{p}+\Delta)(1-p-\Delta)} \tag{87}$$

and

$$(\widehat{p}+\Delta) \cdot u[\alpha^*\theta + s_2^* + (1-\alpha^*)b_1^* + b_2^*] + (1-\widehat{p}-\Delta) \cdot u[\alpha^*\theta + s_2^*] - c_1 - c_2 = \Omega_1 + \Omega_2. \tag{88}$$

Solving for s_2^* and b_2^*, we obtain

$$s_2^* = \exp\left\{\Omega_1 + \Omega_2 + c_1 + c_2 - (\widehat{p}+\Delta) \cdot \ln\left[\frac{(\widehat{p}+\Delta)(1-p-\Delta)}{(p+\Delta)(1-\widehat{p}-\Delta)}\right]\right\} - \alpha^*(p+\delta\Delta)b_1^* \tag{89}$$

and

$$b_2^* = s_2^*\left\{\frac{(\widehat{p}+\Delta)(1-p-\Delta)}{(p+\Delta)(1-\widehat{p}-\Delta)} - 1\right\} - b_1^*\left\{1 - \alpha^*\left[1 + (p+\delta\Delta)\left(\frac{(\widehat{p}+\Delta)(1-p-\Delta)}{(p+\Delta)(1-\widehat{p}-\Delta)} - 1\right)\right]\right\}. \tag{90}$$

If the project cannot be improved at $t=2$, we have $s_2^* = b_2^* = 0$.[31]

Fig. 3 shows how s_2^* and b_2^* vary with $\widehat{p}$ for the special case of $\Omega_1 = 1$, $\Omega_2 = 4$, $c_1 = 1$, $c_2 = 0.2$, $p = 0.1$, $\delta = 0.5$, and $\Delta = 0.2$. The horizontal axis shows $\widehat{p}$, the vertical axis s_2^* and b_2^*. The figure reveals that if the incentive compatibility constraint is not binding, b_2^* is not, in general, a monotone function of $\widehat{p}$.

B.2. Empirical evidence for a non-monotonic effect of CEO optimism

As the previous example shows, the effect of optimism on compensation is not, in general, monotone if the agent's incentive compatibility constraint is not binding. In what follows, I thus investigate whether or not there is any evidence in the data for a non-monotonic relation between a CEO's optimism and his compensation. In particular, I examine whether or not there is evidence for a locally positive effect of optimism over a particular range of the measures LongHolder and HighForecast. That is, I investigate if for any level of optimism there is any evidence that slightly more optimistic CEOs receive higher compensation than slightly less optimistic CEOs. Overall, I do not find convincing evidence that this is the case.

For the purpose of this analysis, I begin by constructing dummy variables that indicate different levels of optimism. The first dummy variable takes the value one if the value of the optimism measure under consideration, LongHolder or HighForecast, is between 0.0 and 0.1. The second dummy takes the value one if the value of the optimism measure is between 0.1 and 0.2, and so on. The eleventh dummy takes the value one if the value of the optimism measure is equal to 1.0.

[31] If the project can be improved and Assumption 1 holds, we have $s_2^* = \exp\{\Omega_1 + \Omega_2 + c_1 - \widehat{p}c_2/\Delta\} - \alpha^*(p+\delta\Delta)b_1^*$ and $b_2^* = \exp\{\Omega_1 + \Omega_2 + c_1 + (1-\widehat{p})c_2/\Delta\} - \exp\{\Omega_1 + \Omega_2 + c_1 - \widehat{p}c_2/\Delta\} - (1-\alpha^*)b_1^*$.

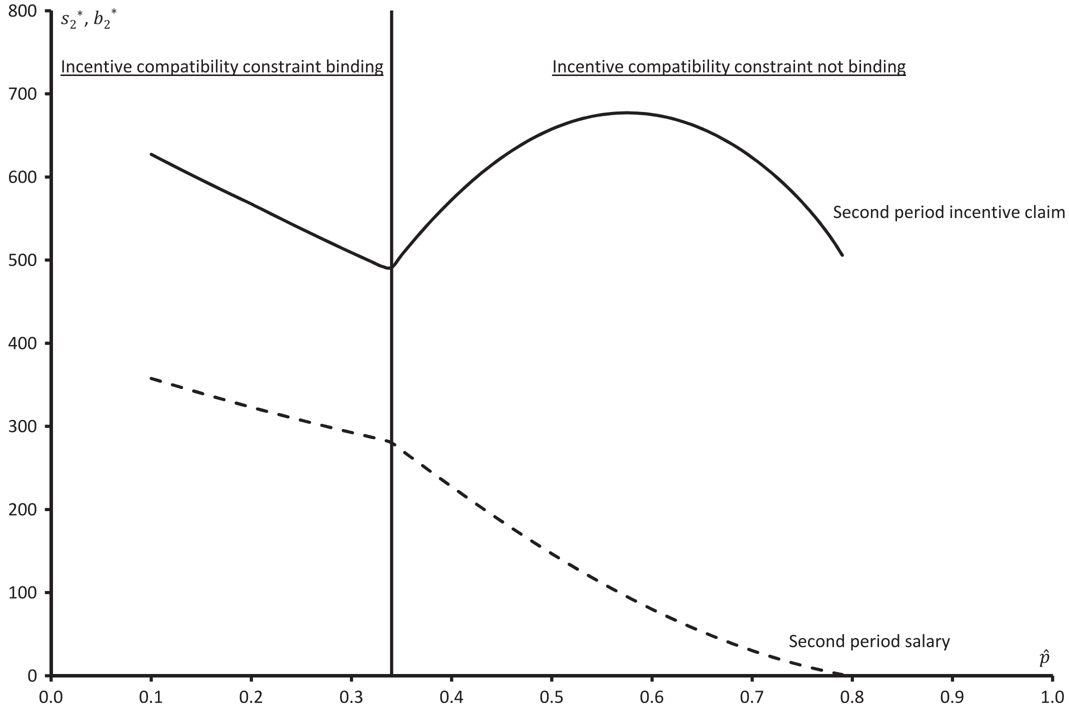

Fig. 3. Example of incentive pay and salary in period 2 if Assumption 1 is violated. This figure shows how s_2^* and b_2^* vary with $\hat{p}$ for the special case of $u(w)=\ln(w)$, $\Omega_1=1$, $\Omega_2=4$, $c_1=1$, $c_2=0.2$, p=0.1, $\delta=0.5$, and $\Delta=0.2$. The horizontal axis shows $\hat{p}$, the vertical axis s_2^* and b_2^*.

In the second step, I re-estimate the compensation regressions presented in Section 3, replacing LongHolder and HighForecast with the corresponding dummy variables. These specifications estimate the effect of optimism on compensation for each of the 11 possible levels of optimism relative to the base level of no optimism (LongHolder=0 or HighForecast=0) without imposing the restriction that the effect be monotone.[32]

Table B1 presents the results of these regressions. Panel A shows the results for dummies based on LongHolder, and Panel C shows the results for dummies based on HighForecast. Both panels display negative and significant coefficient estimates on the optimism dummies, and in particular, for dummies indicating high levels of optimism. This confirms the results presented throughout the paper. Optimistic CEOs tend to receive fewer incentives and lower total compensation than their non-optimistic peers.

A notable exception are the positive and significant coefficient estimates on three dummies in the regression regarding the CEO's restricted stock grants reported in Panel A. These dummies, $D(0.1<LH\leq 0.2)$, $D(0.7<LH\leq 0.8)$, and $D(LH=1.0)$, indicate CEO-firm combinations for which the variable LongHolder takes on values between 0.1 and 0.2, between 0.7 and 0.8, or is equal to one. These estimates thus present some evidence that some optimistic CEOs may actually receive larger restricted stock grants than their unbiased peers, i.e., CEOs for whom the variable LongHolder is equal to zero. This finding, however, must be interpreted with caution. It stands in contrast to the insignificant coefficient estimates on the optimism measures in all regressions pertaining to restricted stock grants in all other analyses throughout the paper. Furthermore, the corresponding regression in Panel C reveals a negative and significant coefficient estimate on the dummy that indicates a level of HighForecast between 0.9 and 1.0. The coefficient estimates on all other dummies in this regression are not significant. Thus, the overall evidence for a positive effect of optimism on the amount of restricted stock grants that a CEO receives is weak.

The third step of the analysis is to examine whether or not the coefficient estimates provide any evidence for a locally non-monotonic effect of optimism on the different compensation variables. To do so, I conduct Wald tests of the null hypothesis that the coefficient estimates on two dummies that indicate adjacent levels of optimism are equal to each other. In other words, I test whether or not the effect of optimism on compensation—relative to the base level of no optimism—is the same for similar levels of optimism.

Panel B shows the p-values of these tests for the dummies based on the optimism measure LongHolder. Panel D presents the p-values of the tests for the dummies

[32] An alternative approach when searching for a non-monotonic effect of optimism would be to add higher-order terms of the optimism measures to the regressions, e.g., to regress compensation on LongHolder, LongHolder^2, and LongHolder^3. The problem with this approach is that the optimism measures and their higher-order terms are very highly correlated with each other: The R^2 in a regression of LongHolder on LongHolder^2 is 0.955, and the R^2 in a regression of HighForecast on HighForecast^2 is 0.933. This multicollinearity problem makes this alternative approach unappealing in my setting.

Table B1
Regressions with dummies for different levels of optimism.

This table presents regression results using indicator variables for different levels of CEO optimism denoted $D(\ldots)$ in Panels A and C. All other variables are defined as in Tables 4 and 13. The sample period is 1996 to 2005. Heteroegeneity-robust standard errors that allow for clustering at the firm level are reported in parentheses. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively. Panels B and D present p-values from Wald tests for equality of the coefficient estimates on the dummies reported in Panels A and C.

						Panel A
	Ln(Opt. + 1)	Ln(Rst.st. + 1)	Ln(Bon. + 1)	Ln(Sal. + 1)	Ln(Total + 1)	Inc./Total
$D(0.0<LH\leq 0.1)$	−0.316	−0.466	−0.171	0.058	0.064	0.013
	(0.281)	(0.855)	(0.384)	(0.069)	(0.111)	(0.027)
$D(0.1<LH\leq 0.2)$	−0.564	1.230**	0.048	−0.170	−0.120	0.041
	(0.713)	(0.527)	(0.563)	(0.152)	(0.114)	(0.040)
$D(0.2<LH\leq 0.3)$	−0.856	0.021	0.536	0.131	0.084	−0.038
	(0.589)	(0.886)	(0.866)	(0.160)	(0.237)	(0.061)
$D(0.3<LH\leq 0.4)$	−0.500	0.134	0.545	−0.091	−0.119	−0.008
	(0.660)	(1.092)	(0.790)	(0.083)	(0.175)	(0.057)
$D(0.4<LH\leq 0.5)$	−0.335	−0.693	−0.016	−0.113	−0.304 ***	0.045
	(0.408)	(0.577)	(0.552)	(0.121)	(0.101)	(0.030)
$D(0.5<LH\leq 0.6)$	−0.417	0.416	0.643	0.778	0.136	−0.064
	(0.469)	(0.624)	(0.515)	(0.544)	(0.251)	(0.051)
$D(0.6<LH\leq 0.7)$	−0.973***	−0.290	−0.462	0.006	−0.244**	−0.055*
	(0.331)	(0.715)	(0.472)	(0.099)	(0.118)	(0.029)
$D(0.7<LH\leq 0.8)$	0.034	1.024**	−1.388***	−0.115	−0.140	0.014
	(0.634)	(0.484)	(0.256)	(0.108)	(0.136)	(0.061)
$D(0.8<LH\leq 0.9)$	−1.101	−0.394	−1.281	−0.642	−0.305	−0.064
	(0.707)	(1.227)	(0.928)	(0.516)	(0.215)	(0.065)
$D(0.9<LH<1.0)$	−1.848**	−0.772	0.039	−0.758	−0.229	−0.071
	(0.878)	(1.345)	(0.302)	(0.620)	(0.229)	(0.093)
$D(LH=1.0)$	−0.584	1.109**	−0.800***	−0.041	−0.151	−0.055*
	(0.361)	(0.549)	(0.280)	(0.064)	(0.097)	(0.030)
Ln(MktCap)	0.643***	0.257***	0.982***	0.074*	0.455***	0.071***
	(0.100)	(0.099)	(0.099)	(0.044)	(0.027)	(0.008)
Std.return	−0.445	−0.402	4.176***	−0.582	0.284	0.125
	(1.139)	(1.180)	(0.933)	(0.441)	(0.314)	(0.101)
Leverage	−0.581	0.317	0.206	0.108	0.029	−0.026
	(0.505)	(0.474)	(0.467)	(0.083)	(0.118)	(0.037)
MtB	0.013	−0.003	−0.071***	−0.001	0.005	0.000
	(0.019)	(0.024)	(0.022)	(0.011)	(0.008)	(0.002)
Cash/Assets	−0.071	0.495	0.689	−0.114	0.297	0.004
	(0.748)	(0.672)	(0.641)	(0.175)	(0.201)	(0.052)
R&D/Assets	−0.032	2.614*	3.875**	0.436	0.196	0.107
	(1.218)	(1.427)	(1.866)	(0.333)	(0.405)	(0.100)
R&D missing	0.335	−0.301	0.333	−0.163	−0.007	0.009
	(0.509)	(0.375)	(0.313)	(0.114)	(0.093)	(0.026)
Boardsize	0.033	−0.034	−0.064**	0.013	−0.001	−0.003
	(0.033)	(0.039)	(0.029)	(0.012)	(0.007)	(0.002)
Independent	0.160	0.837*	−0.049	0.225**	0.076	0.004
	(0.434)	(0.477)	(0.364)	(0.112)	(0.103)	(0.030)
Return	−0.096	0.069**	0.184	−0.007	−0.047	−0.004
	(0.069)	(0.029)	(0.138)	(0.008)	(0.029)	(0.003)
EBIT/Assets	−0.099	0.755	7.180***	0.323*	0.422*	0.193***

	(*0.822*)	(*0.629*)	(*0.845*)	(*0.195*)	(*0.251*)	(*0.071*)
Firm, year, tenure, age, and gender dummies	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.483	0.584	0.534	0.678	0.767	0.578
N	5,777	5,777	5,777	5,777	5,777	5,777

Panel B

Null hypothesis	Ln(Options+1)	Ln(Rst.stock+1)	Ln(Bonus+1)	Ln(Salary+1)	Ln(Total+1)	Incentives/Total
$D(0.0<LH\le 0.1)=D(0.1<LH\le 0.2)$	0.736	0.080*	0.732	0.164	0.215	0.538
$D(0.1<LH\le 0.2)=D(0.2<LH\le 0.3)$	0.745	0.225	0.631	0.194	0.425	0.259
$D(0.2<LH\le 0.3)=D(0.3<LH\le 0.4)$	0.613	0.919	0.995	0.129	0.386	0.686
$D(0.3<LH\le 0.4)=D(0.4<LH\le 0.5)$	0.829	0.500	0.584	0.875	0.341	0.410
$D(0.4<LH\le 0.5)=D(0.5<LH\le 0.6)$	0.891	0.166	0.337	0.097*	0.101	0.051*
$D(0.5<LH\le 0.6)=D(0.6<LH\le 0.7)$	0.314	0.436	0.101	0.154	0.165	0.871
$D(0.6<LH\le 0.7)=D(0.7<LH\le 0.8)$	0.161	0.105	0.075*	0.409	0.548	0.290
$D(0.7<LH\le 0.8)=D(0.8<LH\le 0.9)$	0.239	0.272	0.910	0.290	0.512	0.366
$D(0.8<LH\le 0.9)=D(0.9<LH<1.0)$	0.514	0.831	0.165	0.885	0.806	0.947
$D(0.9<LH<1.0)=D(LH=1.0)$	0.171	0.181	0.040**	0.259	0.747	0.861

Panel C

	Ln(Opt.+1)	Ln(Rst.st.+1)	Ln(Bon.+1)	Ln(Sal.+1)	Ln(Total+1)	Inc./Total
$D(0.0<HF\le 0.1)$	0.104	−0.030	0.184	0.144	−0.009	−0.041
	(*0.488*)	(*0.419*)	(*0.322*)	(*0.166*)	(*0.121*)	(*0.030*)
$D(0.1<HF\le 0.2)$	−0.243	−0.514	−0.057	−0.080	−0.088	−0.027
	(*0.304*)	(*0.334*)	(*0.283*)	(*0.102*)	(*0.077*)	(*0.023*)
$D(0.2<HF\le 0.3)$	−0.126	−0.623	0.035	0.079	−0.094	−0.010
	(*0.306*)	(*0.424*)	(*0.330*)	(*0.146*)	(*0.117*)	(*0.026*)
$D(0.3<HF\le 0.4)$	−0.350	−0.392	−0.383	−0.031	0.001	−0.035
	(*0.301*)	(*0.379*)	(*0.260*)	(*0.102*)	(*0.071*)	(*0.023*)
$D(0.4<HF\le 0.5)$	−0.104	−0.144	−0.356	0.050	−0.037	−0.032
	(*0.247*)	(*0.273*)	(*0.257*)	(*0.159*)	(*0.059*)	(*0.020*)
$D(0.5<HF\le 0.6)$	−0.528	−0.441	−0.561	−0.379	−0.015	0.007
	(*0.454*)	(*0.689*)	(*0.396*)	(*0.351*)	(*0.145*)	(*0.042*)
$D(0.6<HF\le 0.7)$	−0.173	−0.458	−0.398	−0.153	−0.073	−0.011
	(*0.336*)	(*0.430*)	(*0.340*)	(*0.157*)	(*0.106*)	(*0.024*)
$D(0.7<HF\le 0.8)$	−0.374	0.118	−0.806*	−0.172	−0.005	0.011
	(*0.369*)	(*0.546*)	(*0.433*)	(*0.180*)	(*0.121*)	(*0.031*)
$D(0.8<HF\le 0.9)$	−0.397	−0.582	−0.671*	0.010	−0.269**	−0.072***

Table B1 (*continued*)

Panel C

	Ln(Opt.+1)	Ln(Rst.st.+1)	Ln(Bon.+1)	Ln(Sal.+1)	Ln(Total+1)	Inc./Total
	(*0.348*)	(*0.581*)	(*0.368*)	(*0.145*)	(*0.132*)	(*0.026*)
$D(0.9<HF<1.0)$	−1.270**	−1.052**	−0.185	0.008	−0.307**	−0.070
	(*0.531*)	(*0.433*)	(*0.479*)	(*0.091*)	(*0.124*)	(*0.048*)
$D(HF=1.0)$	−0.523*	−0.210	−0.579**	−0.027	−0.140*	−0.040**
	(*0.272*)	(*0.341*)	(*0.248*)	(*0.086*)	(*0.076*)	(*0.019*)
ForecastLead	0.002*	0.000	0.001	0.000	0.000	0.000*
	(*0.001*)	(*0.002*)	(*0.001*)	(*0.001*)	(*0.000*)	(*0.000*)
ForecastWidth	0.310	0.038	−1.004	−0.125	−0.066	−0.071
	(*1.385*)	(*2.055*)	(*1.506*)	(*0.934*)	(*0.498*)	(*0.115*)
ForecastWidth^2	−0.487	−0.819	1.050	0.115	0.228	0.051
	(*1.514*)	(*2.166*)	(*1.668*)	(*0.939*)	(*0.555*)	(*0.118*)
Ln(MktCap)	0.687***	0.119	0.867***	0.095***	0.425***	0.073***
	(*0.085*)	(*0.085*)	(*0.091*)	(*0.030*)	(*0.025*)	(*0.006*)
Std.return	−1.513	1.634	2.945**	−0.619	0.119	0.116
	(*1.385*)	(*1.291*)	(*1.256*)	(*0.417*)	(*0.350*)	(*0.094*)
Leverage	−0.611	0.971**	−0.205	0.062	0.001	−0.007
	(*0.422*)	(*0.419*)	(*0.402*)	(*0.108*)	(*0.103*)	(*0.032*)
MtB	0.002	−0.009	−0.065***	−0.008	0.001	−0.001
	(*0.019*)	(*0.021*)	(*0.020*)	(*0.006*)	(*0.010*)	(*0.001*)
Cash/Assets	0.584	−0.265	1.475***	−0.171	0.257	0.091*
	(*0.669*)	(*0.599*)	(*0.549*)	(*0.120*)	(*0.182*)	(*0.048*)
R&D/Assets	−0.247	2.643*	3.249**	0.634	0.389	0.014
	(*1.455*)	(*1.481*)	(*1.520*)	(*0.441*)	(*0.536*)	(*0.125*)
R&D missing	0.039	−0.569	0.123	−0.079	−0.117	−0.032
	(*0.349*)	(*0.362*)	(*0.262*)	(*0.069*)	(*0.073*)	(*0.022*)
Boardsize	0.017	−0.023	−0.062**	0.026**	−0.009	−0.004**
	(*0.027*)	(*0.034*)	(*0.028*)	(*0.013*)	(*0.007*)	(*0.002*)
Independent	0.131	0.309	0.113	0.221**	−0.078	−0.019
	0.378	0.404	0.300	0.106	0.093	0.026
Return	−0.113*	0.123***	0.296	−0.009	−0.048	−0.001
	0.068	0.028	0.186	0.008	0.026	0.002
EBIT/Assets	0.362	0.423	8.524***	0.019	0.602	0.273***
	0.680	0.584	0.768	0.169	0.240	0.059
Firm, year, tenure, age, and gender dummies	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.447	0.534	0.519	0.734	0.724	0.545
N	8,238	8,238	8,238	8,238	8,238	8,238

Panel D

Null hypothesis	Ln(Options+1)	Ln(Rst.stock+1)	Ln(Bonus+1)	Ln(Salary+1)	Ln(Total+1)	Incentives/Total
$D(0<HF\leq 0.1)=D(0.1<HF\leq 0.2)$	0.487	0.301	0.539	0.165	0.555	0.685
$D(0.1<HF\leq 0.2)=D(0.2<HF\leq 0.3)$	0.743	0.814	0.813	0.188	0.960	0.570

$D(0.2 < HF \leq 0.3) = D(0.3 < HF \leq 0.4)$	0.559	0.641	0.259	0.356	0.463	0.409
$D(0.3 < HF \leq 0.4) = D(0.4 < HF \leq 0.5)$	0.403	0.506	0.929	0.438	0.615	0.885
$D(0.4 < HF \leq 0.5) = D(0.5 < HF \leq 0.6)$	0.352	0.667	0.611	0.185	0.881	0.365
$D(0.5 < HF \leq 0.6) = D(0.6 < HF \leq 0.7)$	0.457	0.982	0.719	0.501	0.724	0.681
$D(0.6 < HF \leq 0.7) = D(0.7 < HF \leq 0.8)$	0.639	0.367	0.419	0.933	0.641	0.537
$D(0.7 < HF \leq 0.8) = D(0.8 < HF \leq 0.9)$	0.960	0.340	0.796	0.418	0.101	0.022**
$D(0.8 < HF \leq 0.9) = D(0.9 < HF < 1.0)$	0.126	0.452	0.369	0.988	0.802	0.972
$D(0.9 < HF < 1.0) = D(HF = 1.0)$	0.169	0.063*	0.434	0.631	0.186	0.542

based on HighForecast. As can be seen from Panel B, the null hypothesis that the effect of optimism on compensation is the same for two adjacent levels of optimism can typically not be rejected. There are four exceptions. The null of $D(0.0 < LH \leq 0.1) = D(0.1 < LH \leq 0.2)$ is rejected at the 10% level in the regression pertaining to restricted stock grants. The hypotheses of $D(0.6 < LH \leq 0.7) = D(0.7 < LH \leq 0.8)$ and $D(0.9 < LH < 1.0) = D(LH = 1.0)$ are rejected at the 10% level and the 5% level for the CEO's bonus payments. The null of $D(0.4 < LH \leq 0.5) = D(0.5 < LH \leq 0.6)$ is rejected at the 10% level regarding the CEO's salary. And, finally, the null of $D(0.4 < LH \leq 0.5) = D(0.5 < LH \leq 0.6)$ is rejected at the 10% level in the regression for the fraction of incentives in the CEO's total compensation.

However, with respect to the regressions pertaining to the CEO's restricted stock grants, the null hypotheses $D(0.7 < LH \leq 0.8) = D(0.8 < LH \leq 0.9)$ and $D(0.9 < LH < 1.0) = D(LH = 1.0)$ cannot be rejected. In other words, even though Panel A provided some evidence that some optimistic CEOs may actually receive larger restricted stock grants than their unbiased peers, the hypothesis that very optimistic CEOs receive the same amount of restricted stock grants as slightly less optimistic CEOs cannot be rejected.

Similar to Panel B, Panel D reveals little evidence against the null hypothesis of equal coefficients on the optimism dummies based on the variable HighForecast. There are two exceptions. The null hypothesis of $D(0.9 < HF < 1.0) = D(HF = 1.0)$ is rejected at the 10% level in the regression pertaining to restricted stock grants. Thus, the coefficient on $D(0.9 < HF < 1.0)$, -1.052, in the restricted stock grants regression presented in Panel C is significantly different from the coefficient on $D(HF = 1.0)$, -0.210. This finding can be interpreted as evidence that the effect of optimism on the amount of restricted stock grants may indeed be locally positive for very high levels of optimism. The second exception is the null of $D(0.7 < HF \leq 0.8) = D(0.8 < HF \leq 0.9)$, which is rejected at the 5% level in the regression pertaining to the fraction of incentives in the CEO's total compensation. This, however, is evidence of a locally negative effect of optimism. In summary, Table B1 thus provides only very little evidence for a non-monotonic effect of optimism on compensation.

Appendix C. Description of cleanse indicators in the insider filings data

As mentioned in Section 2, the insider filings data obtained from Thomson Reuters contain cleanse indicators that indicate the overall level of confidence in each record. The following information regarding these indicators is taken from the data description file that is provided by Thomson Reuters together with the data. Thomson's proprietary data cleansing process verifies the accuracy and reasonableness of insider-reported figures by reference to external sources. Data (e.g., transaction prices, acquisition/disposition indicators, etc.) that appear erroneous or unreasonable are corrected by substituting information from alternative sources. The cleanse indicator indicates Thomson's level of confidence concerning the accuracy of a particular record contained in the database.

There are nine cleanse indicators:

- R: Data verified through the cleansing process.
- H: Cleansed with a very high level of confidence.
- L: One or more data cleansing actions were undertaken, but secondary sources were unavailable for complete verification.
- I: Some data elements were improved (inserted or replaced) in order to make the data usable. In some cases, records with a cleanse indicator of "I" may contain data that could not be verified or were determined to be outside a reasonable range.
- C: A record added to a nonderivative table or a derivative table in order to correspond with a record on the opposing table.
- W: Indicates an improperly reported holding record on the derivative table. This occurs when the insider reports a holdings value in the number of derivatives or number of underlying shares field (and no value was reported for resulting derivatives held).
- Y: An as-reported holding value identified by data cleansing.
- S: No cleansing attempted; security does not meet our collection requirements.
- A: Numerous data elements were missing or invalid; reasonable assumptions could not be made.

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