# CEO Stock Options and Analysts' Forecast Accuracy and Bias

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## Contents



**Abstract**

In this study, we investigate the relations between CEO stock options and analysts' earnings forecast accuracy and bias. We argue that a higher level of stock options may induce managers to undertake riskier projects, to change

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C.-F. Lee, J. Lee (eds.), *Handbook of Financial Econometrics and Statistics*,
DOI 10.1007/978-1-4614-7750-1_97,
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and/or reallocate their effort, and to possibly engage in gaming (such as opportunistic earnings and disclosure management) and hypothesize that these managerial behaviors will result in an increase in the complexity of forecasting and, hence, in less accurate analysts' forecasts. We also posit that analysts' optimistic forecast bias will increase as the level of stock options pay increases. We reason that as forecast complexity increases with stock options pay, analysts, needing greater access to management's information to produce accurate forecasts, have incentives to increase the optimistic bias in their forecasts. Alternatively, a higher level of stock options pay may lead to improved disclosure because it better aligns managers' and shareholders' interests. The improved disclosure, in turn, may result in more accurate and less biased analysts' forecasts.

Using ordinary least squares estimation, we test these hypotheses relating the level of CEO stock options pay to analysts' forecast accuracy and bias on a sample of firms from the Standard & Poor's ExecuComp database over the period 1993–2003. Our OLS models relate forecast accuracy and forecast bias (the dependent variables) to CEO stock options (the independent variable) and controls for earnings characteristics, firm characteristics, and forecast characteristics. We measure forecast accuracy as negative one times the absolute value of the difference between forecasted and actual earnings scaled by beginning of period stock price and forecast bias as forecasted minus actual earnings scaled by beginning of period stock price. We control for differences in earnings characteristics by including earnings volatility, whether the firm has a loss, and earnings surprise; for differences in firm characteristics by including firm size, growth (measured as book-to-market ratio, percentage change in total assets, and percentage change in annual sales), and corporate governance quality (measured as percentage of shares outstanding owned by the CEO, whether the CEO is also chairman of the board of directors, number of annual board meetings, and whether directors are awarded stock options); and for differences in forecast characteristics by including analyst following and analyst forecast dispersion. In addition, the models include controls for industry and year. We use four measures of options: new options, existing exercisable options, existing unexercisable options, and total options (sum of the previous three), all scaled by total number of shares outstanding, and estimate two models for each dependent variable, one including total options and the other including new options, existing exercisable options, and existing unexercisable options. We also use both contemporaneous as well as lagged values of options in our main tests.

Our results indicate that analysts' earnings forecast accuracy decreases and forecast optimism increases as the level of stock options (particularly new options and existing exercisable options) in CEO pay increases. These findings suggest that the incentive alignment effects of stock options are more than offset by the investment, effort allocation, and gaming incentives induced by stock options grants to CEOs. Given that analysts' forecasts are an important source of information to capital markets, our finding of a decline in the quality of

the information provided by analysts has implications for the level and variability of stock prices. It also has implications for information asymmetry and cost of capital, as well as for valuation models that rely on analysts' earnings forecasts.

**Keywords**

CEO stock options • Analysts' forecast accuracy • Analysts' forecast bias • CEO compensation • Agency costs • Investment risk taking • Effort allocation • Opportunistic earnings management • Opportunistic disclosure management • Forecasting complexity

## 97.1 Introduction

Firms grant equity incentives such as stock pay, restricted stock, and stock options to create incentives for executives to make decisions that benefit shareholders.[1] By linking executive compensation to shareholder wealth, stock options purportedly help reduce agency costs that arise from the separation of ownership and control in corporations. Over the last decade, stock options have become an increasingly larger component of executive compensation. Most large firms compensate their top executives through stock options which, on a Black-Scholes valuation basis, now represent the largest single component of managerial pay (Murphy 1999; Hall and Murphy 2003).

Several studies have examined the economic implications of stock options and other forms of equity compensation. Much of that research has focused on the relation between stock options compensation and firm performance (Core et al. 1999; Guay 1999; Hanlon et al. 2003; Lam and Chng 2006; Bauman and Shaw 2006), on the link between stock options and investment decisions (Smith and Watts 1992; Bizjak et al. 1993), and on the relation between stock options and dividend policy and dividend yield (Lambert et al. 1989; Atan et al. 2010). Other research has examined whether stock options and other equity-based compensation induce managers to increase short-term stock price through earnings management (Bartov and Mohanram 2004; Cheng and Warfield 2005; Cao and Laksmana 2010).[2] Efendi et al. (2007) provide evidence that the amount of stock options in-the-money is the most influential factor affecting the likelihood of a misstatement. Bergstresser and Philippon (2006) document that managers with a large proportion of stock and options holdings are more likely to use discretionary accruals to manipulate earnings. Chen (2002) finds a negative relationship between incentive compensation and stock ownership held by outside directors.

[1]Other reasons for granting stock options are to attract and retain executives, to conserve cash, to reduce reported accounting expense, and to defer taxes.

[2]Although there is evidence relating earnings management to stock options compensation, little is known about whether this earnings management actually results in higher payouts or about its effect on other goals of the firm.

The purpose of this study is to examine the implications of executive stock options compensation for the accuracy of and bias in analysts' earnings forecasts. Prior research has studied the links between stock options compensation and earnings/disclosure management and between disclosure quality/forecast complexity and analysts' forecast properties. However, it has not directly examined the link between stock options compensation and analysts' forecast accuracy and bias. Our study provides a direct test of this link. One contribution of our study is that it provides a triangulation of the relationships observed in prior research. If financial intermediaries such as analysts can see through the incentives for manipulation by managers with large stock options grants, then the quality of the information will not be affected. However, if analysts cannot see through this manipulation, it will affect the accuracy and bias of their forecasts, and, hence, it becomes an important issue. In this regard, it validates those findings by empirically documenting the relation between stock options compensation and the quality of analysts' earnings forecasts (a common proxy for a firm's information environment).

Higher levels of stock options may induce managers to undertake riskier projects, to change and/or reallocate their effort, and to possibly engage in gaming (such as opportunistic earnings and disclosure management). Consequently, the forecasting task will be more complex as the proportion of stock options compensation increases, leading to less accurate forecasts. While the above reasoning suggests that forecast accuracy may decrease as the level of stock options in CEO pay increases, higher stock options pay may also result in increased accuracy if it better aligns managers' and shareholders' interests. Hanlon et al. (2003) report an increase in future operating earnings associated with past stock options grants, providing empirical support for improved incentive alignment. Better incentive alignment likely improves managers' disclosures which, in turn, may lead to more accurate forecasts.

Analysts' compensation and reputation are, to a large extent, dependent on the accuracy of their forecasts. They can improve the accuracy of their forecasts if they have access to management's private information.[3] Such access becomes even more valuable as the difficulty of the forecasting task increases. Analysts can increase access to management's private information by developing better relations with management. One way of accomplishing this is by making optimistic forecasts. In so doing, analysts trade off forecast bias for improved accuracy. If forecasting difficulty increases with the level of stock options in CEO pay, then so will the optimistic bias in analysts' earnings forecasts. Alternatively, the improved management disclosures resulting from the increased incentive alignment effects of stock options may lead to less biased forecasts.

We present empirical evidence on the relation between the level of stock options in CEO pay and the accuracy and bias of analysts' earnings forecasts for firms in the Standard & Poor's ExecuComp database over the period 1993–2003.

[3]Ke and Yu (2006) and Chen and Matsumoto (2006) are examples of recent research on analysts' incentives for access to management, i.e., the management relations hypothesis.

We estimate the relations between the level of CEO stock options pay and analysts' forecast accuracy and bias using ordinary least squares estimation. We use four measures of options: new options, existing exercisable options, existing unexercisable options, and total options (sum of the previous three) all scaled by total number of shares outstanding. We estimate two models, one including total options and the other including new options, existing exercisable options, and existing unexercisable options. We also use both contemporaneous as well as lagged values of options in our main tests. Our results indicate that analysts' earnings forecast accuracy decreases and forecast optimism increases as the level of stock options (particularly for new options and existing exercisable options) in CEO pay increases. These findings suggest that the incentive alignment effects of stock options are more than offset by the investment, effort allocation, and gaming incentives induced by stock options grants to CEOs.

While stock options may help companies attract, retain, and motivate executives, they also have associated costs. Hall and Murphy (2003) indicate that stock options may be an inefficient form of compensation because the value to recipients who are undiversified and risk averse, and who neither can sell nor hedge against their risk, is less than the cost to the firm. Consequently, options are a costly form of compensation relative to cash or stock compensation. We document a decrease in the quality of analysts' earnings forecasts as the level of stock options in CEO pay increases. Given that analysts' forecasts are an important source of information to capital markets, a decline in the quality of the information provided by analysts has implications for the level and variability of stock prices. It also has implications for information asymmetry and cost of capital.

Our findings also have implications for investors, academics, and other users of financial analysts' forecasts. Because analysts' forecasts serve as expectations of a firm's future prospects, they play an important role in firm valuation. Analysts' forecasts are also commonly used as measures of the market's earnings expectations in studies that investigate the relation between earnings and stock returns and changes in analysts' forecasts are related to stock returns (Givoly and Lakonishok 1979; Imhoff and Lobo 1984; Stickel 1991; Barber et al. 2001; Jegadeesh et al. 2004). Furthermore, earnings forecasts serve as inputs to other research outputs such as stock recommendations (Loh and Mian 2006), target price forecasts (Bandyopadhyay et al. 1995), valuation models (Frankel and Lee 1998), and growth and return on equity investment models (Easton et al. 2002). By identifying the relations between the level of stock options in CEO pay and forecast accuracy and bias, our study provides investors, researchers, and other users with an ex ante indicator of the accuracy of analysts' forecasts.

The rest of this paper is organized as follows. Section 97.2 develops the research hypotheses, and Sect. 97.3 describes the sample selection and research design. Section 97.4 presents the results of the empirical analysis. Section 97.5 reports the results of sensitivity tests, and Sect. 97.6 contains the conclusions of the study.

## 97.2 Hypotheses

### 97.2.1 CEO Stock Options and Forecast Accuracy

An increase in stock options pay to CEOs may increase the complexity of the forecasting task for several reasons. *First*, the convex payoffs from options may induce otherwise risk-averse managers to undertake riskier projects going forward (Murphy 2003; Ross 2004). Theoretical models (Smith and Stulz 1985; Smith and Watts 1992; Bizjak et al. 1993) demonstrate that, because managers' investment decisions are particularly difficult to monitor, firms with substantial investment opportunities tend to encourage higher investment activities by aligning the interests of managers and shareholders through stock options grants. Consistent with this notion, Rajgopal and Shevlin (2002) find empirical evidence linking executive stock options and exploration risks in the oil and gas industry. Relatedly, Guay (1999) documents that equity risk is positively related to the convexity in executives' compensation schemes. These results are consistent with stock options providing managers with incentives to mitigate risk-related incentive problems.

*Second*, the incentive effect of stock options is to motivate managers to exert higher effort. Such contributions will translate into higher performance in both the current and future periods. Managers exert effort in multiple dimensions (Banker and Datar 1989; Holmstrom and Milgrom 1991). With new incentives, managers may also reallocate their effort contributions in addition to exerting higher effort. Stock options grants may induce managers to reallocate their effort mix from short-term effort that focuses more on improving current performance to long-term (or strategic) effort that places more emphasis on improving future performance (Bushman and Indjejikian 1993; Feltham and Xie 1994). To the extent that managers were short-term oriented prior to receiving stock options grants, the reallocation of effort mix could have a negative impact on current performance. The extent of this potential effect on current performance cannot be easily gauged because the reallocation of effort mix is not directly observable or predictable. This, in turn, may result in an increase in forecasting complexity.[4]

*Third*, managers with higher levels of stock options may engage in higher levels of gaming (Hall 2003). This gaming behavior can take many forms including opportunistic earnings and disclosure management. Lambert (2001) points out that earnings management strategies will be influenced by the shape of the compensation contract (i.e., whether it is linear, concave, or convex in a given region). An increase in stock options pay relative to cash compensation will increase the convexity of the compensation contract and result in increased incentives for earnings management that is anti-smoothing in nature. Consequently, managers

[4]Furthermore, Feltham and Xie (1994) show that, if there are multiple tasks and multiple public signals that are influenced by the manager's action, it is unlikely that the market price provides an efficient single performance measure. Therefore, overly relying on stock-based compensation may lead to incongruent behavior by CEOs, further increasing the difficulty of the forecasting task.

may increase their current earnings when earnings are high and reduce their current earnings when earnings are low. Such behavior will directly contribute to an increase in earnings volatility. Bartov and Mohanram (2004) provide evidence consistent with the above argument. They document that managers inflate earnings through accruals management in the period leading up to abnormally large stock options exercises. Other research has examined whether stock options and other equity-based compensation induce managers to engage in high levels of earnings management. For example, Cheng and Warfield (2005) document that managers with high equity incentives are more likely to manage earnings in order to boost stock price, and that this earnings management, in turn, increases personal gains from executives' insider trading. Bergstresser and Philippon (2006) also report that managers with a large proportion of stock and options holdings are more likely to use discretionary accruals to manipulate earnings.[5]

Another form of gaming could be voluntary disclosure management. Prior research (e.g., Yermack 1997; Aboody and Kaznik 2000) shows that the timing of corporate voluntary disclosures is related to the granting of stock options. Aboody and Kaznik (2000) observe that CEOs who receive their options before earnings are announced are significantly more likely to issue bad news forecasts and less likely to issue good news forecasts than are CEOs who receive their awards after the earnings announcement.[6] They also find that management forecasts issued during the 3 months prior to scheduled awards are significantly less optimistically biased than forecasts issued for the same firms during other months. Because managers receiving stock options employ such opportunistic disclosure strategies, the complexity of the forecasting task increases as stock options pay increases. This is especially true when CEOs get multiple stock options grants during the same fiscal year.

The above arguments suggest that an increase in the level of stock options in CEO compensation likely increases the difficulty of forecasting, resulting in less accurate forecasts. However, recent research provides evidence suggesting that stock options can improve the alignment between managers' and shareholders' interests. Hanlon et al. (2003) examine whether stock options granted to the top five executives are related to future operating earnings. Their results indicate that each

[5]However, in related research, Hribar and Nichols (2007) provide evidence that not controlling for operating volatility increases the risk of over-rejecting the null hypothesis of no earnings management.

[6]Although Aboody and Kaznik (2000) study only fixed schedule awards, we argue that the incentive to maximize the stock options pay by manipulating the stock price at the grant date is present for all stock options awards, and that the incentive is especially strong for firms that make multiple grants in a given year. We note that a large number of our sample firms made multiple grants in the same fiscal year thus increasing this incentive. It is also interesting to note that the stock options award dates are generally not publicly known until the issue of proxy statements which are available only 2–3 months after the fiscal year-end (Yermack 1997).

dollar of stock options granted is associated with more than one dollar of future operating earnings over the next 5 years.

Cheng and Warfield (2005) examine the link between stock options and stock ownership and earnings management. They provide evidence that managers with high equity incentives (stock options and stock ownership) are more likely to provide reported earnings meeting or just beating analysts' forecasts and are less likely to report large positive earnings surprises, suggesting that stock options motivate types of earnings management that might increase forecast accuracy.

Given that the literature provides mixed evidence, we present our hypothesis in null form:

**H1** Analysts' earnings forecast accuracy is unrelated to the level of stock options in CEO pay.

The alternate hypothesis is that earnings forecast accuracy is either positively or negatively related to the level of stock options in CEO pay. Given that the alternate hypothesis is nondirectional, we test H1 using a two-tailed test.

### 97.2.2 CEO Stock Options and Forecast Bias

Lim (2001) presents a model demonstrating that statistically optimal forecasts, in terms of mean squared error, may be positively and predictably biased. In this model, analysts trade off forecast bias for forecast accuracy. Analysts have incentives to provide accurate forecasts in order to increase their compensation and market value. They need access to management's private information to improve their forecast accuracy. Consequently, they have to maintain favorable relations with management to ensure that they have access to such information. One way of accomplishing this is by issuing optimistically biased forecasts. Although forecast bias by itself is not desirable, analysts can increase their forecast accuracy by incorporating in their forecasts the private information that management makes available to them as a reward for their forecast optimism. And, because access to management's private information is more valuable when firms' earnings are less predictable, analysts have greater incentives to issue optimistic forecasts for such firms.

Lim (2001) and Das et al. (1998) provide empirical evidence that analysts' forecasts are more optimistically biased when earnings are less predictable and the forecasting task is more complex. Recent examples of research supporting the management relations hypothesis include Chen and Matsumoto (2006) and Ke and Yu (2006). Chen and Matsumoto (2006) find that analysts issuing more favorable recommendations experience a greater increase in their relative forecast accuracy compared with analysts who issue less favorable recommendations. Ke and Yu (2006) document that analysts produce more accurate forecasts and are less

likely to be fired by their employers when they issue initial optimistic earnings forecasts.

A higher level of CEO stock options pay may increase the forecasting complexity because it may induce managers to undertake riskier investments, to change/reallocate their effort, to manipulate accounting earnings, and to issue opportunistic voluntary disclosures. Therefore, we expect analysts' optimistic forecast bias to increase as the level of stock options in CEO pay increases. However, as discussed in the previous section, there is also evidence suggesting that stock options can align the incentives of management and shareholders (see, e.g., Hanlon et al. 2003), which, in turn, may lead to better disclosure and less optimistic bias. Accordingly, we provide the following hypothesis stated in null form:

**H2** Analysts' optimistic earnings forecast bias is unrelated to the level of stock options in CEO pay.

The alternate hypothesis is that earnings forecast bias either increases or decreases with the level of stock options in CEO pay. Given that the alternate hypothesis is nondirectional, we test H2 using a two-tailed test.

## 97.3 Data Description and Research Design

### 97.3.1 Sample Selection

Our sample comprises firms with data available in the ExecuComp, I/B/E/S, and Compustat databases for the period 1993–2003. We exclude financial institutions and agricultural firms[7] and observations for which the CEOs are not identified in ExecuComp. These selection criteria result in an initial sample of 6,272 firm-year observations.

We obtain compensation data from ExecuComp, earnings forecasts, actual earnings, and stock prices from I/B/E/S. I/B/E/S forecasts generally exclude extraordinary and other special items. By using forecast and actual earnings from I/B/E/S, we ensure greater consistency between these two variables (Philbrick and Ricks 1991). We test our hypotheses using forecasts made 9 months before the earnings announcement.[8] We obtain other required financial data from Compustat.

[7]To be consistent with the prior literature on executive pay (Core et al. 1999; Hanlon et al. 2003), we omit financial institutions and agricultural companies. However, for completeness, we also conducted the analysis with these companies included in the sample. Our main conclusions are unaffected by this inclusion.

[8]We repeat all our analyses using 3-month-ahead forecasts to examine the robustness of our results to the forecast horizon. Most results for the 3-month forecasts mirror those presented for the 9-month forecasts.

**Table 97.1** Sample selection procedure

| | |
|---|---|
| Total firm-year observations on ExecuComp data for years 1993–2003, where the CEO is identified and without financial and agricultural firms | 11,016 |
| Less: Observations lost when merging with I/B/E/S data | (4,744) |
| Subtotal | 6,272 |
| Less: Observations with total compensation less than $1 million | (718) |
| Subtotal | 5,554 |
| Less: Observations with missing financial data | (553) |
| Less: Deletion of extreme values and other restrictions | (568) |
| **Final sample for tests on forecast accuracy** | **4,433** |

Additionally, we require firms to have stock prices greater than one dollar to avoid the small deflator problem, to have at least three analysts' forecasts available to obtain a reliable estimate of forecast dispersion, and to have total CEO pay of at least one million dollars to avoid including firms that have low CEO incentives. These restrictions, along with deletion of observations with values in the top and bottom 1 % of the variables used in the regressions, result in 4,433 firm-year observations for the 9-month-ahead forecast accuracy tests and 4,279 firm-year observations for the 9-month-ahead forecast bias tests.[9] Table 97.1 summarizes our sample selection criteria.

## 97.3.2 Variable Measurement

### 97.3.2.1 CEO Options (OPTIONS)

We measure the level of CEO options pay (OPTIONS) as the ratio of the number of options to total number of shares outstanding. This is consistent with the measure employed by Cheng and Warfield (2005). It is a simple parsimonious variable that measures the relative proportion of stock options in a CEO's compensation for a particular year. We use four measures of CEO options: new options, existing exercisable options, existing unexercisable options, and total options (sum of the previous three), all scaled by total number of shares outstanding. We also use both contemporaneous as well as lagged values of OPTIONS in our main tests.[10]

### 97.3.2.2 Forecast Accuracy (ACCURACY)

We measure forecast accuracy for the 9-month-ahead forecast as minus one times the absolute value of the deviation of the mean EPS forecast from the actual EPS for

[9]The sample firms represent a variety of industries, with the largest representation being retail (8 %), electronic equipment (6.7 %), business services (5.3 %), and telecommunications (6 %).

[10]As a sensitivity check, when using lagged OPTIONS, we delete observations that have a new CEO in the current year. Our main results are robust to deletion of these observations.

that year divided by stock price at the forecast date. This measure increases with forecast accuracy and is defined as

$$\text{ACCURACY}_{it} = (-1) * \frac{\left|\text{FEPS}_{it}^{t-1} - \text{AEPS}_{it}\right|}{P_{i,t-1}} \tag{97.1}$$

where, for firm i, $\text{ACCURACY}_t$ is minus one times the absolute forecast error at time t, $\text{FEPS}_t^{t-1}$ is the mean EPS forecast from I/B/E/S for year t made at time t − 1 (i.e., 9 months prior to the fiscal year-end), $\text{AEPS}_t$ is the actual earnings per share obtained from I/B/E/S, and $P_{t-1}$ is the stock price at the time of the forecast obtained from I/B/E/S.

#### 97.3.2.3 Forecast Bias (BIAS)

We measure forecast bias for firm i at time t as the difference between the mean EPS forecast made 9 months prior to the fiscal year-end and the actual EPS, divided by stock price at the forecast date:

$$\text{BIAS}_{it} = \frac{\text{FEPS}_{it}^{t-1} - \text{AEPS}_{it}}{P_{i,t-1}} \tag{97.2}$$

The variable BIAS increases as the level of forecast optimism increases.

#### 97.3.2.4 Other Factors Affecting Forecast Accuracy and Bias

In our empirical tests, we control for previously identified determinants of forecast accuracy and bias. These include earnings characteristics, firm characteristics, and forecast characteristics.

#### 97.3.2.5 Earnings Characteristics

Prior research (Lang and Lundholm 1996; Das et al. 1998; Brown 2001; Duru and Reeb 2002) identifies earnings volatility (VOLROA), whether firms have accounting losses (LOSS), and absolute earnings surprise (ABSESUP) as earnings characteristics that negatively affect forecast accuracy. Kross et al. (1990) and Lim (2001) provide evidence that long-term earnings volatility is associated with less accurate forecasts. This is because the forecasting task is more difficult for firms with historically volatile earnings compared to firms with historically more stable earnings. Prior studies (Brown 2001) also document that analysts' forecasts of firms with losses are generally less accurate than those of firms with profits, partly due to the increased difficulty with estimating losses stemming from other managerial incentives such as "big baths." Lang and Lundholm (1996) and Duru and Reeb (2002), among others, find that larger earnings surprises are associated with less accurate forecasts. This may be due to the effect of anchoring to previously reported earnings.

Consistent with prior research, we measure VOLROA as the standard deviation of return on assets estimated using data from the prior 5 years, LOSS as an indicator

variable representing firm-years with reported losses, and ABSESUP as the absolute value of the difference between the current year's EPS and the previous year's EPS, divided by stock price at the beginning of the year.

The same earnings characteristics also affect analysts' optimistic bias. In addition, Gu and Wu (2003) provide evidence that optimistic forecast bias is negatively associated with earnings skewness (SKEW) primarily due to mean-median differences in skewed earnings distributions. Prior research reports that earnings predictability variables, such as earnings volatility and whether the firm is a loss firm, are positively related to optimistic bias (Duru and Reeb 2002). However, after controlling for the level of earnings, Eames and Glover (2003) do not find a significant relation between forecast error and earnings predictability. Given this finding, we include level of earnings (LEVEARN), measured as annual earnings scaled by year-end market value of equity, as a control variable.[11] We include earnings surprise (ESUP) in place of absolute earnings surprise as a control variable for bias. This variable is measured as the difference between the current year's EPS and the previous year's EPS, divided by the price at the beginning of the year. We also include negative earnings surprise (NEGESUP), where NEGESUP equals 0 if ESUP is positive and equals ESUP if ESUP is negative. We include ESUP and NEGESUP to control for the anchoring behavior of analysts who tend to anchor their forecasts closely to previous period's actual results.

#### 97.3.2.6 Firm Characteristics

We include size (SIZE), growth (GROWTH, CHASSETS, and CHSALES), and governance variables (SHROWN, CEOCHAIR, NUMMTGS, and DIROPT) as firm-specific control variables that are likely to be related to forecast accuracy and bias. We measure SIZE as the natural log of assets at the beginning of the year. Previous studies report that SIZE is related to analyst forecast accuracy and bias (Duru and Reeb 2002; Gu and Wu 2003; Ho and Tsay 2004). Because large firms have a richer information environment, we expect a positive relation between accuracy and size. From a strategic reporting bias standpoint, analysts have stronger incentives to issue optimistic forecasts for smaller firms to facilitate management communication since there is less public information available for these firms (Lim 2001; Gu and Wu 2003). Therefore, we expect the coefficient on SIZE to be negatively related to optimistic forecast bias.

We include the following three proxies for growth, GROWTH, CHASSETS, and CHSALES, where GROWTH is the ratio of the book value of equity at the beginning of the year to the market value of equity at the beginning of the year (i.e., the book-to-market ratio), CHASSETS is the percentage change in total assets at the beginning of the year, and CHSALES is the percentage

[11]Gu (2003) argues that inclusion of earnings level as a control variable will induce spurious relationships between the variable capturing forecast efficiency and other control variables. Our main results are stronger when we exclude earnings level as a control variable.

change in annual sales at the beginning of the year.[12] We include these measures of growth as control variables because firm growth is an important driver of forecast complexity; however, we do not offer directional predictions for these proxies for growth.[13]

Prior research (Byard et al. 2006) shows that analyst forecast accuracy is related to a firm's corporate governance quality. We include SHROWN, CEOCHAIR, NUMMTGS, and DIROPT as proxies for a firm's governance quality. We measure SHROWN as the number of shares owned by the CEO divided by the total number of shares outstanding. Extant evidence indicates that insider ownership generally serves to align insiders' interests with those of shareholders (e.g., McConnell and Servaes 1990). Additionally, higher insider ownership is negatively associated with earnings management (Warfield et al. 1995). Higher insider ownership induces insiders, including the CEO, to maximize shareholder wealth, thereby mitigating the agency problem. Therefore, we expect SHROWN to be positively related to accuracy. The variable CEOCHAIR is an indicator variable which equals one if the CEO is also the chairman of the board and zero otherwise. A CEO who is also chairman of the board of directors could undermine the effectiveness of the board by dissuading directors from expressing alternative viewpoints. Separation of the positions of Chairman and CEO is also an important indicator of board independence (Jensen 1993; Daily and Dalton 1997). Combining these positions leads to a conflict of interest and impairs the board's independence and effectiveness in executing its oversight and governance responsibilities.

The variable NUMMTGS indicates the number of board meetings held in a year. Boards that meet more frequently should be more effective monitors of management (Conger et al. 1998). In addition, Xie et al. (2003) find that the level of earnings management is lower for companies whose boards meet more frequently. The variable DIROPT is an indicator variable which equals one if the directors are awarded stock options in the year and zero otherwise. Directors receiving higher pay may be less vigilant in monitoring the management. This is especially true if the directors were appointed to the board by the same CEO. Although CEOCHAIR, NUMMTGS, and DIROPT are important proxies of a firm's governance quality, we do not offer directional predictions for these variables.

#### 97.3.2.7 Forecast Characteristics

Prior research has identified two forecast characteristics that are related to forecast accuracy and bias – number of analysts following a firm (Duru and Reeb 2002; Das et al. 1998) and dispersion in analysts' forecasts (Lang and Lundholm 1996; Gu and Wu 2003). This research finds that forecast accuracy is higher for firms with larger analyst following (FOLLOW) and lower for firms with

[12]Prior research on forecast accuracy and bias (e.g., Duru and Reeb 2002) does not control for differences in growth. Our results are robust to the exclusion of GROWTH as a control variable in the regressions.

[13]The variance inflation factors for variables in our main regressions are all below three, indicating that there are no severe multicollinearity problems.

higher analysts' forecast dispersion (DISP). It also documents that optimistic forecast bias decreases with analyst following and increases with forecast dispersion.

Forecast dispersion may also proxy for the degree of difficulty in forecasting earnings, with high analysts' forecast dispersion firms exhibiting lower levels of earnings predictability. Therefore, we also expect forecast dispersion to be negatively related to forecast accuracy and positively related to forecast bias.

### 97.3.3 Empirical Models

We estimate the following regression model to test our first hypothesis on forecast accuracy:

$$\begin{aligned} \text{ACCURACY}_{it} = {} & a_0 + a_1\text{OPTIONS}_{it} + a_2\text{VOLROA}_{i,t-1} + a_3\text{LOSS}_{it} + a_4\text{ABSESUP}_{it} \\ & + a_5\text{GROWTH}_{i,t-1} + a_6\text{SIZE}_{i,t-1} + a_7\text{FOLLOW}_{i,t-1} + a_8\text{DISP}_{i,t-1} \\ & + a_9\text{SHROWN}_{it} + a_{10}\text{CEOCHAIR}_{it} + a_{11}\text{NUMMTGS}_{it} \\ & + a_{12}\text{DIROPT}_{it} + a_{13}\text{GROWTH}_{i,t-1} + a_{14}\text{CHASSETS}_{i,t-1} \\ & + a_{15}\text{CHSALES}_{i,t-1} + \langle\text{Industry controls}\rangle + \langle\text{Year controls}\rangle \\ & + \varepsilon_{it} \end{aligned} \tag{97.3}$$

We include industry and year indicator variables to control for industry and year fixed effects. We employ the 48 industries (other than financial and agricultural) identified by Fama and French (1997) as our industry categories.

Hypothesis 1 predicts that forecast accuracy changes with the level of CEO stock options pay. Therefore, we expect $a_1$, the coefficient on OPTIONS, to be different from zero. Recall that we are using four measures of OPTIONS: new options, existing exercisable options, existing unexercisable options, and total options (sum of the previous three). We use two models to test our hypothesis. We use total options as the measure of OPTIONS in the first model, and we use new options, existing exercisable options, and existing unexercisable options as measures of OPTIONS in the second model. In addition, we use both contemporaneous as well as lagged values of OPTIONS in our tests.

We include VOLROA, LOSS, and ABSESUP in the model to control for cross-sectional differences in earnings characteristics because prior research documents that these variables affect forecast accuracy. We include SIZE, GROWTH, CHASSETS, and CHSALES to control for differences in firm characteristics, and we include FOLLOW and DISP to account for the effects of differences in forecast characteristics on forecast accuracy. We include SHROWN, CEOCHAIR, NUMMTGS, and DIROPT to control for cross-sectional differences in corporate governance. We discuss the expected signs on the control variables and present their definitions in Sect. 97.3.2.

We estimate the following regression model to test our second hypothesis on forecast bias:

$$\begin{aligned} BIAS_{it} = {} & a_0 + a_1 OPTIONS_{it} + a_2 SKEW_{i,t-1} + a_3 VOLROA_{i,t-1} + a_4 LOSS_{it} \\ & + a_5 LEVEARN_{it} + a_6 ESUP_{it} + a_7 NEGESUP_{it} + a_8 SIZE_{i,t-1} \\ & + a_9 FOLLOW_{it} + a_{10} DISP_{it} + a_{11} SHROWN_{it} + a_{12} CEOCHAIR_{it} \\ & + a_{13} NUMMTGS_{it} + a_{14} DIROPT_{it} + a_{15} GROWTH_{i,t-1} + a_{16} CHASSETS_{i,t-1} \\ & + a_{17} CHSALES_{i,t-1} + \langle \text{Industry controls} \rangle + \langle \text{Year controls} \rangle + \varepsilon_{it} \end{aligned} \tag{97.4}$$

Hypothesis 2 predicts that forecast bias increases or decreases as the level of CEO stock options pay changes. Therefore, we expect $a_1$, the coefficient on OPTIONS, to be different from zero. Once again, we use two models to test hypothesis 2. The first model uses total options as the measure of OPTIONS. The second model uses new options, existing exercisable options, and existing unexercisable options as measures of OPTIONS. We also include both contemporaneous and lagged values of these four measures.

We include SKEW, VOLROA, LOSS, LEVEARN, ESUP, and NEGESUP in the model to control for cross-sectional differences in earnings characteristics that have been shown in prior research to affect forecast bias. We include SIZE, GROWTH, CHASSETS, and CHSALES to control for differences in firm characteristics, and we include FOLLOW and DISP to account for differences in forecast characteristics that affect forecast bias. We include SHROWN, CEOCHAIR, NUMMTGS, and DIROPT to control for cross-sectional differences in corporate governance. We discuss the expected signs on the control variables and present their definitions in Sect. 97.3.2.

## 97.4 Empirical Analysis

### 97.4.1 Descriptive Statistics

Table 97.2 presents descriptive statistics for the key variables. Consistent with prior research, the mean forecast bias (BIAS) is positive and 0.64 % of stock price. The median value of forecast bias is 0.37 %, which is consistent with prior research. The mean and median values of forecast accuracy (ACCURACY) are negative by construction. The mean value of forecast accuracy is −1.30 % of stock price. The level of new CEO stock options (NOPT) has a mean value of 0.21 % and a median value of 0.11 % indicating that, on average, a significant amount of CEO stock options are awarded relative to the number of shares outstanding.

Table 97.3 presents the correlation matrix for the stock options variables used in the regression analysis. Forecast accuracy is significantly negatively related to all

**Table 97.2** Descriptive statistics on CEO options, forecast accuracy, forecast bias, and control variables

| Variable | Obs. | Mean | Median | Standard deviation | 25 % | 75 % |
|---|---|---|---|---|---|---|
| **1. CEO options** | | | | | | |
| *NOPT* (%) | 4,433 | 0.2146 | 0.1120 | 0.3644 | 0.0363 | 0.2535 |
| *NOPT*, $t-1$ (%) | 4,433 | 0.2070 | 0.0974 | 0.3831 | 0.0238 | 0.2342 |
| *EOPT* (%) | 4,433 | 0.5839 | 0.3205 | 0.7980 | 0.1019 | 0.7451 |
| *EOPT*, $t-1$ (%) | 4,433 | 0.5320 | 0.2801 | 0.7535 | 0.0822 | 0.6798 |
| *UEOPT* (%) | 4,433 | 0.4369 | 0.2474 | 0.6246 | 0.0856 | 0.5623 |
| *UEOPT*, $t-1$ (%) | 4,433 | 0.4177 | 0.2229 | 0.6042 | 0.0701 | 0.5402 |
| *TOPT* (%) | 4,433 | 1.2356 | 0.8285 | 1.3963 | 0.3394 | 1.6435 |
| *TOPT*, $t-1$ (%) | 4,433 | 1.1561 | 0.7411 | 1.3698 | 0.2912 | 1.5276 |
| **2. Forecast variables** | | | | | | |
| *ACCURACY* | 4,433 | −0.0129 | −0.0067 | 0.0186 | −0.0142 | −0.0026 |
| *BIAS* | 4,279 | 0.0064 | 0.0037 | 0.0216 | −0.0017 | 0.0100 |
| *FOLLOW* | 4,433 | 17.2673 | 15.0000 | 9.7937 | 9.0000 | 23.0000 |
| *DISP* | 4,433 | 0.0040 | 0.0021 | 0.0059 | 0.0010 | 0.0044 |
| *SKEW* | 4,279 | 0.0000 | 0.0000 | 0.0011 | −0.0004 | 0.0004 |
| **3. Control variables** | | | | | | |
| *VOLROA* | 4,433 | 0.0365 | 0.0252 | 0.0392 | 0.0115 | 0.0480 |
| *ABSESUP* | 4,433 | 0.0319 | 0.0156 | 0.0480 | 0.0069 | 0.0360 |
| *ESUP* | 4,279 | 0.0007 | 0.0034 | 0.0468 | −0.0150 | 0.0150 |
| *LOSS* | 4,433 | 0.1066 | 0.0000 | 0.3087 | 0.0000 | 0.0000 |
| *LEVEARN* | 4,279 | 0.0418 | 0.0486 | 0.0604 | 0.0285 | 0.0690 |
| *SIZE* | 4,433 | 7.8174 | 7.755 | 1.6550 | 6.6395 | 8.9370 |
| *GROWTH* | 4,433 | 0.2645 | 0.1126 | 0.5428 | 0.0456 | 0.2907 |
| *CHASSETS* (%) | 4,433 | 16.9140 | 8.8190 | 37.04481 | 1.7000 | 21.0000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| *CHSALES* (%) | 4,433 | 14.1356 | 8.9430 | 30.5571 | 1.8000 | 20.0000 |
| *SHROWN* (%) | 4,433 | 1.5556 | 0.2335 | 3.9541 | 0.0763 | 0.9024 |
| *CEOCHAIR* | 4,433 | 0.6932 | 1.000 | 0.4612 | 0.0000 | 1.000 |
| *NUMMTGS* | 4,433 | 7.0746 | 7.0000 | 2.8362 | 5.0000 | 9.0000 |
| *DIROPT* | 4,433 | 0.5736 | 1.000 | 0.4946 | 0.000 | 1.000 |

Variable definitions:
*NOPT* = new stock options to CEO in the current year scaled by total number of shares outstanding
*EOPT* = existing exercisable stock options of CEO scaled by total number of shares outstanding
*UEOPT* = existing unexercisable stock options of CEO scaled by total number of shares outstanding
*TOPT* = sum of *NOPT*, *EOPT*, and *UEOPT*
*ACCURACY* = (−1) * absolute value of [mean EPS forecast − actual EPS]/price at forecast date
*BIAS* = signed forecast error measured as [mean EPS forecast − actual EPS]/price at forecast date
*FOLLOW* = number of analysts following the firm
*DISP* = forecast dispersion, measured as the standard deviation of analysts' forecasts deflated by price at the forecast date
*SKEW* = difference between the mean and the median forecast scaled by price at the forecast date
*VOLROA* = earnings volatility measured as the standard deviation of return on assets for the previous 5-year period
*ABSESUP* = earnings surprise measured as the absolute value of the difference between the current year's EPS and the last year's EPS, divided by price at the beginning of the year
*ESUP* = change in earnings (CHG_EPS) measured as the difference between the current year's EPS and the last year's EPS, divided by price at the beginning of the year
*LOSS* = a dummy variable which equals to 1 when earnings are negative and 0 otherwise
*LEVEARN* = annual earnings scaled by the year-end market value of equity
*SIZE* = firm size measured as the natural log of beginning assets
*GROWTH* = beginning book value of equity divided by the beginning market value of equity
*CHASSETS* = annual percentage change in total assets at the beginning of the year
*CHSALES* = annual percentage change in total sales at the beginning of the year
*SHROWN* = number of shares owned by the CEO divided by the total number of shares outstanding
*CEOCHAIR* = an indicator variable which equals "1" if the CEO is also the chairman of the board and "0" otherwise
*NUMMTGS* = the number of board meetings held in a year
*DIROPT* = an indicator variable which equals "1" if the directors are awarded stock options in the year and "0" otherwise

**Table 97.3** Correlation matrix and Pearson correlation coefficients

| | NOPT | NOPT, $t-1$ | EOPT | EOPT, $t-1$ | UEOPT | UEOPT, $t-1$ | TOPT | TOPT, $t-1$ |
|---|---|---|---|---|---|---|---|---|
| *ACCURACY* | −0.173 (0.00) | −0.125 (0.00) | −0.128 (0.00) | −0.106 (0.00) | −0.132 (0.00) | −0.116 (0.00) | −0.177 (0.00) | −0.144 (0.00) |
| *BIAS* | 0.131 (0.00) | 0.095 (0.00) | 0.102 (0.00) | 0.080 (0.00) | 0.089 (0.00) | 0.077 (0.00) | 0.132 (0.00) | 0.104 (0.00) |
| *NOPT* | 1.000 | 0.337 (0.00) | 0.373 (0.00) | 0.301 (0.00) | 0.546 (0.00) | 0.346 (0.00) | 0.717 (0.00) | 0.412 (0.00) |
| *NOPT*, $t-1$ | | 1.000 | 0.358 (0.00) | 0.320 (0.00) | 0.528 (0.00) | 0.676 (0.00) | 0.529 (0.00) | 0.752 (0.00) |
| *EOPT* | | | 1.000 | 0.871 (0.00) | 0.328 (0.00) | 0.431 (0.00) | 0.815 (0.00) | 0.767 (0.00) |
| *EOPT*, $t-1$ | | | | 1.000 | 0.287 (0.00) | 0.341 (0.00) | 0.704 (0.00) | 0.786 (0.00) |
| *UEOPT* | | | | | 1.000 | 0.771 (0.00) | 0.778 (0.00) | 0.644 (0.00) |
| *UEOPT*, $t-1$ | | | | | | 1.000 | 0.682 (0.00) | 0.817 (0.00) |
| *TOPT* | | | | | | | 1.000 | 0.833 (0.00) |

*p*-values are reported in parentheses
Variable definitions:
*ACCURACY* = (−1) * absolute value of [mean EPS forecast − actual EPS]/price at forecast date
*BIAS* = signed forecast error measured as [mean EPS forecast − actual EPS]/price at forecast date
*NOPT* = new stock options to CEO in the current year scaled by total number of shares outstanding
*EOPT* = existing exercisable stock options of CEO scaled by total number of shares outstanding
*UEOPT* = existing unexercisable stock options of CEO scaled by total number of shares outstanding
*TOPT* = sum of *NOPT*, *EOPT*, and *UEOPT*

four components of CEO options, and forecast bias is significantly positively related to all four components.

### 97.4.2 Estimation Results

Tables 97.4 and 97.5 present estimation results of our empirical models on forecast accuracy and bias respectively. In each table, we present the results for our two models, one using total options and the other using new options, existing exercisable options, and existing unexercisable options. We present the results using contemporaneous measures of OPTIONS in Panel A and the results using lagged values in Panel B.

Table 97.4 presents estimation results for Eq. 97.3. This specification is used to test our first hypothesis that analyst forecast accuracy is unrelated to CEO stock options.[14] For the total options measure (model 1 in Table 97.4), the coefficient on TOPT is negative and statistically significant at the 1 % level for both contemporaneous and lagged values, indicating rejection of hypothesis H1. Model 2 results also indicate rejection of hypothesis H1 as both new options (NOPT) and existing exercisable options (EOPT) have strong negative relations (significant at the 5 % level or better) with forecast accuracy. Additionally, the relations between forecast accuracy and the control variables are generally consistent with expectations and with prior research. In particular, negative earnings (LOSS), absolute earnings surprise (ABSESUP), and dispersion in analysts' forecasts (DISP) are all negatively related to forecast accuracy as predicted, and their coefficients are statistically significant at the 1 % level in both Panel A and Panel B. Earnings volatility (VOLROA) is also negative, as expected, and significant at the 5 % level in all regressions.

Analyst following (FOLLOW) and firm size (SIZE) are positively related to forecast accuracy, as expected, but neither is significant. Among the variables without predicted signs, number of board meetings (NUMMTGS) is negative and significant at 1 % when contemporaneous values are used, and change in sales (CHSALES) is negative and significant for all specifications.

The above findings are consistent with the notion that the increased forecasting complexity accompanying the increase in CEO stock options compensation adversely affects the forecasting ability of financial analysts. This adverse effect leads to a decline in the accuracy of their forecasts. The above result strongly holds for total options in model 1 and new options and existing exercisable options in model 2.

Table 97.5 presents estimation results for Eq. 97.4. This specification is used to test hypothesis H2. If $a_1$, the coefficient on OPTIONS, is significantly different

[14]We also estimate the regression without the absolute value of earnings surprise (ABSESUP) that might be mechanically related to accuracy. The main results are not affected by the exclusion of that variable. We note that inclusion of ABSESUP can only weaken the hypothesized relationship between ACCURACY and OPTIONS because ABSESUP is closely related to ACCURACY.

**Table 97.4** Stock options and forecast accuracy

| | | Model 1 | | Model 2 | |
|---|---|---|---|---|---|
| | Sign | Coefficient | t-Statistics | Coefficient | t-Statistics |
| **Panel A: Contemporaneous options** | | | | | |
| ***TOPT*** | +/− | **−0.1162** | **−5.74**$^{***}$ | | |
| ***NOPT*** | +/− | | | **−0.1336** | **−2.63**$^{***}$ |
| ***EOPT*** | +/− | | | **−0.1300** | **−3.79**$^{***}$ |
| ***UEOPT*** | +/− | | | **−0.0882** | **−1.85**$^{*}$ |
| ***VOLROA, t − 1*** | − | −0.0073 | −2.33$^{**}$ | −0.0169 | −2.33$^{**}$ |
| ***LOSS*** | − | −0.0098 | −11.45$^{***}$ | −0.0098 | −11.42$^{***}$ |
| ***ABSESUP*** | − | −0.0988 | −17.67$^{***}$ | −0.0987 | −17.65$^{***}$ |
| ***SIZE, t − 1*** | + | 0.0004 | 1.39 | 0.0004 | 1.40 |
| ***FOLLOW*** | + | 0.0000 | 0.58 | 0.0000 | 0.55 |
| ***DISP*** | − | −0.6203 | −13.67$^{***}$ | −0.6191 | −13.63$^{***}$ |
| ***SHROWN*** | + | −0.0031 | −0.49 | −0.0029 | −0.46 |
| ***CEOCHAIR*** | ? | −0.0006 | −1.04 | −0.0005 | −1.00 |
| ***NUMMTGS*** | ? | −0.0002 | −2.78$^{***}$ | −0.0002 | −2.79$^{***}$ |
| ***DIROPT*** | ? | 0.0007 | 1.41 | 0.0007 | 1.39 |
| ***GROWTH, t − 1*** | ? | 0.0752 | 1.45 | 0.0741 | 1.43 |
| ***CHASSETS, t − 1*** | ? | −0.0000 | −0.37 | −0.0000 | −0.38 |
| ***CHSALES, t − 1*** | ? | −0.0000 | −1.98$^{**}$ | −0.0000 | −1.99$^{**}$ |
| ***INTERCEPT*** | ? | −0.0042 | −1.52 | −0.0042 | −1.52 |
| ***Industry control*** | | Yes | | Yes | |
| ***Year control*** | | Yes | | Yes | |
| **Observations** | | 4,433 | | 4,433 | |
| **F-value** | | 30.84 | | 29.93 | |
| **Adjusted $R^2$** | | 30.77 % | | 30.74 % | |
| **Panel B: Lagged (previous year's) options** | | | | | |
| ***TOPT, t − 1*** | +/− | **−0.1058** | **−5.21**$^{***}$ | | |
| ***NOPT, t − 1*** | +/− | | | **−0.1308** | **−3.64**$^{***}$ |
| ***EOPT, t − 1*** | +/− | | | **−0.1223** | **2.18**$^{**}$ |
| ***UEOPT, t − 1*** | +/− | | | **−0.0307** | **−0.36** |
| ***VOLROA, t − 1*** | − | −0.0164 | −2.27$^{**}$ | −0.0166 | −2.30$^{**}$ |
| ***LOSS*** | − | −0.0102 | −11.91$^{***}$ | −0.0103 | −11.94$^{***}$ |
| ***ABSESUP*** | − | −0.1011 | −17.97$^{***}$ | −0.1011 | −17.95$^{***}$ |
| ***SIZE, t − 1*** | + | 0.0002 | 0.66 | 0.0002 | 0.64 |
| ***FOLLOW*** | + | 0.0000 | 0.78 | 0.0000 | 0.73 |
| ***DISP*** | − | −0.6114 | −13.46$^{***}$ | −0.6131 | −13.42$^{***}$ |
| ***SHROWN*** | + | −0.0062 | −1.07 | −0.0063 | −1.08 |
| ***CEOCHAIR*** | ? | −0.0002 | −0.42 | −0.0002 | −0.37 |
| ***NUMMTGS*** | ? | 0.0001 | 0.75 | 0.0001 | 0.70 |
| ***DIROPT*** | ? | 0.0005 | 0.91 | 0.0005 | 0.94 |
| ***GROWTH, t − 1*** | ? | 0.0564 | 1.09 | 0.0556 | 1.07 |
| ***CHASSETS, t − 1*** | ? | −0.0000 | −0.09 | −0.0000 | −0.13 |

(*continued*)

**Table 97.4** (continued)

| | | Model 1 | | Model 2 | |
|---|---|---|---|---|---|
| | Sign | Coefficient | t-Statistics | Coefficient | t-Statistics |
| ***CHSALES, t − 1*** | ? | −0.0000 | −2.50** | −0.0000 | −2.48** |
| ***INTERCEPT*** | ? | −0.0045 | −1.62 | −0.0043 | −1.53 |
| ***Industry control*** | | Yes | | Yes | |
| ***Year control*** | | Yes | | Yes | |
| **Observations** | | 4,425 | | 4,425 | |
| **F-value** | | 30.29 | | 29.41 | |
| **Adjusted $R^2$** | | 30.45 % | | 30.40 % | |

Variable definitions:
*NOPT* = new stock options to CEO in the current year scaled by total number of shares outstanding
*EOPT* = existing exercisable stock options of CEO scaled by total number of shares outstanding
*UEOPT* = existing unexercisable stock options of CEO scaled by total number of shares outstanding
*TOPT* = sum of *NOPT*, *EOPT*, and *UEOPT*
*ACCURACY* = (−1) * absolute value of [mean EPS forecast − actual EPS]/price at forecast date
*FOLLOW* = number of analysts following the firm
*DISP* = forecast dispersion, measured as the standard deviation of analysts' forecasts deflated by price at the forecast date
*VOLROA* = earnings volatility measured as the standard deviation of return on assets for the previous 5-year period
*ABSESUP* = earnings surprise measured as the absolute value of the difference between the current year's EPS and the last year's EPS, divided by price at the beginning of the year
*LOSS* = a dummy variable which equals to 1 when earnings are negative and 0 otherwise
*SIZE* = firm size measured as the natural log of beginning assets
*GROWTH* = beginning book value of equity divided by the beginning market value of equity
*CHASSETS* = annual percentage change in total assets at the beginning of the year
*CHSALES* = annual percentage change in total sales at the beginning of the year
*SHROWN* = number of shares owned by the CEO divided by the total number of shares outstanding
*CEOCHAIR* = an indicator variable which equals "1" if the CEO is also the chairman of the board and "0" otherwise
*NUMMTGS* = the number of board meetings held in a year
*DIROPT* = an indicator variable which equals "1" if the directors are awarded stock options in the year and "0" otherwise
***Significant at the 0.01 level, **Significant at the 0.05 level, *Significant at the 0.10 level. Significance levels are based on two-tailed tests

from zero, the empirical results will reject our hypothesis H2 stated in the null. Once again, to test H2, we use two models, one with total options for OPTIONS and the second with new options, existing exercisable options, and existing unexercisable options for OPTIONS. As before, we present the results for both contemporaneous (Panel A) and lagged (Panel B) values of OPTIONS.[15]

[15]We also estimate the model without earnings surprise (ESUP), negative earnings surprise (NEGESUP), and level of earnings (LEVEARN) that might be mechanically related to bias. The relationship between level of options and bias is not affected by the omission of those variables.

**Table 97.5** Stock options and forecast bias (optimism)

| | | Model 1 | | Model 2 | |
|---|---|---|---|---|---|
| | Sign | Coefficient | t-Statistics | Coefficient | t-Statistics |
| **Panel A: Contemporaneous options** | | | | | |
| ***TOPT*** | +/− | **0.1245** | **4.78**$^{***}$ | | |
| ***NOPT*** | +/− | | | **0.1061** | **3.56**$^{***}$ |
| ***EOPT*** | +/− | | | **0.1007** | **2.28**$^{**}$ |
| ***UEOPT*** | +/− | | | **0.0223** | **0.37** |
| ***SKEW, t − 1*** | − | −0.3056 | −1.14 | −0.3105 | −1.16 |
| ***VOLROA, t − 1*** | ? | 0.0382 | 3.95$^{***}$ | 0.0378 | 3.91$^{***}$ |
| ***LOSS*** | ? | 0.0107 | 7.56$^{***}$ | 0.0104 | 7.39$^{***}$ |
| ***LEVEARN*** | ? | −0.0615 | −8.55$^{***}$ | −0.0615 | −8.55$^{***}$ |
| ***ESUP*** | ? | −0.0542 | −6.23$^{***}$ | −0.0541 | −6.22$^{***}$ |
| ***NEGESUP*** | ? | 0.0026 | 3.39$^{***}$ | 0.0026 | 3.36$^{***}$ |
| ***SIZE, t − 1*** | − | −0.0005 | −1.47 | −0.0005 | −1.43 |
| ***FOLLOW*** | − | −0.0000 | −0.11 | −0.0000 | −0.09 |
| ***DISP*** | + | 0.0000 | 1.46 | 0.0000 | 1.49 |
| ***SHROWN*** | − | −0.0099 | −1.23 | −0.0097 | −1.21 |
| ***CEOCHAIR*** | ? | 0.0007 | 1.03 | 0.0007 | 1.05 |
| ***NUMMTGS*** | ? | 0.0000 | 0.13 | 0.0000 | 0.14 |
| ***DIROPT*** | ? | 0.0001 | 0.11 | 0.0001 | 0.10 |
| ***GROWTH, t − 1*** | ? | −0.2095 | −3.18$^{***}$ | −0.2149 | −3.26$^{***}$ |
| ***CHASSETS, t − 1*** | ? | −0.0000 | −1.07 | −0.0000 | −1.09 |
| ***CHSALES, t − 1*** | ? | 0.0000 | 0.35 | 0.0000 | 0.34 |
| ***INTERCEPT*** | ? | 0.0080 | 2.25$^{**}$ | 0.0081 | 2.27$^{**}$ |
| ***Industry control*** | | Yes | | Yes | |
| ***Year control*** | | Yes | | Yes | |
| **Observations** | | 4,279 | | 4,279 | |
| **F-value** | | 14.85 | | 14.54 | |
| **Adjusted $R^2$** | | 18.26 % | | 18.35 % | |
| **Panel B: Lagged (previous year's) options** | | | | | |
| ***TOPT, t − 1*** | +/− | **0.1283** | **4.95**$^{***}$ | | |
| ***NOPT, t − 1*** | +/− | | | **0.1273** | **3.95**$^{***}$ |
| ***EOPT, t − 1*** | +/− | | | **0.1038** | **2.24**$^{**}$ |
| ***UEOPT, t − 1*** | +/− | | | **0.0294** | **0.41** |
| ***SKEW, t − 1*** | − | −0.2593 | −0.96 | −0.2639 | −0.98 |
| ***VOLROA, t − 1*** | ? | 0.0337 | 3.46$^{***}$ | 0.0328 | 3.37$^{***}$ |
| ***LOSS*** | ? | 0.0115 | 8.11$^{***}$ | 0.0113 | 8.01$^{***}$ |
| ***LEVEARN*** | ? | −0.0607 | −8.41$^{***}$ | −0.0605 | −8.38$^{***}$ |
| ***ESUP*** | ? | −0.0546 | −6.16$^{***}$ | −0.0545 | −6.15$^{***}$ |
| ***NEGESUP*** | ? | 0.0026 | 3.38$^{***}$ | 0.0027 | 3.40$^{***}$ |
| ***SIZE, t − 1*** | − | −0.0005 | −1.46 | −0.0005 | −1.55 |
| ***FOLLOW*** | − | −0.0000 | −0.19 | −0.0000 | −0.21 |
| ***DISP*** | + | 0.0000 | 1.51 | 0.0000 | 1.56 |

(*continued*)

**Table 97.5** (continued)

| | | Model 1 | | Model 2 | |
|---|---|---|---|---|---|
| | Sign | Coefficient | t-Statistics | Coefficient | t-Statistics |
| ***SHROWN*** | – | −0.0031 | −0.42 | −0.0035 | −0.47 |
| ***CEOCHAIR*** | ? | 0.0008 | 1.23 | 0.0009 | 1.32 |
| ***NUMMTGS*** | ? | 0.0001 | 0.86 | 0.0001 | 0.71 |
| ***DIROPT*** | ? | −0.0000 | −0.01 | −0.0000 | −0.07 |
| ***GROWTH, t − 1*** | ? | −0.1978 | −2.98*** | −0.1927 | −2.90*** |
| ***CHASSETS, t − 1*** | ? | −0.0000 | −1.24 | −0.0000 | −1.25 |
| ***CHSALES, t − 1*** | ? | −0.0000 | −0.01 | 0.0000 | 0.05 |
| ***INTERCEPT*** | ? | 0.0072 | 2.01** | 0.0078 | 2.18** |
| ***Industry control*** | | Yes | | Yes | |
| ***Year control*** | | Yes | | Yes | |
| **Observations** | | 4,264 | | 4,264 | |
| **F-value** | | 14.64 | | 14.36 | |
| **Adjusted $R^2$** | | 18.09 % | | 18.21 % | |

Variable definitions:
*NOPT* = new stock options to CEO in the current year scaled by total number of shares outstanding
*EOPT* = existing exercisable stock options of CEO scaled by total number of shares outstanding
*UEOPT* = existing unexercisable stock options of CEO scaled by total number of shares outstanding
*TOPT* = sum of *NOPT*, *EOPT*, and *UEOPT*
*BIAS* = signed forecast error measured as [mean EPS forecast − actual EPS]/price at forecast date
*FOLLOW* = number of analysts following the firm
*DISP* = forecast dispersion, measured as the standard deviation of analysts' forecasts deflated by price at the forecast date
*SKEW* = difference between the mean and the median forecast scaled by price at the forecast date
*VOLROA* = earnings volatility measured as the standard deviation of return on assets for the previous 5-year period
*ABSESUP* = earnings surprise measured as the absolute value of the difference between the current year's EPS and the last year's EPS, divided by price at the beginning of the year
*ESUP* = change in earnings (CHG_EPS) measured as the difference between the current year's EPS and the last year's EPS, divided by price at the beginning of the year
*LOSS* = a dummy variable which equals to 1 when earnings are negative and 0 otherwise
*LEVEARN* = annual earnings scaled by the year-end market value of equity
*SIZE* = firm size measured as the natural log of beginning assets
*GROWTH* = beginning book value of equity divided by the beginning market value of equity
*CHASSETS* = annual percentage change in total assets at the beginning of the year
*CHSALES* = annual percentage change in total sales at the beginning of the year
*SHROWN* = number of shares owned by the CEO divided by the total number of shares outstanding
*CEOCHAIR* = an indicator variable which equals "1" if the CEO is also the chairman of the board and "0" otherwise
*NUMMTGS* = the number of board meetings held in a year
*DIROPT* = an indicator variable which equals "1" if the directors are awarded stock options in the year and "0" otherwise
***Significant at the 0.01 level, **Significant at the 0.05 level, *Significant at the 0.10 level. Significance levels are based on two-tailed tests

For the total options measure (model 1 in Table 97.5), the coefficient on TOPT is positive and statistically significant at the 1 % level for both contemporaneous and lagged values, indicating rejection of hypothesis H2. The model 2 results also indicate rejection of hypothesis H2 as both new options (NOPT) and existing exercisable options (EOPT) have strong positive relations (significant at the 5 % level or better) with forecast bias. These results are consistent with the management relations hypothesis.

Additionally, the relations between forecast bias and the control variables are generally consistent with the prior literature. We document a positive relation between forecast bias and volatility of return on assets (VOLROA) and loss firms (LOSS). We furthermore document a negative relation between forecast bias and growth (GROWTH) for all the regressions. These results are consistent with the results reported in prior research (Das et al. 1998; Duru and Reeb 2002; Eames and Glover 2003).

The evidence presented in Tables 97.4 and 97.5 supports the predictions that analysts' earnings forecast accuracy decreases and forecast optimism increases as the level of stock options (in particular, new options and exercisable options) in CEO pay increases. These results are robust to the time period (current versus prior year) when the options are granted.

### 97.4.3 Additional Analysis

As an additional test, we examine the relations between an alternate measure of CEO stock options and forecast accuracy and bias while controlling for endogeneity in the model. Since the results reported in Tables 97.4 and 97.5 are most pronounced for new options, we focus on an alternate proxy for new options, the proportion of stock options pay in CEO total compensation (compensation mix, COMPMIX). We measure this variable as the ratio of the Black-Scholes value of the new options granted to the CEO in a given year to the total compensation granted to the CEO in that year, where total compensation is the value of stock options plus cash compensation (i.e., salary plus bonus). This is consistent with the measure employed by Klassen and Mawani (2000) and Ittner et al. (2003). We also control for endogeneity as this may be a potential problem if both the level of CEO stock options pay and analysts' forecast accuracy/bias are determined by common variables such as a firm's fundamentals. To address this potential endogeneity problem, we examine the relations between CEO options and analysts' forecast accuracy/bias using two-stage least squares regression analysis (2SLS).

In the first stage, we regress the level of CEO options, the dependent variable, on previously identified, firm-specific determinants of stock options grants as well as control variables (Core et al. 1999; Aggarwal and Samwick 1999). These additional variables, related to cross-sectional differences in options compensation, include the prior year's return on assets (ROA), leverage ratio (LEV), and standard deviation of monthly returns for the prior 12-month period (STD). Three sets of variables are common to both regressions: growth (GROWTH), firm size (SIZE), and share

**Table 97.6** 2SLS estimation of compensation mix and forecast accuracy and bias

| | | Column 1 | | Column 2 | |
|---|---|---|---|---|---|
| | Sign | Coefficient | t-Statistics | Coefficient | t-Statistics |
| **Panel A: Compensation mix and forecast accuracy** | | | | | |
| ***COMPMIX*** | NA/+/– | | | **−0.3776** | **−8.69**$^{***}$ |
| ***VOLROA, t − 1*** | NA/– | | | −0.0378 | −0.89 |
| ***LOSS*** | NA/– | | | −0.0084 | −8.31$^{***}$ |
| ***ABSESUP*** | NA/– | | | −0.1094 | −16.52$^{***}$ |
| ***SIZE, t − 1*** | +/+ | 0.0271 | 7.25$^{***}$ | 0.0002 | 0.55 |
| ***FOLLOW*** | NA/+ | | | 0.0001 | 1.80$^{*}$ |
| ***DISP*** | NA/– | | | −0.5852 | −10.91$^{***}$ |
| ***SHROWN*** | –/+ | −0.7432 | −7.35$^{***}$ | −0.0030 | −0.40 |
| ***CEOCHAIR*** | NA/? | | | −0.0009 | −1.37 |
| ***NUMMTGS*** | NA/? | | | −0.0002 | −2.03$^{**}$ |
| ***DIROPT*** | NA/? | | | 0.0009 | 1.46 |
| ***GROWTH, t − 1*** | +/? | 3.0900 | 3.69$^{***}$ | 0.0738 | 1.21 |
| ***CHASSETS, t − 1*** | NA/? | | | 0.0000 | 0.29 |
| ***CHSALES, t − 1*** | NA/? | | | 0.0000 | −1.85 |
| ***STD*** | +/NA | 1.1769 | 15.36$^{***}$ | | |
| ***ROA*** | +/NA | 0.1501 | 2.54$^{**}$ | | |
| ***LEV*** | –/NA | −0.1513 | −5.19$^{***}$ | | |
| ***INTERCEPT*** | ?/? | 0.1972 | 5.40$^{***}$ | 0.0097 | 2.74$^{***}$ |
| ***Industry control*** | | Yes | | Yes | |
| ***Year control*** | | Yes | | Yes | |
| **Observations** | | 3,973 | | 3,973 | |
| **F-value** | | 19.46 | | 25.52 | |
| **Adjusted $R^2$** | | 16.75 % | | 23.76 % | |
| **Panel B: Compensation mix and forecast bias** | | | | | |
| ***COMPMIX*** | NA/+ | | | 0.01343 | 2.88$^{***}$ |
| ***SKEW, t − 1*** | NA/– | | | −0.3156 | −1.16 |
| ***VOLROA, t − 1*** | NA/? | | | 0.0381 | 3.83$^{***}$ |
| ***LOSS*** | NA/? | | | 0.0116 | 7.80$^{***}$ |
| ***LEVEARN*** | NA/? | | | −0.0564 | −7.79$^{***}$ |
| ***ESUP*** | NA/– | | | −0.0560 | −6.33$^{***}$ |
| ***NEGESUP*** | NA/– | | | 0.0028 | 3.52$^{***}$ |
| ***SIZE, t − 1*** | +/– | 0.0242 | 6.40$^{***}$ | −0.0008 | −2.35$^{**}$ |
| ***FOLLOW*** | NA/– | | | −0.0000 | −0.44 |
| ***DISP*** | NA/+ | | | 0.0000 | 1.72$^{*}$ |
| ***SHROWN*** | –/– | −0.7714 | −7.58$^{***}$ | −0.0104 | −1.26 |
| ***CEOCHAIR*** | NA/? | | | 0.0010 | 1.37 |
| ***NUMMTGS*** | NA/? | | | 0.0000 | 0.03 |
| ***DIROPT*** | NA/? | | | 0.0001 | 0.12 |
| ***GROWTH, t − 1*** | +/? | 3.0284 | 3.61$^{***}$ | −0.1895 | −2.83$^{***}$ |

(*continued*)

**Table 97.6** (continued)

| | | Column 1 | | Column 2 | |
|---|---|---|---|---|---|
| | Sign | Coefficient | t-Statistics | Coefficient | t-Statistics |
| ***CHASSETS, t − 1*** | NA/? | | | 0.0000 | 0.68 |
| ***CHSALES, t − 1*** | NA/? | | | −0.0000 | −1.63 |
| ***STD*** | +/NA | 1.2514 | 15.72*** | | |
| ***ROA*** | +/NA | 0.1228 | 1.96** | | |
| ***LEV*** | −/NA | −0.1327 | −4.44*** | | |
| ***INTERCEPT*** | ?/? | 0.1972 | 5.40*** | 0.0075 | 1.91* |
| ***Industry control*** | | Yes | | Yes | |
| ***Year control*** | | Yes | | Yes | |
| **Observations** | | 3,742 | | 3,742 | |
| **F-value** | | 19.31 | | 15.95 | |
| **Adjusted $R^2$** | | 17.12 % | | 17.17 % | |

Variable definitions:
*COMPMIX* = Black-Scholes value of stock options in CEO compensation divided by CEO total compensation (i.e., cash salary + bonus + options)
*ACCURACY* = (−1) * absolute value of [mean EPS forecast − actual EPS]/price at forecast date
*BIAS* = the signed forecast error measured as the [mean EPS forecast − actual EPS]/price at forecast date
*FOLLOW* = number of analysts following the firm
*DISP* = forecast dispersion, measured as the standard deviation of analysts' forecasts deflated by price at the forecast date
*SKEW* = difference between the mean and the median forecast scaled by price at the forecast date
*VOLROA* = earnings volatility measured as the standard deviation of return on assets for the previous 5-year period
*ESUP* = change in earnings measured as the difference between the current year's EPS and the last year's EPS, divided by price at the beginning of the year
*NEGESUP* = 0 if *ESUP* is positive and is equal to *ESUP* if *ESUP* is negative
*LOSS* = a dummy variable which equals 1 when earnings are negative and 0 otherwise
*LEVEARN* = annual earnings scaled by the year-end market value of equity
*GROWTH* = beginning book value of equity divided by beginning market value of equity
*SIZE* = firm size measured as the natural log of beginning assets
*SHROWN* = number of shares owned by the CEO divided by the total number of shares outstanding
*CEOCHAIR* = an indicator variable which equals "1" if the CEO is also the chairman of the board and "0" otherwise
*NUMMTGS* = the number of board meetings held in a year
*DIROPT* = an indicator variable which equals "1" if the directors are awarded stock options in the year and "0" otherwise
*STD* = the standard deviation of monthly returns over previous year
*ROA* = return on assets for year
*LEV* = financial leverage (liabilities over equity)
***Significant at the 0.01 level, **Significant at the 0.05 level, *Significant at the 0.10 level. Significance levels are based on one-tailed tests when the coefficient sign is predicted and on two-tailed tests otherwise
*NA* = not applicable

ownership (SHROWN). In the second stage, we use the models described in Eqs. 97.3 and 97.4 with compensation mix (COMPMIX) as the proxy for OPTIONS.

The results reported in Table 97.6 are consistent with the results presented in Tables 97.4 and 97.5. That is, for compensation mix (COMPMIX), we observe a negative association between accuracy and COMPMIX and a positive association between bias and COMPMIX.

## 97.5 Sensitivity Analyses

We conduct several additional tests to examine the robustness of our findings. First, we control for cross-sectional correlation, since our tests are based on pooled cross-sectional and time series data. Although we include fixed industry and year effects in our primary tests, we conduct Fama-MacBeth estimation with industry controls to account for residual cross-sectional correlation as an additional test. The Fama-MacBeth t-statistics of the coefficient on total options in model 1 and new options and exercisable options in model 2 are statistically significant at the 5 % level or higher for all the tests.

Second, we assess the sensitivity of our results to use of the median analysts' forecast in place of the mean forecast for computing forecast accuracy and bias. We estimate models (3) and (4) using these alternative measures of forecast accuracy and bias as dependent variables and without earnings skewness as an independent variable. We find that the results reported in Tables 97.4 and 97.5 are robust to the choice of median analysts' forecasts in place of mean forecasts.

Finally, since our sample period of years 1993–2003 includes both pre- and post-SOX periods, we delete years 2002 and 2003 and carry out a subsample analysis without the post-SOX periods. For the pre-SOX subsample, consistent with our main results in Tables 97.4 and 97.5, total options in model 1 and new options and exercisable options in model 2 have a significant negative association (at the 5 % level or better) with forecast accuracy and a significant positive association (at the 5 % level or better) with forecast bias.

## 97.6 Summary and Conclusions

We examine the relation between the level of CEO stock options and the accuracy and bias of analysts' earnings forecasts. We use four different measures of stock options: new options, existing exercisable options, existing unexercisable options, and total options (sum of the previous three). We also use both contemporaneous as well as the lagged values of options compensation in our tests. We hypothesize that forecast accuracy is related to the level of CEO stock options pay. This is because higher levels of stock options may induce managers to undertake riskier

projects, to change and/or reallocate their effort, and to possibly engage in gaming (such as opportunistic earnings and disclosure management). However, higher levels of stock options may also better align managers' incentives with those of shareholders and lead to more accurate forecasts. We also hypothesize that forecast bias is related to the level of stock options in CEO pay. The underlying rationale for this is that as the forecast complexity increases with stock options pay, analysts, who need greater access to management's information to produce accurate forecasts, increase the optimistic bias in their forecasts. Alternatively, because higher levels of CEO stock options may better align managers' and shareholders' incentives, they may lead to less biased forecasts.

Our results indicate that analysts' earnings forecast accuracy decreases and forecast optimism increases as the level of stock options in CEO pay increases. Furthermore, our results are robust to the measure of CEO stock options and to the use of current or prior year values of options. These findings suggest that the incentive alignment effects of stock options are more than offset by the investment, effort allocation, and gaming incentives induced by stock options grants to CEOs.

Our study contributes to the current debate on the costs and benefits of the stock options pay to managers. It demonstrates that the level of stock option compensation in CEO pay is an important determinant of analysts' earnings forecast accuracy and bias. Analysts are an important information intermediary in capital markets. The decline in the quality of their forecasts with increased stock options compensation indicates that stock option compensation indirectly affects the quality of the information available to market participants.

**Acknowledgments** We thank Zhaoyang Gu, Emad Mohd, Mohamed Shehata, K. (Shiva) Sivaramakrishnan, Scott Whisenant, Yoonseok Zang, Jian Zhou, the anonymous reviewers, and workshop participants at the University of Houston, Drexel University, Wilfrid Laurier University, the 2005 American Accounting Association Meeting, the 2005 Canadian Academic Accounting Association Meeting, and the 2005 European Accounting Association Meeting for their helpful comments and Alper Ozesen and Li Wang for their research assistance. We gratefully acknowledge the contribution of Thompson Financial for providing forecast data, available through the Institutional Brokers Estimate System (I/B/E/S). These data have been provided as part of a broad academic program to encourage earnings expectations research. We also thank the Social Sciences and Humanities Research Council of Canada (SSHRC) for their financial support.

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