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# The effect of analyst coverage on CEO compensation structure: evidence from the S&P 1500

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## Abstract

**Purpose** – What is the role of analysts in reducing agency problems and information asymmetry between stockholders and managers? The purpose of this paper is to confirm the analyst's role by examining his or her influence on CEO compensation structure.
**Design/methodology/approach** – The major population for this study consists of publicly traded corporations of the S&P 1500 for which data on CEO compensation is available from Standard & Poor's Execucomp database, along with the proxy statements of these firms. Regression analysis is used to test hypotheses about the effect of analyst coverage on CEO compensation.
**Findings** – The evidence shows that CEOs of firms with greater analyst coverage or higher analyst coverage quality (analyst coverage index) have higher pay-for-performance (Delta), more compensation incentives to increase firm risk (Vega), more total compensation, and more excess compensation. Even after controlling for the effect of other types of corporate governance, including internal governance and institutional holdings, analysts' activities still have an incremental effect on CEO compensation structure.
**Practical implications** – The authors findings may be useful to investors who use analyst coverage to evaluate the firm's CEO compensation, as it suggests that investors may reference the information about analyst coverage of firms to craft appropriate CEO compensation structures.
**Originality/value** – The authors results contribute by showing that the extra effect of analyst activities on CEO compensation structure exists, even after controlling for other types of governance mechanisms, such as internal governance and institutional investors' holdings.

**Keywords** Corporate finance, Corporate governance

**Paper type** Research paper

## 1. Introduction

Academic research (Bergstresser and Philippon, 2006; Boone *et al.*, 2011; Jensen and Murphy, 1990) often agrees that the increase in CEO wealth in relation to stock prices is an appropriate method for linking management incentives to the interests of shareholders. For rational investors, monitoring CEO actions through governance mechanisms can help in determining an optimal compensation contract. Compared with traditional governance mechanisms, unlike the internal governance devices designed to protect current shareholders interests, analysts are expected to provide information in the interests of both current and prospective shareholders as well as other participants in the market. In addition, institutional investors may affect the CEO compensation structure of the firms they cover (Hartzell and Starks, 2003). Similar to analysts, institutional investors also have professional knowledge in analysis. However, institutional investors who may sit on board create another type of agency problem when they can affect the CEO's decisions to serve their own interests. Therefore, I conjecture that analysts' actions may convey information about optimal compensation contracts that could mitigate agency costs for individuals and organizations interested in the firm. Thus, the purpose of this paper is to examine whether analyst monitoring affects CEO compensation contracts.

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Based on previous studies, there are three measures of compensation structure, pay-for-performance sensitivity (Delta) associated with equity, compensation incentives to increase firm's risk (Vega)[1], and the level of total compensation. How can analysts affect the CEO's compensation structure? Greater analyst coverage creates a better information environment for firms and leads to lower levels of information asymmetry (Bushman and Smith, 2001; Healy and Palepu, 2001; Yu, 2008). Thus, analyst monitoring of performance helps motivate corporate managers to exert effort in making good decisions that increase firm value and create stockholder wealth. Because the value of CEO incentive compensation (stock options) is positively correlated to a firm's value, the active role of analysts in monitoring and marketing can result in a compensation contract for the CEO that includes more equity and is more performance sensitive (Delta). In addition, while analyst coverage imposes detection on misbehaving managers, I conjecture that analyst following activities tend to strengthen the incentives of shareholders and outsiders to discipline CEOs effectively by setting their compensation as a convex function of the stock price measured by Vega, since CEO's with higher Vega implement investment choices with higher risk and higher net present values (Coles *et al.*, 2006). Based on the previous deduction, such CEOs would require a higher level of compensation since they bear more firm-specific risk through their increased pay-for-performance sensitivity generated from stock options. Thus, I expect to find a positive relationship between CEO total compensation and analyst coverage.

My main sample contains observations of all S&P 1500 firms over the period 2000-2006. However, to reduce the possibilities that companies disclose information to selected parties (such as analysts and institutional investors) about their forecasting earnings, the Securities and Exchange Commission (SEC) adopted Regulation FD in October of 2000. Therefore, I also examine the effect of Regulation FD on my empirical results. This finding is consistent with the view that analysts' forecasts are more objective after the passage of Reg FD.

Analysts can act as an alternative external governance mechanism. However, at present, understanding of the effect of analysts' behaviors on the management compensation structure is lacking. This paper contributes to the literature by examining analysts' influence on the executive compensation structure of firms. My main results contribute by showing that the extra effect of analyst activities on CEO compensation structure exists, even after controlling for other types of governance mechanisms, such as internal governance and institutional investors' holdings. Further, the results of the additional tests shedding light on the effectiveness of Reg FD also contribute to the literature in this area.

## 2. Development and key hypothesis

Two hypotheses explain the effect of corporate governance and management compensation structure. The substitution hypothesis (Almazan and Suarez, 2003; Borokhovich *et al.*, 1997; Fahlenbrach, 2009) predicts that executive compensation contracts represent one of a number of ways of aligning the incentives of managers and shareholders. The complementarity hypothesis (Cremers and Nair, 2005; Hadlock and Lumer, 1997; Hartzell and Starks, 2003) predicts that governance mechanisms are complementary to each other. This suggests that firms with stronger governance have higher overall pay-for-performance sensitivity and a higher level of compensation.

The monitoring is performed by stock market actors such as institutional investors and analysts. A potential alternative interpretation of the effect of analyst coverage on CEO compensation structure is that both monitoring by analysts and managerial incentive compensation arise simultaneously. For a given firm, the relation between monitoring function and incentive compensation should be determined by their benefits and costs. While monitoring by outsiders such as analysts can be beneficial, such monitoring requires independent disclosure of information concerning managerial actions, which is costly. At the same time, while incentive compensation better aligns managers' and stockholders' interests, incentive compensation typically create costs since managers take excessive risk and then require extra pay. These cost-benefit relations indicate that monitoring by analysts and incentive compensation is mutually complementary. Thus, this paper will focus on the complementarity hypothesis.

Security analysts' monitoring of performance helps motivate corporate managers, thus reducing the agency costs arising from the separation of ownership and control and improving the quality of financial information. The literature shows that firms which disclose a higher quality of financial information can create more value through improving the efficiency of investment (Biddle and Hilary, 2006; Bushman and Smith, 2001). Thus, analysts' activities can enhance the investor cognizance of the firms they cover. The positive impact of analyst following on stock price is a logical conclusion from their marketing effect[2]. As a consequence, since the firm may establish a compensation contract with a high proportion of equity options to align the interests of CEO and stockholders, greater analyst coverage is needed to impose a compensation contract on the executive that is more performance sensitive, as CEOs participate in the capital gains through the exercise of equity options. The conjecture is consistent with the complementarity hypothesis.

Using compensation policy to tie managers' wealth and firm stock price can induce managers to take actions that increase equity value. However, Smith and Stulz (1985) find that when managers' wealth is determined by firm performance, the attitude of risk-aversion can cause managers to reject projects that increase firm risk, but have positive net present values. Following studies by Jensen and Meckling (1976) and Smith and Stulz (1985), they explore whether the risk-related agency problem can be reduced by using stock options to structure managers' wealth as a convex function of stock prices measured by the sensitivity of CEO wealth to stock return volatility, or Vega. Thus, while analyst coverage imposes detection on misbehaving managers, firms with greater analyst coverage, which can establish CEO compensation as a more convex function of stock price, lead their CEOs to accept projects with higher risk and higher net present values through analyst monitoring. Taken as a whole, these discussions suggest that analyst coverage also offers CEOs incentives to increase firm risk.

To summarize, I propose the following hypothesis associated with CEO compensation sensitivity:

*H1a.* Analyst coverage is positively associated with CEO pay-for-performance sensitivity (Delta) and the sensitivity of CEO compensation to stock return volatility (Vega).

High-quality disclosures produced by analyst coverage also effectively bond managers by increasing transparency, and managers forego the opportunity to bias disclosures in a self-serving manner. Given this, firms have to rely on implicit contracts that reward managers for perceived increases in the quality of the firm's financial communications (Hayes and Schaefer, 2000). In addition, Matsunaga and Park (2001) find that missing analyst earnings forecasts has a negative effect on CEO bonus compensation. Accordingly, I provide the following hypothesis:

*H1b.* Analyst coverage is positively associated with CEO total compensation and excess compensation.

Doukas *et al.* (2008) provide a different view of the analyst's role. They find that the quality and quantity of information provided by analysts is affected by investment-banking and trading commission-based incentives. Moreover, excess coverage may produce investor overconfidence because the information content of analysts' earnings forecasts is overstated. Therefore, there is a limitation associated with adopting the number of analysts covering a particular firm as the proxy variable for the analyst monitoring role. To account for this limitation, I follow Knyazeva (2007) and create an aggregate measure of analyst coverage, called the analyst coverage index that is a proxy for the quality of analyst coverage[3]. Similar to *H1a* and *H1b* (based on the complementarity hypothesis), I propose my second hypothesis:

*H2a.* The analyst coverage index is positively associated with CEO pay-for-performance sensitivities.

*H2b.* The analyst coverage index is positively associated with CEO total and excess compensation.

## 3. Methodology

### *3.1 Sample selection*

The main sample includes all S&P 1500 firm-years with data on CEO compensation available from Standard & Poor's Execucomp database, along with the proxy statements of these firms[4]. Because of the significant changes to the SEC reporting requirements regarding executive compensation, the information about stock options provided from new version of proxy statements is much different from versions that were produced prior to May, 2007. This affects the data from Execucomp used to calculate Delta and Vega. Additionally, in response to concerns that managers disseminate information to selected analysts, the SEC adopted Regulation FD in October of 2000. Thus, my sample period runs from 2000 to 2006 with the same version of proxy statement and same regulation environment. I delete firms in the financial industry. Table I outlines our sample selection procedures. My data source for analyst coverage comes from I/B/E/S. The data of internal corporate governance comes from IRRC database and firms' proxy statements. I extract institutional ownership information from the CDA/Spectrum Institutional 13(f) filings. Finally, other control variables come from the Compustate Database, while the stock price data and capitalization come from the CRSP. My basic observations comprise 5,408 firm-years.

However, I need to drop 155 firm-years because the data on cash flow volatility required in order to estimate the residual analyst coverage (See Section 4.3.1) are unavailable, reducing the sample size to 5,253 observations. Next, since there are 100 observations with TDC1 unavailable, the sample consists of 5,135 when TDC1 (total compensation) is a dependent variable. Finally, I consider five dimensions in creating the analyst coverage index (See Section 3.2.1). I then delete firm-years due to related variables being unavailable. My sample thus consists of 5,104 firm-years when I use analyst coverage index as an independent variable.

| Descriptions | Sample size |
|---|---|
| All Standard & Poor's Execucomp database annual CEO compensation between 2000 and 2006 (non-financial firms) | 9,622 |
| Less: removal of observations for which detailed data to estimate Delta and Vega are unavailable | (3,113) |
| Less: removal of observations for which data are unavailable in the IRRC database | (688) |
| Less: removal of observations without covering analysts | (413) |
| Less: removal of observations for which variables used to estimate residual coverage are unavailable | (155) |
| Total | 5,253 |

**Table I.**
Sample selection

*3.2 Variables definitions*

*3.2.1 Analysts activities*. This paper uses two variables, analyst coverage and analyst coverage index, to define the activities of analysts. I measure analyst coverage[5] by the average number of analysts who made forecasts of a firm's earnings in any given year.

Alternatively, in order to control for the analyst's self-interest bias as described by Doukas *et al.* (2008), I construct a composite index of analyst coverage activities. Following Knyazeva (2007), in addition to the number of analysts covering the firm, I add four other dimensions to the analyst coverage index. First, forecast error is measured by the average absolute value of forecast error scaled by the stock price at the prior fiscal-year-end[6]. Second, I use a measure called analyst agreement, defined as the ratio of the highest number of increasing (decreasing) forecasts in one-year-ahead earnings forecasts to the total number of analysts covering the firm, to evaluate the uncertainty in analyst forecast information. Third, to reflect the quality of coverage information, I use the total number of stocks covered by a median analyst following the firm as a component of the analyst coverage index. Fourth, I use the median number of other firms in the same industry covered by the firm's analysts as an index component. Finally, I aggregate an analyst coverage index by equally weighting firm rank along the above five dimensions. This index is positively associated with the quality of analyst coverage.

*3.2.2 CEO compensation structure.* 3.2.2.1 The sensitivities of CEO compensation. Following Empirical studies (Black *et al.*, 2014; Bulan *et al.*, 2010; Core and Guay, 1999; Nourayi and Daroca, 2008; Nourayi and Mintz, 2008), I use the two measures, Delta and Vega, to measure the sensitivities of CEO compensation. Delta[7] is measured as the change in the value of CEO's equity and option holdings in response to a 1 percent change in the firm's stock price. Vega is measured as the change in the value of CEO's option holdings in response to a 1 percent change in the firm's stock return volatility. I provide the detail of these estimations in the Appendix.

3.2.2.2 Level of Compensation. Total compensation is measured as the sum of salary, bonus, current stock and stock option grants, and other annual compensation such as life insurance benefits and country club memberships[8]. In addition, Fahlenbrach (2009), Nourayi and Daroca (2008), and Graham *et al.* (2012) find that firms' characteristics are associated with the level of their executive compensation. Therefore, I construct two variables to proxy for excess compensation, excess total compensation measured by Graham *et al.* (2012) and industry-adjusted total compensation. Excess compensation is obtained by using the residual from a first stage regression of CEO compensation on other firm's characteristics (in addition to industry) and CEO-specific characteristics[9]. Next, I use the industry-adjusted total compensation, which removes the logarithm of median total CEO compensation for the same industry (two-digit SIC code) from the logarithm of a firm's total CEO compensation.

*3.2.3 Proxies for corporate governance mechanism*. Following Linck *et al.* (2008), I employ four proxy variables for internal governance mechanisms, including the proportion of outside directors, the tenure of directors defined as the average number of years of the directors at the firm as director, duality defined as the dual position of CEO and Chairman of the board, and E-index[10] (Bebchuk *et al.*, 2009) to proxy for the level of management entrenchment. The E-index is negatively associated with the level of management entrenchment. Next, Hartzell and Starks (2003) confirm that institutional holdings are associated with a higher fraction of a CEO's salary that is paid in equity, due to increased monitoring. Hence, following Hartzell and Starks (2003), I consider institutional investor influence, measured as the shares held by 13-f institutional investors divided by the total number of shares outstanding for a given firm.

*3.2.4 Other variables*. In addition to the variables associated with governance, several variables are assumed to capture the environment in which the firm operates and the scope of its managers' discretion. Following the literature (Bulan *et al.*, 2010; Coles *et al.*, 2008; Core and Guay, 1999; Fahlenbrach, 2009; Hartzell and Starks, 2003), I control for firm size measured by the log of market value, growth measured by growth rate of assets, return of volatility measured by the standard deviation of daily stock return over the last year, capital ratio measured by net PP&E divided by sales, high-tech industries defined as 3-digit SIC codes[11], and firm age defined as the number years since IPO date[12]. Finally, I include CEO age in my regression framework because they need additional equity incentives to align their interests with those of other shareholders when the CEOs are near retirement and their quality of management has established (Gibbons and Murphy, 1992).

## 4. Empirical results

### *4.1 Summary statistics*

Descriptive statistics on the principal variables are given in Table II. Panel A shows the summary statistics of the compensation variables for the entire sample and across years. Cash compensation increases from 2003 to 2005. The increasing pattern of total compensation is similar to that of cash compensation. Total compensation in 2006 is highest, but the cash compensation is lowest, implying that there is an unexplained increase in incentive compensation (stock and stock options) in 2006. On average, for Delta, a 1 percent increase in the firm's stock price results in a median increase in CEO wealth of $103,948, while the mean increase is $277,093. This distribution is heavily skewed since the mean is significantly higher than the median. For Vega, a 1 percent increase in the volatility of a firm's stock return corresponds to a median (mean) increase in CEO wealth of $160,406 ($370,840).

Panel B presents summary statistics on the proxies for analysts' activities and on the firm characteristics. This Panel contains cross-sectional means, medians, $Q_1$'s, and $Q_3$'s of firm time-series average. A firm in my sample (in IBES database) has, on average, 10.98 analysts, 76.28 percent of which agree with the direction of the next year earnings. Firm size, which is the logarithm of the mean market value of equity is 7.6785, is 204.86 million. The institutional shareholders hold 75.32 percent on average. Approximately 31 percent of my sample firms used in this study is high-tech firms.

*Panel A: compensation summary statistics (in thousand)*

| | | Delta | | Vega | | Cash compensation | | Total compensation | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Observations | Mean | Median | Mean | Median | Mean | Median | Mean | Median |
| 2000 | 553 | 289.8791 | 68.2929 | 503.9223 | 147.9170 | 1,357.2329 | 1,062.8120 | 4,500.8628 | 1,798.7090 |
| 2001 | 758 | 225.6654 | 88.4619 | 412.1546 | 174.9067 | 1,286.9829 | 974.5780 | 4,188.7942 | 1,764.7050 |
| 2002 | 803 | 150.4574 | 59.1875 | 319.2517 | 141.7150 | 1,338.9291 | 1,080.4000 | 3,526.9950 | 1,737.5360 |
| 2003 | 851 | 261.7553 | 111.9338 | 365.0293 | 169.4105 | 1,478.6999 | 1,123.0000 | 4,622.0659 | 2,081.9990 |
| 2004 | 832 | 329.1684 | 149.6622 | 364.5617 | 177.5733 | 1,730.2074 | 1,362.5000 | 6,445.3107 | 2,784.5145 |
| 2005 | 835 | 344.5770 | 150.1137 | 326.8396 | 155.5963 | 1,830.4306 | 1,438.2290 | 6,698.7847 | 3,276.0230 |
| 2006 | 776 | 349.3145 | 153.8937 | 321.2888 | 151.4675 | 1,275.6325 | 918.6770 | 10,923.9368 | 4,017.3610 |
| Average | 5,408 | 277.0934 | 103.9484 | 370.8395 | 160.4055 | 1,482.9000 | 696.1000 | 5,590.2000 | 2,329.8000 |

*Panel B: descriptive statistics of major variables*

| Variables | Number of observations | Mean | $Q_1$ | Median | $Q_3$ | Minimum | Maximum | SD |
|---|---|---|---|---|---|---|---|---|
| Analyst activities | | | | | | | | |
| Coverage | 5,253 | 10.9810 | 5.5455 | 9.2000 | 14.9091 | 1.0000 | 43.9167 | 7.0030 |
| Residual coverage | 5,253 | 0.0034 | −3.2480 | −0.4873 | 2.8088 | −10.9587 | 13.7091 | 4.9557 |
| Analyst coverage index | 5,104 | 22.6165 | 18.0000 | 23.0000 | 27.0000 | 2.0000 | 41.0000 | 6.3975 |
| Residual coverage index | 5,104 | −0.0001 | −3.6741 | 0.1755 | 3.7905 | −15.3968 | 20.0227 | 5.4481 |
| Analyst agreement | 5,104 | 0.7628 | 0.6129 | 0.80000 | 1.0000 | 1.0000 | 0.3913 | 0.1921 |
| Compensation | | | | | | | | |
| Delta (in million) | 5,253 | 0.2592 | 0.0029 | 0.0094 | 0.2531 | 0.0000 | 1.6939 | 0.5732 |
| Vega (in million) | 5,253 | 0.3768 | 0.0064 | 0.1620 | 0.3874 | 0.0000 | 2.8993 | 0.8514 |
| Cash compensation (in million) | 5,153 | 1.4917 | 0.7000 | 1.1167 | 1.8841 | 0.0000 | 43.5115 | 1.5240 |
| Total compensation (in million) | 5,153 | 6.2095 | 1.6440 | 3.2629 | 6.4297 | 0.0000 | 243.5581 | 12.8591 |
| Industry-adjusted compensation (in million) | 5,146 | 2.4552 | −0.9503 | 0.5662 | 3.4759 | −4.9642 | 56.5967 | 6.0066 |
| Excess compensation (in thousand) | 5,126 | −0.0079 | −0.4314 | 0.0494 | 0.4755 | −12.1620 | 2.9117 | 0.9084 |
| Characteristics of Board and CEO | | | | | | | | |
| Duality | 5,253 | 0.6630 | 0.0000 | 1.0000 | 1.0000 | 0.0000 | 1.0000 | 0.4727 |
| % independent directors | 5,253 | 0.6893 | 0.5833 | 0.7143 | 0.8182 | 0.1000 | 0.9412 | 0.1577 |
| Directors' tenure | 5,253 | 8.4360 | 5.8333 | 7.9000 | 10.3636 | 1.0000 | 20.2000 | 3.6559 |

*(continued)*

**Table II.**
Summary statistics

Table II.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CEO age | 5,253 | 55.2020 | 50.0000 | 55.0000 | 60.0000 | 33.0000 | 92.0000 | 7.2549 |
| Other variables | | | | | | | | |
| Institutional holdings | 5,253 | 0.7532 | 0.6596 | 0.7836 | 0.8696 | 0.0024 | 0.9800 | 0.1612 |
| Size | 5,253 | 7.6785 | 6.6865 | 7.5557 | 8.5456 | 4.8213 | 12.2969 | 1.2422 |
| Growth rate of assets | 5,253 | 0.1302 | −0.0021 | 0.0756 | 0.1754 | −0.6787 | 3.9921 | 0.3082 |
| Stock return volatility | 5,253 | 0.0259 | 0.0172 | 0.0229 | 0.0310 | 0.0068 | 0.1131 | 0.0129 |
| Capital ratio | 5,253 | 0.4421 | 0.1311 | 0.2299 | 0.4621 | 0.0050 | 5.1369 | 0.5709 |
| High-tech firm | 5,253 | 0.3103 | 0.0000 | 0.0000 | 1.0000 | 0.0000 | 1.0000 | 0.4627 |
| Firm age | 5,253 | 25.9521 | 10.0000 | 19.0000 | 35.0000 | 3.00000[a] | 81.00000 | 20.4952 |
| E-index | 5,253 | 2.6067 | 1.0000 | 2.0000 | 3.0000 | 0.0000 | 5.0000 | 1.5023 |

**Notes:** [a]Since Compustate sometimes provides the two years previous to an IPO, there are 45 observations with the firm age equal to 3. The data of cash flow over the previous five years is also available for these firms. This table reports the sample statistics for the principal variables. Panel A shows the means and medians for all variables year by year. Panel B contains cross-sectional means, medians $Q_1$'s, $Q_3$'s, minimum, maximum, and standard deviations for all observations over the period 2000-2006. All variables are defined in Section 3.2 and the Appendix

*4.2 Univariate tests associated with CEO compensation*

I perform univariate analyses to search for an association between analyst activities and CEO compensation. The results are reported in Table III. Panel A of Table III reports that the mean (median) values of CEO compensation variables are conditional on the level of analyst coverage. The high- (low-) coverage subsample consists of firms in the highest (lowest) tercile of the residual coverage. As reported in Column (3), the differences between high-coverage firms and low-coverage firms

**Table III.** Univariate comparisons of analyst activities and CEO compensation

*Panel A: residual coverage*

| | High coverage (1) | | Low coverage (2) | | Difference (3) (1)-(2) | |
|---|---|---|---|---|---|---|
| Variables | Median | Mean | Median | Mean | Wilcoxon *Z* | *t*-statistic |
| Delta (in million) | 0.1675 (1,751) | 0.4054 (1,751) | 0.0875 (1,751) | 0.2022 (1,751) | 8.61*** | 8.21*** |
| Vega (in million) | 0.2700 (1,751) | 0.5933 (1,751) | 0.1450 (1,751) | 0.2780 (1,751) | 9.43*** | 8.86*** |
| Total compensation (in million) | 4.1435 (1,717) | 6.3246 (1,717) | 3.0955 (1,718) | 4.4807 (1,718) | 7.10*** | 9.17*** |
| Excess total compensation (in thousand) | 0.1442 (1,708) | 0.1107 (1,708) | 0.0666 (1,709) | 0.0501 (1,709) | 2.88*** | 2.26** |
| Industry-adjusted compensation (in million) | 1.3659 (1,715) | 3.5075 (1,715) | 0.4046 (1,716) | 1.6511 (1,716) | 6.16*** | 9.49*** |

*Panel B: residual analyst coverage index*

| | High analyst rank (1) | | Low analyst rank (2) | | Difference (3) (1)-(2) | |
|---|---|---|---|---|---|---|
| Variables | Median | Mean | Median | Mean | Wilcoxon *Z* | *t*-statistic |
| Delta (in million) | 0.1547 (1,671) | 0.3324 (1,671) | 0.0648 (1,672) | 0.1866 (1,672) | 10.06*** | 6.83*** |
| Vega (in million) | 0.2194 (1,671) | 0.4533 (1,671) | 0.1302 (1,672) | 0.2746 (1,672) | 8.04*** | 6.45*** |
| Total compensation (in million) | 3.9201 (1,656) | 5.6920 (1,656) | 2.8789 (1,657) | 4.4750 (1,657) | 6.51*** | 6.24*** |
| Excess total compensation (in thousand) | 0.1423 (1,648) | 0.0948 (1,648) | 0.0458 (1,649) | 0.0208 (1,649) | 3.65*** | 2.76** |
| Industry-adjusted compensation (in million) | 1.0880 (1,654) | 2.8819 (1,654) | 0.2780 (1,655) | 1.6474 (1,655) | 5.92*** | 6.49*** |

**Notes:** In Panel A, residual coverage is the residuals from a regression of number of covering analysts on firm size, past performance, growth, external financing activities, and cash flow volatilities (see Table IV). The high- (low-) coverage subsample consists of firms in the highest (lowest) tercile of residual coverage. In Panel B, residual coverage index is the residuals from a regression of analyst coverage index (see Section 3.2.1) on firm size, past performance, growth, external financing activities, and cash flow volatilities (see Table IV). The high- (low-) coverage subsample consists of firms in the highest (lowest) tercile of residual coverage index. Delta is measured as the change in the value of CEO's equity and option holdings in response to a 1 percent change in the firm's stock price. Vega is measured as the change in the value of CEO's option holdings in response to a 1 percent change in the firm's stock return volatility. Total compensation is measured as the summation of salary, bonus, current stock and stock option grants, and other annual compensation such as life insurance benefits and country club memberships (Execucomp item TDC1). The excess compensation is obtained by using the residual from a first stage regression of CEO compensation on other firm (in addition to industry) and CEO-specific characteristics. The industry-adjusted total compensation is total compensation subtracted from the median total CEO compensation for the same industry. Sample size is reported in parentheses. *,**,***Statistically significant at the 10, 5, and 1 percent levels, respectively are always significantly positive for all compensation variables, for both *z*-statistics and *t*-statistics. Panel B of Table III reports the mean (median) values of CEO compensation variables conditional on the level of residual analyst coverage index. The results are consistent with those in Panel A. In sum, all univariate tests results suggest that analyst activities, as measured by analyst coverage and analyst coverage index, are associated with CEO compensation structure in the manner I hypothesize[13].

### *4.3 Analysts coverage and compensation*

*4.3.1 Empirical model.* One important concern for the OLS test exploring the relationship between analyst coverage and CEO compensation structure is controlling for firm characteristics that may be related to analyst coverage. This will lead to a spurious relationship between analyst behaviors and compensation structure. Therefore, following Yu (2008), I use the residual values of analyst coverage (i.e. residual coverage) to mitigate this concern. Analyst coverage (the number of analysts who made forecasts about firm's earnings in any given year) is related to firms' characteristics including firm size (the log of market value), growth (growth rate of assets), volatility of cash flows (the standard deviations of cash flow of a firm over the previous five years), past performance (lagged return on assets), and external financing activities (the net amount of cash flows received from debt financing and equity financing, deflated by total asset). I first run the following regression:

$$\begin{aligned} Analyst\ Coverage = {} & Size + Growth + Volatility\ of\ Cash\ Flows \\ & + Past\ Performance + External\ Financing\ Activity \\ & + Year\ Dummies \end{aligned} \quad (1)$$

I calculate the residuals from the above regression, called residual coverage, and use it as the proxy for analyst coverage. Table IV shows the results generated from this regression. The coefficients of all independent variables are consistent with predictions.

I then estimate the effect of residual analyst coverage on CEO compensation structure with the following OLS regression. The substantial skewness of the dependent variables (such as total compensation and industry-adjusted total compensation) is accounted for by taking logarithms of those variables. I use a two-way fixed-effect regression model with both year and industry dummy variables. This yields the following regression model:

$$COM_{it} = \alpha_t + \omega_j + \beta(RC)_{it} + \gamma X_{it}^T + \varepsilon_{it} \quad (2)$$

where $t$ indexes years, $j$ indexes industries, $i$ indexes firms, $COM_{it}$ is the observed compensation variables including in Delta, Vega, the logarithm of total compensation, excess total compensation or industry-adjusted total compensation, $RC_{it}$ is a vector of the residual from regression Equation (1), $X_{it}$ is a vector of firm-specific control variables related to the CEO compensation, $\alpha_t$ is the year-fixed effect, $\omega_j$ is the industry-fixed effect, and $\varepsilon_{it}$ is the error term.

*4.3.2 The relationships among analyst coverage, Delta and Vega.* Table V shows the results of an ordinary least squares estimation of the logarithm of Delta and Vega

| Dependent variable: number of covering analysts | Predicted sign | |
|---|---|---|
| Intercept | | −5.7297 (0.2620)*** |
| Size | + | 6.9044 (0.2679)*** |
| Growth rate of assets | + | 1.0816 (0.4149)*** |
| Cash flow volatility | − | −0.0022 (0.0002)*** |
| Lagged return on assets | + | 2.0802 (1.1367)* |
| External financing activities | − | −3.1301 (1.1990)*** |
| Year-fixed effects | | Yes |
| Industry-fixed effects | | Yes |
| Adjusted $R^2$ | | 0.4861 |
| Observations | | 5,253 |

**Notes:** This table reports the results of the ordinary least squares regression that generates residual analyst coverage. The main sample includes all S&P 1500 firm-years with data on CEO compensation available from Standard & Poor's Execucomp database or the proxy statements of these firms from 2000 to 2006. Firm size is measured by the log of market value; growth is measured by growth rate of assets; cash flow volatilities is measured by standard deviations of cash flow of a firm over the previous five years, deflated by lagged assets; past performance is measured by lagged return on assets; external financing activities is measured by the net amount of cash flows received from debt financing and equity financing, deflated by total asset. Standard errors, reported in parentheses, are adjusted for firm-level clustering. *,**,***Statistically significant at the 10, 5, and 1 percent levels, respectively

**Table IV.** Regression that generates residual coverage

(Columns (1)-(2)) on the residual coverage, governance variables, and the firm-specific control variables. I find that the residual coverage is positive and significantly related to Delta and Vega with an economically large effect. More precisely, the coefficients of coverage on regressions of Delta and Vega are 0.0495 and 0.0486, respectively. Thus, a one standard deviation increase in the residual coverage results in a 24.53 percent higher Delta which corresponds to a dollar amount of $63,166, and a 24.08 percent higher Vega[14] which corresponds to a dollar amount of $89,936. These results support the prediction of *H1a*. This evidence is consistent with the complementarity hypothesis, under which greater analyst coverage allows CEOs to increase their pay-for-performance sensitivity (Delta) and their compensation incentives to increase firm's risk (Vega).

Except for duality, the signs of the coefficients of other proxies for corporate governance are consistent with the predictions of the hypothesis. Stronger governance, such as higher percentage of outside directors in the board, shorter directors' tenure, and greater institutional holding, is associated with higher Delta and Vega. Additionally, the coefficients of E-index are negative, consistent with the contention that risk-averse CEOs seek a reduction in their pay-for-performance sensitivity rather than the compensation resulting from equity ownership in their companies (Bebchuk and Fried, 2004). Findings related to institutional ownership are also consistent with Hartzell and Starks (2003). Among the different corporate governance mechanisms, the effect of analysts' coverage on Delta and Vega has the greatest explanatory power, other things being equal[15].

Consistent with the findings of previous studies (Core and Guay, 1999), I find that CEOs of large companies have a substantially higher dollar exposure to the stock price of their companies than do CEOs of smaller firms. Companies with higher growth rates, and higher capital expenditures ratios also seem to create substantially more equity incentives for their CEOs. The positive coefficients of the dummy of

| Variables | Pay-for-performance sensitivity Delta (1) | Vega (2) | Total comp. (3) | Total compensation Excess total comp. (4) | Industry-adjusted total Comp. (5) |
|---|---|---|---|---|---|
| Intercept | −6.4984 (0.7309)*** | −6.3741 (0.7492)*** | −2.1686 (0.4836)*** | −2.2449 (0.4682)*** | −1.2566 (0.7179)* |
| Residual coverage | 0.0495 (0.0041)*** | 0.0486 (0.0041)*** | 0.0212 (0.0029)*** | 0.0050 (0.0028)* | 0.0309 (0.0039)*** |
| Duality | 0.2138 (0.0439)*** | 0.1495 (0.0450)*** | 0.1305 (0.0310)*** | 0.0281 (0.0305) | 0.1371 (0.0415)*** |
| % independent directors | 0.3370 (0.1509)** | 0.7603 (0.1532)*** | 0.1826 (0.0889)** | 0.1578 (0.0859)* | 0.0299 (0.1288) |
| Directors' tenure | −0.0815 (0.0437)* | −0.0777 (0.0439)* | −0.2049 (0.0282)*** | −0.1387 (0.0275)*** | −0.0609 (0.0415) |
| CEO age | −0.3762 (0.1682)** | −0.5209 (0.1713)** | 0.0642 (0.1112) | 0.1600 (0.1083) | −0.1774 (0.1470) |
| E-index | −0.0793 (0.0472)* | −0.0672 (0.0498) | 0.0425 (0.0250)* | 0.0472 (0.0242)* | 0.3783 (0.2265)* |
| Institutional ownership | 1.1076 (0.1437)*** | 0.9890 (0.1450)*** | 0.6227 (0.0896)*** | 0.6593 (0.0879)*** | 0.3120 (0.1311)** |
| Size | 1.1221 (0.0377)*** | 1.1669 (0.0392)*** | 0.9889 (0.0299)*** | 0.0883 (0.0298)** | 0.9520 (0.0338)*** |
| Growth | 0.6209 (0.0648)*** | 0.3283 (0.0617)*** | 0.1763 (0.0504)*** | 0.2151 (0.0507)*** | 0.2651 (0.0544)*** |
| Volatilities | −30.4304 (2.3734)*** | −16.1130 (2.5949)*** | 0.8094 (1.6858) | 0.5145 (1.6454) | 9.3128 (2.1508)*** |
| Capital ratio | 0.0445 (0.0462) | 0.0935 (0.0461)** | 0.1134 (0.0266)*** | 0.0583 (0.0264)** | 0.0524 (0.0445) |
| Dummy of high tech | 0.4839 (0.0755)*** | 0.3675 (0.0788)*** | 0.1266 (0.0458)** | 0.0040 (0.0422) | 0.2686 (0.0681)*** |
| Firm age | −0.0506 (0.0304)* | −0.1097 (0.0298)* | 0.0667 (0.0170)*** | 0.0443 (0.0165)*** | 0.0682 (0.0279)*** |
| Year-fixed effects | Yes | Yes | Yes | Yes | Yes |
| Industry-fixed effects | Yes | Yes | Yes | Yes | Yes |
| Adjusted $R^2$ | 0.3808 | 0.3319 | 0.3424 | 0.0823 | 0.2034 |
| Observations | 5,253 | 5,253 | 5,153 | 5,126 | 5,146 |

**Notes:** This table shows the results of ordinary least squares regressions examining the effect of analysts' coverage on compensation variables. The sample consists of S&P 1,500 firms over the period 2000-2006. The dependent variables in columns (1) and (2) are the logarithm of Delta and Vega, respectively. The details of the estimations of Delta and Vega are described in the Appendix. The dependent variables in column (3)-(5) are the logarithm of total compensation (Execucomp item TDC1), the excess total compensation which is obtained by using the residual from a first stage regression of CEO compensation on other firm (in addition to industry) and CEO-specific characteristics, and the industry-adjusted total compensation in which is the logarithm of median total compensation for the same industry is removed from the logarithm of total compensation. Residual coverage is the residuals from a regression of number of covering analysts on firm size, past performance, growth, external financing activities, and cash flow volatilities (see Table IV). The proxy variables for internal corporate governance (such as duality, percentage of outside directors in the board, and directors' tenure), and institutional holdings are discussed in Subsection 3.2.3. The definitions of other control variables are discussed in Subsection 3.2.4. Standard errors, reported in parentheses, are adjusted for firm-level clustering. *,**,***Statistically significant at the 10, 5, and 1 percent levels, respectively

**Table V.** Residual coverage and CEO compensation

high-tech firm means that CEOs of firms in high-tech industries are willing to take higher risk related to growth opportunities because of the better incentive alignment through their larger equity portfolios. The negative coefficients of firm age in both the Delta and Vega regressions show that younger firms create more dollar equity incentives for their CEOs.

In theory, CEO age is positively associated with pay-for-performance sensitivities. However, empirical results are inconsistent with this prediction. Guay (1999) argues that it is difficult to predict the sign of correlation coefficient on CEO compensation and CEO age. Therefore, the negative correlation coefficient on CEO age in Column (1) and (2) of Table V can be accepted.

In sum, this evidence, regardless of external and internal governance mechanisms, is consistent with my hypothesis. It shows that governance mechanisms are complementary to CEO's incentive compensation in reducing agency problems. Even after controlling for the effect of other type of corporate governance mechanism, analyst coverage still retains significant incremental explanatory power. In addition to monitoring functions, analysts play a marketing role which can improve investor cognizance through reducing information asymmetries and improving the quality of financial information. Institutional investors and board of directors do not have such a function. Therefore, the incremental effects of analyst coverage on CEO pay-for-performance sensitivity and his or her compensation incentive to increase firm's risk may correlate to the marketing function provided by analysts.

*4.3.3 The level of compensation.* In this section, I examine the relation between analyst coverage and CEO compensation levels. Columns (3)-(5) in Table V show the results[16]. All other things being equal, the coefficients of coverage on regressions of total compensation, excess compensation and industry-adjusted total compensation are 0.0212, 0.0050, and 0.0309, respectively, meaning that a one standard deviation increase in the number of analysts covering a given firm means a 10.51 percent higher total compensation, a 2.48 percent higher excess compensation, and a 15.31 percent higher industry-adjusted total compensation. Therefore, these results are economically meaningful and consistent with the prediction of *H1b* that analyst coverage is positively associated with the level of total compensation.

If analysts cover firms whose CEOs' objective is to maximize their firms' value, CEOs are monitored as they approve risky projects that may maximize their firms' value. These firms provide stock options to CEOs to align incentives of CEOs and stockholders, and then institute CEO compensation plans with greater pay-for-performance sensitivity. Thus, these CEOs would require a higher level of compensation due to their bearing more firm-specific risk through pay-for-performance sensitivities and higher possibility of job loss through accepting risky projects. The results in Table V show that analysts serve in this monitoring capacity.

The coefficients of institutional ownership concentration and other variables associated with internal governance from Columns (3)-(5) in Table V are consistent with those in Columns (1)-(2). According to control variables, companies with larger size, higher growth rate, higher capital expenditures ratios, and longer age appear to create substantially more total compensation for their CEOs. The CEOs of firms in high-tech industries have more total compensation than those of firms in other industries. The coefficients of E-index are significantly positive from Columns (3)-(5), consistent with entrenchment hypothesis that risk-averse CEOs pursue an increase in their level of compensation rather than have compensation determined by risky stock options (Bebchuk and Fried, 2004).

Recall from Columns (1)-(2) in Table V that the coefficients of residual coverage are positive, while the coefficients of residual coverage from Columns (3) and (5) in Table V are also positive. In sum, after controlling for the influence on other governance mechanisms, analyst coverage remains positively related to CEO pay-for-performance sensitivity, CEO compensation incentives to increase firm risk, and level of compensation, consistent with my hypothesis. Since the reputation and career of an analyst is heavily dependent on forecast accuracy, analysts must track firms for long periods and carefully make good coverage decisions. An increase in reputation and influence of analysts can create many tangible and intangible benefits for brokerage houses. Therefore, analysts may affect CEO's activities and CEO's compensation through their effect of their coverage on firm's value. This view point is the major contribution of this paper.

*4.4 Analyst coverage index and compensation*

In this paper, I construct a composite index of analyst coverage to consider multiple dimensions affecting analyst following activities. The analyst coverage index is positively related to coverage quality. Following the treatment of analyst coverage, I use the residual values of analyst coverage index (i.e. residual coverage index) to mitigate the effect of firm's characteristics on analyst coverage index, while those also correlate to the determinants of CEO compensation structure.

The effects of residual analyst coverage index on compensation structure report in Table VI. Consistent with *H2a*, the first two columns reveal that the coefficients of residual analyst coverage index are positive and significantly different from zero.

**Table VI.** Analyst coverage index and CEO compensation

| | Pay-for-performance sensitivity | | Total compensation | | |
|---|---|---|---|---|---|
| Variables | Delta (1) | Vega (2) | Total comp. (3) | Excess total comp. (4) | Industry-adjusted total comp. (5) |
| Intercept | −6.9106 (0.7617)*** | −6.5840 (0.7855)*** | −2.2953 (0.5023)*** | −2.1706 (0.4871)*** | −1.7731 (0.7512)** |
| Residual analyst coverage index | 0.0447 (0.0036)*** | 0.0317 (0.0037)*** | 0.0195 (0.0023)*** | 0.0064 (0.0022)*** | 0.0193 (0.0034)*** |
| Duality | 0.2152 (0.0455)*** | 0.1558 (0.0469)*** | 0.1262 (0.0320)*** | −0.0348 (0.0315) | 0.1367 (0.0428)*** |
| % independent directors | 0.3183 (0.1556)** | 0.7059 (0.1596)*** | 0.1679 (0.0922)* | 0.1491 (0.0884)* | 0.0421 (0.1322) |
| Directors' tenure | −0.1065 (0.0468)** | −0.1219 (0.0478)** | −0.2117 (0.0291)*** | −0.1405 (0.0284)*** | −0.0791 (0.0431)* |
| CEO age | −0.3438 (0.1738)** | −0.5186 (0.1783)*** | 0.0861 (0.1152) | 0.1563 (0.1125) | 0.1461 (0.1531) |
| E-index | −0.1185 (0.0506)** | −0.0868 (0.0496)* | 0.0172 (0.0260) | 0.0432 (0.0251)* | 0.3983 (0.2357)* |
| Total institutional ownership | 1.1469 (0.1505)*** | 1.0442 (0.1531)*** | 0.6030 (0.0928)*** | 0.6395 (0.0909)*** | 0.2559 (0.1368)*** |
| Size | 1.1438 (0.0392)*** | 1.1855 (0.0411)*** | 0.9931 (0.0310)*** | 0.0857 (0.0308)*** | 0.9840 (0.0349)*** |
| Growth | 0.6204 (0.0661)*** | 0.3376 (0.0653)*** | 0.1846 (0.0527)*** | 0.2223 (0.0532)*** | 0.2632 (0.0582)*** |
| Volatilities | −27.5106 (2.4675)*** | −13.9352 (2.7198)*** | −0.0657 (1.7598) | −0.6700 (1.7087) | 11.1973 (2.2489)*** |
| Capital ratio | 0.1313 (0.0451)*** | 0.2002 (0.0450)*** | 0.1461 (0.0258)*** | 0.0534 (0.0255)** | 0.1098 (0.0443)** |
| Dummy of high tech | 0.4926 (0.0781)*** | 0.4250 (0.0814)*** | 0.1262 (0.0471)*** | 0.0096 (0.0429) | 0.2828 (0.0714)*** |
| Firm age | −0.0178 (0.0311) | −0.1120 (0.0306)*** | 0.0760 (0.0172)*** | 0.0502 (0.0168)*** | 0.0765 (0.0283)*** |
| Year-fixed effects | Yes | Yes | Yes | Yes | Yes |
| Industry-fixed effects | Yes | Yes | Yes | Yes | Yes |
| Adjusted $R^2$ | 0.3796 | 0.3211 | 0.3604 | 0.0814 | 0.2094 |
| Observations | 5,014 | 5,014 | 4,970 | 4,946 | 4,963 |

**Notes:** This table shows the results of ordinary least squares regressions examining the effect of analyst coverage index on compensation variables. The sample consists observations over the period 2000-2006. Except for residual analyst coverage index, the dependent variables and control variables are the same as those in Table V. Residual coverage index is the residuals from a regression of analyst coverage index (see Section 3.2.1) on firm size, past performance, growth, external financing activities, and cash flow volatilities (see Table IV). Standard errors, reported in parentheses, are adjusted for firm-level clustering. *,**,***Statistically significant at the 10, 5, and 1 percent levels, respectively

More precisely, the coefficients of residual coverage index on regressions of Delta and Vega are 0.0447 and 0.0317, respectively. Thus, a one standard deviation increase in the residual coverage index (5.4481) results in a 24.35 percent higher Delta, and a 17.27 percent higher Vega. The associations between analyst coverage index and Delta and Vega are, in general, both statistically significant and economically meaningful. Further, as expected, consistent with *H2b*, the next three columns reveal that the coefficients of residual analyst coverage index are positive and significantly different from zero. The coefficients of coverage index on regressions of total compensation, excess compensation and industry-adjusted total compensation are 0.0195, 0.0064, and 0.0193, respectively, meaning that a one standard deviation increase in the residual coverage index (5.4481) is associated with a 10.62 percent increase in total compensation, a 3.49 percent increase in excess compensation, and a 10.51 percent increase in industry-adjusted total compensation. These findings also are consistent with the results reported in Table V related to the effects of the number of analysts covering firms on CEO compensation structure. Taken as a whole, my empirical results suggest that analyst coverage index has an economically significant and influence on CEO compensation structure, consistent with my hypothesis.

### *4.5 The effect of Regulation FD*

The purpose of Reg FD, which became effective on October 23, 2000, is to reduce information asymmetries between individual and institutional market participants. Based on previous studies[17], the objectivity of analyst forecasts is improved by Reg FD. Thus, I propose that analyst coverage has greater explanatory power for CEO compensation post-FD than pre-FD.

In order to explore the effect of Reg FD, I expand my main sample including all S&P 1500 firm-years with data on CEO compensation available from Standard & Poor's Execucomp database between 1996 and 1999. To be included in our sample, an observation has to satisfy the criteria presented in Section 3.1. The full sample comprises 7,933 observations. The first restricted sample (post-FD) contains 5,014 observations, and the second one (pre-FD) contains 2,919 observations[18]. In this paper, two variables measure the analyst coverage, the number of analysts covering a firm, and the analyst coverage index. Because these two measures produce the same results, I present only the findings associated with the summary measure, analyst coverage index. I also use the Equation (1) to calculate the residual analyst coverage index, and then use the following equations to test the effect of Reg FD:

$$COM_{it} = \alpha_t + \omega_j + \beta_1(RC)_{it} + \beta_2(RC)_{it} \times POST + \gamma X_{it}^T + \varepsilon_{it} \quad (3)$$

$RC_{it}$ is a vector of the residual analyst coverage index. POST is an indicator variable that equals 1 if the observation falls between 2000 and 2006 (post-FD), and 0 if the observation falls between 1996 and 1999 (pre-FD); all other variables are as defined earlier. The coefficient $\beta_1$ on *RC* represents the effect of residual analyst coverage index on CEO compensation in the pre-FD period. The coefficient $\beta_1+\beta_2$ represents the effect of residual analyst coverage index on CEO compensation in the post-FD period.

Results are presented in Table VII[19]. For all regressions, the coefficients of $\beta_1$'s (analyst coverage index) are significantly positive (0.0209, 0.0175, 0.0099, 0.0074, and 0.0730), consistent with *H2a* and *H2b*. If SEC intervention via Reg FD has improved the objectivity of analysts' forecast behaviors, then the analyst coverage index should have a greater effect on CEO compensation. Consistent with my hypotheses, the coefficients

| Variables | Pay-for-performance sensitivity Delta (1) | Vega (2) | Total comp. (3) | Total compensation Excess total comp. (4) | Industry-adjusted total comp. (5) |
|---|---|---|---|---|---|
| Intercept | −12.5473 (0.5412)*** | −11.2096 (0.5677)*** | 4.0409 (0.3156)*** | −1.0032 (0.3052)*** | −64.2561 (2.0888)*** |
| Residual analyst coverage index | 0.0209 (0.0067)*** | 0.0175 (0.0070)** | 0.0099 (0.0050)** | 0.0074 (0.0035)** | 0.0730 (0.0271)*** |
| Residual analyst coverage index× POST | 0.0357 (0.0076)*** | 0.0279 (0.0080)*** | 0.0204 (0.0056)*** | 0.0070 (0.0038)* | 0.1253 (0.0326)*** |
| Duality | 0.2011 (0.0401)*** | 0.1615 (0.0417)*** | 0.1410 (0.0279)*** | 0.0029 (0.0245) | 1.1268 (0.1741)*** |
| % Independent directors | 0.5283 (0.1239)*** | 0.7500 (0.1279)*** | 0.1148 (0.0760) | 0.2094 (0.0076)*** | 1.2949 (0.5325) |
| Directors' tenure | −0.2418 (0.0435)*** | −0.3055 (0.0459)*** | −0.3028 (0.0303)*** | −0.1587 (0.0271)*** | −1.9245 (0.1832)*** |
| Total institutional ownership | 0.6600 (0.0993)*** | 0.7259 (0.1045)*** | 0.1922 (0.0649)*** | 0.3665 (0.0624)*** | 1.6027 (0.4270)*** |
| CEO age | −0.0069 (0.0029)** | −0.0093 (0.0030)*** | −0.0025 (0.0018) | −0.0026 (0.0017) | −0.0108 (0.0119) |
| Size | 0.6973 (0.0246)*** | 0.6447 (0.0257)*** | 0.4563 (0.0151)*** | 0.0034 (0.0013) | 2.9581 (0.0885)*** |
| Growth | 0.3797 (0.0714)*** | 0.1772 (0.0673)*** | 0.1437 (0.0391)*** | 0.3024 (0.0369)*** | 0.7974 (0.2540)*** |
| Volatilities | −26.0682 (2.1855)*** | −11.3318 (2.3725)*** | −2.8144 (1.6000)* | −1.8112 (1.4479) | −13.6098 (10.3983) |
| Capital ratio | −0.0182 (0.0369) | 0.0361 (0.0379) | 0.0458 (0.0239)* | 0.0562 (0.0266)** | 0.1485 (0.1887) |
| Dummy of high tech | 0.3495 (0.0700)*** | 0.2750 (0.0728)*** | 0.0253 (0.0391) | 0.0211 (0.0437) | 0.0496 (0.2781) |
| Firm age | −0.0031 (0.0011)*** | −0.0087 (0.0011)*** | 0.0083 (0.0006)*** | 0.0027 (0.0007)*** | 0.0441 (0.0048)*** |
| Year-fixed effects | Yes | Yes | Yes | Yes | Yes |
| Industry-fixed effects | Yes | Yes | Yes | Yes | Yes |
| Adjusted $R^2$ | 0.3883 | 0.3295 | 0.3335 | 0.0936 | 0.2870 |
| Observations | 7,933 | 7,933 | 7,881 | 7,543 | 7,870 |

**Notes:** This table shows the results of ordinary least squares regressions examining the effect of Regulation FD on the relationships between analyst coverage index and compensation variables. The sample consists of observations over the period 1996-1999 (pre-FD) and those over the period 2000-2006 (post-FD). The dependent variables and control variables are the same as those in Table VI. Residual coverage index is the residuals from a regression of analyst coverage index (see Section 3.2.1) on firm size, past performance, growth, external financing activities, and cash flow volatilities (see Table IV). POST is an indicator variable that equals 1 if the observation falls between 2000 and 2006 (post-FD), and 0 if the observation falls between 1996 and 1999 (pre-FD). Standard errors, reported in parentheses, are adjusted for firm-level clustering. *,**,***Statistically significant at the 10, 5, and 1 percent levels, respectively

**Table VII.** Analyst coverage index and CEO compensation: expanded sample

on Residual Analyst Coverage Index × POST in Columns (1)-(5) are significantly positive. The coefficients of $\beta_1 + \beta_2$ (residual coverage index on regressions) of Delta, Vega, and total compensation are 0.0566 (0.0209 + 0.0357), 0.0454 (0.0175 + 0.0279), and 0.0303 (0.0099 + 0.0204), respectively. This result suggests that the relation between analyst coverage and CEO compensation is significantly increased in the post-FD period.

### *4.6 Robustness checks*

I perform four sensitivity analyses to check the robustness of my findings. First, I check the undue influence of outliers. I truncate the independent variables (size, growth, capital ratio, and cash flow volatility) and dependent variable (varied with different regressions) at the 1 and 99 percent levels of their respective distributions, and rerun the tests from Tables IV to V. The results (not tabulated) are virtually the same as with the main sample. Second, recall that for the univariate analyses associated with the relationship between analyst coverage activities and CEO compensation structure in Table III, I use the sample excluding outliers. The results of the additional test, not tabulated, are consistent with those reported in Table III. Third, I repeat the tests using the number of analysts covering firms as a measure of analyst coverage. The empirical results (not tabulated) are the same as before. Finally, in order to control for industry effect, I also use the relative analyst coverage to repeat all tests. For this, I calculate the industry median values of number of covering analysts for each two-digit SIC code. I then subtract medians from each observation of the analyst coverage. The results of relative analyst coverage (not tabulated) are qualitatively unchanged.

## 5. Conclusion

There are three main results in this paper. First, I find that analyst coverage is positively related to CEO pay-for-performance sensitivity (Delta), the sensitivity of CEO option wealth to stock return volatility (Vega) and level of compensation. Second, I construct an analyst coverage index to proxy for analyst coverage quality and find results similar to those found for the number of covering analysts. Finally, I provide an additional test to support my conjecture that the relative increase in the effect of analyst coverage on CEO compensation is due to the passage of Reg FD. The evidence is again consistent with my hypotheses.

### Notes

1. See Section 3.2.2 and the Appendix.
2. See Chung and Jo (1996) and Jung *et al.* (2012).
3. The Section 3.2.1 provides details on definitions of variables for analyst coverage index.
4. If a firm's compensation data are not available on Execucomp, I extract it from its proxy statement.
5. I do not delete firm observations with less than three covering analysts, as firms covered by very few analysts may be those that have the poorest information environment and governance mechanisms.
6. This definition is similar to the unexpected earnings measure of Lang and Lundholm (1996). Forecast error is thus defined as:

$$Forecast\ Error_{it} = \frac{\sum_{j=1}^{n} |EPS_{it} - FEPS_{ijt}|/n}{P_{it-1}}$$

   where $FEPS_{ijt}$ is the mean I/B/E/S consensus forecast of earnings made over the month $j$ of a given fiscal year $t$ for firm $i$, $EPS_{it}$ is actual earnings for firm $i$ for fiscal year $t$, $P_{it}$ is the stock price per share at the end of fiscal year $t-1$ for firm $i$, and $n$ is the number of months that have analyst forecast data available from I/B/E/S.
7. Similar to Bulan *et al.* (2010), the Delta of this paper is the sum of equity Delta and option Delta. The definition of option Delta is the same as in Core and Guay (2002). I consider the effect of restricted stocks on Delta.
8. This is the definition of TDC1 in the Execucomp database.
9. I follow previous research in choosing the observable characteristics that determine the level of CEO pay (Core and Guay, 1999, 2002; Graham *et al.*, 2012; Murphy, 1999). I regress the logarithm of total compensation on firm-level variables such as firm size (natural log of total assets), market book ratio (market value of equity plus the book value of debt divided by total assets), stock returns (annual stock returns from CRSP), net income before extraordinary items and discontinued operations divided by total assets, and return volatility (standard deviation of daily log returns over the past five years), and on CEO-level variables such as CEO tenure, whether CEO is also Chairman of the Board, and CEO's gender. My main sample includes the full ExecuComp sample of firms. The main dependent variable is log (total compensation, TDC1).

10. Four mechanisms, staggered boards, limits to shareholder amendments of the bylaws, supermajority requirements for mergers, and supermajority requirements for charter amendments, limit the extent to which a majority of shareholders can force their opinions on management. Two other provisions are used to prevent takeover: poison pills and golden parachute arrangements. The data for the E-index is from the IRRC Database.
11. The dummy variable of high tech is equal to 1, if the 3-digit SIC code is 272, 283, 355, 357, 360-369, 381, 382, 481, 484, 489, 573, 737, or 873, and 0 otherwise.
12. Some control variables, such as board size, CEO tenure, CEO age and firm age, are accounted for by taking the logarithms of the variable.
13. See Section 4.3.1. Following Yu (2008), the residual coverage (residual coverage index) is the difference between actual analyst coverage (analyst coverage index) and expected analyst coverage (expected analyst coverage index), when I use Equation (1) to calculate expected analyst coverage (expected analyst coverage index).
14. The standard deviation of residual coverage is 4.9557. Therefore, an increase of one (sample) standard deviation in residual coverage (4.9557) increases the Delta by approximately $0.0495 \times 4.9557 = 24.53$ percent. Similarly, an increase of one (sample) standard deviation in residual coverage (4.9557) increases the Vega by approximately $0.0486 \times 4.9557 = 24.08$ percent.
15. A one standard deviation increase in the number of outside directors leads to a 5.32 percent higher Delta, and a 12 percent higher Vega. A one standard deviation decrease in the directors' tenure leads to a 3.86 percent higher Delta, and a 3.68 percent higher Vega. An increase of one standard deviations in institutional holdings (almost 15 percent) leads to a 19.13 percent higher Delta, and a 17.08 percent higher Vega.
16. Note I require additional variables to calculate excess total compensation and medians total CEO compensation for the industries to calculate the industry-adjusted compensation in Columns (4) and (5), which is the primary cause of differences in sample size across these Columns() and Column (3).
17. See Janakiraman *et al.* (2007), Kross and Suk (2012) and Mohanram and Sunder (2006).
18. Before 2000, many firms' proxy statements do not provide sufficient information to calculate Delta and Vega.
19. Because there are many sample firms with data for the E-index unavailable from IRRC over the period 1996-1999, I drop the E-index from all regressions in Table VII.

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## Appendix

$$CEO\ \ Delta = Equity\ \ Delta + Option\ \ Delta$$

$$Equity\ \ Delta = N_{os}P \times 0.01$$

$N_{os}$ is the number of shares owned by CEO.

$$option\ \ Delta = \sum_{j=1}^{3}\left[\frac{\partial(option\ \ value_j)}{\partial(P)}\right] \times (P) \times 0.01$$

$P$ is the stock price at the end of the fiscal year.

$$option\ \ Velta = \sum_{j=1}^{3} \left[ \frac{\partial(option\ \ value_j)}{\partial\sigma} \right] \times 0.01$$

$j = 1$, new option grants; $j = 2$, exercisable option grants; $j = 3$, unexercisable option grants.

Stock option value is calculated based on the Black and Scholes (1973) formula for valuing European call options, as modified to account for dividend payouts by Merton (1973):

$$\frac{\partial(option\ \ value)}{\partial(P)} = e^{-dt} N(Z)$$

$$\frac{\partial(option\ \ value)}{\partial(price)} = e^{-dt} N'(Z) S T^{(1/2)}$$

where $Z = [ln(S/X) + T(r - d + (1/2)\sigma^2)]/\sigma T^{(1/2)}$, $N'$ is the normal density function, $N$ the cumulative probability function for the normal distribution, $S$ the price of the underlying stock, $X$ the exercise price of the option, $\sigma$ the standard deviation of daily returns for the previous year, $r$ the risk-free interest rate (treasury yield corresponding to time-to-maturity), $T$ the time-to-maturity of the option in years, and $d$ the expected dividend rate over the life of the option.

I follow Core and Guay's (1999) methodology to estimate option values. Option grants are decomposed into new option grants and option grants in previous years. For new grants, the exercise price and time-to-maturity are taken from the proxy statement or Execucomp. For option grants in previous years, I perform the following process:

(1) I use data on previously granted options including number of exercisable and unexercisable options outstanding and current realizable value of exercisable and unexercisable options. The number and realizable value of the unexercisable options is reduced by the number and realizable value of the current year's grant.

(2) Current realizable value is used to estimate average exercise price of exercisable and unexercisable options. The average exercise price is estimated as (fiscal-year-end price − (realizable value/number of options)).

(3) Assume that the time-to-maturity of unexercisable options is equal to one year less than the time-to-maturity of the most recent year's grant or nine years if no new grant was issued. Conversely, assume that the time-to-maturity of exercisable options is equal to three years less than the time-to-maturity of unexercisable options or six years if no new grant was issued.

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