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ABSTRACT

Miscalibration is a standard measure of overconfidence in both psychology and economics. Although it is often used in lab experiments, there is scarcity of evidence about its effects in practice. We test whether top corporate executives are miscalibrated, and whether their miscalibration impacts investment behavior. Over six years, we collect a unique panel of nearly 7,000 observations of probability distributions provided by top financial executives regarding the stock market. Financial executives are miscalibrated: realized market returns are within the executives' 80% confidence intervals only 38% of the time. We show that companies with overconfident CFOs use lower discount rates to value cash flows, and that they invest more, use more debt, are less likely to pay dividends, are more likely to repurchase shares, and they use proportionally more long-term, as opposed to short-term, debt. The pervasive effect of this miscalibration suggests that the effect of overconfidence should be explicitly modeled when analyzing corporate decision-making.

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I. Introduction

A key role of managers is to estimate future unknowns (e.g., demand, cash flows, competition) and to use these predictions as inputs to design corporate policies. This task is complicated by overconfidence, as psychological evidence indicates that people exhibit overconfidence in predictions, i.e., they forecast probability distributions that are too narrow. This happens either because people overestimate their ability to predict the future[1] or because they underestimate the volatility of random events.[2] Despite the importance of this issue, there has been no wide-scale empirical research that studies the relation between the overconfidence (i.e., miscalibration of beliefs) of managers and the corporate policies they devise.

In this paper we measure the overconfidence of managers in a unique sample of 6,901 S&P 500 forecasts made by top U.S. financial executives. Our measure of overconfidence is based on miscalibration of beliefs and is operationalized using a method drawn from laboratory experiments. We link our estimate of executive overconfidence to firm-level archival data and study how miscalibration is reflected in corporate policies. Each quarter from March 2001 to June 2007, we surveyed hundreds of U.S. Chief Financial Officers (CFOs) and asked them to predict expected one- and ten-year stock market returns, as well as the 10^{th} and 90^{th} percentiles of the distribution of market returns. We use the narrowness of individual probability distributions for stock market returns as a proxy for each respondent's confidence. By evaluating the same forecasting task across all executives, we can assess whether CFOs are miscalibrated and this bias can be disentangled from any potential bias in the mean estimate (what we refer to as optimism). We examine the time-series and cross-sectional

[1]Surveyed subjects typically provide too-narrow confidence bounds for their predictions (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).

[2]Studies have shown that professionals are miscalibrated with regard to estimating the probabilities of random outcomes, e.g., 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, Lüders, and Schröder (2005) find that stock market forecasters are overconfident on average and become more overconfident with past successful forecasts, and Bar-Yosef and Venezia (2006) report that subjects (students and security analysts) in the laboratory exhibit overconfidence in their predictions of future accounting numbers. Deaves, Lüders, and Lou (2003) find that laboratory subjects who are miscalibrated also tend to trade excessively.

determinants of overconfidence[3] (i.e., the narrowness of the confidence interval), and analyze the relation between our overconfidence measure and a range of corporate policies including capital spending, mergers and acquisitions, financing, and payout.

Recent research examines the relation between corporate policies and managerial biases. In several papers, Malmendier and Tate measure CEO overconfidence as an overestimation of their own firm's future returns (feeling "above average") 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 2005b). They show that biased managers exhibit high investment-cash flow sensitivity (Malmendier and Tate 2005a), engage intensively in unsuccessful mergers and acquisitions (Malmendier and Tate 2007), and avoid tapping the capital markets (Malmendier, Tate, and Yan 2006). Using Malmendier and Tate's 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), are more likely to issue narrow range estimates, and are more likely to manage earnings to meet these forecasts.

In contrast, our empirical design allows us to separate overconfidence from optimism. We define overconfidence as a general miscalibration in beliefs (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, Hackbarth 2007). According to this definition, overconfident people overestimate the precision of their own beliefs, or underestimate the variance of risky processes; in other words, their subjective probability distributions are too narrow. The specific interpretation of overconfidence is important particularly when testing theoretical predictions regarding 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 2007), which we refer to as optimism, and overconfident managers who either underestimate the *volatility* of their firms' future cash flows (Shefrin 2001, Hackbarth 2007) or overweight their

[3] Although we measure relative confidence, we use the term *overconfidence* because the majority of CFOs provide responses that would be considered overconfident by any reasonable metric, as discussed in Section III.

private signals relative to public information (Gervais, Heaton, and Odean 2007, Gervais and Goldstein 2007).[4] Our data allow us to disentangle respondents' biases in the first and second moments, in other words, we can measure miscalibration (overconfidence) separately from optimism. To our knowledge, our paper is the only one with direct and distinct measures of miscalibration and optimism, and that links both these constructs to firms and their actions.

Furthermore, our survey provides evidence for a different subset of officers than the Malmendier and Tate studies do. Our survey respondents are finance officers, mostly CFOs. Bertrand and Schoar (2003) show that there is a pronounced "CFO effect" in corporate decisions related to investment, acquisitions, capital structure, and payout. Graham, Harvey, and Puri (2007) present evidence that CFOs play a relatively important role in capital structure, payout, and capital allocation decisions. Therefore, in this paper, we conduct experiments that uniquely address whether and how personal characteristics of CFOs affect these important corporate decisions.

The paper consists of two parts. In the first part, we investigate whether respondent CFOs are, on average, overconfident in their predictions. According to the confidence bounds that CFOs provide, they are severely miscalibrated: only 38% of the realized S&P 500 returns fall within the 80% confidence interval that respondents offer. We document that expected market returns and confidence bounds depend on recent past market returns and on returns of the CFOs' own firms. Interestingly, the lower confidence bound is far more sensitive to past market returns than is the upper confidence bound. As a consequence of the different sensitivities, executives are more confident following periods of high market return and less confident following low market returns periods. This behavior is consistent with the argument of Soll and Klayman (2004) that people make inferences about the distribution of random or unknown variables from a few known cases (such as past returns), and with Arnold (1986), March and Shapira (1987) and Kahneman and Lovallo (1993), who argue that managers focus on downside risk. In addition, we document that CFO confidence is a time-persistent personal characteristic that increases with forecasting skill.

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

In the second part of the paper, we associate CFO overconfidence with a variety of corporate policies. We present a simple model in which overconfident managers underestimate cash flow volatility, and as a result use low discount rates to value these cash flows. In the model, an overconfident manager decides first about the size of the investment and then determines the mix of financing, given market prices for financial claims. The manager overinvests in projects and generally believes that investors underestimate the value of the firm and the value of equity. As a result, the manager prefers to use internal resources before external sources of financing and is less likely to pay dividends. Furthermore, we find that for reasonable modeling assumptions and parameters, debt leverage increases with overconfidence, as does the likelihood of engaging in share repurchases.

The empirical tests corroborate the predictions of the model. First, we find that our S&P 500-based overconfidence measure is correlated with a firm-specific overconfidence measure. That is, managers who provide narrow estimates for the S&P 500 return distribution tend to estimate very tight distributions for their own firms' cash flows. Second, consistent with the implication that overconfident managers use lower discount rates, we find that overconfident CFOs expect a lower internal rate of return (IRR) for their firms' projects. Third, we document that firms with overconfident managers (based on their S&P 500 predictions) invest more in capital expenditures and in acquiring other firms. Moreover, the market reaction to these acquisitions is negative on average. Fourth, firms with overconfident managers have higher leverage. Fifth, these firms are less likely to pay dividends and more likely to repurchase shares.

Our paper is organized as follows. Section II details the method that we use to collect the overconfidence data, the construction of variables, and it presents some summary statistics. In Section III, we provide evidence on the miscalibration in CFO expectations. Section IV explores the determinants of overconfidence. Section V presents a simple model of overconfidence and corporate policies, and derives empirical predictions. Section VI tests the predictions of the model in data on corporate policies. Some concluding remarks are offered in Section VII.

II. Data

A. 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, collected in 26 quarterly surveys conducted by Duke University between March 2001 and June 2007. 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.[5] The survey usually contains eight questions about the U.S. economy, firm policies, and firm short-term forecasts. 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 overconfidence proxies on two survey questions. The first question is:

> "Over the next year, I expect the 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 ____%"

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"*.[6]

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

[5] 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 III). We explore this issue further in Section II.E.

[6] The first question appeared in the surveys in its current form starting 2001Q2. The second question has been asked in its current form since 2002Q1. In the earliest surveys, executives were asked only for their expected returns.

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 firms. Overall, our sample includes 6,901 one-year expected returns and 6,280 ten-year expected returns with valid 10^{th} and 90^{th} percentile information. Of this sample, 2,653 observations are from public firms (self-reported), and of them, we are able to match 2,262 observations (858 unique firms) to CRSP and Compustat. For the analysis in Section VI, we exclude utility firms (2-digit SIC code 49) and financial firms (2-digit SIC code 60 to 69), and require respondents to respond to the optimism questions (see Section II.C below), leaving 1,421 observations (594 unique firms). For 1,104 observations (504 unique firms) there is a full set of survey responses and accounting data.

B. Measures of Overconfidence

Our overconfidence measure maps each CFO's 10^{th} and 90^{th} percentile predictions into an individual probability distribution for each respondent. Wide distributions reflect high subjective uncertainty about the estimated variable, while narrow distributions reflect subjective confidence. We use the method proposed by Davidson and Cooper (1976) to recover respondent i's individual probability distribution, based on the normal distribution. The imputed volatility is calculated as:

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

where $x(0.90)$ and $x(0.10)$ represent the 90^{th} and 10^{th} 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 90^{th} and 10^{th} percentiles, this simple approximation is the preferred method for estimating the standard deviation of a probability distribution of a random variable.

Our desired overconfidence variable is a relative measure that is independent of CFOs' opinions about the future *level* of the stock market.[7] To disentangle the tightness of confidence bounds from the level of expected returns and contemporaneous market effects, we use a double-sorting procedure. This procedure allows us to measure the narrowness of CFOs' confidence intervals with respect to the confidence intervals of other CFOs who hold similar beliefs about the expected stock market returns at the same point in time. First, for each survey date, we form groups (deciles) based on expected returns. Then, within each group, we sort again and form deciles based on the size of confidence intervals.[8] We use this procedure to generate two overconfidence variables, one short-term and one long-term. *Overconfidence ST* is the short-term overconfidence measure and is based on one-year forecasts of the S&P 500. *Overconfidence LT* is the long-term overconfidence measure, analogously based on the ten-year forecasts. To ease interpretation of the results, we orthogonalize the long-term overconfidence variable against the short-term overconfidence variable and scale them so that they have values between 0 and 1.

C. Attitudes Towards the Stock Market, U.S. Economy, and the CFOs' Own Firms

Our survey data have the advantage of allowing for the measurement of overconfidence while 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 overconfidence variables.

In addition, we are also interested in isolating the effects of overconfidence from other, potentially correlated, attitudes about the U.S. economy and about the CFOs' own firms.

[7]For example, CFOs who are bullish about the stock market may also anticipate high volatility and thus provide wide confidence intervals because they believe that the direction of the stock market is related to volatility, and not because they have low confidence.

[8]Our results are qualitatively the same if, instead of the double-sorting procedure, we decile rank respondents according to their confidence interval scaled by their expected returns. The non-parametric double-sorting procedure that we use has the advantage of not imposing a linear relation between confidence intervals and expected returns.

In particular, it is plausible that managers who exhibit overconfidence are also optimistic about the future of their firms. Alternatively, it is possible that managers who anticipate a bright future for their firms feel more confident. In these two cases, our tests might capture the effects of the covariates of overconfidence, rather than the direct effect of overconfidence. To address this concern, in addition to using *Optimism ST* or *LT*, which are based on the expected returns of the stock market, we introduce additional controls for optimism about the U.S. economy (*Optimism U.S.*) and firm-specific optimism (*Optimism firm*), based on two questions that appear in most surveys.[9] The questions are:

> "a. Rate your optimism about the U.S. economy on a scale from 0-100, with 0 being the least optimistic and 100 being the most optimistic.
>
> b. Rate your optimism about the financial prospects for your company on a scale from 0-100, with 0 being the least optimistic and 100 being the most optimistic."

To facilitate the interpretation of these variables, we decile-rank them within a given quarter's survey, orthogonolize them, and scale them so that they have values between 0 and 1.

D. Firm 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, book leverage, asset market-to-book ratio, profitability, five-year sales growth, collateralized assets, capital expenditures scaled by lagged assets, cash spent on acquisitions scaled by lagged assets, and indicator variables for repurchases and dividend payments. We merge the survey 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 the market and firms; in addition, we use CRSP to approximate

[9] We have responses for these questions for about 85% of the identified observations (excluding three surveys: 2001Q4, 2002Q1, 2005Q1).

firm age. Third, we use merger transactions data and information about acquired targets from Thomson SDC Platinum.[10]

E. Summary Statistics

In Table I, 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 sales of the median firm is \$2.1bn. The average asset market-to-book ratio (M/B) is 1.48, and the average annualized five-year sales growth rate is 9.4%. Profitability (operating profit scaled by lagged total assets) averages 13.4% and capital expenditure intensity (capital expenditures scaled by lagged total assets) averages 8.0%. 58.2% of the firms pay dividends and 41.6% repurchase their own shares. Respondents come from a balanced range of industries (Table I, Panel B).

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 2006. Overall, our sample firms are more established and advanced in their life cycle than most Compustat firms. In particular, respondent firms are relatively mature and large: 49.7% of the identified firms in our sample are from the top firm-age quintile of Compustat firms and 61.7% are from the top sales quintile of Compustat firms. It is not surprising that our procedure of matching responses to Compustat firms finds successful matches more often for mature and large companies. In other characteristics, such as market-to-book ratio, past sales growth, and debt, our sample firms are 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 and mature firms, and therefore our results should be interpreted with this in mind.

[10]To ensure that our results are not driven by outliers and following the practice of many studies using similar data, we winsorize our survey data within each survey date at the 1% level. Similarly, we winsorize Compustat and CRSP data.

III. Are CFOs Overconfident?

In this section we conduct two tests to assess whether CFO respondents are, on average, overconfident. There could be two reasons for CFO 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. Second is a compelling argument by Goel and Thakor (2008). They argue 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 actions with excessive risk. As a consequence, the variance of outcomes from their actions is greater, and therefore overconfident managers will be over-represented among the right-tail "winners" and are more likely to get promoted.

We perform two tests to investigate whether CFOs are overconfident. The first test 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. The second test compares the individual volatility imputed from the survey data to the individual volatility as predicted by a simple model of bias.

A. Method I: Ex Ante Predictions vs. Ex Post Realizations

We begin by calculating CFO overconfidence as miscalibration of beliefs. We compute the percentage of executives for whom the realized return of the stock market falls within their 80% confidence intervals, as derived from the 10^{th} and 90^{th} percentile survey responses. If executives are well-calibrated and our sample period is representative, we expect this figure to be 80%.

Table II presents the response statistics per survey. We list the survey means for the lower confidence bounds (column (1)), expected returns (column (2)), and upper confidence bounds (column (3)) for the one-year forecasts. In column (4) we present the mean of the individual volatilities where each is computed using Equation (1), and 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. Similarly, we present the results for the ten-year forecasts starting in column (6). Finally, we report market data in columns (11) to (13): realized returns and volatility for the forecasted horizon, and the VIX[11] for the survey date.

Table III compares the S&P 500 forecasts to realizations. In column (1) we calculate the average forecast error (the difference between mean expected returns from Table II, column (2), and the S&P 500 return realization in column (11)). The mean forecast error is 1.4%.

In columns (2) to (4) of Table III we compute for each survey cohort the percentage of CFOs for whom the S&P 500 realization was in the 80% confidence interval. We judge whether CFOs are miscalibrated by examining whether ex post market realizations fall in the ex ante confidence intervals. Over the sample period, only 37.9% of the stock market return realizations are within the 80% confidence bounds estimated by CFOs (see column (3) and Figure 1). This degree of miscalibration is not unusual for studies that request respondents to estimate 80% confidence bounds (Lichtenstein, Fischoff, and Phillips 1982, Russo and Schoemaker 1992, Klayman, Soll, Gonzáles-Vallejo, and Barlas 1999, Soll and Klayman 2004). Thus, based on a miscalibration definition, CFOs as a group are overconfident in our sample.

B. Method II: Model of Bias

Next, we consider a simple model of forecasting that allows us to assess ex ante whether CFOs are overconfident. With the model, we assess the tightness of CFO confidence intervals without needing to compare forecasts to outcomes (as in the Section III.A). This procedure helps us assess whether ten-year stock market forecasts are too tight (even though ex post realizations are not yet available), and also provides additional tightness benchmarks for the one-year forecasts. In particular, we test whether the 10^{th} and 90^{th} percentiles provided by

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

CFOs match anticipated volatility, as well as whether they are calibrated to historical S&P 500 volatility.

We assume that the true model of the S&P 500 returns is:

$$r_{SP} = \mu_{SP} + \tilde{\epsilon}_{SP}, \tag{2}$$

where μ_{SP} is the unobservable mean return, and the error term $\tilde{\epsilon}_{SP} \sim N(0, \sigma_{SP}^2)$.

Forecaster i believes that the future return of the S&P 500 is

$$\hat{r}_i = \hat{\mu}_i + \hat{\epsilon}_i, \tag{3}$$

where $\hat{\mu}_i$ is the mean return estimate, and ϵ_i is a forecaster-specific error term. The forecaster does not know the unobservable mean return of the stock market μ_{SP}, instead she believes that

$$\hat{\mu}_i = \mu_{SP} + \bar{e} + \hat{e}_i, \tag{4}$$

where $\bar{e}$ potentially captures a systematic bias in beliefs about the mean. If $\bar{e} > 0$ then forecasters are on average optimistic. The error term $\hat{e}_i$ captures the uncertainty that forecaster i has about the mean, and $\hat{e}_i \sim N(0, \sigma_e^2)$. For simplicity, we assume mutual independence between $\hat{e}_i$ and $\hat{\epsilon}_i$.

The forecaster-specific error term $\hat{\epsilon}_i$ is assumed to be normally distributed $\hat{\epsilon}_i \sim N(0, \sigma_{SP}^2 + \theta_i)$. The additional term θ_i potentially captures underestimation ($\theta_i < 0$) or overestimation ($\theta_i > 0$) of stock market volatility. This parameter corresponds with the definition of overconfidence as an underestimation of the volatility of random process (as in Hackbarth 2007).

Thus the total variance of the forecasted returns $\hat{r}_i$ is:

$$\hat{\sigma}_i^2 = \sigma_{SP}^2 + \theta_i + \sigma_e^2. \tag{5}$$

In the context of our survey, we interpret the CFO responses as the mean and the 10^{th} and 90^{th} percentiles of the return distribution $\hat{r}_i$, from which we can extract the total variance $\hat{\sigma}_i^2$.

B.1. Model Calibration: Are CFOs Optimistic?

Using the survey data, we calibrate some of the parameters of the model. We estimate whether CFOs are optimistic on average with respect to the S&P 500 by examining whether their forecast errors (expected returns minus realized returns) are significantly greater than zero. The forecast error, therefore, is:

$$\bar{e} = E[\hat{r}_i] - \mu_{SP}. \tag{6}$$

Forecast errors are presented in Table III, column (1). The average forecast error is positive but insignificantly different from zero: $\bar{e} = 1.4\%$ ($t = 0.29$).[12] Hence, expected returns provided by the CFOs are unbiased within the sample period.

B.2. Model Calibration: Are CFOs Overconfident?

We first assess whether CFOs are overconfident in the short-term. For each survey we estimate the mean bias about the variance, $\bar{\theta}$, across agents:

$$\bar{\theta} = E[\hat{\sigma}_i^2] - \sigma_{SP}^2 - \sigma_e^2. \tag{7}$$

We estimate $E[\hat{\sigma}_i^2]$ as the mean of the individual variances in each survey, averaged across surveys (0.0036), and σ_e^2 as the variance of point estimates across forecasters, averaged across surveys (0.0015). We use three different proxies for the variance of the stock market, σ_{SP}^2, based on: (1) market expectation of future stock market variance, averaged across surveys[13]

[12] All our statistical inferences adjust for overlapping periods, using Newey and West (1987).

[13] Based on the VIX index (see Table II, column (13)). The mean annual variance imputed by the VIX over the sample period was 0.0424 (20.6% in standard deviation terms).

(0.0424), (2) realized stock market variance, averaged across surveys[14] (0.0264), and (3) historical stock market variance[15] (0.0201).

Even if we pick the most conservative (lowest) estimate for the variance of the stock market, drawn from historical statistics, CFOs underestimate the variance of the stock market by $E[\bar{\theta}] = -0.0180$ ($t = -69.9$) (-13.4% in standard deviation terms). Therefore, CFOs are overconfident as a group according to the short-term miscalibration definition.

Next, we assess ex ante whether CFOs are overconfident in the long term. To do so, we calibrate Equation (7) for long-term overconfidence. We estimate $E[\hat{\sigma}_i^2]$ as the mean of the individual variances, averaged across surveys (0.0015), and σ_e^2 as the mean of the variance of point estimates, averaged across surveys (0.0007) (both are annualized). We use two estimates for the ten-year stock market variance, σ_{SP}^2, both based on historical realizations: (1) the average annualized stock market variance across all ten-year windows from 1950 to 2006 (0.0209), and (2) the lowest annualized stock market variance across all ten-year windows since 1950 (0.0129).

The results indicate that CFOs in our sample are overconfident in the long term. When using the average stock market variance for the calculation, the bias in the perceived variance of stock market returns is $\bar{\theta} = -0.0200$ (-14.2% in standard deviation terms). Based on the lowest stock market variance in any given ten year window, CFOs still underestimate the variance by $\bar{\theta} = -0.0121$ (-11.0% in standard deviation terms). This bias is depicted in Figure 3. The top histogram presents the distribution of annualized ten-year historical market volatilities; the bottom histogram presents the distribution of the corresponding survey-imputed volatilities. While historical ten-year volatilities are concentrated between 11% and 16%, almost the entire distribution of survey-based volatilities is below 10%.

[14] The mean of the squared one-year realized volatility (measured using daily returns): 0.0264 (16.3% in standard deviation terms; see Table II, column (12)).

[15] The variance of the S&P 500 is the mean of all historical one-year windows of realized variance of the S&P 500 between January 1950 and December 2006, 0.0201 (14.2% in standard deviation terms). The historical distributions of the one-year volatilities are illustrated in Figure 2. In the top chart we present the histogram of the distribution of one-year historical volatilities of the S&P 500. In the bottom panel of the figure we provide the histogram of imputed survey volatilities for comparison. The histograms indicate that CFOs anticipate distinctly lower volatilities than those actually experienced over the previous 57 years.

IV. Determinants of Overconfidence

In this section, we investigate which factors affect managerial forecasts, and examine some candidate variables that could potentially explain temporal and cross-sectional overconfidence.

A. Past Market and Firm Performance

There is a theoretical argument that, following good outcomes, people predict narrower distributions of future events. In a model by Einhorn and Hogarth (1978), 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 judgement 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 attribute to their own abilities. As an extension of this reasoning, Hilary and Menzly (2006) find that security analysts exhibit greater aggressiveness following successes in predicting earnings.

Table IV explores the relation between one-year survey forecasts and future and past S&P 500 return realizations.[16] In Panel A we regress average forecasts across surveys (lower bounds, expected returns, and upper bounds), as well as the average imputed individual volatility, on future and past S&P 500 one-year returns. Since we examine quarterly forecasts for one-year horizons, we encounter autocorrelations due to overlapping data and therefore adjust the standard errors for the two-year overlap[17] in the data using the Newey and West (1987) procedure with 7 quarterly lags. The statistically insignificant coefficients on one-year future S&P returns in columns (1) to (3) indicate that the CFOs' stock market forecasts are not associated with future market return realizations.

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

[17]Allowing for data overlap for both one-year past returns and for one-year future returns.

Interestingly, CFOs are more confident following periods of high stock market returns. One-year forecasts are correlated with past S&P 500 returns (columns (1) to (3) in Panel A). This effect is especially strong on the lower bound ($R^2 = 0.75$) and on the expected returns that CFOs provide. Since the average confidence upper bounds are not affected by past returns very much ($R^2 = 0.14$), individual volatility effectively increases following poor past returns and decreases following periods of high stock market returns (negative coefficient in column (4) of Panel A).[18] This effect is depicted in the 10^{th} and 90^{th} percentiles (averaged across respondents) shown in Figure 4. In March 2003, the lower confidence bound was relatively low (−7.0%) because the actual S&P 500 return in the year before the survey date was exceptionally low (−31.0%). Likewise, the average lower confidence bound in September 2003 was relatively high (1.1%) because the realized return in the preceding year was especially high (17.5%). The average upper confidence bound, however, does not co-move as much with past market returns. These results are consistent with the model of Gervais and Odean (2001) and with Alba, Hutchison, 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 of projects (Arnold 1986, March and Shapira 1987, Kahneman and Lovallo 1993).

In Panel B of Table IV, 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, we face cross-sectional correlation (executives forecast the same index) and overlapping data problems (forecasting horizon is one year and observations are quarterly). We address the issue by using a Fama and MacBeth (1973) approach in which we perform cross-sectional regressions of forecasts on past one-year firm returns.[19] Then, we compute the mean of the regressions' coefficients and adjust the standard errors with the Newey and West (1987) procedure for three lags. This procedure is also

[18] These results are in line with Deaves, Lüders, and Schröder (2005), who analyze the forecasts of German stock market forecasters and with Shefrin (2005), who reports results from the UBS survey of retail investors.

[19] Since the Fama and MacBeth (1973) procedure captures common cross-sectional effects (such as market returns) in the intercepts of the cross-sectional regressions, we effectively control for the market return and the regression coefficients reflect the effect of past firm idiosyncratic returns on forecasts.

advantageous because it implicitly demeans firm returns each quarter, so that the effects reflected in the regressions in Panel B are distinct from the market-wide effects depicted in the regressions in Panel A. The results suggest that lower return bounds and expected returns provided by CFOs are associated with their own firms' past returns. These results are consistent with the model of den Steen (2004) in which agents become overconfident after making decisions and afterwards succeeding. Comparing the results in Panel A to those in Panel B, 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.

B. Personal Characteristics

In this section, we examine the personal determinants of CFO overconfidence. In particular, we explore the persistence of overconfidence through time, its relation to demographic attributes, and its association with skill.

B.1. Persistence of Overconfidence

First, we investigate whether overconfidence and optimism are persistent characteristics of decision makers. Across surveys, there are 785 pairs of sequential responses from the same executives (i.e., respondent from the same firm with same position in the firm). For these observations, the correlation between sequential *Overconfidence ST* (*Overconfidence LT*) is 0.45 (0.29), and the correlation between sequential *Optimism ST* (*Optimism LT*) is slightly lower, 0.35 (0.25). Hence, both optimism and overconfidence persist through time for a given CFO, although overconfidence exhibits stronger persistence. These results are consistent with evidence about the stability of individual biases over time (Jonsson and Allwood 2003, Glaser, Langer, and Weber 2005).

B.2. Demographic Profile

Second, we conduct a test that explores the relation between executive biases and demographic characteristics. We collect demographic details from respondents in two surveys (2003Q4 and 2004Q1). The questions inquire about age, education, professional experience, and gender. Our analysis (untabulated) reveals few significant relations between overconfidence and demographic attributes. Specifically, we find that CFOs with different levels of education and experience express the same degree of overconfidence. Furthermore, we find no significant gender effect in overconfidence.

B.3. Do Overconfidence Variables Capture Skill?

Third, we consider the possibility that our overconfidence variables capture skill rather than miscalibration, i.e., CFOs who forecast the stock market better also provide narrower confidence bounds. To investigate the relation between overconfidence and skill we examine whether overconfident CFOs produce more accurate forecasts. Table V, column (1) presents regressions of absolute forecast error (as a proxy for skill) on the overconfidence variables. The results indicate that overconfident CFOs predict future stock market returns more precisely.

However, the tradeoff between the size of confidence intervals and the improvement in accuracy is less than proportional. When moving from the median to the top decile of long-term overconfidence, the size of the confidence intervals decreases by about 6.5% (untabulated), but the average absolute forecast error decreases only by 0.36% (half of 0.71%, Table V, column (1)). This difference in magnitudes implies that miscalibration overshadows accuracy on net. In other words, although overconfident CFOs are slightly more accurate, their confidence intervals are still *much* too narrow.

To formally test this hypothesis, we examine whether the likelihood that a realization that would fall within the confidence interval is correlated with overconfidence, even after controlling for the absolute forecast error. Thus, we regress an indicator variable of whether

S&P 500 realizations fall within each individual confidence interval on three variables: the two individual overconfidence measures, and the absolute forecast error. The results indicate that overconfidence plays an important role in explaining the CFOs' tight confidence intervals. If skill (low forecast error) entirely explains CFOs' tight confidence intervals, then the overconfidence variables should not be significant in the regression. The results in column (2) show that both overconfidence variables remain negative and statistically significant, even after controlling for the absolute forecast error. These results are consistent with the findings of the psychology literature, suggesting that overconfidence increases with accuracy (Sporer, Penrod, Read, and Cutler 1995) and expertise (Arkes, Dawes, and Christensen 1986, Paese and Feuer 1991, Spense 1996). We conclude therefore that although CFO overconfidence is associated with skill, our overconfidence variables capture genuine miscalibration.

V. A Simple Model of Overconfidence and Corporate Policies

To motivate our empirical predictions, we develop a simple model of investment and financing decisions by overconfident managers. The purpose of the model is to provide a common framework within which to derive empirical predictions about various corporate policies. In this section we describe the main assumptions of the model and provide intuition for its key implications. The detailed model and calibration results are provided in Appendix B. In Section VI we interpret our empirical results within the context of the model's implications.

We assume that overconfidence affects managerial judgment in two distinct ways. First, by definition, managers who are overconfident should underestimate the volatility of their own firms' cash flows.[20]

[20] Hackbarth (2007) presents a model in which overconfident managers underestimate cash flow volatility. In the presence of bankruptcy costs, this bias causes them to invest less than otherwise. Furthermore, this bias leads them to believe that the market overvalues their firms' equity since the equity is modeled as an option on the firm's assets, and thus is perceived to have a lower value when asset volatility is lower.

Assumption 1 (Underestimation of Own Cash Flow Volatility) *Overconfident managers underestimate the volatility of their own firms' cash flows.*

Second, we argue that overconfident managers use low discount rates when valuing cash flows. This effect is supported by asset pricing models that link volatility and uncertainty to expected returns. Overconfident managers might use too low discount rates if they either perceive volatility as too low,[21] or if they underestimate ambiguity, i.e., they are too confident about the business model and parameters that generate their firms' cash flows,[22] or both.

Assumption 2 (Low Discount Rates) *Overconfident managers use lower discount rates than unbiased managers do.*

In sum, we assume that overconfident managers perceive cash flows as safer, and at the same time use lower discount rates to value them. Firm policies of overconfident managers, therefore, should reflect these beliefs.

A. Investment Decision

The manager decides how much to invest. To an overconfident manager, investment projects seem safer than they really are, and he evaluates them with a low discount rate. Therefore, in comparison to a less confident manager, a greater number of projects will be perceived to have positive net present value and an overconfident manager will invest more.[23]

[21]Traditional asset pricing research links investor expected returns to volatility through the market price of risk (e.g., Rubinstein 1973), as long as investors care about this risk. In the case of firms, managers should care about whether cash flows are systematic or idiosyncratic because they have underdiversified human capital invested in their firms and they usually hold undiversifiable equity stakes.

[22]Recent theoretical models in asset pricing argue that agents demand a higher risk premium when they are not sure about the model or parameters that generate returns (e.g., Anderson, Hansen, and Sargent 2000, Cagetti, Hansen, Sargent, and Williams 2002, Hansen and Sargent 2001, Epstein and Schneider 2002, Maenhout 2004). Hence, lower ambiguity is associated with lower expected returns.

[23]The hypothesis between the relation between overconfidence and degree of investment is consistent with the finding of Camerer and Lovallo (1999) that lab subjects are likely to enter into a business market when payoffs are linked to their abilities. An alternative, non-mutual exclusive, explanation for why some firms invest more than others is related to managerial agency costs and empire building (Jensen 1986).

Proposition 1 (Overinvestment) *Overconfident managers invest more than less confident managers.*

Furthermore, the manager believes that the cumulative value of his firm's projects is higher than what outside investors believe.

Proposition 2 (Overvaluation) *Overconfident managers perceive the value of investment projects as being higher than outside investors perceive them to be.*

B. Financing Decision

Next, the manager decides about the capital structure of his firm. He believes that investors underestimate the value of projects, and as a consequence incorrectly price the firm's securities. Since there are no frictions in our setting (e.g., bankruptcy costs, agency costs, taxes, etc.), the manager attempts to maximize current shareholder wealth by exploiting perceived market mispricings. The model implies that at the chosen leverage, the manager perceives his firm's equity to be undervalued by the market.[24]

Proposition 3 (Overvaluation of Equity) *Overconfident managers believe that their firms' equity is undervalued by the market.*

In our setting the effects of overconfidence on capital structure and payout decisions rely primarily on the balance of two effects of overconfidence (underestimation of volatility, and overvaluation of cash flows due to low discount rate), and the overall effect ultimately depends on the parameter values. Using standard modeling assumptions in Appendix B, we find that the effect of low discount rates dominates the effect of underestimated volatility for the parameter values that are commonly used in the literature. Hence, the following propositions hold for reasonable choice of parameters.

The model generates several results regarding capital structure and payout policies. Since external securities seem expensive, an overconfident manager prefers to use internal cash

[24] In a survey of CFOs, Graham and Harvey (2006) find that most executives believe that their firms' equity is undervalued by the market.

first to finance the firm's investment. Therefore, overconfident managers hoard cash by not distributing cash dividends.

Proposition 4 (Fewer Dividends) *Overconfident managers are less likely to pay out cash dividends.*

Furthermore, among external financing choices the manager chooses more debt as overconfidence increases. This happens because the manager perceives the firm's equity as undervalued to a degree that intensifies with overconfidence. This also causes the manager to borrow more in order to exploit the perceived mispricing by repurchasing shares.

Proposition 5 (High Leverage) *Debt leverage increases with managerial overconfidence.*

Proposition 6 (Share Repurchases) *Overconfident managers engage in more share repurchases.*

VI. Does Overconfidence Affect Corporate Policies?

A. The Effects of Overconfidence on Managerial Judgement

A.1. Do Overconfident Managers Underestimate Their Own Firms' Cash Flow Volatility?

Our tests examine the effects of managerial overconfidence on corporate policies. To do so, we assume that our S&P 500 overconfidence variables are reasonable proxies for CFOs' overconfidence about their own firms' cash flows (Assumption (1)).[25] We begin by testing directly whether this is a reasonable assumption.

[25] An extensive literature in psychology and in experimental economics examines whether biases like overconfidence spill over from one domain into others. 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

In the 2007Q2 survey, we ask CFOs to provide mean estimates and 10^{th} and 90^{th} percentiles for 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 overconfidence measure pursuing the same procedure as in Section II.B ($Overconfidence_{IRR}$). As with the S&P 500-based overconfidence variables, this variable reflects perceived volatility of own-firm returns, controlling for the level of expected returns.

Next, we test whether $Overconfidence_{IRR}$ is correlated with our S&P 500-based overconfidence variables. Such a correlation would suggest that our primary overconfidence variables are reasonable proxies for own firm overconfidence. In Table VI, Panel A, column (1), $Overconfidence_{IRR}$ is regressed on the S&P 500-based short-term and long-term overconfidence variables, the S&P 500-based optimism variables, and industry controls. The results indicate that firm-based overconfidence is significantly correlated with S&P 500-based overconfidence. IRR-based overconfidence has a sensitivity of 0.32 and 0.16 for short-term and long-term S&P 500-based overconfidence, respectively (t = 7.7 and t = 2.5, respectively). Hence, our S&P 500-based overconfidence variables appear to be reasonable proxies for own-

(2005), Klayman, Soll, Gonzáles-Vallejo, and Barlas (1999), Jonsson and Allwood (2003). These studies show that although people sometimes exhibit different levels of overconfidence across domains, their relative ranking varies as expected across domains. While many studies find that overconfidence spills over from one domain to another, others find weak or no carryover effects. 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 empirical economics. For example, Puri and Robinson (2007) find that people with optimistic beliefs about their life-span also make optimistic economic decisions, e.g., they are more likely to be self-employed and tilt their portfolios towards individual stocks.

firm managerial overconfidence. We use the S&P 500 overconfidence variables in the rest of our analysis.

A.2. Do Overconfident Managers Use Low Discount Rates?

Assumption (2) postulates that overconfident managers use low discount rates to value future cash flows. Graham and Harvey (2001) report that most firms invest when their company's expected IRR is greater than its discount/hurdle rate. It therefore follows that companies with lower discount/hurdle rates will have lower average IRR on their portfolio of investments. Cross-sectionally, we expect IRR and discount rates to be positively correlated. We therefore use the CFOs' expected IRR from current investments as a proxy for the discount rates that they use. This allows us to examine the reasonableness of Assumption (2) that overconfident managers use low discount rates (i.e., low IRR) by regressing the self-reported IRR on overconfidence and optimism variables, and on industry controls.

The results in Table VI, Panel A, columns (2) and (3), show that self-reported IRR is significantly higher for optimistic managers and lower for overconfident managers. In column (2), the entire sample is used in the regression, while in column (3) the sample is restricted to respondents who report that they are involved in investment decisions (5, 6, or 7 on the investment involvement question). As expected, managers who believe that the S&P 500 will perform well also predict that their firm's IRR will be higher. A shift from the median to the top decile of short-term optimism increases IRR by 1.0% ($t = 3.5$) to 1.4% ($t = 2.1$), in columns (2) and (3), respectively.

Importantly, overconfident managers provide lower IRR forecasts, which we argue is reflective of overconfident managers using lower discount rates. When the entire sample is considered (column (2)), a shift from the median to the top decile of short-term overconfidence is associated with IRR falling by 1.4% ($t = -3.7$). When only managers who are actively involved in investment decisions are considered, the same shift in short-term overconfidence results in IRR falling by 1.7% ($t = -3.4$), and a similar shift in long-term overconfidence results in another decline of 1.0% in IRR ($t = -1.3$). Assuming that firms invest according to a hurdle rate rule, and therefore own-firm IRR would be correlated with the firms' discount rate, these results are consistent with our modeling assumption that overconfident managers use lower discount rates (Assumption (2)).

B. Investment Policy

The model predicts that corporate investment increases with managerial overconfidence, and that marginal investments destroy value in the eyes of investors (Propositions (1) and (2)). We test these propositions in Table VI, Panel A, columns (4) to (6).[26]

Overall, firms with overconfident managers invest more in capital expenditures in general (column (4)), and make more acquisitions in particular (column (5)). Both capital expenditures and acquisition intensity increase with long-term overconfidence ($t = 3.0$ and $t = 2.4$, respectively) but not with short-term overconfidence, possibly because investments are generally long-term decisions. To quantify the effect, moving from the median to the top decile of long-term overconfidence increases capital expenditures by about 1.5% (the mean of capex intensity across sample firms is 8.0%). Note that no optimism-related variable is statistically significant, highlighting the importance of our overconfidence measure in the decision making process.

We further investigate the relation between CFO overconfidence and the characteristics of mergers executed by their firms. In column (6) of Table VI, we analyze market reaction to merger announcements. For each observation in our sample we identify announced mergers from Thomson SDC Platinum (minimum size $1m) according to the date nearest to the survey date, restricting the date-difference to, at most, two years. The regression includes controls for the method of payment (stock or cash), whether the merger is diversifying or

[26] All our corporate policy regressions contain a similar set of controls for the known determinants of such policies. Specifically, our controls include collateral (measured as the portion of tangible assets out of total assets), logged firm value, asset market-to-book, book leverage, profitability, five-year past sales growth, 12-month past returns, a dividend-payer dummy, industry fixed effects, and survey date fixed effects. In addition, we include the S&P 500 optimism variables and firm and U.S. optimism variables. We believe that these variables control for common determinants of corporate policies, including for growth opportunities that could be correlated with overconfidence. Furthermore, to maintain consistency with the corporate finance literature, we exclude utilities and financial firms from the sample. In a robustness test, we confirm that our results qualitatively hold for the entire sample of firms.

not (according to whether the acquirers' 2-digit SICs match the targets' 2-digit SICs), and the log of transaction value.

Our results show that merger plans by firms with overconfident managers are negatively received by the market. We find that firms with overconfident CFOs experience lower announcement returns (3-day cumulative returns) at an economically and statistically significant magnitude. A shift from the median to the top decile of long-term overconfidence reduces bidder announcement returns by -1.3% ($t = -2.1$) (mean announcement returns are 0.8%).[27]

Overall, the results indicated in Table VI, Panel A, support the main assumption and propositions of the model, and are consistent with overconfident managers using lower discount rates, and investing more on average. Their acquisitions are also poorly received by the market.[28]

C. Dividend Policy

The model implies that overconfident managers distribute fewer cash dividends because they prefer using internal resources to finance investments (Proposition (4)). We test this proposition in Table VI, Panel B, columns (1) and (2). In column (1), we test whether dividends are lower for firms with overconfident managers. We perform a probit regression of a dividend payer dummy on the overconfidence and optimism variables, in addition to the usual controls. Consistent with Proposition (4), the results in column (1) indicate that firms with overconfident managers are less likely to distribute dividends. The effect is statistically significant and economically important. A shift for the average firm from the median of the

[27]Malmendier and Tate (2007) report a similar effect on acquisition announcement returns for firms with CEOs who do not exercise their executive options, and who are described as "optimistic" and "confident" in the press. Our results are also consistent with Doukas and Petmezas (2007) who find that acquirers who engage in a high number of acquisitions in a short period of time appear to destroy value.

[28]In an untabulated analysis we test whether our results are stronger for firms with high market beta. These firms should have stronger results, because S&P 500-based overconfidence should proxy better for own-firm-based overconfidence among firms with cash flows that vary more closely with the market. The estimated signs of the interactions of overconfidence and market beta match the predicted signs for most part, and they are generally statistically significant. The results are available upon request.

distribution of overconfidence to the top decile results in a 10.5% decrease in the propensity to distribute dividends.

In column (2), we test the link between investments and dividends, as implied by Proposition (4). In particular, the proposition implies that overconfident managers are less likely to pay dividends because they hoard cash for future investments. Hence, the effect of overconfidence on dividend policy should be particularly evident as it interacts with investment decisions. We test this conjecture by regressing the dividend payer indicator on an interaction of capex intensity with overconfidence variables. The results show that the main effect of long-term overconfidence is no longer significant, and almost the entire effect of overconfidence on dividends is due to the interaction between capital expenditures and overconfidence.[29] Hence, this result is consistent with the hypothesis that firms with overconfident managers do not distribute dividends so that they can instead use internal cash to fund investments.

D. Leverage and Debt Maturity

The model predicts that overconfident managers are predisposed to high leverage (Proposition (5)). To test this proposition, we regress book-leverage on a set of right-hand side variables similar to those used in the previous tests. The results in Table VI, Panel B, column (3), indicate that short-term and long-term overconfidence variables are positively related to debt leverage ($t = 2.7$ and $t = 0.5$, respectively), consistent with Prediction (5). To illustrate the economic magnitude of the effect, a shift from the median to the top decile of short-term overconfidence increases debt leverage ratios by about 2.3% (average leverage in our sample is 21.8%). This result provides a possible explanation for Frank and Goyal's (2007) finding that CFOs have individual preferences for their corporations' debt leverage.

[29] To ensure that the effect we document is not driven by a mechanical relationship between dividend payout and investments (paying dividends means that there are less funds for investments), we repeat this test with a repurchases dummy as a left hand variable. Consistent with our model but inconsistent with a mechanical explanation, we find that there is no significant relation between repurchase policy and investment policy interacted with overconfidence variables. Results are untabulated due to brevity and are available upon request.

In addition, we examine how debt maturity varies with overconfidence. If future cash flows are perceived as safe, then managers may be willing to commit to longer debt maturities. We test this hypothesis in column (4). We construct a variable that measures the portion of long-term debt (above one year in maturity) out of total debt (*LT debt/Total debt*) and use it as the dependent variable. The coefficients on both overconfidence variables are positive and statistically significant. An increase from the median to the top decile in each overconfidence variable is associated with a higher share of long-term debt by 3.2% ($t = 2.0$) and 4.7% ($t = 2.8$), for short-term and long-term overconfidence, respectively. (The mean proportion of long-term debt out of total debt is 76.8%.) Thus, overconfidence is associated with committing more heavily to debt, and in particular, to long-term debt.

E. Share Repurchases

According to the model, overconfident managers repurchase shares when they perceive that equity is undervalued by the market (Proposition (6)). In Table VI, Panel B, column (5), we use probit regressions to test whether repurchases are associated with CFO overconfidence. The table indicates that firms with overconfident managers are more likely to repurchase shares than are firms with less confident managers. The effect is statistically and economically significant. A shift for the average firm from the median of the distribution of long-term overconfidence to the top decile results in an increase of 6.5% in the propensity to engage in repurchases. (The average propensity to repurchase shares is 41.6%.)

VII. Conclusion

We provide new evidence and novel insights about the relation between the behavioral biases of managers and corporate policies. Our study is based on a unique data set of stock market predictions by top financial executives collected over a span of more than six years. Our survey measures overconfidence as the degree of miscalibration of beliefs, a method that has been exclusively used before in laboratory experiments. Our data set is distinct because we have direct measures of both overconfidence and optimism for a large number of top U.S. executives, and because we can link our estimates to archival data and thus examine the relation between overconfidence and corporate actions.

We find that CFOs are miscalibrated on average: only 38% of stock market realizations fall within the 80% confidence intervals that executives provide. Confidence intervals are especially narrow following high stock market returns because managers condition their lower confidence bound on past stock market performance. Moreover, our results indicate that miscalibration depends on personal traits (skill), in addition to corporate characteristics.

Our analysis links managerial overconfidence (measured as miscalibration) to corporate policies. First, we argue that a first-order effect of overconfidence on corporate decision making is that overconfident managers use low discount rates when valuing future cash flows. We find that overconfident managers do indeed invest in projects with lower IRRs. Second, we find a strong correlation between overconfidence based on S&P 500 forecasts and overconfidence based on own-firm IRR forecasts. These results support our use of S&P 500-based overconfidence variables as reasonable proxies for own-firm overconfidence, and is consistent with the psychology and economics literature about the spillover of biases from one domain to another.

While previous research provides evidence that behavioral biases exist, we show these biases are prevalent even among top corporate decision makers. More importantly, we establish a link between behavioral biases and corporate financial actions. Firms with overconfident CFOs invest more and engage in more acquisitions. Moreover, overconfident managers are less likely to pay dividends, instead using the funds to make investments. We also find a relation between managerial overconfidence and capital structure: firms with overconfident CFOs have higher debt ratios and rely more heavily on long-term debt.

There is no role for overconfidence in standard models of firm behavior. Our evidence that overconfidence impacts a wide range of corporate policies implies that it is time to consider overconfidence as an integral modeling assumption, rather than just an interesting psychological curiosity.

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Appendix A: Variable Definitions

Variables from CFO Survey

Raw short-term forecast	Survey response of expected one-year S&P 500 return.
Raw long-term forecast	Survey response of expected ten-year S&P 500 return.
Raw lower (upper) bounds	Survey response for the level of S&P 500 returns for which there is a 1-in-10 chance of being lower (greater). Applies to short-term (one-year) and long-term (ten-year) returns.
abs(forecast error)	Absolute value of the forecast error (forecasted returns minus realized returns).
Individual volatility	(Raw upper bound - raw lower bound) / 2.65. 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	Decile ranking of individual short-term expected returns within each survey date. Orthogonalized with respect to *Overconfidence ST*. Variable is scaled between 0 and 1.
Optimism LT	Decile ranking of individual short-term expected returns within each survey date. Orthogonalized with respect to *Overconfidence ST* and *Optimism ST*. Variable is scaled between 0 and 1.
Overconfidence ST	Decile ranking of individual volatility of short-term forecasts within each survey date and forecast decile (i.e., double sorting on short-term optimism). Ranking is scaled between 0 and 1, and sorted in descending order so that 0 (1) reflects the decile of least (most) overconfident managers.
Overconfidence LT	Decile ranking of individual volatility of long-term forecasts within each survey date and forecast decile (i.e., double sorting on raw long-term optimism). Orthogonalized with respect to *Overconfidence ST*. Ranking is scaled between 0 and 1, and sorted in descending order so that 0 (1) reflects the decile of least (most) overconfident managers.
Optimism firm	Raw response to a question about how optimistic managers are about their firms' financial future (responses range from 0 to 100). Variable is decile-ranked within survey date and scaled between 0 and 1.
Optimism U.S.	Raw response to a question about how optimistic managers are about the future of the U.S. economy (responses range from 0 to 100). Variable is decile-ranked within survey date and scaled between 0 and 1.
IRR	Internal rate of returns (IRR) as predicted by survey respondents (in 2007 Q2 survey). Measured in percentage points.
$\text{Overconfidence}_{IRR}$	Decile ranking of individual volatility derived from IRR forecasts within each IRR forecast decile (i.e., double sorting on IRR levels). Ranking is scaled between 0 and 1, and sorted in descending order so that 0 (1) reflects the decile of least (most) overconfident managers.

Variables from CRSP

Age	Firm age in years. Calculated as years elapsed since first appearance on CRSP.
12-month cumulative returns	Cumulative value-weighted monthly returns over 12 months. Applied to market and firm returns.
Merger announcement returns (-1,1)	Cumulative three-day returns of acquirers around merger announcements. Announcement dates are from Thomson SDC Platinum.

Variables from The Chicago Board Options Exchange

Volatility Index (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.

Variables from Annual Compustat

Sales	Annual sales in millions of USD (item 12).
5-year Sales growth	Annualized 5-years sales (item 12) growth.
Book leverage	Total debt / total assets at book values = (long-term debt (item 9) + debt in current liabilities (item 34)) / total assets at book value (item 6).
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).
LT debt / Total debt	Portion of long-term debt (item 9) out of total debt (item 9 + item 34).
Profitability	Operating profit (item 13) / lag(total assets (item 6)).
Collateral	Tangible assets / total assets at book values = (plant property & equipment (item 8) + inventory (item 3)) / total assets (item 6).
Dividends	1 if declared dividends (item 21), and 0 otherwise.
Repurchases	1 if purchase of common and preferred stock (item 115) is greater than 1% of equity, and zero otherwise.
Capital expenditures (capex) 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)).
Acquisitions intensity	Acquisitions (item 129) / lag(total assets (item 6)).

Appendix B: Model of Overconfidence and Corporate Policies

A. Investment Decision

In the model, an overconfident manager decides on the number of projects that his firm will invest in. Each project requires a \$1 investment and produces gross return R_i in the next period. Project returns are diminishing in their order, so that project $i+1$ is less profitable than project i: $E[R_i] \geq E[R_{i+1}]$. For simplicity, we assume that project realizations are independent. Furthermore, we assume that there are no frictions such as taxes, agency costs, bankruptcy costs, or transaction costs. Therefore, the manager chooses the number of projects that maximizes his current shareholders' wealth:

$$\begin{aligned} \max_{I} \quad & \sum_{i=1}^{I} \frac{E[R_i]}{1+\hat{r}} - I \\ s.t. \quad & I \geq 0 \quad ; \quad E[R_i] \geq E[R_{i+1}], \end{aligned} \tag{1}$$

where I is the total investment in projects and $\hat{r}$ is the discount rate that the manager uses. (Investors use $r > \hat{r}$ to discount the cash flows.)

Because overconfident managers use lower discount rates, they invest in more projects. Given that project outcomes are uncorrelated and expected returns are diminishing, the last project that the overconfident manager chooses (project $\hat{I}$) satisfies $E[R_{\hat{I}}] \geq 1+\hat{r}$. Since the overconfident manager uses lower discount rates $\hat{r} < r$ and since projects' expected returns are diminishing with the number of projects $E[R_i] \geq E[R_{i+1}]$, the overconfident manager invests at least as much as an unbiased manager would. In other words, the overconfident manager believes that some negative NPV projects are actually profitable and as a result invests in them:

Proposition 1 (Overinvestment) *Overconfident managers invest more than less confident managers.*

The manager disagrees with the market not only about the optimal number of projects, but also about their cumulative fair value. The total value of the $\hat{I}$ projects, according to the manager's perception, is higher than the total value of projects that investors perceive:

$$\hat{V}(\hat{I}) = \sum_{i=1}^{\hat{I}} \frac{E[R_i]}{1+\hat{r}} - \hat{I} > \sum_{i=1}^{\hat{I}} \frac{E[R_i]}{1+r} - \hat{I} = V(\hat{I}),$$

where $\hat{V}(\hat{I})$ and $V(\hat{I})$ represent the value of the firm with overinvestment, as perceived by the overconfident manager and by investors, respectively.

Proposition 2 (Overvaluation) *Overconfident managers perceive the value of investment projects as being higher than outside investors perceive them to be.*

B. Financing Decision

Given that the overconfident manager decides to invest $\hat{I}$ in projects, he next decides about the capital structure of the firm. At the outset, the firm's balance sheet is composed of cash (B) and equity (allocated into s shares). Projects can be financed with b cash (out of B available to the firm), with newly issued debt with face value F and market value $D(F)$, and with s' newly issued shares. Since the manager and outside investors disagree about the value of the firm's financial claims, the manager maximizes current shareholder value and attempts to profit from market perceived mispricings, subject to raising sufficient funds to finance the projects:

$$\begin{aligned} \max_{b,F,s'} \quad & D(F) - \hat{D}(F) + \frac{s'}{s+s'}\left(E(F) - \hat{E}(F)\right) \\ s.t. \quad & b + D(F) + \frac{s'}{s+s'}E(F) \geq \hat{I} \\ & 0 \leq b \leq B \quad ; \quad F \geq 0 \quad ; \quad s' > -s, \end{aligned} \tag{2}$$

where D and E are market values of the debt and equity claims, respectively. $\hat{D}$ and $\hat{E}$ represent these values as perceived by the manager.

Because the overconfident manager always perceives his firm's assets (i.e., the current value of the project) to be more valuable than investors believe them to be, he prefers to use internal funds first, i.e., $b = B$. Also he would use external funds to the extent that his misperception of the projects' net present value outweighs his misperception of security mispricing. Therefore, he raises the minimum funds necessary, but not more than that. The minimum financing constraint is hence binding: $B + D + \frac{s'}{s+s'}E = \hat{I}$.

After substituting the constraint into the objective function and using the accounting identity $V = D + E$, the manager's problem can be restated as:[30]

$$\begin{aligned} \max_{F} \quad & \frac{\hat{E}(F)}{E(F)}\left(V(\hat{I}) - \hat{I} + B\right) - \left(\hat{V}(\hat{I}) - \hat{I} + B\right) \\ s.t. \quad & F \geq 0. \end{aligned} \tag{3}$$

The only variables in the objective function that are affected by the choice of the face value F are the equity valuations $\hat{E}$ and E. Thus, the debt level that maximizes perceived shareholder value occurs when the ratio $\frac{\hat{E}(F)}{E(F)}$ is maximized. In other words, at the chosen capital structure, the manager believes that the market undervalues the firm's equity the most.

To determine in what situations the manager perceives the value of the equity as undervalued by the market in absolute terms, i.e., $\frac{\hat{E}(F)}{E(F)} > 1$, we put more structure on the problem and calibrate the model. We assume that both the overconfident manager and outside investors use the Merton (1974) framework to value corporate claims.[31] However, the investors use different parameters to value corporate claims than does the overconfident manager. Outside investors believe that the current value of the firm's assets is $V(\hat{I})$ and that the volatility of cash flows is σ. Conversely, the manager uses parameters based on his perception of cash flow volatility: $\hat{V}(\hat{I})$ and $\hat{\sigma}$, respectively, i.e., higher asset value and lower cash flow volatility.

[30] Full mathematical derivation is available upon request.

[31] In Merton's model the firm's equity is priced as a call option on the firm's assets, and zero-coupon debt is priced as a riskless bond minus the value of a put option on the firm's assets. There are no frictions such as taxes, agency costs, bankruptcy costs, or transaction costs.

In the Merton model, equity is valued as a call option on the firm's assets with a strike equal to the face value of debt. Lower volatility has two effects on the price of equity in this framework. First, volatility has a direct effect through the volatility component of the call option, i.e., lower volatility means a lower call option price. Second, lower volatility increases the value of the option indirectly, through the value of the underlying asset. Lower volatility results in lower discount rates, which in turn increase the present value of discounted cash flows, i.e., the option's underlying asset worth is more.

The ratio $\frac{\hat{E}(F)}{E(F)}$ is therefore greater than 1 when the indirect effect of low volatility is greater than its direct effect. While other option parameters matter (such as interest rates and duration), we find that this ratio is mostly sensitive to the degree in which volatility affects discount rates. If volatility is assumed not to have an effect on discount rates (as in Hackbarth (2007)), then $\frac{\hat{E}(F)}{E(F)}$ is less than 1, i.e., the manager believes that the stock market overvalues his firm's equity. However, even a weak positive relation between volatility and discount rates causes $\frac{\hat{E}(F)}{E(F)}$ to be greater than 1, since the valuation of call options is very sensitive to the value of the underlying asset.

In the calibration we assume that the firm can invest any amount I in projects with linearly diminishing returns $E[R_i] = 5 - i$.[32] The investment required for each project is \$1.00. For simplicity, we assume that the firm can also invest in fractional projects. The volatility of cash flows is $\sigma = 0.60$,[33] although, the overconfident manager perceives the volatility as lower by a factor of 3, as documented earlier in this paper, i.e., $\hat{\sigma} = 0.20$.

We follow the traditional asset pricing models and assume that volatility is related to discount rates in a linear fashion: $r = \lambda\sigma$, where the market price of risk, λ, is set to be 0.37.[34] Therefore, the overconfident manager discounts cash flows with $\hat{r} = 0.07$ instead of $r = 0.22$. Additional assumptions are that the risk free rate is $r_f = 0.05$, the investment horizon is one year, and the firm's assets initially consist of \$1.00 cash (B).

[32] This is an arbitrary linear functional form. Linear functions facilitate the calculation, but should not affect the generalization of the results.

[33] Volatility of individual firms typically range between 50% to 100% per annum.

[34] Fama and French (2002) estimate the market price of risk (Sharpe ratio) as 0.31 for 1872 to 2000 and 0.44 for the period of 1951 to 2000. In our calibration we use the estimate employed by Basak and Cuoco (1998).

Using these parameters, we calculate that the manager invests more than an unbiased manager optimally would (by 2.9%)[35] and that he overvalues the projects by 10.0% more than the market does.[36] The manager finances the investment first with cash, and raises debt in order to cover the remainder of the investment and to repurchase shares. The manager chooses the leverage that maximizes the perceived gains from exploiting perceived market mispricings, i.e., the chosen debt face value ($4.91) maximizes the discrepancy in valuations between investors' valuation and his private valuation of issued securities (Equation 2). At this debt face value, the manager perceives the firm's equity as the most undervalued by the market (Equation 3), $\frac{\hat{E}(F)}{E(F)} = 1.21$. The issued debt is only mildly undervalued by the market, $\frac{\hat{D}(F)}{D(F)} = 1.05$.

With this set of parameters, we find that as long as the price of risk, λ, is above 0.01, the ratio $\frac{\hat{E}(F)}{E(F)}$ is greater than 1, i.e., the manager perceives the firm's equity as undervalued by the market:[37]

Proposition 3 (Overvaluation of Equity) *Overconfident managers believe that their firms' equity is undervalued by the market.*

Since external financing seems expensive, the overconfident manager prefers to finance investments with internal cash, and therefore does not distribute dividends before investing in the project.

Proposition 4 (Fewer Dividends) *Overconfident managers are less likely to pay out cash dividends.*

Figure A1 presents the manager's value function from issuing securities (Equation 2) as a function of debt leverage $(D/V(\hat{I}))$. The different curves represent overconfidence degrees ranging from $\hat{\sigma} = 0.60$ (unbiased) to $\hat{\sigma} = 0.10$ (extremely overconfident); an overconfidence

[35] While the overconfident manager overinvests $\hat{I} = \$3.93$, an unbiased manager invests $I^* = \$3.78$.

[36] The overconfident manager perceives the gross value of the investment as $\hat{V}(\hat{I}) = \$9.76$, while the market values it at $V(\hat{I}) = \$11.10$.

[37] Debt is perceived undervalued by the market as long as $\lambda > 0$, although to a lesser extent than equity is (see discussion of calibration charts below).

level of $\hat{\sigma} = 0.20$ is represented with a black marked line. The figure shows that while the value function of unbiased managers ($\sigma = 0.60$) is insensitive to debt leverage, optimal leverage increases with managerial overconfidence (optimal leverage is marked with small open black circles). While a manager with a mild overconfidence level of $\hat{\sigma} = 0.50$ chooses an optimal leverage 0.32, a manager who is more overconfident, $\hat{\sigma} = 0.20$, chooses an optimal leverage 0.46.

Furthermore, the figure shows that although overconfident managers are predisposed to higher leverage, at some point additional leverage is perceived to be value-decreasing. This happens because at high leverage, market valuation of equity is not perceived as being undervalued, while debt is perceived to be undervalued by the market. Therefore, the optimal leverage for overconfident managers is within the middle range, even without an explicit offsetting effect (e.g., bankruptcy costs).

Figure A2a shows the discrepancy between the manager's subjective valuation and the market valuation of equity, as a function of debt leverage. The figure demonstrates that the chosen leverage is set at the point in which the discrepancy in equity valuations between the manager and the market is the greatest (Equation (3)). Figure A2b shows a similar chart for debt. At the optimal leverage ratio, the overconfident manager believes that debt is undervalued by the market, although to a lesser extent than equity.

The calibration yields two additional results. The manager chooses debt leverage that increases with the level of overconfidence. The intuition is that at low and medium leverage levels, the overconfident manager believes that investors undervalue his firms' equity more than they undervalue his firms' debt. Since the manager tries to exploit market mispricing, as overconfidence increases, he wishes to borrow more in order to repurchase more seemingly undervalued shares.

Proposition 5 (High Leverage) *Debt leverage increases with managerial overconfidence.*

Proposition 6 (Share Repurchases) *Overconfident managers engage in more share repurchases.*

In a robustness test we find that Propositions (5) and (6) depend on the relation between volatility and discount rates. In particular, we find that these propositions hold, as long as the market price of risk, λ, is greater than 0.09. Since this value is far below all estimations of the market price of risk in the literature, we believe that Propositions (5) and (6) are generalizable. When $\lambda > 0.09$, and as overconfidence increases, the overconfident manager believes that his firm's equity is undervalued by the market to a greater extent. This happens because the positive effect of low perceived volatility on the equity valuation (lower discount rates) dominates its negative effect (safer assets).

Figure A1. Perceived Value from Issuing Securities and Optimal Leverage

Value derived from issuing securities as perceived by overconfident managers, as a function of debt leverage. Optimal leverage is marked with circles.

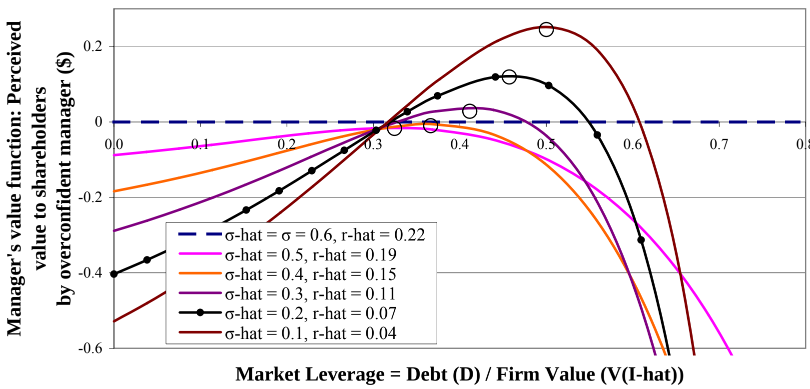

Figure A2. Securities Overvaluation by Overconfident Managers

Figure A2a. The ratio of the value of equity as perceived by overconfident managers to the value of equity as perceived by the market, as a function of debt leverage.

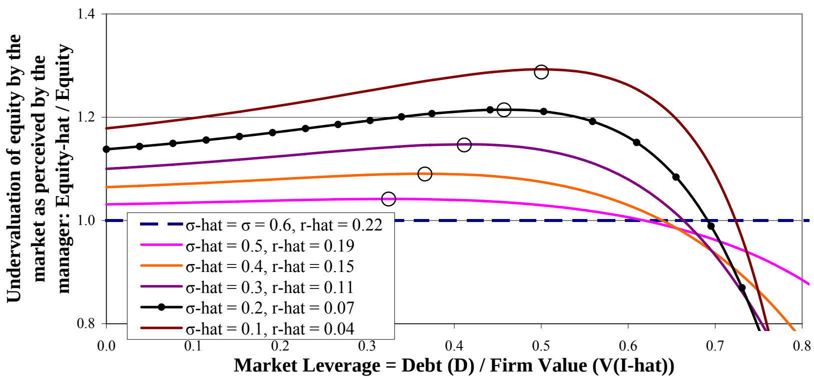

Figure A2b. The ratio of the value of debt as perceived by overconfident managers to the value of debt as perceived by the market, as a function of debt leverage.

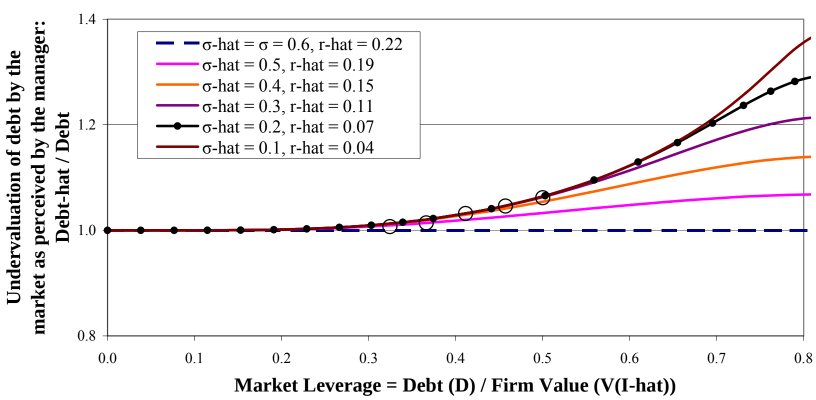

Table I
Summary Statistics

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 size 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 2006. The columns represent Compustat quintiles, and the numbers report the percentage of sample observations that fall within each quintile. Variable definitions are provided in Appendix A.

Panel A: Summary Statistics

Survey Variables (Full Sample)	Obs	Mean	Std Dev	Min	Median	Max
Raw forecasts ST (%)	6901	6.40	3.82	-15.00	6.00	25.00
Individual volatility ST (%)	6901	4.89	3.57	0.38	3.77	26.42
Confidence interval ST (%)	6901	13.02	9.78	0.09	10.00	100.00
Optimism ST	6901	0.50	0.31	0.00	0.56	1.00
Overconfidence ST	6901	0.50	0.31	0.00	0.56	1.00
Raw forecasts LT (%)	6280	7.68	2.73	1.00	8.00	40.00
Individual volatility LT (%)	6280	3.33	2.09	0.38	3.02	19.25
Confidence interval LT (%)	6280	8.98	6.97	0.04	8.00	125.00
Optimism LT	6280	0.50	0.32	0.00	0.56	1.00
Overconfidence LT	6280	0.50	0.32	0.00	0.56	1.00
abs(forecast error ST) (%)	5158	8.52	8.11	0.00	6.35	66.00
S&P 500 realization within confidence interval	5158	0.40	0.49	0.00	0.00	1.00
Optimism firm	5360	0.51	0.32	0.00	0.56	1.00
Optimism U.S.	5403	0.51	0.31	0.00	0.56	1.00
IRR	316	13.19	6.17	2.00	12.00	40.00
Overconfidence$_{IRR}$	316	0.48	0.30	0.00	0.44	1.00
Firm Characteristics (for sample firms that can be linked to Compustat)						
Profitability	1142	0.13	0.12	-1.60	0.13	0.46
log(Sales)	1144	7.66	1.95	0.82	7.63	11.05
Asset Market-to-Book	1144	1.48	0.89	0.21	1.18	6.63
Collateral	1144	0.38	0.22	0.01	0.38	0.93
5yr Sales growth	1108	0.09	0.17	-0.32	0.07	1.42
Book leverage	1143	0.22	0.18	0.00	0.22	1.17
LT debt / Total debt	1061	0.77	0.28	0.00	0.88	1.00
Dividends	1149	0.58	0.49	0.00	1.00	1.00
Repurchases	1149	0.42	0.49	0.00	0.00	1.00
Capex intensity	1143	0.08	0.11	-0.21	0.05	1.23
Acquisitions intensity	1086	0.04	0.09	-0.02	0.00	1.03
Firm Characteristics (for sample firms that can be linked to CRSP)						
Age (years)	1149	32.45	22.27	2.50	25.92	81.33
Firm 12-month past returns	1147	0.18	0.49	-0.91	0.13	5.23
Beta (β_{MKT})	1133	1.13	0.86	-0.48	0.94	4.49
Merger announcement returns (%)	375	0.83	5.16	-15.12	0.86	18.74

Table I: Summary Statistics (Cont.)

Panel B: Distribution of Responses by Industry and Size

Industry	Full Sample	Identified Sample
Retail / Wholesale	815	197
Mining / Construction	254	52
Manufacturing	1904	473
Transportation / Energy	380	144
Communications / Media	316	88
Tech (Software / Biotech)	471	156
Banking / Finance / Insurance	995	333
Service / Consulting	597	119
Healthcare / Pharmaceutical	291	67
Other	774	170
Total	6797	1799

Revenues	Full Sample	Identified Sample
Less than $24m	894	63
$25 - 99m	1423	138
$100 - 499m	1929	365
$500 - 999m	669	283
$1 - 4.999bn	1059	552
More than $5bn	578	411
Total	6552	1812

Panel C: Distribution of sample firms across Compustat quintiles

	Compustat quintiles				
Variable	Q1	Q2	Q3	Q4	Q5
Age (years)	5.9	9.1	16.5	18.9	49.7
Sales	0.3	3.7	12.0	22.4	61.7
Asset Market-to-Book	13.5	28.9	24.4	23.9	9.3
Profitability	1.3	13.2	29.4	32.0	24.2
5-year Sales growth	8.5	28.7	32.0	20.6	10.3
Collateral	10.7	22.5	25.4	25.2	16.2
Book leverage	10.6	20.0	30.1	30.4	8.9
LT debt / Total debt	7.9	17.6	27.5	26.5	20.6
Capex intensity	10.5	19.4	26.9	25.9	17.4

Table II: S&P 500 Return Forecasts and Confidence Intervals

The table presents summary statistics by survey date. *Avg lower bound (%)* is the average CFO 10^{th} percentile for one-year (column (1)) or ten-year (column (6)) S&P 500 returns. *Avg one-year S&P 500 expected return (%)* is the average CFO forecasts for one-year (column (2)) or ten-year (column (7)) S&P 500 returns. *Avg upper bound (%)* is average CFO 90^{th} percentile for one-year (column (3)) or ten-year (column (8)) S&P 500 returns. *One-year (Ten-year) Individual volatility(%)* is the 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. *Realized one-year S&P 500 return (%)* is the realized one-year S&P 500 return following the survey date. *Realized volatility* is the annual volatility of the S&P 500 over the year 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.

	One-year forecasts						Ten-year forecasts						Market data		
		Avg lower bound (%)	Avg expected return (%)	Avg upper bound (%)	Avg individual volatility (%)	Dis-agreement volatility (%)		Avg lower bound (%)	Avg expected return (%)	Avg upper bound (%)	Avg individual volatility (%)	Dis-agreement volatility (%)	Realized one-year returns (%)	Realized volatility (%)	VIX (%)
Survey date	Obs	(1)	(2)	(3)	(4)	(5)	Obs	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
13 Mar 2001	138	n/a	5.3	n/a	n/a	6.7	141	n/a	9.4	n/a	n/a	3.0	-3.6	20.4	27.6
11 Jun 2001	146	-2.7	6.0	13.6	6.1	3.8	145	n/a	9.2	n/a	n/a	2.4	-19.2	18.8	24.0
10 Sep 2001	136	-5.0	4.6	12.9	6.8	5.9	136	n/a	9.1	n/a	n/a	2.6	-16.7	24.1	31.8
3 Dec 2001	188	-4.3	6.9	14.8	7.2	5.3	188	n/a	8.8	n/a	n/a	2.5	-18.5	25.9	25.8
12 Mar 2002	173	-0.4	7.4	12.6	4.9	3.6	173	3.7	8.4	12.7	3.3	2.4	-31.0	26.5	19.6
4 Jun 2002	315	-3.3	5.1	10.6	5.2	3.6	308	3.0	8.2	12.2	3.5	2.6	-5.2	27.1	23.9
17 Sep 2002	351	-4.2	5.0	10.9	5.7	4.2	344	3.2	8.0	12.1	3.4	2.4	17.5	21.8	38.0
3 Dec 2002	276	-2.0	6.8	12.5	5.5	4.0	271	3.4	7.9	11.9	3.2	2.7	15.6	17.6	28.3
17 Mar 2003	182	-6.9	4.6	11.3	6.9	4.3	178	2.0	7.4	11.5	3.6	2.3	28.7	14.5	31.8
12 Jun 2003	350	-1.6	7.9	14.4	6.1	4.9	344	1.9	7.6	12.2	3.9	2.6	13.8	12.5	20.4
15 Sep 2003	151	1.1	7.7	12.6	4.3	3.8	147	3.3	7.4	10.6	2.8	1.9	11.2	11.6	19.3
4 Dec 2003	216	1.1	9.2	15.0	5.2	3.8	212	3.4	8.2	12.1	3.3	2.3	11.4	11.2	16.3
18 Mar 2004	202	-0.9	7.4	13.7	5.5	4.4	198	2.9	7.8	11.8	3.3	2.1	6.0	10.8	18.5
9 Jun 2004	175	-0.4	7.1	12.3	4.8	3.6	172	3.1	8.0	11.5	3.1	2.8	6.2	10.7	15.8
8 Sep 2004	180	-0.6	6.7	12.0	4.7	3.8	174	2.7	7.6	11.1	3.2	2.9	10.3	10.2	14.1
1 Dec 2004	284	-0.2	6.6	11.4	4.4	3.1	281	3.2	7.6	11.1	3.0	2.6	6.2	10.4	13.0
22 Feb 2005	271	-0.6	6.2	11.1	4.4	3.2	269	3.2	7.5	11.3	3.1	2.7	9.2	10.4	13.1
24 May 2005	308	-0.9	5.3	9.9	4.1	2.6	299	2.6	7.3	11.3	3.3	3.3	5.4	9.5	12.7
28 Aug 2005	315	-0.7	5.6	10.2	4.1	3.0	309	2.3	7.2	10.9	3.2	2.2	8.0	10.8	13.7
15 Nov 2005	337	-0.8	5.5	10.2	4.2	3.0	329	2.3	6.9	11.0	3.3	2.1	13.6	10.0	12.2
23 Feb 2006	264	-0.6	6.4	11.4	4.5	3.2	258	2.1	7.2	11.1	3.4	2.3	12.7	9.6	11.9
23 May 2006	477	-0.1	6.2	10.8	4.1	3.3	470	3.1	7.7	11.8	3.3	2.5	21.1	10.5	18.3
29 Aug 2006	453	-0.9	5.7	10.2	4.2	3.2	436	2.6	7.7	11.7	3.4	4.0	12.2	12.1	12.3
21 Nov 2006	383	-0.1	6.7	11.8	4.5	3.2	374	2.9	7.9	12.1	3.5	3.4			9.9
1 Mar 2007	373	0.4	7.0	11.8	4.3	3.4	364	2.8	7.8	11.7	3.4	2.7			15.8
1 Jun 2007	395	0.2	7.4	12.3	4.6	3.5	384	3.1	7.9	11.6	3.2	2.2			12.8
Average	271	-1.4	6.4	12.0	5.1	3.9	266	2.9	7.9	11.6	3.3	2.6	5.0	15.1	19.5

Table III
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 (%)* (see definitions in Table II). *S&P 500 realizations: % below 10^{th} percentile* is the percentage of respondents for whom the realized one-year S&P 500 return is below their 10^{th} percentile predictions. *S&P 500 realizations: % between 10^{th} and 90^{th} percentiles* is the percentage of respondents for whom the realized one-year S&P 500 return is between their 10^{th} percentile and 90^{th} percentile predictions. *S&P 500 realizations: % above 90^{th} percentile* is the percentage of respondents for whom the realized one-year S&P 500 return is above their 90^{th} percentile predictions.

		S&P 500 realizations...		
	Average forecast error (%)	% below 10^{th} percentile	% between 10^{th} and 90^{th} percentiles	% above 90^{th} percentile
Survey date	(1)	(2)	(3)	(4)
13 Mar 2001	9.0	n/a	n/a	n/a
11 Jun 2001	25.2	96.6	3.4	0.0
10 Sep 2001	21.2	89.0	11.0	0.0
3 Dec 2001	25.2	91.0	9.0	0.0
12 Mar 2002	38.2	100.0	0.0	0.0
4 Jun 2002	10.3	73.0	27.0	0.0
17 Sep 2002	-12.5	0.0	14.0	86.0
3 Dec 2002	-8.8	0.0	19.9	80.1
17 Mar 2003	-24.1	0.0	2.7	97.3
12 Jun 2003	-4.8	0.0	50.3	49.7
15 Sep 2003	-3.5	0.0	53.6	46.4
4 Dec 2003	-2.2	0.0	68.5	31.5
18 Mar 2004	1.5	11.9	83.2	5.0
9 Jun 2004	1.0	5.1	86.9	8.0
8 Sep 2004	-3.7	0.0	47.2	52.8
1 Dec 2004	0.4	4.9	78.9	16.2
22 Feb 2005	-2.9	0.0	61.3	38.7
24 May 2005	-0.1	3.9	82.5	13.6
28 Aug 2005	-1.8	0.0	56.5	43.5
15 Nov 2005	-8.1	0.0	19.9	80.1
23 Feb 2006	-6.3	0.0	31.8	68.2
23 May 2006	-14.9	0.0	3.8	96.2
29 Aug 2006	-6.6	0.0	23.4	76.6
Average	1.4	21.6	37.9	40.4

Table IV
Determinants of Forecasts and Individual Volatilities

The table explores the determinants of CFO forecasts of the one-year ahead S&P 500 return and 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 7 lags. Observation units in Panel A are the means of survey responses within a given quarter. Panel B presents results from Fama and MacBeth (1973) regressions, where standard errors (in parentheses) are adjusted for autocorrelation using the Newey and West (1987) procedure with three lags. In Panel B, the independent variables are past firm returns. In both panels, dependent variables are expressed as decimals (not percentage points). Variable definitions are provided in Appendix A. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% level, respectively.

Panel A: Regressions of average forecasts on S&P 500 returns

	One-year forecasts (%)			
	Lower bound	Expected return	Upper bound	Individual volatility
	(1) FM	(2) FM	(3) FM	(4) FM
12-months future S&P return	-0.64	-1.38	-3.96**	-1.25
	(1.27)	(0.90)	(1.94)	(1.06)
12-months past S&P return	11.36***	4.44***	0.52	-4.09***
	(1.49)	(1.01)	(2.05)	(1.12)
Intercept	-1.54***	6.37***	12.12***	5.16***
	(0.13)	(0.29)	(0.46)	(0.19)
Observations	22	23	22	22
R^2	0.75	0.38	0.14	0.49

Panel B: Regressions of forecasts on own-firm returns (Fama-MacBeth)

	One-year forecasts (%)			
	Lower bound	Expected return	Upper bound	Individual volatility
	(1) FM	(2) FM	(3) FM	(4) FM
12-months past firm return	0.47**	0.37***	0.13	-0.10
	(0.17)	(0.10)	(0.29)	(0.12)
Intercept	-1.81**	6.29***	11.92***	5.18***
	(0.70)	(0.20)	(0.32)	(0.33)
Average number of observations	80	83	80	80
Number of regressions	22	23	22	22
Average R^2	0.01	0.01	0.02	0.02

Table V
Skill and Overconfidence

The table explores the relation between CFO overconfidence and skill. Column (1) presents the results of a regression of absolute forecast errors (in percentage) on overconfidence measures (based on a Fama-MacBeth regression). Column (2) presents the results of a regression where the dependent variable is an indicator variable that receives the value 1 if the S&P 500 realization is within the 10^{th} and 90^{th} percentiles provided by CFOs, and 0 otherwise (Fama-MacBeth regression). Standard errors are adjusted for autocorrelation of three lags using the Newey and West (1987) procedure. Variable definitions are provided in Appendix A. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% level, respectively. All regressions have intercepts that are not presented.

	abs(forecast error) (%)	Realization within 10^{th} and 90^{th} and percentiles (0/1) $\times$100
	(1) Fama-MacBeth	(2) Fama-MacBeth
Overconfidence ST	-0.58***	-51.01***
	(0.17)	(3.45)
Overconfidence LT	-0.71***	-5.80***
	(0.20)	(1.84)
abs(forecast error) (%)		-6.01***
		(0.66)
Average number of observations	268	273
Number of regressions	18	18
Average R^2	0.02	0.35

Table VI
Overconfidence and Corporate Policies

The table presents results about the relation between managerial overconfidence and corporate policies. The dependent variables in Panel A are overconfidence based on self-reported IRR (column (1)), self-reported IRR (columns (2) and (3)), capex intensity (%) (column (4)), acquisitions intensity (%) (column (5)), and 3-day merger announcement returns (-1, 1) (column (6)). The dependent variables in Panel B are book leverage (column (1)), $\frac{LT\ debt}{Total\ debt}$ (column (2)), dividend payer dummy (columns (3) and (4)), and stock repurchase dummy (column (5)). All regressions are OLS apart from regressions (3) to (5) in Panel B, which are probit regressions (marginal effects for the average firm are reported). Independent variables in all regressions include *Overconfidence ST*, *Overconfidence LT*, *Optimism ST*, *Optimism LT*, *Optimism firm*, *Optimism U.S*. The regression in Panel A, column (3), is restricted to respondents who reported that they take an active role in the investment decision making process (5 or more out of 7). Columns (4) to (6) in Panel A and all the columns in Panel B include firm characteristics controls: book leverage (except for in Panel B, column (1)), collateral, log(sales), asset M/B, profitability, dividends indicator (except for in Panel B, column (3)), 5-year sales growth, and 12-month past returns. All regression include industry and survey fixed effects. Industry fixed effects are based on nine broad industry classifications (provided by respondents) in Panel A, columns (1) to (3), and on 2-digit SIC elsewhere. The regressions in Panel B, columns (3) and (4), include a repurchase dummy and a capex intensity control. The regression in Panel B, column (5) includes a dividend payer dummy. Utilities and financial firms are excluded from the sample. Variable definitions are provided in Appendix A. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% level, respectively. Standard errors are clustered at the 2-digit SIC level.

Panel A: Discount Rates and Investment Decisions

		IRR (%)		Capex	Acq's	Merger ann.
		All	Involved in	intensity	intensity	returns (-1, 1)
	$\text{Overconfidence}_{IRR}$		investments	(%)	(%)	(%)
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS
Overconfidence ST	0.32***	-2.72***	-3.30***	-1.27	-1.03	-0.58
	(0.04)	(0.74)	(0.98)	(1.12)	(1.01)	(1.19)
Overconfidence LT	0.16**	-0.28	-1.93	2.94***	2.32**	-2.56**
	(0.07)	(1.24)	(1.48)	(0.98)	(0.98)	(1.20)
Optimism ST	0.03	2.81***	2.03*	-0.09	-0.06	-0.35
	(0.07)	(0.80)	(0.95)	(1.22)	(0.95)	(1.17)
Optimism LT	0.03	-1.02	-0.66	-0.47	-0.87	2.23*
	(0.05)	(0.74)	(1.42)	(0.97)	(1.08)	(1.11)
Optimism firm	0.04	1.52	0.92	-0.12	-0.59	0.70
	(0.06)	(0.96)	(1.18)	(0.67)	(0.57)	(0.92)
Optimism U.S.	0.06	1.96	2.57	0.99	1.07	-1.81
	(0.05)	(1.50)	(1.64)	(1.27)	(1.35)	(1.34)
Observations	313	313	198	1104	1051	369
Adj. R^2	0.17	0.09	0.15	0.21	0.17	0.36

Table VI: Overconfidence and Corporate Policies (Cont.)

Panel B: Dividends, Capital Structure, and Repurchases

	Dividends 0/1	Dividends 0/1	Book leverage (%)	$\frac{LT\ debt_q}{Total\ debt_{q-1}}$ (%)	Repurchases 0/1
	(1) probit	(2) probit	(3) OLS	(4) OLS	(5) probit
Overconfidence ST	0.06	0.10	4.62***	6.39**	-0.04
	(0.07)	(0.09)	(1.69)	(3.15)	(0.08)
× Capex intensity		-0.64			
		(0.65)			
Overconfidence LT	-0.21**	-0.08	0.84	9.41***	0.13**
	(0.10)	(0.13)	(1.57)	(3.35)	(0.06)
× Capex intensity		-2.02***			
		(0.68)			
Optimism ST	-0.03	-0.02	0.78	-4.87	0.00
	(0.07)	(0.06)	(1.67)	(2.95)	(0.10)
Optimism LT	-0.01	0.01	0.55	-3.46	-0.11*
	(0.08)	(0.09)	(1.88)	(3.18)	(0.07)
Optimism firm	0.02	0.03	-0.44	3.41	0.10
	(0.08)	(0.08)	(1.73)	(2.93)	(0.06)
Optimism U.S.	0.09	0.08	-1.92	-0.73	-0.13*
	(0.07)	(0.07)	(1.54)	(2.40)	(0.08)
Observations	1027	1027	1104	1023	1050
Adj. R^2 (Pseudo-R^2)	0.38	0.38	0.37	0.27	0.29

Figure 1. Time-Series of CFO Miscalibration

Figure 1. The percentage of CFOs for whom S&P 500 realized returns fall in the 80% confidence interval, by survey quarter

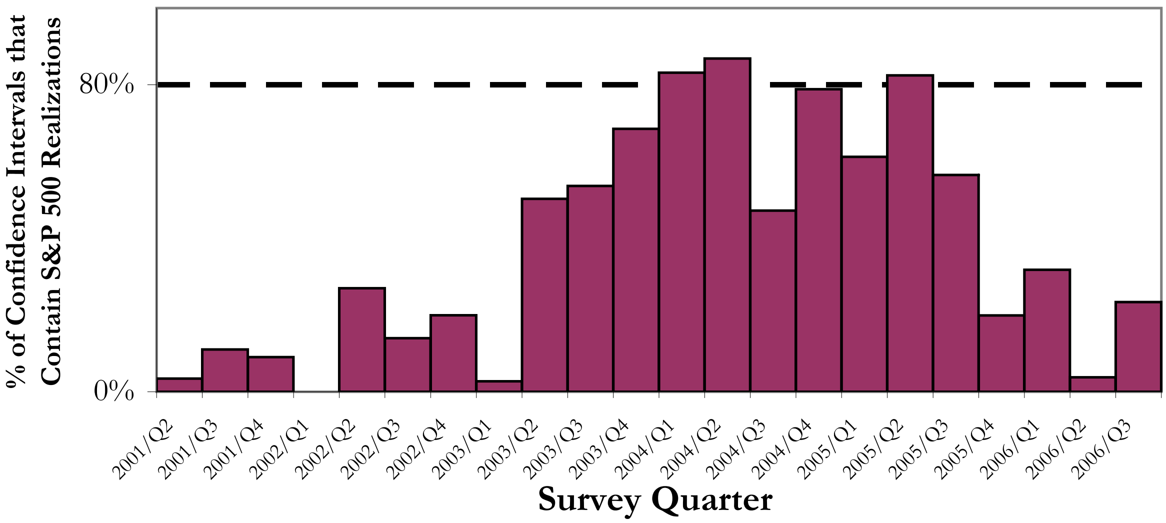

Figure 2. Distribution of One-Year S&P 500 Volatilities

Figure 2a. Historical distribution of S&P 500 one-year volatility (1950-2006)

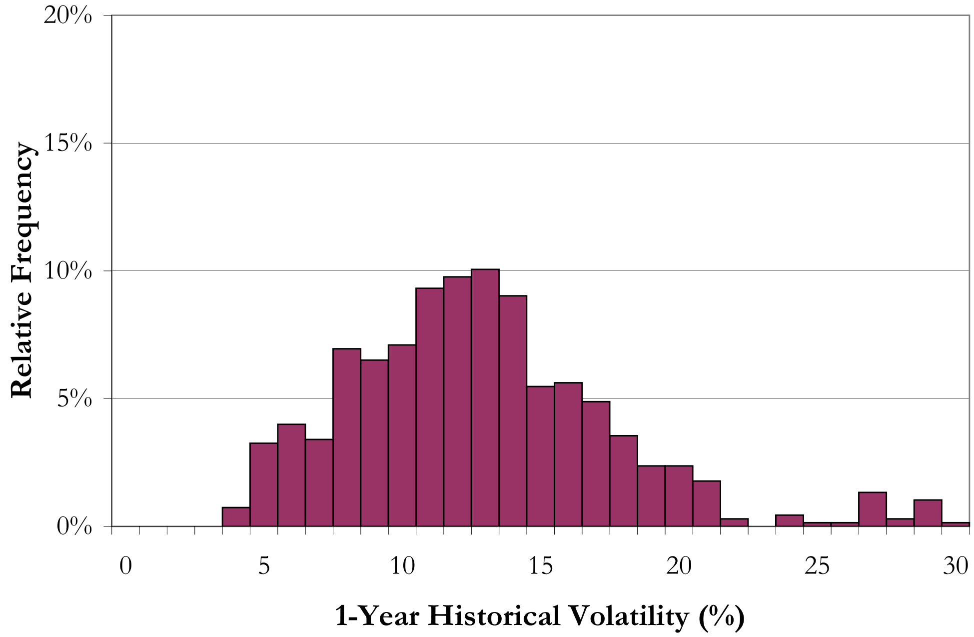

Figure 2b. One-year volatility imputed from survey confidence intervals

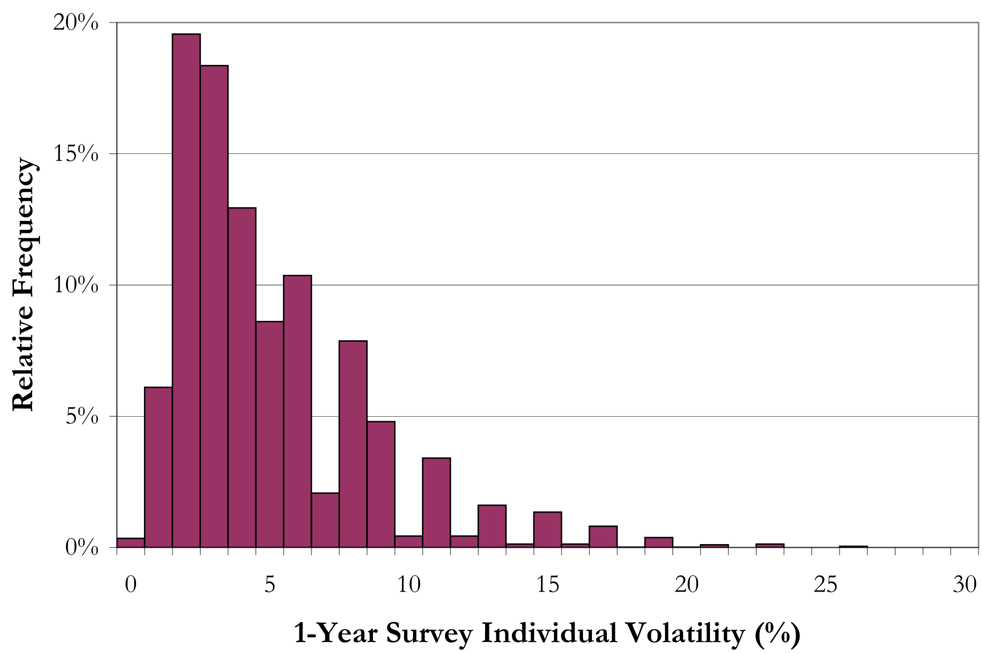

Figure 3. Distribution of Ten-Year S&P 500 Volatilities

Figure 3a. Historical distribution of S&P 500 ten-year volatility (1950-2006)

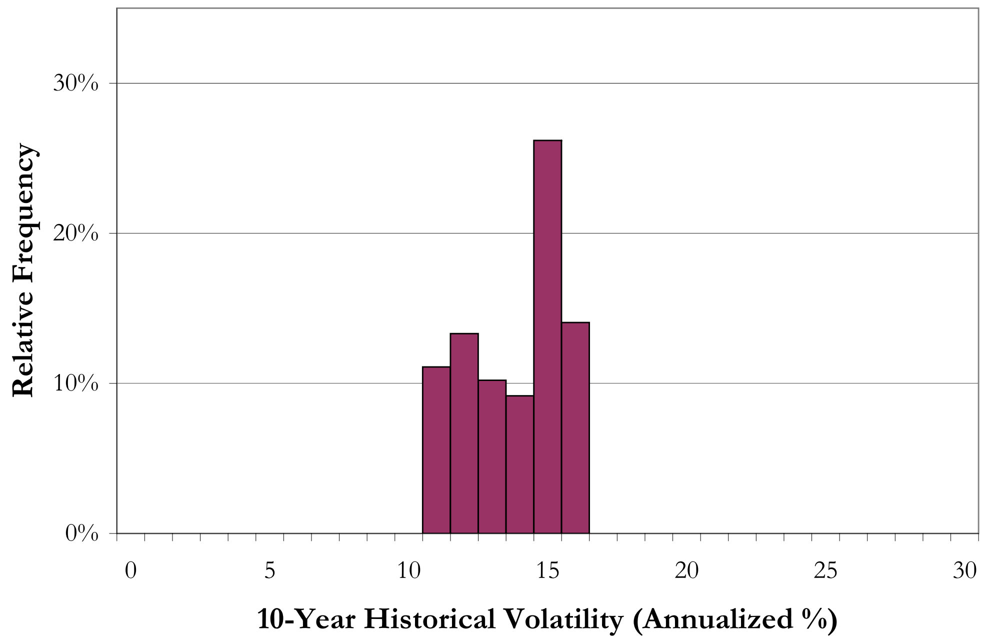

Figure 3b. Ten-year volatility imputed from survey confidence intervals

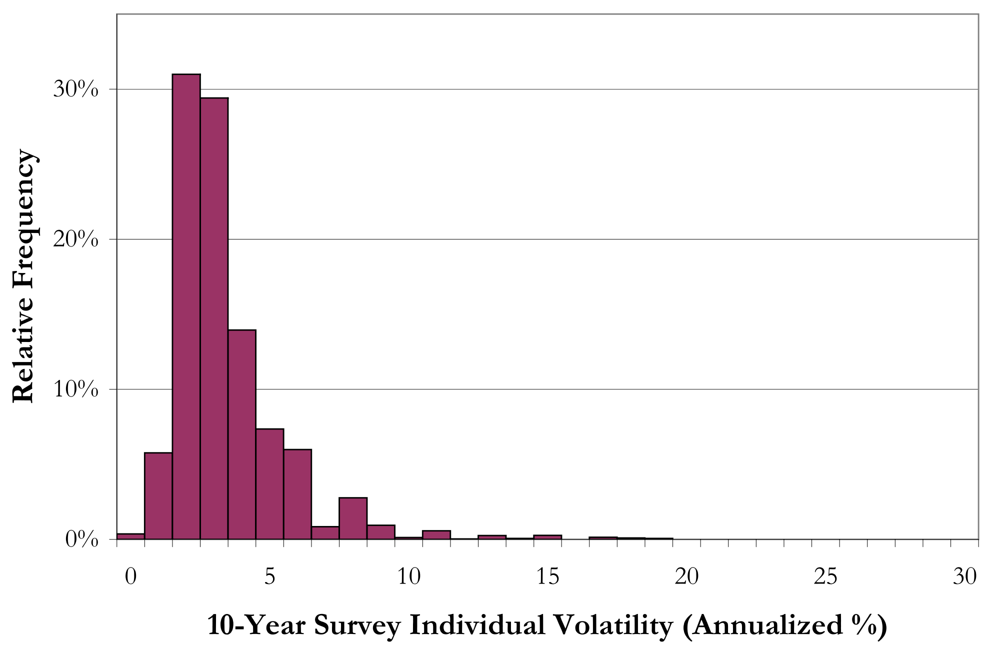

Figure 4. Expected Returns, Confidence Bounds, and Realized Returns

Figure 4. Means of expected returns, 80% confidence bounds (means of lower and upper confidence bounds), and one-year ahead realized S&P 500 returns, by survey quarter