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MANAGERIAL MISCALIBRATION

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ABSTRACT

Miscalibration is a form of overconfidence examined in both psychology and economics. Although it is often analyzed in lab experiments, there is scant evidence about the effects of miscalibration in practice. We test whether top corporate executives are miscalibrated, and study the determinants of their miscalibration. We study a unique panel of over 11,600 probability distributions provided by top financial executives and spanning nearly a decade of stock market expectations. Our results show that financial executives are severely miscalibrated: realized market returns are within the executives' 80% confidence intervals only 33% of the time. We show that miscalibration improves following poor market performance periods because forecasters extrapolate past returns when forming their lower forecast bound ("worst case scenario"), while they do not update the upper bound ("best case scenario") as much. Finally, we link stock market miscalibration to miscalibration about own-firm project forecasts and increased corporate investment.

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1. Introduction

In designing corporate policies, managers must estimate future unknowns (e.g., demand, cash flows, competition), a task that is complicated by miscalibration.[1] Evidence from psychological lab experiments indicates that people are generally miscalibrated, in that their forecast probability distributions are too narrow. This happens either because people overestimate their ability to predict the future[2] or because they underestimate the volatility of random events.[3] But while miscalibration is a well-documented effect in the lab, to the best of our knowledge, there is no systematic evidence of miscalibration among business executives.

Our paper is the first to apply a laboratory approach to measure miscalibration in a population of thousands of real world financial managers. We measure the miscalibration of managers in a unique sample of over 11,600 S&P 500 forecasts made by top U.S. financial executives. Our measure is based on beliefs (with respect to the true distribution of outcomes) and is operationalized using a method drawn from laboratory experiments. We measure the extent to which financial executives are well-calibrated and we study the channels through which miscalibration occurs. Finally, we test whether stock market miscalibration is related to miscalibration of own-firm internal rate of return (IRR) and to the intensity of corporate investment.

Each quarter from March 2001 to February 2010, we surveyed U.S. Chief Financial Officers (CFOs) and asked them to predict one- and ten-year stock market returns, as well as the 10^{th} and 90^{th} percentiles of the distribution of market returns ("worst case" and "best case" outcomes). We follow Odean (1998), Kyle and Wang (1997), and Hackbarth (2008) in using

[1] In the psychology literature, researchers usually refer to "miscalibration" as overconfidence. Conversely, in the finance literature, researchers often use the term overconfidence to express "above average" feeling (e.g., Malmendier and Tate 2005 and 2008, and Malmendier, Tate and Yan 2006). In this study we use "miscalibration" and "overconfidence" interchangeably. When overconfidence is in the sense "above average," we state it explicitly.

[2] Surveyed subjects typically provide confidence bounds for their predictions that are too narrow (Alpert and Raiffa 1982). Researchers also document that experts in a variety of professional fields overestimate the precision of their information, e.g., clinical psychologists (Oskamp 1965), and physicians and nurses (Christensen-Szalanski and Bushyhead 1981, Baumann, Deber, and Thompson 1991).

[3] Studies have shown that professionals are miscalibrated with regard to estimating the probabilities of random outcomes, for example, engineers (Kidd 1970) and entrepreneurs (Cooper, Woo, and Dunkelberg 1988). Related to our study, Von Holstein (1972) documents that investment bankers provide miscalibrated forecasts of stock market returns; Deaves, Luders, and Schröder (2005) find that stock market forecasters are miscalibrated on average and become more overconfident with previous successful forecasts; and Bar-Yosef and Venezia (2006) report that subjects (students and security analysts) in the laboratory exhibit miscalibration in their predictions of future accounting numbers. Deaves, Luders, and Lou (2003) find that laboratory subjects who are miscalibrated also tend to trade excessively. None of these studies link miscalibration to real actions in the corporate world.

second moment information to define the narrowness of individual probability distributions for stock market returns, which provides us with a measure of each respondent's miscalibration (i.e., the standardized narrowness of the confidence interval).[4]

Miscalibration is a behavioral bias that is an aspect of overconfidence. Previous research in finance treats overconfidence as feeling "above average".[5] In contrast, our design focuses on miscalibration of beliefs.[6] As a result, we use a different lens than that previously employed in the field (e.g., the approach of Malmendier and Tate (2005)). According to our definition, miscalibrated people overestimate the precision of their own forecasts, or underestimate the variance of risky processes; in other words, their subjective probability distributions are too narrow.

Our interpretation of miscalibration is important when testing theoretical predictions concerning the effects of biases on corporate policies. Theoretical models distinguish between optimistic managers who overestimate the *mean* of their firms' cash flows (Shefrin 2001, Heaton 2002, Hackbarth 2008), which we refer to as optimism, and miscalibrated managers who either underestimate the *volatility* of their firms' future cash flows (Shefrin 2001, Hackbarth 2008) or overweight their private signals relative to public information (Gervais, Heaton, and Odean 2007, Gervais and Goldstein 2007).[7] Our data allow us to disentangle respondents' biases in the first and second moments. In other words, we can separate miscalibration from optimism. To our knowledge, our paper is the only one with direct and distinct measures of miscalibration and optimism and the only one to link both of these constructs to firms and their actions.

[4] Although we measure relative calibration, we use the term miscalibration because the majority of CFOs provide responses that would be considered miscalibrated by any reasonable metric, as discussed in Section 3.

[5] In several papers Malmendier and Tate measure CEOs' overconfidence in the sense of feeling "above average" (Malmendier and Tate 2005 and 2008, and Malmendier, Tate and Yan 2006). Their measure is based on the degree of under-diversification of the executives' personal portfolios, and also according to the CEOs' representation in the popular press (Malmendier and Tate, 2005). They show that biased executives exhibit high investment-cash flow sensitivity, engage intensively in unsuccessful mergers and acquisitions, and avoid tapping the capital markets. Using their news-based proxy, Hribar and Yang (2006) show that firms with CEOs who feel "above average" are more likely to issue point estimates in their earnings forecasts (rather than estimate ranges), to issue narrow range estimates, and to manage earnings to meet these forecasts.

[6] See Lichtenstein and Fischoff (1977), Koriat, Lichtenstein, and Fischoff (1980), Lichtenstein, Fischoff, and Phillips (1982), Kruger and Dunning (1999), Alba and Hutchison (2000), Shefrin (2001), Soll and Klayman (2004), and Hackbarth (2008).

[7] Daniel, Hirshleifer, and Subrahmanyam (1998), Odean (1999), and Gervais and Odean (2001) use similar overconfidence definitions for stock market investors.

Our survey respondents are finance officers, mostly CFOs.[8] Previous research motivates studying the behavior of financial executives. Bertrand and Schoar (2003) show that there is a pronounced "CFO fixed effect" in corporate decisions but they do not study managerial characteristics of individual CFOs. Graham, Harvey, and Puri (2010) present evidence that CFOs play a relatively important role in decisions such as capital allocation. Kaplan, Klebanov and Sorensen (2010) link the performance of chief executives to 30 individual characteristics.

Our main contribution is in testing managerial miscalibration and understanding the drivers of this bias. In the quarterly survey, CFOs provide expected stock market returns and an 80% confidence interval for their prediction. According to the confidence bounds that CFOs provide, they are severely miscalibrated: only 33% of the time do realized S&P 500 returns fall within the 80% confidence interval that respondents offer. Even during the least volatile quarters in our sample, only 59% of realized returns fall within the 80% confidence intervals provided.

Importantly, we document that miscalibration is time varying and explore its underlying economic mechanism. We show that CFOs have wider confidence intervals following negative return periods. We explore the mechanism that drives this result and find that it relates to asymmetric extrapolations on the part of executives. Specifically, when forming the lower bound ("worst case"), CFOs extrapolate past returns, especially when they are negative. The upper bound ("best case") is far less sensitive to past returns. Therefore, following bad periods in the stock market, the lower bound decreases, while the upper bound remains almost static—and the confidence interval that executives provide widens.

This behavior is consistent with Soll and Klayman's (2004) argument that people make inferences about the distribution of random or unknown variables from a few known cases (such as past returns), and with the work of Arnold (1986), March and Shapira (1987) and Kahneman and Lovallo (1993), who argue that managers focus on downside risk. In addition, we document that miscalibration and optimism are time-persistent personal characteristics; executives with these characteristics adapt very little in response to new data realizations.

We also study whether miscalibration is correlated with the corporate internal rate of return (IRR) and investment. We find that the degree of miscalibration on S&P 500 returns is

[8] Our population of executives is different from groups previously studied in the behavioral finance field. For example, Malmendier and Tate (2005, 2008), and Malmendier, Tate, and Yan (2006) study overconfidence (in the sense of "above average") in the population of CEOs.

correlated with the narrowness of own-firm IRR forecasts. Furthermore, firms with miscalibrated executives invest more on average; the effect is magnified when miscalibrated executives are optimistic as well.

Our paper is organized as follows. Section 2 details the method that we use to collect the miscalibration data and the construction of variables; it also presents some summary statistics. In Section 3, we provide evidence on the miscalibration in CFO expectations. Section 4 explores the determinants of miscalibration. Section 5 tests the relation between CFO miscalibration and optimism to corporate forecasts and corporate investment policy. Some concluding remarks are offered in Section 6.

2. Data

2.1. Executive Survey

Our study is based on a unique data set of stock market predictions made by senior finance executives, the majority of whom are CFOs and financial vice presidents. The data were collected in 37 quarterly surveys conducted by Duke University between March 2001 and February 2010. Each quarter, we poll between 2,000 and 3,000 financial officers with a short survey on important topical issues (Graham and Harvey 2006). The usual response rate for the quarterly survey is 5% to 8% and most of the responses arrive within the first two days of the survey invitation date.[9] The survey usually contains eight questions about the U.S. economy, firm policies, and short-term corporate expectations. Some of the questions are identical for each survey and some change over time depending on economic conditions. The historical surveys as well as aggregated responses can be accessed at www.cfosurvey.org.

We base our miscalibration proxies on two survey questions. The first question is:

> *Over the next year, I expect the annual S&P 500 return will be:*
> *- There is a 1-in-10 chance the actual return will be less than ___%*
> *- I expect the return to be: ___%*
> *- There is a 1-in-10 chance the actual return will be greater than ___%*

[9] The bulk of our tests exploit variation within the respondent group, yet the overall response rate of 5% to 8% could potentially lead to non-response bias in the inference of some tests (e.g., in Section 3). We explore this issue further in Section 2.5.

The second question is similar but relates to annualized stock market return forecasts over the next 10 years. The initial words change from *"Over the next year, I expect the S&P 500 return will be"* to *"Over the next 10 years, I expect the average annual S&P 500 return will be"*.[10]

In contrast to most studies that use survey data, we are able to examine the characteristics of a sizable fraction of the respondents. Although the survey does not require CFOs to provide identifying information, about half of the firms voluntarily provide such information, and about a quarter of the firms are confirmed to be U.S. public companies.

Overall our sample includes 11,681 one-year expected returns and 11,353 ten-year expected returns with valid 10th and 90th percentile information. Of this sample, 4,028 observations are from public companies (self-reported), and of them, we are able to match 3,201 observations (1,030 unique firms) to CRSP and Compustat. For 2,044 observations (672 unique firms) there is a full set of survey responses, accounting and market data.

2.2. Measuring Miscalibration

Our miscalibration measure maps each CFO's 10th and 90th percentile predictions into an individual probability distribution. Wide distributions reflect high subjective uncertainty about the estimated variable, while narrow distributions reflect subjective confidence. By employing executives' estimates for the same common macroeconomic variable, we avoid using private information in the forecasting process.

Starting with the confidence bound information, we use the Davidson and Cooper (1976) method to recover respondent *i*'s individual probability distribution, based on the normal distribution. The imputed individual volatility is calculated as:

$$\hat{\sigma}_i = \frac{x(0.90) - x(0.10)}{Z} \qquad (1)$$

where $x(0.90)$ and $x(0.10)$ represent the 90th and 10th percentile of the respondent's distribution, and Z is the number of standard deviations within the confidence interval. For confidence intervals of 80% in a normal distribution, Z equals 2.65. Keefer and Bodily (1983) show that, given information about the 10th and 90th percentiles, this simple approximation is the preferred method for estimating the standard deviation of a probability distribution of a random variable.

[10] The first question has appeared in its current form since 2001Q2. The current form of the second question dates from 2002Q1.

We note however that the distribution of the imputed individual volatility is skewed to the right; therefore, we use a logged version of the imputed individual volatility, which assumes that the logged distribution of returns is normally distributed:

$$\hat{\sigma}_i = exp\left(\frac{log(1+upper\ bound)-log(1+lower\ bound)}{2.65}\right) - 1 \qquad (2)$$

Then, we winsorize the variable by 1% within survey date, to temper the effect of outliers. Also, we multiply the variable by minus one, so that low imputed individual volatility will correspond to higher miscalibration. Finally, as miscalibration should be determined within the survey date (as market conditions change over time), we standardize the variables to have a mean of zero and a standard deviation of one within each survey date. As CFOs provide estimates for short-term (one year) and long-term (10 year) S&P 500 average returns, we create short- and long-term miscalibration variables: *Miscalibration ST* and *Miscalibration LT*.

2.3. Measuring Optimism

Our survey data have the advantage of allowing us to measure miscalibration while simultaneously controlling for potential optimism in expected returns. We create two optimism variables, *Optimism ST* and *Optimism LT*, based on expected one- and ten-year return forecasts, respectively. The optimism variables are formed using a procedure that parallels the construction of the miscalibration variables. First, we add one and log the expected return estimate of the S&P 500. Second, we winsorize the estimates at the 1% level, and finally we standardize the variables to have a zero mean and a standard deviation of one, within each survey date. In this construct, high optimism corresponds to high S&P 500 estimates.

2.4. Company and Market Data

Throughout the analysis we use several databases with firm-level information. A detailed description of the variables is provided in Appendix A. First, we retrieve accounting data from Compustat, including industry classification (SIC), market leverage, asset market-to-book ratio, profitability, five-year sales growth, collateralized assets, net investments scaled by lagged assets, and indicator variables for repurchases and dividend payments.[11] We merge the survey

[11] To ensure that our results are not driven by outliers and in keeping with the practice of many studies using similar data, we winsorize our survey data within each survey date at the 1% level. Similarly, we ensure that our corporate policy results are not driven by outliers by winsorizing the Compustat universe data by 1%. Our results remain qualitatively the same when we apply a tighter winsorization of 5%.

observations with annual Compustat data, matching by the nearest fiscal end-of-year date. Second, we use CRSP to compute one-year past returns for firms. Third, we use Yahoo! for historical S&P 500 prices and for Volatility Index (VIX) data.[12]

2.5. Summary Statistics

In Table 1, Panels A through D, we present summary statistics for survey responses and the characteristics of the respondent firms. Panel A presents a broad profile of the sample (firm data are for non-utilities and non-financial firms). The annual revenue of the average (median) firm is $7.8bn ($2.1bn). The average (median) asset market-to-book ratio (M/B) is 1.70 (1.38). Profitability (operating profit scaled by lagged total assets) averages 10.7% and investment intensity (net investments scaled by lagged total assets) averages 8.4%. 60.1% of the firms pay dividends and 42.8% repurchase their own shares.

Panel B presents a sample breakdown by industry and revenues. The panel shows the breakdown for the full sample, the subsample of respondents from public firms, and the subsample of identified firms (all of which are public firms). The panel demonstrates that industry composition is similar in the full sample and the identified sample. The breakdown by revenue suggests that public firms in our sample are larger than the private firms, and that the firms that could be identified are larger on average than those that could not be identified.

In Panel C we compare the attributes of the portion of our sample for which we have Compustat data to the attributes of the pooled population of Compustat firms between 2001 and 2009. Overall, our sample firms are larger than most Compustat firms: 62.2% are from the top sales quintile of Compustat firms. By oversampling large firms, our sample captures the important players in the economy. For other characteristics such as market-to-book ratio, past sales growth, and debt leverage, the variables for our sample firms have central tendencies similar to the universe of Compustat firms. Overall, based on the portion of our respondents that we can link to Compustat, our sample appears to over-represent large. Our results should therefore be interpreted with this in mind.

One might wonder whether the key variables of interest, optimism and miscalibration, affect the likelihood of a CFO responding to our survey, or whether they are somehow related to

[12] VIX is an index that reflects the average of imputed volatility across traded options in the S&P 500 futures index, traded on the Chicago Board of Options Exchange (CBOE).

the likelihood that we can identify a firm and include it in our analysis. For example, perhaps CFOs are more likely to respond to a survey if they are optimistic or their firms are performing particularly well. As we next describe, we do not find evidence that this is problematic in our survey sample. First, Panel C shows that the past five-year sales growth for our sample firms is representative of historic sales growth for Compustat firms. Second, Panel D presents our key variables at different subsamples. Optimism appears as statistically constant across subsamples (i.e., full sample, public firms sample, and identified firms sample). Third, the economic variation in miscalibration across different subsamples of firms suggests that CFOs in larger firms are less miscalibrated. This facts runs counter to the concern that miscalibrated CFOs are more likely to appear in our sample of identified firms.

In sum, while it is not possible to eliminate all possible concerns about sample representativeness, we do not find the variation in key variables that is symptomatic of deep problems with our sample. We also show in Panel C that, to the extent that we detect a pattern in the sample, it is concentrated in our ability to better access forecasts of executives large firms, which is the direction of bias one would prefer if the objective is to understand the operation of firms that are the dominant players in the economy.

3. Are CFOs Miscalibrated?

In this section we use three methods to assess whether CFO respondents are, on average, miscalibrated.[13] The first method compares CFOs' imputed individual volatilities to historical volatility distributions. The second method measures the fraction of ex post S&P 500 return realizations that fall between the 10^{th} and 90^{th} percentiles provided by CFOs' predictions. In the third method, we compare CFOs' imputed individual volatility to realized S&P 500 volatility and to the volatility implied in S&P 500 options (as measured by the VIX index).

[13] There could be two reasons for CFO miscalibration (overconfidence). First, as discussed in the introduction, previous studies in psychology have almost unanimously shown that people, and professionals in particular, are overconfident on average. The second reason depends on a compelling argument made by Goel and Thakor (2008). They posit that top executives should be expected to be overconfident because promotion in corporations is typically based on past performance, which is ultimately tied to the risk taken by executives. Overconfident managers underestimate risk and therefore take excessively risky actions. As a consequence, the variance of outcomes from their actions is greater and overconfident managers will therefore be over-represented among the right-tail "winners" and be more likely to get promoted.

3.1. Method I: Historical Volatility Distributions

First, we begin by eyeballing the distribution of historical volatility and compare them to the distribution of imputed individual volatility. Figure 2a plots the distribution of historical volatility computed in a one-year rolling window from 1950 until 2000.[14] The figure shows that the distribution is centered around 12%, and that most of the distribution lies between 8% and 20%. In Figure 2b we present the distribution of the individual volatility imputed from the CFOs' forecasts. The figure shows that imputed individual volatilities are centered around 4%, and that most of the distribution lies between 1% and 15%. Eighty-one percent of the imputed individual volatilities of CFOs are lower than 8%, the lower bound of historical volatility in the 50 years prior to the sample.

The results for long-term volatility are even more pronounced. In Figures 3a and 3b, the dispersion between the historical 10-year annualized volatility distribution (Figures 3a) and the distribution of imputed individual volatility (Figures 3b) is notable, indicating an aggregate underestimation of volatility by managers.

3.2. Method II: Ex Ante Predictions vs. Ex Post Realizations

In this test we assess the extent of CFO miscalibration by comparing the predictions of CFOs to the S&P 500 return realizations. Specifically, we compute the percentage of executives for whom the realized return of the stock market falls within their 80% confidence intervals (based the survey responses of 10^{th} and 90^{th} percentiles). If executives are well-calibrated and our sample period is representative, we expect this figure to be 80%.

Table 2 presents the response statistics per survey. In Panel A we list the survey means for the lower confidence bound (Column (1)), expected returns (Column (2)), and upper confidence bound (Column (3)) for the one-year forecasts. In Column (4) we present the survey mean of the imputed individual volatilities; each is computed using Equation (2). Column (5) contains the disagreement volatility (dispersion of beliefs), which is calculated as the standard deviation of expected returns across all respondents for any given date. Finally, we report market data in Columns (6) to (10): realized returns for the year preceding the survey date and following the survey date, and volatility realized over the year preceding and following the survey date, as

[14] S&P 500 return data is available in Yahoo! since 1950. We limit the sample used to compute distribution to the pre-survey period.

well as the VIX on the survey date, respectively. In Panel B we present the corresponding statistics for the ten-year forecasts (without market data, due to the long horizon).

Table 3 compares the S&P 500 return forecasts to realizations. In Column (1) we calculate the average forecast error (the difference between the mean expected returns from Table 2, Panel A, Column (2), and the actual S&P 500 return realization in Table 2, Panel A, Column (7)). The mean forecast error is 4.8%, suggesting that CFOs were optimistic over the period. This result is primarily driven by the financial crisis of 2008.

We judge whether CFOs are miscalibrated by examining whether ex post market realizations fall in the ex ante confidence intervals. In Columns (2) to (4) of Table 3 we compute for each survey cohort the percentage of CFOs for whom the S&P 500 realization was in the 80% confidence interval. Over the sample period, only 32.8% (Column (3)) of the stock market return realizations are within the 80% confidence bounds estimated by CFOs (illustrated also in Figure 1). This degree of miscalibration is consistent with other studies that request that respondents estimate 80% confidence bounds (Lichtenstein, Fischoff, and Phillips 1982, Russo and Schoemaker 1992, Klayman, Soll, Gonzales, Vallejo, and Barlas 1999, Soll and Klayman 2004). Even in "quiet" stock market periods (between 2001 and 2006, or 2003 and 2006), the percent of stock market return realizations falling in the 80% confidence interval did not exceed 59%. Thus, CFOs as a group appear to be miscalibrated in our sample.

3.3. Method III: Realized Volatility and the Forward Looking Volatility Index (VIX)

Another possibility is to benchmark managers' imputed individual volatilities to realized volatility and to option implied volatility (the latter captured in the Volatility Index (VIX)). In Table 2, Columns (9) and (10), we report the realized S&P 500 volatility over the year following the survey date, and the VIX for each survey date, respectively. The table shows that, for every survey date, both realized return volatility and the VIX are significantly higher than is the individual volatility imputed from CFOs' predictions. While the average imputed individual volatility of the forecasters is 5.3%, the average realized return volatility is 19.5%, and the average VIX during the period was 21.3%.[15]

[15] We note that there is a mismatch between the horizons of the VIX and the imputed individual volatility. While the VIX reflects S&P 500 options' implied volatility over a 30-day horizon, the imputed individual volatility reflects one year volatility expectations. Nonetheless, the overall evidence indicates that executives are miscalibrated on average.

4. Determinants of Forecasts and Miscalibration

In this section we explore the determinants of miscalibration. Our goal is to better understand the mechanism through which executives use available information when forming their predictions.

4.1. How Well Can CFOs Predict Future Returns?

While the CFOs might be miscalibrated in terms of having imputed individual volatilities to be much lower than reasonable benchmarks, they might be very good at forecasting the market return. To test this possibility, Panel A of Table 4 examines whether executive forecasts have any predictive power. We regress the survey the average lower bound, expected return, upper bound, and individual volatility on future S&P 500 returns (separated for positive and negative returns). Because the forecasting periods overlap, we use the Newey-West (1987) correction for the standard errors with 4 quarterly lags. The results show that executive forecasts are *negatively* correlated with outcomes. Following surveys in which CFOs anticipate a high lower bound (i.e., low returns are not anticipated), lower returns are more likely to occur. While the effect occurs for the lower and upper bounds, and expected returns,[16] the relation is the strongest for the lower bound of returns.

4.2. Time Variation and Asymmetric Extrapolation of Past Market Returns

We continue our investigation of the determinants of miscalibration by considering the historical information available to executives. When they attempt to predict future S&P 500 returns, it seems plausible that CFOs might take into account the realized returns over the past year.[17] Soll and Klayman (2004) propose a similar idea: that miscalibration may result from an attempt on the part of forecasters to recall recent extreme realizations in order to establish confidence bounds.

[16] We note that this relation is not driven by the financial crisis of 2008 and is strong in the earlier period.

[17] Other research points to past performance affecting predictions about own future performance. In models by Einhorn and Hogarth (1978) and Van den Steen (2004) decision makers "learn" about their decision making ability by observing the outcomes of past decisions, while ignoring exogenous determinants of these outcomes. Following favorable outcomes, decision makers become more confident about their judgment through a self-attribution mechanism, even if the outcome was independent of their prior decisions. In applying this idea to trading behavior, Gervais and Odean (2001) argue that traders become overconfident after observing a series of past successes that they then attribute to their own abilities. As an extension of this reasoning, Hilary and Menzly (2006) find that security analysts exhibit greater aggressiveness following success in predicting earnings.

Table 4, Panel B, explores the relation between the one-year survey forecasts (separated for the average lower bound, expected return, upper bound, and imputed individual volatility) and past S&P 500 return realizations.[18] Also in this analysis, we average the different variables within survey date, and adjust the standard errors using the Newey-West (1987) procedure (we allow for 8 overlapping periods in the dependent and independent variables). Column (4) shows that individual volatility exhibits a V-shape with respect to past returns: it increases following both positive and negative past market returns. However, it is twice as sensitive to negative past returns than it is to positive past returns.

To understand the mechanism through which this relation occurs, we examine the sensitivity of the different forecasts that executives provide to past returns. Columns (1) to (3) of Panel B show that the lower bound ("worst case scenario") is especially sensitive to poor past returns. To illustrate, following a decline of 10% in stock market returns, the average lower bound that CFOs provide is lower by 0.2% than otherwise. The upper bound increases following low returns, but only by a modest degree; a 10% decline in stock market returns translates to upper bound higher by 0.04%. Past returns explain the lower bound very well the variation in the average lower bound variable (adjusted R^2 = 0.70). Explanatory power is much poorer for average upper bound (adjusted R^2 = 0.02). Importantly, both the lower and upper bounds, as well as expected returns, are insensitive to past positive returns.

These results are consistent with the model of Gervais and Odean (2001) and with the experimental evidence of Alba, Hutchinson, and Lynch (1991) and Soll and Klayman (2004), who argue that forecasters rely heavily on past extreme cases to estimate the distribution of uncertain variables. The lower confidence bound is particularly sensitive to past returns, perhaps because managers tend to focus on downside risk in their analysis (Arnold 1986, March and Shapira 1987, Kahneman and Lovallo 1993).

4.3. Past Own-Firm Returns

Next, we test whether CFO stock market forecasts are influenced by idiosyncratic past returns of their own firms (i.e., the part of their firm's return unrelated to overall market returns). In these regressions (Table 4, Panel C), we face cross-sectional correlation (executives forecast

[18] For reasons of brevity we present only the analysis of one-year forecasts. Ten-year forecasts exhibit similar patterns. Results are available upon request.

the same index) and overlapping data problems (forecasting horizon is one year and observations are quarterly). We address the issue by using the Fama and MacBeth (1973) approach in which we perform cross-sectional regressions of forecasts on past one-year firm returns. Then, we compute the mean of the regressions' coefficients and adjust the standard errors with the Newey and West (1987) procedure for eight lags (to allow for the overlap in the forward looking forecasts and the historical returns). This procedure is also advantageous because it implicitly demeans firm returns each quarter, so that the effects reflected in the regressions in Panel C are orthogonal to the market-wide effects depicted in the regressions in Panel B.

The table shows that although CFOs' forecasts are linked to own-firm performance, the association is relatively weak. The results suggest that the lower return bounds provided by CFOs are associated with their own firms' past positive returns (Column (1)). The stronger the idiosyncratic past returns are, the more miscalibrated the forecaster (Column (4)). Comparing the results in Panel B to those in Panel C, we note that the effect of past market-wide returns on the confidence bounds is larger by an order of magnitude, relative to the effect of past firm-specific returns.

4.4. Personal Characteristics

We also examine the personal determinants of CFO miscalibration. In two surveys (2003Q4 and 2004Q1) we asked executives to report some of their demographic characteristics. Specifically, executives reported their age, years of professional experience, education level, gender, and the proportion of their incentive pay. We use these variables with the intent of discovering whether they can explain the variation in miscalibration and optimism. To ensure that these characteristics do not capture industry-level variation, we control for the fixed effects of the 10-industries reported by executives.

The results in Table 5 suggest that miscalibration increases with age, but decreases with incentive pay. Optimism, on the other hand, increases with experience and for men; it decreases with age.

4.5. The Persistence of Miscalibration

Another important aspect of miscalibration is whether it persists over time. To explore this issue, we examine the responses of repeat respondents. Across surveys, there are 1,622 pairs

of sequential responses that we can identify as coming from the same executives. For these observations, the correlation between sequential *Miscalibration ST* (*Miscalibration LT*) is 0.57 (0.28), and the correlation between sequential *Optimism ST* (*Optimism LT*) is 0.37 (0.33). Hence, both miscalibration and optimism persist over time for a given CFO. These results are consistent with evidence about the stability of individual biases over time (Jonsson and Allwood 2003, Glaser, Langer and Weber 2005).

We test for the joint influence of the persistence of miscalibration and optimism and CFOs' learning from new data. In Table 6 we regress current miscalibration and optimism variables on lagged values (the most recent observation of the same executive), in addition to the returns on the stock market in the preceding year. The regressions show that past miscalibration and optimism are the strongest explanatory variables for the current variables. Nevertheless, executives "update" their traits following new data. For example, CFOs become less miscalibrated following poor stock market returns. Furthermore, optimism exhibits a V-shape pattern with respect to past returns: CFOs are less optimistic following both large good and bad market returns.

5. Miscalibration and Corporate Finance

In the previous sections we documented that CFO forecasts are miscalibrated on average. In this section we investigate whether this miscalibration affects corporate views or policies. We focus on two relevant areas. First, we examine the relation between the miscalibration of S&P 500 returns and miscalibration concerning own-firm returns. Second, we examine the effects of executive miscalibration on corporate investment.

5.1. Miscalibration Regarding Own-Firm Projects

An important question is whether miscalibration with respect to S&P 500 return predictions is related to miscalibration in other areas in which executives make estimates. We test this issue by querying executives about their firms' expected internal rate of returns (IRRs),

including confidence bounds, and examining the correlation between CFOs' S&P 500 miscalibration to the miscalibration imputed from their own firms' IRR.[19]

To implement this test, we ask CFOs in the 2007Q2 survey to provide mean estimates and 10th and 90th percentiles for the return distributions of their own firms' investments in the following year:

> *For the investments that your company makes this year, what do you expect the internal rate of return (IRR) to be?*
>
> *- There is a 1-in-10 chance that the actual IRR will be less than ___%*
>
> *- I expect the IRR to be ___%*
>
> *- There is a 1-in-10 chance that the actual IRR will be greater than ___%*

In addition, we survey respondents about the degree to which they personally affect investment decisions in their firms on a scale of 1 (not at all) to 7 (a lot).

We transform the responses for the IRR question to an own-firm miscalibration measure ($Miscalibration_{IRR}$) according to the procedure used in Section 2.2. As with the S&P 500-based miscalibration variables, this variable reflects the standardized perceived volatility of own-firm investment returns.

Next, we test whether $Miscalibration_{IRR}$ is correlated with our S&P 500-based miscalibration variables. Such a correlation would suggest that our primary miscalibration variables are reasonable proxies for own-firm miscalibration (which is relevant when linking

[19] An extensive literature in both psychology and experimental economics examines whether biases like overconfidence transcend domain. West and Stanovich (1997) find that overconfidence regarding motor skills is correlated with overconfidence regarding cognitive skills. Glaser and Weber (2007) present a study in which overconfidence is measured in several ways, such as by different types of miscalibration questions. The authors find that respondents who exhibit overconfidence in stock market forecasts are likely to exhibit overconfidence in general knowledge questions. Several studies document that individual degrees of overconfidence are stable within tasks (forecasting, in our case), e.g., Glaser, Langer, and Weber (2005), Klayman, Soll, Gonzales, Vallejo, and Barlas (1999), Jonsson and Allwood (2003). These studies show that while people sometimes exhibit different levels of overconfidence across domains, their relative ranking also varies, as expected. While many studies find that overconfidence crosses from one domain to another, others find either a weak carryover effect or none at all. For example, Biais, Hilton, Mazurier, and Pouget (2005) find that although in there is some evidence that overconfidence carries over across domains (subjects that are classified as miscalibrated perform worse in a trading game), in other cases, the link does not exist (there is no relation between miscalibration score and trading volume). Carryover effects are found also in economics: Puri and Robinson (2007) find that people with optimistic beliefs about their lifespan also make optimistic economic decisions, e.g., they are more likely to be self-employed and tilt their portfolios towards individual stocks.

miscalibration to own-firm policies). The pairwise correlation between the S&P 500 short-term miscalibration variable and the IRR miscalibration variable is high: 0.43. In Table 7, Column (1), $Miscalibration_{IRR}$ is regressed on the S&P 500-based short-term and long-term miscalibration variables, the S&P 500-based optimism variables, and industry controls. The results indicate that firm-based miscalibration is significantly correlated with S&P 500-based miscalibration. IRR-based miscalibration has a strong sensitivity of 0.373 (t = 4.3) for short-term S&P 500-based miscalibration. The effect is stronger for executives who are more involved in investment decisions (Column (2)). Hence, the S&P 500 based miscalibration variable is a reasonable proxy for own-firm miscalibration.

5.2. Corporate Investment

We next examine whether miscalibrated executives make bold decisions. We investigate this prediction by examining whether the firms of biased executives invest more. Investment is a particularly important policy because it is a "real" outcome. We hypothesize that corporate investment should be higher for companies run by executives who are (1) miscalibrated, (2) optimistic, and (3) miscalibrated and optimistic.

To test these hypotheses, we regress investment intensity, computed as net investments scaled by total assets, on miscalibration, optimism variables, and firm controls. The results are presented in Table 8. The table shows that firm investment increases with both miscalibration and optimism. The relation is especially strong for the long-term miscalibration and optimism variables, which is expected given that corporate investment has a long-term effect on the firm. This effect is relatively strong: firms run by executives who have long-term miscalibration or optimism that is one standard deviation higher than the average invest 0.7%, or 1.1%, respectively, more each year (Column (4)). This effect is economically significant given that the average (median) investment intensity in the sample is 8.8% (5.4%). Of particular interest, the interaction term between miscalibration and optimism is significant (Columns (2) and (4)); the combined effect of an increase of one standard deviation in miscalibration and optimism on investment intensity is 2.0%.[20] This indicates that biases in the first (optimism) and second (miscalibration) moment of belief reinforce one another when it comes to corporate decision

[20]The net effect is determined by adding up the coefficients: 0.7 + 1.1 + 0.2 = 2.0% (Column (4)).

making. In other words, this evidence is consistent with optimistic executives investing even more when they underestimate future volatility.

6. Conclusion

Over the past nine years, we collected over 11,600 S&P 500 forecasts as well as 80% confidence intervals from Chief Financial Officers. The width of the confidence interval gives us a measure of miscalibration. Importantly, the CFOs are forecasting a common market-wide measure. This allows us to exploit cross-sectional heterogeneity in both optimism and miscalibration. By comparing forecasts to realizations over many periods, we also present a simple measure of miscalibration.

We use several methods to show that CFOs are, on average, severely miscalibrated – their confidence intervals are far too narrow. For example, the 80% confidence interval contains only 33% of the realized returns. Because of our rich panel data, we can identify some of the factors behind this behavior. In particular, we find that miscalibration is less severe following periods of poor returns because the lower bound of the confidence interval ("worst case scenario") is very sensitive to past returns. Furthermore, we document that miscalibration is highly persistent and does not change much in light of new information. We find that miscalibration is more severe with age and it is less severe among executives with high incentive pay.

We find evidence that CFO miscalibration is important for decision making. We show that the miscalibration measure, based on predicting the S&P 500 returns, is highly correlated with the miscalibration measure based on predicting own-firm project returns. Furthermore, firms with miscalibrated or optimistic executives invest more on average; this effect is significantly stronger for firms in which executives are both miscalibrated and optimistic.

Overall, our results shed new light on the biases in corporate forecasts and beliefs, which have important implications for corporate finance. Our study implies that miscalibration is an important bias, one that ought to be part of mainstream research in corporate finance.

References

Alba, Joseph A., and J. Wesley Hutchison, 2000, Knowledge calibration: What consumers know and what they think they know, *Journal of Consumer Research* 27, 123-156.

Alba, Joseph A., J. Wesley Hutchison, and John G. Lynch, 1991, Memory and decision making, in *Handbook of Consumer Research* (Prentice-Hall: Englewood Cliffs, NJ), eds.: Thomas S. Robertson and Harold H. Kassarjian.

Alpert, Murray, and Howard Raiffa, 1982, A progress report on the training of probability assessors, in *Judgement under Uncertainty: Heuristics and Biases* (Cambridge University Press: Cambridge), eds.: Daniel Kahneman, Paul Slovic, and Amos Tversky, 1-49.

Arnold, Jasper H., 1986, Assessing capital risk: You can't be too conservative, *Harvard Business Review* 64, 113-121.

Bar-Yosef, Sasson, and Itzhak Venezia, 2006, An experimental study of overconfidence in accounting numbers predictions, Hebrew University Working Paper.

Baumann, Andrea O., Raisa B. Deber, and Gail G. Thompson, 1991, Overconfidence among physicians and nurses: The micro-certainty, macro-uncertainty phenomenon, *Social Science & Medicine* 32, 167-174.

Bertrand, Marianne, and Antoinette Schoar, 2003, Managing with style: The effect of managers on firm policies, *Quarterly Journal of Economics* 118, 1169-1208.

Biais, Bruno, Denis Hilton, Karine Mazurier, and Sébastien Pouget, 2005, Judgmental overconfidence, self-monitoring and trading performance in an experimental financial market, *Review of Economic Studies* 72, 287-312.

Christensen-Szalanski, Jay J., and James B. Bushyhead, 1981, Physicians' use of probabilistic information in a real clinical setting, *Journal of Experimental Psychology: Human Perception and Performance* 7, 928-935.

Cooper, Arnold C., Carolyn W. Woo, and William C. Dunkelberg, 1988, Entrepreneurs' perceived chances for success, *Journal of Business Venturing* 3, 97-108.

Daniel, Kent D., David Hirshleifer, and Avanidhar Subrahmanyam, 1998, Investor psychology and security market under- and overreactions, *Journal of Finance* 53, 1839-1885.

Davidson, L. B., and D. O. Cooper, 1976, A simple way of developing a probability distribution of present value, *Journal of Petroleum Technology*, September, 1069-1078.

Deaves, Richard, Erik Luders, and Guo Ying Lou, 2003, An experimental test of the impact of overconfidence and gender on trading activity, McMaster University Working Paper.

Deaves, Richard, Erik Luders, and Michael Schröder, 2005, The dynamics of overconfidence: Evidence from stock market forecasters, Centre for European Economic Research Working Paper.

Einhorn, Hillel J., and Robyn Hogarth, 1978, Confidence in judgement: Persistence in the illusion of validity, *Psychological Review* 85, 395-416.

Fama, Eugene F., and James MacBeth, 1973, Risk, return and equilibrium: Empirical tests, *Journal of Political Economy* 81, 607-636.

Gervais, Simon, and Itay Goldstein, 2007, The positive effects of biased self-perceptions informs, *Review of Finance* 11, 453-496.

Gervais, Simon, J.B. Heaton, and Terrance Odean, 2007, Overconfidence, investment policy and manager welfare, Working Paper.

Gervais, Simon, and Terrance Odean, 2001, Learning to be overconfident, *Review of Financial Studies* 14, 1-27.

Glaser, Markus, Thomas Langer, and Martin Weber, 2005, Overconfidence of professionals and lay men: Individual differences within and between tasks, University of Manheim Working Paper.

Glaser, Markus, and Martin Weber, 2007, Overconfidence and trading volume, *Geneva Risk and Insurance Review* 32, 1-36.

Goel, Anand M., and Anjan V. Thakor, 2008, Overconfidence, CEO selection, and corporate governance, *Journal of Finance* 63(6), 2737-2784.

Graham, John R., and Campbell R. Harvey, 2006, The Duke/CFO Business Outlook survey, http:www.cfosurvey.org.

Graham, John R., Campbell R. Harvey, and Manju Puri, 2010, Managerial attitudes and corporate actions, Fuqua School of Business Working Paper.

Hackbarth, Dirk, 2008, Managerial traits and capital structure decisions, *Journal of Financial and Quantitative Analysis* 43(4), 843-882.

Heaton, J.B., 2002, Managerial optimism and corporate finance, *Financial Management* 31, 33-45.

Hilary, Gilles, and Lior Menzly, 2006, Does past success lead analysts to become overconfident?, *Management Science* 52, 489-500.

Hribar, Paul, and Holly Yang, 2006, CEO overconfidence, management earnings forecasts, and earnings management, Cornell University Working Paper.

Jonsson, Anna-Carin, and Carl Martin Allwood, 2003, Stability and variability in the realism of confidence judgments over time, content domain, and gender, *Personality and Individual Differences* 34, 559-574.

Kahneman, Daniel, and Dan Lovallo, 1993, Timid choices and bold forecasts: A cognitive perspective on risk taking, *Management Science* 39, 17-31.

Kaplan, Steven N., Mark Klebanov, and Morten Sorensen, 2010, Which CEO characteristics matter? *Journal of Finance*, forthcoming.

Keefer, Donald L., and Samuel E. Bodily, 1983, Three-point approximations for continuous random variables, *Management Science* 29, 595-609.

Kidd, John B., 1970, The utilization of subjective probabilities in production planning, *Acta Psychologica* 34, 338-347.

Klayman, Joshua, Jack B. Soll, Claudia Gonzales-Vallejo, and Sema Barlas, 1999, Overconfidence: It depends on how, what, and whom you ask, *Organizational Behavior and Human Decision Processes* 79, 216-247.

Koriat, Asher, Sarah Lichtenstein, and Barauch Fischoff, 1980, Reasons for confidence, *Journal of Experimental Psychology: Human Learning and Memory* 6, 107-118.

Kruger, Justin, and David Dunning, 1999, Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments, *Journal of Personality and Social Psychology* 77, 1121-1134.

Kyle, Albert S., and Albert Wang, 1997, Speculation duopoly with agreement to disagree: Can overconfidence survive the market test?, *Journal of Finance* 52(5), 2073-2090.

Lichtenstein, Sarah, and Barauch Fischoff, 1977, Do those who know more also know more about how much they know?, *Organizational Behavior and Human Performance* 20, 159-183.

Lichtenstein, Sarah, Baruch Fischoff, and Lawrence Phillips, 1982, Calibration of probabilities: The state of the art to 1980, in *Judgement under Uncertainty: Heuristics and Biases* (Cambridge University Press: Cambridge), eds.: Daniel Kahneman, Paul Slovic, and Amos Tversky, 306-334.

Malmendier, Ulrike, and Geoffrey Tate, 2005, CEO overconfidence and corporate investment, *Journal of Finance* 60, 2661-2700.

Malmendier, Ulrike, and Geoffrey Tate, 2008, Who makes acquisitions? CEO overconfidence and the market's reaction, *Journal of Financial Economics* 89, 20-43.

Malmendier, Ulrike, Geoffrey Tate, and Jun Yan, 2006, Corporate financial policies with overconfident managers, UC Berkeley and UC Los Angeles Working Paper.

March, James G., and Zur Shapira, 1987, Managerial perspectives on risk and risk taking, *Management Science* 33, 1404-1418.

Newey, Whitney K., and Kenneth D. West, 1987, A simple, positive semidefinite, heteroskedasticity and autocorrelation consistent covariance-matrix, *Econometrica* 55, 703-708.

Odean, Terrence, 1998, Volume, volatility, price, and profit when all traders are above average, *Journal of Finance* 53(6), 1887-1934.

Odean, Terrence, 1999, Do investors trade too much?, *American Economic Review* 89, 1279-1298.

Oskamp, Stuart, 1965, Overconfidence in case study judgements, *Journal of Consulting Psychology* 29, 261-265.

Puri, Manju, and David T. Robinson, 2007, Optimism and economic choice, *Journal of Financial Economics* 86, 71-99.

Russo, J. Edward, and Paul J. H. Schoemaker, 1992, Managing overconfidence, *Sloan Management Review* 33, 7-17.

Shefrin, Hersh, 2001, Behavioral corporate finance, *Journal of Applied Corporate Finance* 14, 113-124.

Soll, Jack B., and Joshua Klayman, 2004, Overconfidence in interval estimates, *Journal of Experimental Psychology: Learning, Memory, and Cognition* 30, 299-314.

Van den Steen, Eric, 2004, Rational overoptimism (and other biases), *American Economic Review* 94, 1141-1151.

Von Holstein, C. Staël, 1972, Probabilistic forecasting: An experiment related to the stock market, *Organizational Behavior and Human Performance* 8, 139-158.

West, Richard F., and Keith E. Stanovich, 1997, The domain specificity and generality of overconfidence: individual differences in performance estimation bias, *Psychonomic Bulletin and Review* 4, 387-392.

Appendix A: Variable Definitions

Variables from CFO Survey

One (Ten) year estimate: lower bound (%)	Survey response for the level of S&P 500 returns in which there is a 1-in-10 chance of being lower. Applies to short-term (one-year) and long-term (ten-year) returns.
One (Ten) year estimate: expected value (%)	Survey response for the (average) expected return of S&P 500. Applies to short-term (one-year) and long-term (ten-year) returns.
One (Ten) year estimate: upper bound (%)	Survey response for the level of S&P 500 returns in which there is a 1-in-10 chance of being higher. Applies to short-term (one-year) and long-term (ten-year) returns.
One (Ten) year estimate: imputed individual volatility (%)	$exp\left(\frac{log(1+upper\ bound)-log(1+lower\ bound)}{2.65}\right)-1$. Applies to short-term (one-year) and long-term (ten-year) forecasts.
Miscalibration ST (LT)	Standardized imputed individual volatility: we subtract the mean within each survey date and divide by the standard deviation within the survey date. Applies to short-term (one-year) and long-term (ten-year) forecasts.
Disagreement volatility (%)	Standard deviation of mean forecasts (expected returns) within survey date. Applies to short-term (one-year) and long-term (ten-year) forecasts.
Optimism ST (LT)	Standardized expected returns: we subtract the mean within each survey date and divide by the standard deviation within the survey date. Applies to short-term (one-year) and long-term (ten-year) forecasts.
Forecast error (%)	One year expected S&P 500 return minus the realized S&P 500 return for the same period.
IRR estimate: lower bound (%)	Survey response for the level of internal rate of return (IRR) in which there is a 1-in-10 chance of being lower. Question was asked in 2007Q2 survey.
IRR estimate: expected value (%)	Survey response for the (average) expected internal rate of return (IRR). Question was asked in 2007Q2 survey.
IRR estimate: upper bound (%)	Survey response for the level of internal rate of return (IRR) in which there is a 1-in-10 chance of being higher. Question was asked in 2007Q2 survey.
$\text{Miscalibration}_{\text{IRR}}$	$exp\left(\frac{log(1+upper\ bound_{IRR})-log(1+lower\ bound_{IRR})}{2.65}\right)-1$. The measure is standardized: we subtract the mean and divide by the standard deviation.
Age	Response to question about the respondent's age: (1) <=39, (2) 40-49, (3) 50-59, (4) 60+
Professional experience	Response to question about the respondent's number of years serving as a financial executive: (1) <= 4 years, (2) 4-9 years, (3) 10-14 years, (4) 15+
Education	Response to question about the respondent's education: (1) High School, (2) Some college, (3) College degree, (4) MBA or other, (5) Non-business masters, (6) =>Masters
Gender	Response to question about the respondent's gender: (0) Female, (1) Male

Proportion of incentives	Response to the question: Approximately what portion of your compensation is incentive based? (e.g., stock option, bonus, etc.): (1) =< 10%, (2) 10-19%, (3) 20-29%, (4) 30-39%, (5) 40-49%, (6) 50%+
Involved in investments	Response to the question: To what degree do you personally affect the investment decisions of your firm? (1) Not at all, to (7) A lot

Variables from Annual Compustat

Market leverage	Total debt / total assets at market values = (long-term debt (item 9) + debt in current liabilities (item 34)) / (share price (item 199) * #shares (item 54) + debt in current liabilities (item 34) + long-term debt (item 9) + preferred-liquidation value (item 10) - deferred taxes and investment tax credit (item 35)).
log(Sales)	Logged annual sales in millions of USD (item 12).
Asset market-to-book (M/B)	Total assets at market values / total assets at book values = (share price (item 199) * #shares (item 54) + debt in current liabilities (item 34) + long-term debt (item 9) + preferred-liquidation value (item 10) - deferred taxes and investment tax credit (item 35)) / total assets (item 6).
Profitability	Operating profit (item 13) / lag(total assets (item 6)).
Repurchases	1 if repurchased common and preferred stock (item 115) is greater than 1% of equity, and zero otherwise.
Dividends	1 if declared dividends (item 21), and 0 otherwise.
Collateral	Tangible assets / total assets at book values = (plant property & equipment (item 8) + inventory (item 3)) / total assets (item 6).
Investment intensity	Net investments / lag(total assets at book values) = (capital expenditures (item 128) + increase in investments (item 113) + acquisitions (item 129) - sales of property, plant and equipment (item 107) - sale of investments (item 109)) / lag(total assets (item 6)).
Long-term debt / Total debt	Portion of long-term debt (item 9) out of total debt (item 9 + item 34).

Variables from CRSP

12-month cumulative returns	Cumulative value-weighted firm monthly returns over 12 months.

Variables from Yahoo!

12-month S&P 500 returns	S&P 500 returns, accumulated over 12 months.
12-month S&P 500 volatility	S&P 500 volatility, computed over 12 months using daily data.
VIX	An index for the implied volatility on 30-day options. The index is constructed by the Chicago Board Options Exchange (CBOE) from a wide range of wide range of S&P 500 (S&P 100 until August 2003) index options (both calls and puts). The index reflects the anticipated volatility in the next 30 days. See http://www.cboe.com/micro/vix/vixwhite.pdf for further details.

Table 1. Summary Statistics

The table presents descriptive statistics of the sample firms. Panel A presents summary statistics for the variables used in the study. Panel B presents an industry and revenue breakdown according to the CFOs' own reporting. Panel C compares the distribution of key attributes of the sample firms to those from the Compustat universe from 2001 to 2009. The columns represent Compustat quintiles, and the numbers report the percentage of sample observations that fall within each quintile. Panel D presents means of key variables across different subsamples. For brevity, the number of observations and standard errors in Panel D are for the variable *Miscalibration ST* (statistics for other variables are largely similar). Variable definitions are provided in Appendix A.

Panel A: Sample Summary Statistics

S&P 500 return forecasts	Obs	Mean	Std Dev	Min	Median	Max
One year return estimate: lower bound (%)	11681	-2.717	8.634	-50.00	0.00	30.00
One year return estimate: expected value (%)	11681	5.743	5.236	-35.00	5.00	80.00
One year return estimate: upper bound (%)	11681	11.701	7.262	-20.00	10.00	100.00
One year return estimate: imputed individual volatility (%)	11681	5.312	4.435	0.07	3.78	41.46
Ten year average return estimate: lower bound (%)	11353	2.388	4.921	-50.00	3.00	75.00
Ten year average return estimate: expected value (%)	11353	7.763	4.921	-25.00	7.00	90.00
Ten year average return estimate: upper bound (%)	11353	12.031	8.069	-10.00	10.00	100.00
Ten year average return estimate: imputed individual volatility (%)	11353	3.368	2.753	0.11	2.80	45.43

Market returns and volatility at survey dates	Obs	Mean	Std Dev	Min	Median	Max
Past year S&P 500 returns (%)	36	-1.201	19.948	-43.42	4.72	50.04
Future year S&P 500 returns (%)	33	1.157	20.638	-47.23	5.86	46.81
Past year S&P 500 volatility (%)	36	19.738	10.188	9.52	18.23	45.37
Future year S&P 500 volatility (%)	33	19.501	10.783	9.52	17.55	45.30
VIX (%)	36	21.888	9.764	9.90	20.26	55.28

Survey variables	Obs	Mean	Std Dev	Min	Median	Max
$\text{Miscalibration}_{IRR}$	349	0.000	1.000	-7.26	0.21	1.48
Expected IRR (%)	349	13.276	6.108	2.00	12.00	40.00
Miscalibration ST	11681	0.000	0.999	-4.49	0.31	1.65
Miscalibration LT	11353	0.000	0.999	-6.29	0.27	1.86
Optimism ST	11681	0.000	0.999	-4.32	-0.03	3.41
Optimism LT	11353	0.000	0.999	-2.72	-0.07	6.87
Investment intensity	2591	8.785	13.327	-24.01	5.39	129.08
Market leverage	2700	17.568	16.787	0.00	13.31	88.09
Dividends	2703	0.601	0.490	0.00	1.00	1.00
Repurchases	2656	0.428	0.495	0.00	0.00	1.00
Asset Market-to-book	2700	1.699	1.084	0.22	1.38	19.69
Sales ($m)	2700	7789.336	12133.770	0.0	2135.9	49694.0
log(Sales ($m))	2700	7.305	1.809	0.56	7.67	9.32
Profitability	2615	0.107	0.151	-1.11	0.11	0.60
Past year S&P 500 return (%)	2486	10.978	41.882	-98.65	9.43	409.23
Age	409	2.474	0.731	1.00	3.00	4.00
Experience	409	3.526	0.795	1.00	4.00	4.00
Education	409	3.748	0.743	3.00	4.00	6.00
Gender (male = 1)	409	0.946	0.226	0.00	1.00	1.00
Propertion of performance-based incentives	409	3.836	1.760	1.00	4.00	6.00

Table 1. Summary Statistics (Cont.)

Panel B: Distribution of Responses by Industry and Revenue Bracket

Industry	Full sample	Public sample	Identified sample
Retail / Wholesale	1501	316	274
Mining / Construction	520	116	94
Manufacturing	3189	1089	853
Transportation / Energy	673	286	234
Communications / Media	508	232	155
Tech (Software / Biotech)	712	328	218
Banking / Finance / Insurance	1756	803	651
Service / Consulting	1026	250	201
Healthcare / Pharmaceutical	713	251	217
Other	1486	357	275
Total	12084	4028	3172

Revenues	Full sample	Public sample	Identified sample
Less than $25m	1342	207	106
$25m to $100m	2690	341	233
$100m to $500m	3605	764	579
$500m to $1bn	1187	496	394
$1bn to $5bn	1786	1052	889
Above $5bn	817	639	526
Total	11427	3499	2727

Panel C: Distribution of Sample Observations Relative to the Compustat Universe

	Compustat quintiles				
Variable	Q1	Q2	Q3	Q4	Q5
Sales	3.2	5.6	8.9	20.1	62.2
Asset Market-to-Book	11.5	21.6	25.2	25.1	16.7
Profitability	5.7	18.4	25.2	27.5	23.1
5-year sales growth	13.2	26.6	27.0	20.1	13.1
Collateral	12.3	19.3	22.4	25.2	20.8
Market leverage	12.5	18.9	25.9	24.1	18.6
Long-term debt / Total debt	16.3	19.1	22.7	24.2	17.7
Investment intensity	11.9	19.2	25.9	26.9	16.2

Panel D: Key Summary Statistics by Subsamples

		Miscalibration		Optimism		Standard Error
Sample	N	ST	LT	ST	LT	Miscalibration ST
Full sample	11681	0.000	0.000	0.000	0.000	0.009
Public firms	3912	-0.055	-0.008	-0.011	-0.005	0.016
Identified firms	3093	-0.084	0.002	-0.021	-0.018	0.019
Revenue						
Less than $100m	3819	0.039	0.004	-0.043	0.014	0.052
$100m to $1bn	4576	0.019	0.005	0.013	-0.009	0.034
Above $1bn	2514	-0.085	0.000	0.038	-0.002	0.029

Table 2. S&P 500 Return Forecasts and Confidence Intervals

The table presents summary statistics by survey date. *Avg lower bound (%)* is the average CFO 10th percentile for one-year (Panel A) or ten-year (Panel B) S&P 500 returns. *Avg one-year S&P 500 expected return (%)* is the average CFO forecasts for one-year (Panel A) or ten-year (Panel B) S&P 500 returns. *Avg upper bound (%)* is average CFO 90th percentile for one-year (Panel A) or ten-year (Panel B) S&P 500 returns. *One-year (Ten-year) average individual volatility (%)* is the average individual volatility imputed from respondents' confidence intervals for the one-year (ten-year) S&P 500 forecasts. *One-year (Ten-year) Disagreement volatility (%)* is the standard deviation of point estimates for the one-year (ten-year) S&P 500 forecasts across respondents. *12-months past (future) S&P 500 returns (%)* is the realized one-year S&P 500 return preceding (following) the survey date. *12-months past (future) realized volatility* is the annual volatility of the S&P 500 over the year preceding (following) the survey date measured with daily returns. *VIX* is the Chicago Board of Options Exchange (CBOE) volatility index, which reflects the average of imputed volatility across traded options on the S&P 500 (S&P 100 before August 2003) futures index.

Panel A: One Year Forecasts and Market Data

		One-year forecasts					Market data				
		Avg lower bound (%)	Avg expected return (%)	Avg upper bound (%)	Avg individual volatility (%)	Disagreement volatility (%)	12-month past S&P 500 returns (%)	12-month future S&P 500 returns (%)	12-month past realized volatility (%)	12-month future realized volatility (%)	VIX (%)
Survey date	Obs	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
11 Jun 2001	144	-2.7	6.1	13.7	6.0	4.0	-14.6	-19.5	21.2	18.8	20.7
10 Sep 2001	136	-5.0	4.6	12.9	6.7	6.1	-26.3	-18.8	21.8	24.2	31.8
03 Dec 2001	188	-4.4	6.9	14.9	7.1	5.9	-15.8	-17.1	22.3	25.9	25.8
12 Mar 2002	171	-0.5	7.4	12.6	4.7	3.8	-7.8	-30.7	21.0	26.6	19.6
04 Jun 2002	313	-3.4	5.1	10.6	5.2	4.0	-17.1	-7.1	18.7	27.1	23.9
17 Sep 2002	346	-4.3	5.0	11.0	5.7	4.4	-14.0	16.2	23.7	21.7	38.0
03 Dec 2002	270	-2.2	6.8	12.7	5.4	4.1	-21.3	16.2	25.8	17.6	28.3
17 Mar 2003	180	-7.1	4.6	11.4	7.0	4.5	-26.3	29.9	27.0	14.1	31.8
12 Jun 2003	348	-1.7	7.9	14.6	5.9	5.4	-0.9	13.3	27.0	12.5	20.4
15 Sep 2003	147	1.1	7.9	12.8	4.2	3.8	16.2	10.9	21.7	11.6	19.3
04 Dec 2003	215	1.1	9.2	15.1	4.9	4.1	17.3	11.3	17.5	11.2	16.3
18 Mar 2004	201	-1.0	7.7	14.1	5.3	6.3	25.3	5.9	14.1	10.8	18.5
09 Jun 2004	170	-0.6	7.0	12.5	4.8	4.5	13.3	5.8	12.5	10.7	15.4
08 Sep 2004	176	-0.8	6.7	12.3	4.7	4.5	10.4	9.1	11.6	10.2	14.1
01 Dec 2004	281	-0.3	6.6	11.5	4.3	3.4	11.9	5.5	11.2	10.3	13.0
22 Feb 2005	265	-0.7	6.3	11.3	4.4	3.2	3.5	8.7	11.0	10.3	13.1
24 May 2005	302	-1.1	5.3	10.0	4.0	2.8	7.1	5.7	10.8	9.5	12.7
26 Aug 2005	302	-1.0	5.7	10.5	4.2	3.3	9.1	7.5	10.2	10.8	13.7
15 Nov 2005	333	-0.9	5.5	10.3	4.1	3.3	3.8	12.6	10.4	10.0	12.2
23 Feb 2006	258	-0.7	6.5	11.5	4.5	3.6	6.3	13.1	10.2	9.6	11.9
23 May 2006	468	-0.2	6.2	10.9	4.0	3.6	5.6	21.3	9.5	10.4	18.3
29 Aug 2006	433	-1.1	5.7	10.5	4.2	3.4	6.9	9.8	10.8	12.3	12.3
21 Nov 2006	374	-0.2	6.8	11.9	4.4	3.5	10.8	2.6	10.0	14.7	9.9
01 Mar 2007	363	0.3	7.1	12.0	4.2	3.6	8.8	-1.6	10.1	17.5	15.8
01 Jun 2007	393	0.2	7.4	12.3	4.4	3.6	19.3	-9.0	10.2	19.9	12.8
07 Sep 2007	460	-1.3	5.5	10.4	4.3	3.6	11.9	-14.9	12.7	20.6	26.2
30 Nov 2007	432	-3.1	4.8	10.0	4.9	4.3	6.0	-40.1	15.3	38.8	22.9
07 Mar 2008	384	-4.8	2.9	8.5	5.0	4.2	-8.0	-47.2	17.8	43.1	27.5
13 Jun 2008	370	-3.3	4.0	9.3	4.6	3.7	-11.2	-30.5	20.2	45.3	21.2
05 Sep 2008	409	-3.9	3.7	9.2	4.9	4.4	-14.4	-19.9	20.6	45.2	23.1
28 Nov 2008	534	-7.8	4.5	13.1	7.9	8.8	-39.1	23.9	38.8	30.6	55.3
26 Feb 2009	439	-10.2	2.0	10.8	8.1	7.7	-43.4	46.8	42.6	23.9	44.7
28 May 2009	427	-4.2	6.8	14.5	6.8	7.7	-35.2	18.4	45.4	17.9	31.7
10 Sep 2009	530	-3.6	6.6	13.9	6.4	7.4	-16.6	n/a	45.0	n/a	23.6
10 Dec 2009	441	-3.7	6.0	12.6	6.1	5.9	25.3	n/a	28.0	n/a	22.3
25 Feb 2010	478	-4.7	5.1	11.7	6.1	5.5	50.0	n/a	23.7	n/a	20.1

Table 2. S&P 500 Return Forecasts and Confidence Intervals (Cont.)

Panel B: Ten Year Forecasts

		Ten-year forecasts				
Survey date	Obs	Avg lower bound (%) (1)	Avg expected return (%) (2)	Avg upper bound (%) (3)	Avg individual volatility (%) (4)	Disagreement volatility (%) (5)
12 Mar 2002	160	3.6	8.5	12.6	3.2	2.6
04 Jun 2002	301	2.9	8.2	12.4	3.4	3.7
17 Sep 2002	339	3.1	8.1	12.2	3.2	3.1
03 Dec 2002	265	3.4	8.0	12.1	3.0	3.3
17 Mar 2003	176	1.9	7.4	11.5	3.4	2.4
12 Jun 2003	341	1.8	7.7	12.4	3.8	4.0
15 Sep 2003	141	3.3	7.5	10.7	2.6	2.0
04 Dec 2003	211	3.4	8.3	12.1	3.1	2.7
18 Mar 2004	197	2.8	7.8	12.1	3.2	2.4
09 Jun 2004	168	3.1	8.0	11.6	3.0	3.1
08 Sep 2004	168	2.6	7.7	11.4	3.1	3.0
01 Dec 2004	272	3.2	7.7	11.3	2.9	3.1
22 Feb 2005	260	3.2	7.7	11.6	2.9	3.9
24 May 2005	291	2.5	7.6	11.8	3.2	5.2
26 Aug 2005	294	2.1	7.4	11.2	3.3	2.4
15 Nov 2005	318	2.3	7.1	11.3	3.1	3.2
23 Feb 2006	253	2.1	7.2	11.3	3.2	2.4
23 May 2006	456	3.0	7.9	12.2	3.2	4.0
29 Aug 2006	416	2.6	7.8	12.2	3.3	4.5
21 Nov 2006	360	2.8	8.0	12.4	3.3	4.2
01 Mar 2007	351	2.7	7.9	12.1	3.3	3.1
01 Jun 2007	381	3.1	8.0	11.9	3.1	3.3
07 Sep 2007	440	3.4	8.3	12.4	3.1	5.2
30 Nov 2007	415	2.9	8.0	12.2	3.2	3.8
07 Mar 2008	364	3.5	8.8	13.2	3.2	7.9
13 Jun 2008	357	2.3	7.9	12.6	3.5	5.8
05 Sep 2008	390	2.4	7.7	11.9	3.3	4.5
28 Nov 2008	501	1.9	7.8	12.5	3.7	5.5
26 Feb 2009	418	1.3	8.2	13.5	4.3	6.9
28 May 2009	404	1.3	7.3	11.6	3.7	5.0
10 Sep 2009	513	0.9	7.7	12.6	4.0	9.0
10 Dec 2009	427	0.7	7.0	11.4	3.8	5.8
25 Feb 2010	455	0.2	7.0	11.9	4.1	6.0

Table 3. One-Year S&P 500 Return Forecasts vs. Realizations

The table compares survey forecasts with S&P 500 realizations by survey date. *Average forecast error (%)* is defined as *Average one-year S&P 500 expected return (%)* minus *Realized one-year S&P 500 return (%)*. *S&P 500 realizations: % below 10th percentile* is the percentage of respondents for whom the realized one-year S&P 500 return is below their 10th percentile predictions. *S&P 500 realizations: % between 10th and 90th percentiles* is the percentage of respondents for whom the realized one-year S&P 500 return is between their 10th percentile and 90th percentile predictions. *S&P 500 realizations: % above 90th percentile* is the percentage of respondents for whom the realized one-year S&P 500 return is above their 90th percentile predictions.

		S&P 500 realizations		
	Average forecast error (%)	% below 10th percentile	% between 10th and 90th percentiles	% above 90th percentile
Survey date	(1)	(2)	(3)	(4)
11 Jun 2001	25.6	96.5	3.5	0.0
10 Sep 2001	23.4	89.0	11.0	0.0
03 Dec 2001	24.0	90.4	9.6	0.0
12 Mar 2002	38.1	100.0	0.0	0.0
04 Jun 2002	12.2	73.5	26.5	0.0
17 Sep 2002	-11.2	0.0	14.5	85.5
03 Dec 2002	-9.4	0.0	20.4	79.6
17 Mar 2003	-25.3	0.0	2.8	97.2
12 Jun 2003	-5.4	0.3	50.3	49.4
15 Sep 2003	-3.1	0.0	57.1	42.9
04 Dec 2003	-2.1	0.9	67.9	31.2
18 Mar 2004	1.9	11.4	83.6	5.0
09 Jun 2004	1.2	10.0	89.4	0.6
08 Sep 2004	-2.5	1.7	67.0	31.3
01 Dec 2004	1.1	8.5	81.9	9.6
22 Feb 2005	-2.4	1.1	67.9	30.9
24 May 2005	-0.4	3.6	83.1	13.2
26 Aug 2005	-1.8	1.0	69.9	29.1
15 Nov 2005	-7.2	0.0	20.7	79.3
23 Feb 2006	-6.6	0.4	31.8	67.8
23 May 2006	-15.0	0.0	3.8	96.2
29 Aug 2006	-4.1	0.7	52.9	46.4
21 Nov 2006	4.2	40.4	59.6	0.0
01 Mar 2007	8.7	75.8	24.2	0.0
01 Jun 2007	16.4	83.5	16.5	0.0
07 Sep 2007	20.4	93.5	6.5	0.0
30 Nov 2007	44.9	99.5	0.5	0.0
07 Mar 2008	50.2	100.0	0.0	0.0
13 Jun 2008	34.6	99.7	0.3	0.0
05 Sep 2008	23.6	93.9	6.1	0.0
28 Nov 2008	-19.4	0.2	18.4	81.5
26 Feb 2009	-44.8	0.0	1.8	98.2
28 May 2009	-11.7	0.5	31.4	68.1
Average 2001-2006	1.5	23.0	42.4	34.6
Average 6/2003-11/2006	-2.8	5.3	59.1	35.5
Average All	4.8	35.6	32.8	31.6

Table 4. Determinants of Forecasts and Individual Volatilities

The table explores the determinants of CFO forecasts of the one-year-ahead S&P 500 return and imputed individual volatilities. Panel A presents regressions of lower bounds, expected returns, upper bounds, and individual volatilities on future S&P 500 returns and past returns, where standard errors (in parentheses) are adjusted for autocorrelation using the Newey and West (1987) procedure with 4 lags. Observation units in Panels A and B are the means of survey responses within a given quarter. The regressions in Panels A and B are weighted by the square root of the number of observations. Panel C presents results from Fama and MacBeth (1973) regressions. In Panels B and C, standard errors (in parentheses) are adjusted for autocorrelation using the Newey and West (1987) procedure with 8 lags. Variable definitions are provided in Appendix A. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Average Forecasts and Future S&P 500 Returns and Volatility

	One-year forecasts (%)			
	Average Lower bound	Average Expected return	Average Upper bound	Average Individual volatility
	(1)	(2)	(3)	(4)
max(0, 12-month future S&P 500 return)	-0.212***	-0.091***	-0.018	0.089***
	(0.035)	(0.019)	(0.016)	(0.027)
min(0, 12-month future S&P 500 return)	0.125***	0.083***	0.056*	-0.027**
	(0.022)	(0.021)	(0.031)	(0.013)
Intercept	0.569	7.371***	12.334***	3.444***
	(0.508)	(0.407)	(0.587)	(0.351)
Observations	33	33	33	33
Adj. R^2	0.556	0.413	0.094	0.266

Panel B: Average Forecasts and Past S&P 500 Returns and Volatility

	One-year forecasts (%)			
	Average Lower bound	Average Expected return	Average Upper bound	Average Individual volatility
	(1)	(2)	(3)	(4)
max(0, 12-month past S&P 500 return)	-0.053	0.004	0.040	0.058***
	(0.039)	(0.033)	(0.034)	(0.010)
min(0, 12-month past S&P 500 return)	0.188***	0.054***	-0.038*	-0.111***
	(0.012)	(0.014)	(0.021)	(0.017)
Intercept	-0.446	6.329***	11.190***	3.225***
	(0.386)	(0.547)	(0.717)	(0.216)
Observations	36	36	36	36
Adj. R^2	0.702	0.183	0.019	0.623

Table 4. Determinants of Forecasts and Individual Volatilities (Cont.)

Panel C: CFO Forecasts and Past Own-Firm Returns and Volatility (Fama-MacBeth)

	One-year forecasts (%)			
	Lower bound	Expected return	Upper bound	Individual volatility
	(1)	(2)	(3)	(4)
max(0, 12-month past own firm return)	0.024***	0.007*	0.001	-0.000***
	(0.008)	(0.004)	(0.005)	(0.000)
min(0, 12-month past own firm return)	0.001	0.002	-0.005	-0.000
	(0.017)	(0.006)	(0.018)	(0.000)
12-month past own firm return volatility	-0.001	-0.013*	-0.020*	-0.000
	(0.011)	(0.006)	(0.010)	(0.000)
Intercept	-2.715***	6.495***	12.756***	0.056***
	(0.656)	(0.468)	(0.524)	(0.003)
Average number of observations	78.9	78.9	78.9	78.9
Number of regressions	29	29	29	29
Average R^2	0.041	0.047	0.046	0.044

Table 5. Miscalibration and Personal Characteristics

The table explores whether miscalibration and optimism are determined by personal characteristics. All regressions are OLS regressions. All regressions include an intercept which is not reported. Variable definitions are provided in Appendix A. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% levels, respectively. All regressions include broad (10 categories) industry fixed effects and intercepts that are not presented. Standard errors are clustered by survey date.

	Miscalibration ST	Miscalibration LT	Optimism ST	Optimism LT
	(1)	(2)	(3)	(4)
Age	0.164	0.189**	0.006	-0.171**
	(0.123)	(0.068)	(0.099)	(0.068)
Professional experience	0.068	-0.106	-0.056	0.129**
	(0.082)	(0.075)	(0.066)	(0.046)
Education	0.030	0.139	-0.007	-0.116***
	(0.049)	(0.082)	(0.052)	(0.034)
Gender (male = 1)	-0.229	-0.048	0.327***	-0.070
	(0.224)	(0.243)	(0.095)	(0.116)
Propertion of incentives	-0.085*	0.014	0.074	0.002
	(0.041)	(0.037)	(0.052)	(0.017)
Industry FE	Yes	Yes	Yes	Yes
Observations	394	396	394	396
Adj. R^2	0.024	0.009	0.006	-0.000

Table 6. Persistence of Miscalibration

The table explores whether miscalibration and optimism are persistent over time for respondents and whether respondents update based on new information. For each respondent that appears on the survey more than once, we use the current observation as the dependent variable, and the most recent response before the current survey as the independent ("lagged") variable. All regressions are OLS regressions. All regressions include an intercept which is not reported. Variable definitions are provided in Appendix A. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% levels, respectively.

	Miscalibration ST	Miscalibration LT	Optimism ST	Optimism LT
	(1)	(2)	(3)	(4)
lag(Miscalibration ST)	0.615***			
	(0.040)			
lag(Miscalibration LT)		0.262***		
		(0.025)		
lag(Optimism ST)			0.399***	
			(0.039)	
lag(Optimism LT)				0.300***
				(0.032)
max(0, 12-month past S&P 500 return)	0.002*	0.001	-0.003**	-0.003**
	(0.001)	(0.002)	(0.002)	(0.001)
min(0, 12-month past S&P 500 return)	-0.002	0.002	0.005***	0.001
	(0.002)	(0.002)	(0.002)	(0.001)
Industry FE	Yes	Yes	Yes	Yes
Observations	1622	1586	1622	1586
Adj. R^2	0.309	0.079	0.145	0.113

Table 7. Own-Firm IRR Miscalibration and S&P 500 Miscalibration

The table presents results about the relation between own-firm IRR miscalibration and S&P 500 miscalibration. The dependent variable is miscalibration based on self-reported IRR. All regressions are OLS regressions. All regressions include industry fixed effects which are based on ten broad industry classifications (provided by respondents). *Involved in investments* restricts the sample to executives who reported that they are involved in investment decisions (provided score of 5 or more, out of 7, in the investment involvement question). All regressions include an intercept which is not reported. Variable definitions are provided in Appendix A. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at the broad industry level.

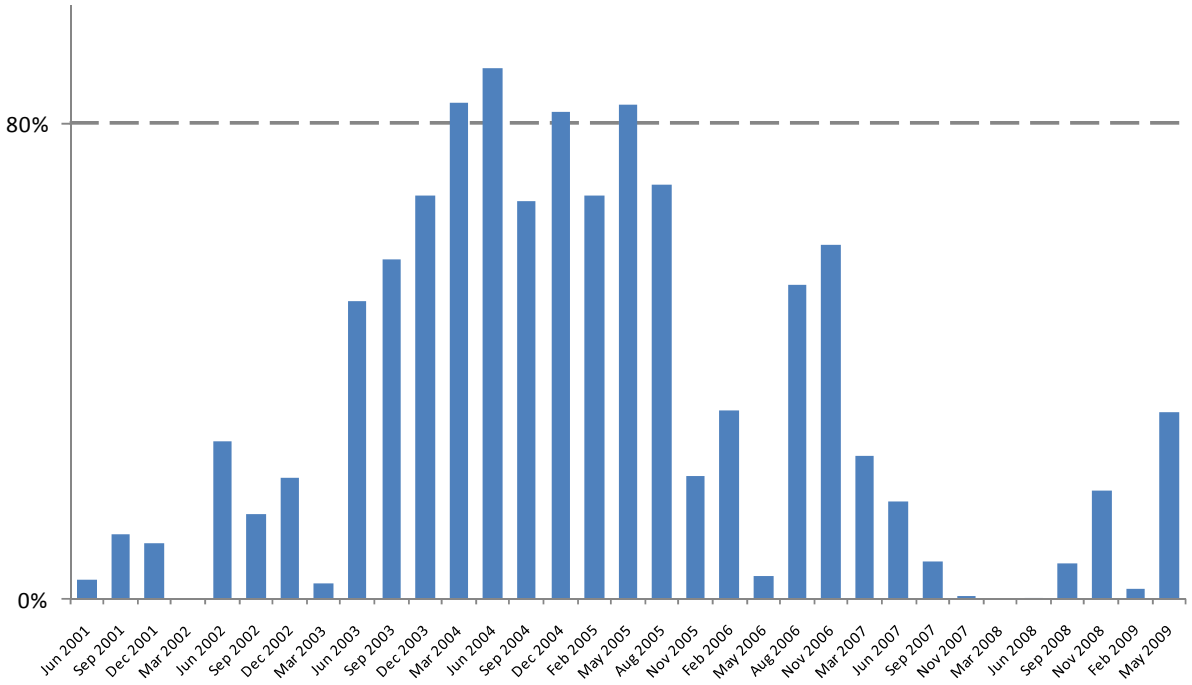
	$Miscalibration_{IRR}$	
	All respondents	Involved in investments
	(1)	(2)
Miscalibration ST	0.373***	0.390**
	(0.087)	(0.124)
Miscalibration LT	0.096	0.117
	(0.074)	(0.102)
Optimism ST	0.026	0.038
	(0.062)	(0.064)
Optimism LT	-0.065	-0.038
	(0.052)	(0.094)
Industry FE	Yes	Yes
Observations	331	213
Adj. R^2	0.210	0.216

Table 8. Miscalibration, Optimism, and Corporate Investment

The table presents results about the relation between managerial miscalibration and investment intensity. The dependent variable is investment intensity (net investment / total assets), expressed in percentage terms. All regressions are OLS regressions. All regressions include an intercept which is not reported. Industry fixed effects are based on 2-digit SIC level classification. Variable definitions are provided in Appendix A. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at the 2-digit SIC level.

	Investment intensity (%)			
	(1)	(2)	(3)	(4)
Miscalibration ST	0.257	0.301		
	(0.246)	(0.249)		
Optimism ST	0.521	0.748		
	(0.405)	(0.470)		
Miscalibration ST × Optimism ST		0.337**		
		(0.145)		
Miscalibration LT			0.751***	0.719**
			(0.272)	(0.282)
Optimism LT			0.856*	1.089**
			(0.451)	(0.506)
Miscalibration LT × Optimism LT				0.239*
				(0.123)
Market leverage	9.580**	9.504**	10.726***	10.683***
	(3.757)	(3.718)	(3.662)	(3.643)
log(Sales)	-1.035**	-1.026**	-0.983**	-0.966**
	(0.421)	(0.420)	(0.428)	(0.425)
Asset Market-to-book	-0.390	-0.389	-0.388	-0.392
	(0.409)	(0.412)	(0.418)	(0.418)
Profitability	29.646***	29.579***	29.614***	29.561***
	(7.959)	(7.947)	(8.015)	(8.013)
Repurchases	-2.954***	-2.944***	-3.049***	-3.055***
	(0.828)	(0.829)	(0.843)	(0.838)
Dividends	1.114	1.139	1.479	1.448
	(1.052)	(1.066)	(1.077)	(1.071)
12-month past returns	0.002	0.002	0.007	0.007
	(0.018)	(0.018)	(0.018)	(0.018)
Industry FE	Yes	Yes	Yes	Yes
Survey Date FE	Yes	Yes	Yes	Yes
Observations	2044	2044	2013	2013
Pseudo R^2	0.111	0.112	0.112	0.112

Figure 1. Time-Series of CFO Miscalibration



The figure presents the percentage of CFOs whose S&P 500 realized returns fall in the 80% confidence interval, by survey quarter.

Figure 2. Distribution of One-Year S&P 500 Volatilities

Figure 2a. Historical Distribution of S&P 500 One-Year Volatility (1950-2000)

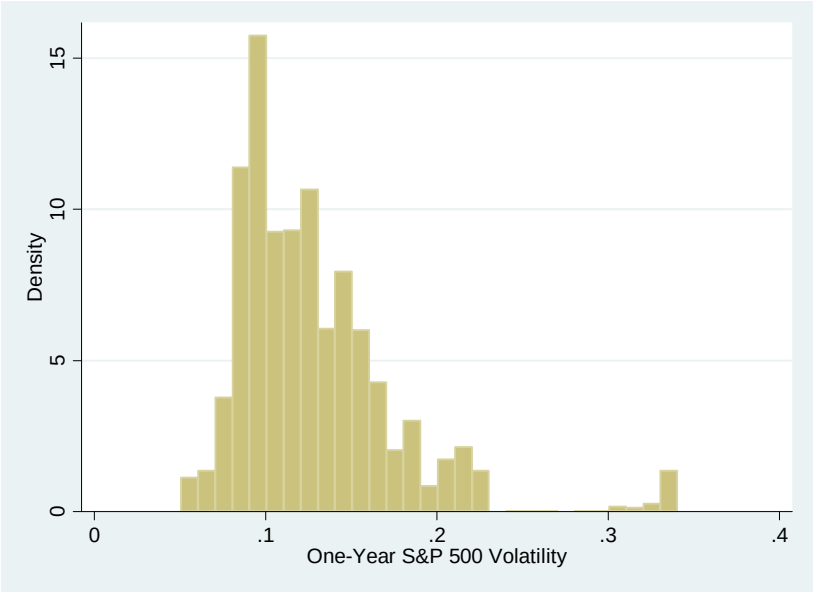


Figure 2b. One-Year Individual Volatility Imputed from Survey Confidence Intervals

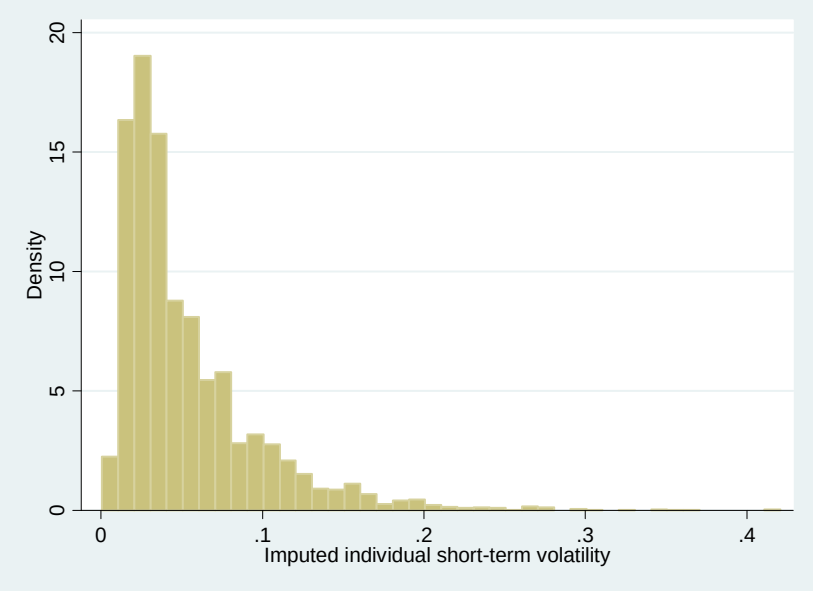


Figure 3. Distribution of Ten-Year S&P 500 Volatilities

Figure 3a. Historical Distribution of S&P 500 Ten-Year Volatility (1950-2000)

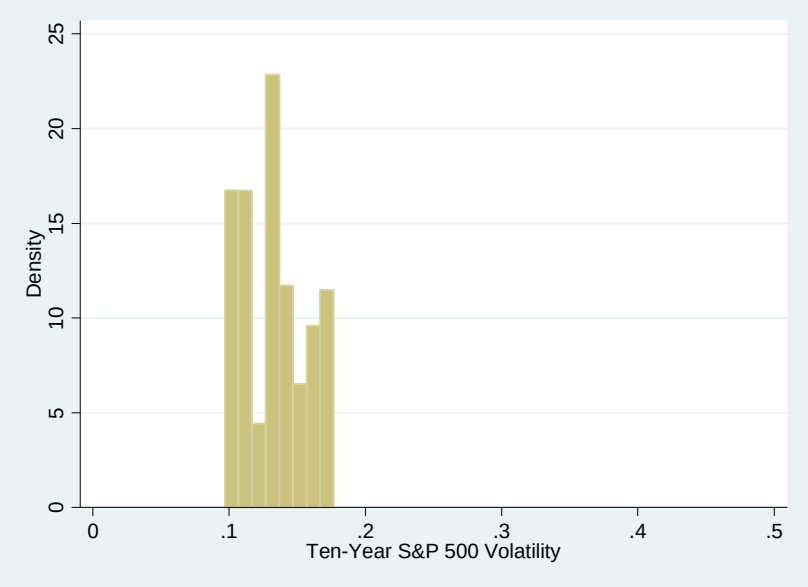


Figure 3b. Ten-Year Individual Volatility Imputed from Survey Confidence Intervals