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The effect of CEO Stock-based compensation on pricing of future earnings

Jae Bum KIM
Singapore Management University, jbkim@smu.edu.sg

Bobae CHOI

The Effect of CEO Stock-Based Compensation on the Pricing of Future Earnings

BOBAE CHOI* and JAE B. KIM**

*Newcastle Business School, University of Newcastle, Callaghan, NSW, Australia and **School of Accountancy, Singapore Management University, Singapore, Singapore

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ABSTRACT This paper examines whether CEO stock-based compensation has an effect on the market's ability to predict future earnings. When stock-based compensation motivates managers to share their private information with shareholders, it will expedite the pricing of future earnings in current stock prices. In contrast, when equity-compensated managers attempt to temporarily manipulate the stock price to maximize their own benefit rather than that of shareholders, the market may not fully anticipate future performance. We find that a CEO's stock-based compensation strengthens the association between current returns and future earnings, indicating that more information about future earnings is reflected in current stock prices. In addition, we find that the positive effect is weaker for firms that have a high level of signed discretionary accruals or a low management forecast frequency. Overall, our study suggests that on average, equity-based compensation improves the informativeness of stock prices about future earnings, while opportunistic discretionary accruals or lowered earnings guidance hamper this improvement.

1. Introduction

This paper aims to examine whether stock-based compensation benefits shareholders by improving their ability to predict future firm performance. Previous evidence on the effectiveness of such compensation schemes is mixed, as prior studies are largely based on tests of the sensitivity of CEO pay with respect to shareholder value, that is, pay-to-performance sensitivity measures (see e.g. Frydman & Saks, 2010; Hall & Liebman, 1998; Jensen & Murphy, 1990). In addition, while some studies suggest that stock-based compensation can mitigate 'managerial disclosure agency problems' and, thus, induce managers to disclose more (e.g. Nagar, Nanda, & Wysocki, 2003), it remains unknown whether such disclosures actually convey any meaningful information to shareholders (Barth, 2003). This study aims to offer an analysis and discussion of whether the information provided by equity-compensated managers improves firms' information environment. We particularly focus on how a CEO's equity incentives affect the extent to which stock prices reflect information about future earnings. Following previous studies (Choi, Myers,

Correspondence Address: Bobae Choi, Newcastle Business School, University of Newcastle, University Drive, Callaghan, NSW 2308, Australia. Email: bobae.choi@newcastle.edu.au

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Zang, & Ziebart, 2011; Durnev, Morck, Yeung, & Zarowin, 2003; Gelb & Zarowin, 2002; Lundholm & Myers, 2002; Tucker & Zarowin, 2006), we measure the informativeness of current stock prices in relation to future earnings using the future earnings response coefficient (FERC).[1]

The existing literature presents opposing expectations regarding the effect of equity incentives on the informativeness of stock prices. One stream of the literature predicts that higher stock-based incentives result in improved voluntary disclosures by firms. For example, Nagar et al. (2003) suggest that managers who are otherwise reluctant to share their private information with shareholders will be induced to disclose more if they are compensated based on equity value. When firms offer stock-based compensation to new employees, voluntary disclosures can also reduce the contracting costs that arise due to the potential mispricing of stock prices (Healy & Palepu, 2001). Noe (1999) further indicates that managers provide earnings forecasts to resolve information asymmetry issues with outside shareholders before trading their stocks. Consistent with these arguments, firms that provide more stock-based compensation are found to make more voluntary disclosures than other firms. If stock-based incentives encourage managers to reveal their private information about future performance to the market, shareholders will be better able to predict future earnings (*the informative disclosure argument*).

However, it has been widely reported that managers who are compensated based on equity tend to engage in earnings management to maximize their remuneration (Bergstresser & Philippon, 2006; Burns & Kedia, 2006; Cheng & Warfield, 2005; Cheng, Warfield, & Ye, 2011). Managers with more stock-based compensation are more likely to distort earnings to inflate their firms' stock prices before exercising options or selling their shares (Bergstresser & Philippon, 2006; Cheng & Warfield, 2005). Furthermore, granting options can create an incentive for managers to temporarily depress a stock price prior to the option award date by managing earnings downward or issuing voluntary disclosures (Baker, Collins, & Reitenga, 2003, 2009; McAnally, Srivastava, & Weaver, 2008). If managers with equity-based incentives temporarily manipulate the stock price, this price will fail to represent the firm's fundamental value. The distortion of short-term earnings by those managers also deteriorates investors' ability to predict future firm performance, as shareholders and analysts often use current earnings information to formulate the expected firm value. Thus, stock-based compensation may weaken the informativeness of current stock prices in relation to future earnings (*the opportunistic manipulation argument*).

In this study, an enhanced FERC implies that more information in quantity and/or more accurate information about future earnings is provided by an equity-compensated manager so that investors can better incorporate such information into their trades. We believe that the FERC is more appropriate for our study than alternative measures for the following reasons. First, a direct measure of management forecast accuracy does not consider the various channels through which managers are able to communicate their private information with shareholders, such as press releases, conference calls, or social and environmental reporting. In addition, using the forecast accuracy measure would limit our sample to only those firms that issue management forecasts.

Second, the FERC is particularly suitable for testing our research questions compared with other short-term earnings-based measures such as the earnings response coefficient (ERC). The analytical model of firm valuation developed by Zhang (2000) and further empirical evidence provided by Chen and Zhang (2007) indicate that a firm's current earnings information is not sufficient to explain variations in stock prices. In particular, Chen and Zhang (2007) suggest that four factors – earnings yield, capital investment, and changes in profitability and

[1]We later explain why the FERC is more appropriate for examining the effect of stock-based incentives on the informativeness of stock prices than other short-term-oriented measures.

growth opportunities – mainly account for current stock movements. Because these factors relate to current and future cash flows, the ERC cannot fully capture the variation in stock prices arising from changes in investors' expectations regarding future cash flows. In the first study introducing the FERC, Collins, Kothari, Shanken, and Sloan (1994) report a significant increase in the explanatory power of the return-earnings model after including future earnings. This result occurs because although realized earnings information may be a good indicator of future earnings, investors predict future performance after combining this information with information from other sources. Investors might change their trading strategies based on anticipated events that affect future earnings but not current earnings. This effect will be captured in the FERC, but not necessarily in the ERC (Collins et al., 1994; Tucker & Zarowin, 2006).[2] In our research setting, we test whether further disclosures provided by equity-compensated managers are sufficiently informative to affect current returns through changes in investors' expectations regarding future earnings.

Based on a sample of 12,213 firm-year observations of S&P 1500 firms during the 1995–2007 period, our analyses yield the following main findings. First, we find that CEO stock-based compensation is significantly positively associated with the FERC, indicating that when firms provide a higher amount of stock-based compensation to their CEOs, their stock prices become more informative of future earnings. This finding supports the informative disclosure argument that disclosures by equity-incentivized managers can mitigate disclosure agency problems. Second, consistent with our prediction, we find that the effect of stock-based compensation on the FERC is less pronounced for firms with a greater magnitude of earnings management. That is, the positive effect appears to be weaker when managers with a higher proportion of equity-based compensation attempt to pursue their own self-interest by managing earnings. Although this result is consistent with the opportunistic manipulation argument, our overall findings suggest that the informative disclosure incentive is dominant, as exhibited by the (on average) positive effect of stock-based compensation on the informativeness of stock prices.

We conduct additional tests to ensure the robustness of our results and to provide additional insights. First, similar results are obtained when a continuous variable of stock-based compensation is used instead of the percentile rank variable. Second, our findings are not adversely affected by the incomplete coverage of the First Call database when the main regression models are re-estimated after excluding observations before 1998. In addition, stock-based compensation is found to remain positively associated with the FERC after the adoption of the revised FAS123 (FAS123R). Moreover, when earnings are split into two components, near-term (i.e. current and one-year ahead earnings) and long-term (i.e. two-year and three-year forward earnings), the positive association is found for the longer-term future earnings but not for the near-term earnings.

We address the potential endogeneity issue regarding stock-based compensation in two ways. First, we re-estimate our regression models using the predicted variable calculated from a stock-based compensation model (i.e. a two-stage analysis). The inferences from the two-stage analysis are the same as those from the main tests. Second, we conduct a change analysis by utilizing two events during our sample period: (i) the initiation of an equity-based payment scheme and (ii) a substantial increase in such payments. We find that the FERC is increased in the post-period (three-year period inclusive of the event year) compared with the pre-period (three-

[2]This notion is further supported by Choi et al. (2011), who stress the importance of the FERC, especially when examining the effect of management forecasts. They report that characteristics of management forecasts are closely related to the FERC but rarely influence the degree to which returns reflect current-period earnings, that is, the ERC.

year period ending at the year prior to the event). These results help to alleviate the concern that our findings are driven by inverse causality or by other firm characteristics that may affect both the FERC and a CEO's compensation scheme.

In addition, we find that the positive effect of stock-based compensation on the FERC is weakened for firms with less frequent management forecasts. This result is consistent with previous studies that suggest forecast frequency represents a manager's ability to predict future performance (Baik, Farber, & Lee, 2011; Trueman, 1986). The result can be viewed as additional support for the informative disclosure argument, as an improvement in stock prices' informativeness about future earnings is not observed for firms with a low frequency of management forecasts. Furthermore, the negative effect of equity-based compensation on the FERC for firms with a high level of earnings management is mainly observed when managers are involved in a larger amount of net sales in the subsequent year, thus supporting the opportunistic manipulation argument. However, we still observe a positive effect of stock-based compensation on the FERC for the other group (i.e. firms with managers who carry a small amount of future net sales). Finally, we obtain the same inference regarding the positive effect of stock-based compensation from an alternative test based on a measure of firm opacity proposed by Anderson, Duru, and Reeb (2009). Stock-based compensation is found to be negatively associated with the opacity of a firm's information environment. This negative association is weaker for firms with a higher level of earnings management or a lower frequency of management forecasts than for other firms, consistent with our main findings.

Our results provide insights beyond those of Cheng and Lo (2006) and Noe (1999), who document that managers who are compensated based on equity make use of management forecasts for their own benefit. They argue that such managers achieve higher trading profits by using corporate voluntary disclosures. Our results indicate that in firms that provide stock-based compensation, shareholders will also be better off as a consequence of the improved informativeness of stock prices.

Furthermore, this paper contributes to the existing literature examining the various factors that affect firms' information environments. Previous studies suggest that current stock prices' informativeness about future earnings improves when firms have smooth earnings (Tucker & Zarowin, 2006), greater analysts following and institutional ownership (Ayers & Freeman, 2003), and more informative and more frequent voluntary disclosures (Butler, Kraft, & Weiss, 2007; Lundholm & Myers, 2002). Many of these factors are related to managers' discretionary reporting behaviors or to external factors such as analysts following that cannot be directly controlled by shareholders. Mandating managers' reporting patterns would not be ideal; as Butler et al. (2007) note, only voluntary disclosures have a positive impact on the informativeness of stock prices. Our findings indicate that by providing managers with stock-based compensation, shareholders can at least motivate them to voluntarily provide more informative disclosures to the market, which leads to better information environments for firms.

The remainder of this paper is organized as follows. In the next section, our hypotheses are developed. The research models are then explained, along with the sample and the data used in our empirical models. Finally, we present the results and conclude the paper.

2. Hypothesis Development

Many studies examine whether compensating CEOs based on equity through the granting of stocks and stock options actually increases shareholder value. In an early study, Jensen and Murphy (1990) document that CEOs received only $3.25, on average, for every $1000 increase in shareholder wealth during the 1969–1983 period, indicating that tying CEO payment to the value of equity does not provide CEOs with much incentive to maximize shareholder value.

However, Hall and Liebman (1998) reach a different conclusion in their study of the 1980–1994 period. They find that the sensitivity of total CEO compensation (including salaries, bonuses and the value of annual stock option grants) in relation to firm performance rose dramatically over the period; the median elasticity between CEO compensation and firm market value more than tripled from 1.2 to 3.9. The different results of these early studies can be attributed to the different datasets and research periods involved. To resolve this issue, Frydman and Saks (2010) examine long-term executive compensation trends using an extensive dataset of large firms from 1936 to 2005. Their results agree with those of Hall and Liebman (1998), finding a large increase in pay-to-performance based on two measures, the Jensen–Murphy statistic and the value of equity at stake, during the 1980s and 1990s.

Nagar et al. (2003) approach the issue of incentive alignment through stock-based compensation by focusing on disclosure agency problems. Their main argument is that managers are more likely to communicate their private information to shareholders if their compensation is tied more closely to the firm's equity value. Otherwise, managers are not willing to reveal their private information because of the possible private benefits of retaining such information. Nagar et al. (2003) use two measures to proxy for the extent of these disclosures: the frequency of management earnings forecasts and analysts' ratings of disclosures taken from the Association for Investment Management Research survey. Consistent with their conjecture, both measures are found to be positively associated with the proportion of CEO pay linked to stock prices. Voluntary disclosures may also reduce the contracting costs associated with stock-based compensation. New employees whose remuneration is tied to stock prices will require extra compensation for the additional risk they bear in case of mispriced company stock. Thus, firms that heavily rely on stock-based compensation schemes are more likely to make voluntary disclosures to reduce the information asymmetry between managers and shareholders (Healy & Palepu, 2001).

However, Barth (2003) raises some issues with Nagar et al.'s (2003) findings. In particular, Barth (2003) questions the actual benefits that shareholders gain from more frequent managerial disclosures because stock-based compensation can also incentivize managers to distort such disclosures. For example, Aboody and Kasznik (2000) find that managers release self-serving forecasts to maximize the value of their stock option awards by announcing bad news and delaying good news around the award date. Shareholders may not use the information from managerial disclosures if they do not know whether the managers reveal true information. Furthermore, Barth (2003) argues that the disclosure proxies used by Nagar et al. (2003), such as the frequency of managerial earnings forecasts, do not necessarily test whether more information is conveyed to the market because these measures do not consider the information content. Thus, it has not yet been determined whether CEO stock-based compensation actually leads to the enhanced informativeness of stock prices.

Granting shares and stock options can incentivize managers to provide certain types of voluntary disclosures, especially surrounding insider trading. Cheng and Lo (2006) report that managers engage in more selling activities during periods of increased disclosures of bad news. Noe (1999) also indicates that insider trading tends to follow management forecasts. However, managers will act in a subtle manner when capitalizing on private information due to legal restrictions on insider trading. Insider trading would be associated with less sensitive private information, such as the firm's long-term performance, rather than biased disclosures regarding short-term performance. In this case, shareholders will be able to learn about future performance either directly through the private information embedded in voluntary disclosures or indirectly by watching the managers' trading patterns (*the informative disclosure argument*).

However, stock-based compensation may provide managers with an incentive to engage in earnings management in an attempt to maximize their private benefits (Bergstresser &

Philippon, 2006; Burns & Kedia, 2006; Cheng & Warfield, 2005; Cheng et al., 2011). Higher abnormal accruals are found in firms in which CEO compensation is more extensively linked to the value of stock and option holdings (Bergstresser & Philippon, 2006). In particular, abnormally high discretionary accruals are found before managers exercise abnormally large options (Bartov & Mohanram, 2004). Managers with greater stock-based incentives are also likely to report earnings that beat or meet analysts' forecasts before selling their shares (Cheng & Warfield, 2005). Given the previous finding that current earnings information is useful in forecasting future cash flows and earnings (Barth, Cram, & Nelson, 2001; Dechow, Kothari, & Watts, 1998; Kim & Kross, 2005), distorted current earnings will not properly reflect the true performance of the firm. Thus, disclosing such earnings may deteriorate shareholders' ability to predict future performance, leading to a decrease in the informativeness of stock prices (*the opportunistic manipulation argument*).

In sum, the two arguments presented above suggest the opposing relationships between CEO stock-based compensation and the informativeness of stock prices. Therefore, we present the following null hypothesis and two competing hypotheses to test this association.

H1: CEO stock-based compensation does not have any effect on the informativeness of stock prices in relation to future earnings.
H1a: CEO stock-based compensation improves the informativeness of stock prices in relation to future earnings.
H1b: CEO stock-based compensation deteriorates the informativeness of stock prices in relation to future earnings.

While we argue that the earnings management (proxied by discretionary accruals) induced by stock-based compensation decreases the informativeness of stock prices about future earnings in developing H1, a higher level of discretionary accruals may capture managers' effort to communicate their private information to shareholders. For instance, income smoothing can help shareholders better estimate future earnings based on a series of past earnings information (Subramanyam, 1996; Tucker & Zarowin, 2006). However, earnings management can still be implemented by equity-incentivized managers in a relatively short period to achieve a certain goal, for example, to maximize payouts from option exercises (Bartov & Mohanram, 2004) or from a disposal of shares (Cheng & Warfield, 2005). In these situations, earnings management may or may not have a significantly negative effect on the informativeness of stock prices. Thus, empirical tests are required to determine the dominant effect of managers' earnings management practices on stock price informativeness. Therefore, we propose the following additional hypothesis in an alternative form.

H2: CEO stock-based compensation leads to lesser informativeness of current stock prices in relation to future earnings when a CEO engages in upward earnings management compared with when she does not manage earnings.

3. Research Design

3.1. Research Models

Following studies such as those by Collins et al. (1994), Gelb and Zarowin (2002), and Lundholm and Myers (2002), we use the FERC to measure the informativeness of stock prices in relation to future earnings. The FERC is estimated using the following model adopted from

Collins et al. (1994):

$$\mathrm{RET}_t = b_0 + b_1 \times X_{t-1} + b_2 \times X_t + b_3 \times X_{t3} + b_4 \times \mathrm{RET}_{t3} + \varepsilon_t, \tag{1}$$

where RET_t is the cumulative return for fiscal year t; X_t is the income available to common shareholders before extraordinary items, deflated by the market value of equity at the beginning of fiscal year t; X_{t3} is the sum of the income available to common shareholders before extraordinary items for years $t + 1$ through $t + 3$, deflated by the market value of equity at the beginning of fiscal year t; and RET_{t3} is the cumulative return for fiscal years $t + 1$ through $t + 3$. The FERC is calculated as the estimated coefficient of the sum of future earnings, b_3. In the above model, X_{t-1} represents the prior expectation for current earnings (X_t). Due to the mean-reverting nature of earnings, the coefficient on X_{t-1} is expected to be negative and the coefficient on X_t to be positive. The realized future earnings (X_{t3}) have two components: expected and unexpected components. There can be events occurring in future periods that affect future earnings but that were not anticipated at the end of period t. The measurement error caused by these events is controlled by future stock returns (RET_{t3}). The expected sign of the coefficients on X_{t3} is positive and that of the coefficient on $\mathrm{RET}t_3$ is negative. (See, for example, Collins et al. (1994), Gelb and Zarowin (2002), and Lundholm and Myers (2002) for further explanations of the FERC model.)

We then develop our test models by expanding the basic FERC model as follows:

$$\begin{aligned}\mathrm{RET}_t = {} & b_0 + b_1 \times X_{t-1} + b_2 \times X_t + b_3 \times X_{t3} + b_4 \times \mathrm{RET}_{t3} + b_5 \times \mathrm{EQ\_COMP}_t \\ & + b_6 \times X_{t-1} \times \mathrm{EQ\_COMP}_t + b_7 \times X_t \times \mathrm{EQ\_COMP}_t + b_8 \times X_{t3} \times \mathrm{EQ\_COMP}_t \\ & + b_9 \times \mathrm{RET}_{t3} \times \mathrm{EQ\_COMP}_t + \text{Control Variables} + \varepsilon_t,\end{aligned} \tag{2}$$

where $\mathrm{EQ\_COMP}_t$ is the proportion of stock-based compensation in the CEO's total pay, measured as the sum of the stock option and restricted stock grant values divided by the total pay. We estimate the preceding regression model and the other models using the percentile rank variable of stock-based compensation to ensure that the stock-based compensation variable is more comparable across industries. The percentile rank is measured within each industry according to the two-digit SIC industry classification. We also check the sensitivity of the results using the continuous variable of stock-based compensation. H1a predicts that the coefficient b_8 is positive, and the opposing H1b proposes that the coefficient is negative.

To further test the cross-sectional variation in the effect of stock-based compensation on the FERC in terms of the extent of earnings management (as stated in H2), we construct the following additional variable:

> HIGH_EM = a dummy variable for the highest group of earnings management that takes the value of one if a firm belongs to the highest quintile group of performance-matched discretionary total accruals (Kothari, Leone, & Wasley, 2005) in year t.

We then include the interaction term of the additional variable with future earnings and $\mathrm{EQ\_COMP}_t$ in our research model as follows:

$$\begin{aligned}\mathrm{RET}_t = {} & b_0 + b_1 \times X_{t-1} + b_2 \times X_t + b_3 \times X_{t3} + b_4 \times \mathrm{RET}_{t3} + b_5 \times \mathrm{EQ\_COMP}_t \\ & + b_6 \times X_{t-1} \times \mathrm{EQ\_COMP}_t + b_7 \times X_t \times \mathrm{EQ\_COMP}_t + b_8 \times X_{t3} \times \mathrm{EQ\_COMP}_t \\ & + b_9 \times \mathrm{RET}_{t3} \times \mathrm{EQ\_COMP}_t + b_{10} \times \mathrm{HIGH\_EM}_t + b_{11} \times X_{t3} \times \mathrm{HIGH\_EM}_t \\ & + b_{12} \times X_{t3} \times \mathrm{HIGH\_EM}_t \times \mathrm{EQ\_COMP}_t + \text{Control Variables} + \varepsilon_t.\end{aligned} \tag{3}$$

H2 suggests that a higher level of earnings management can weaken the association between stock-based compensation and the FERC, leading to the following prediction: $b_{12} < 0$.

To ensure that stock-based compensation does not capture the effects of other factors, we control for a set of variables that previous research suggests affect the FERC (e.g. Choi et al., 2011; Gelb & Zarowin, 2002; Lundholm & Myers, 2002). First, to control for firms' different information environments, we include firm size (SIZE), the number of analysts following (AC), and the number of management forecasts issued over year t (NUM_MF). More information tends to be available for larger firms, for firms covered by more analysts, and for firms with more management forecasts, indicating a positive relationship between these variables and the FERC. SIZE is measured as the natural log of the market value of total equity. AC is calculated as the natural log of one plus the number of analysts following the firm in the month before the earnings announcement for fiscal year t. To capture the difficulty in predicting future earnings, we add a dummy variable for negative future earnings (LOSS) and the standard deviation of earnings for years t through $t + 3$ (STD_EARN). It is relatively difficult to predict future earnings (i.e. a lower FERC) if firms recognize a loss or have more volatile earnings. In addition, the market is more likely to value growth firms based on their future performance, thus leading to a higher FERC. We include a variable of firm growth (GROWTH) by measuring the percentage growth in total assets from year $t-1$ to $t + 1$. The interaction terms of these variables with future earnings (X_{t3}) are also included in the regression models. Finally, we include industry and year fixed effects in our regressions to control for potential return variations over time and across industries. All of the continuous variables are winsorized at the 1% and 99% levels. The full list of variables, including definitions, is presented in Appendix 1.

3.2. *Sample and Data*

Our sample consists of S&P 1500 companies during the 1995–2007 period. Firms from the utilities and financial industries are excluded. Because the FERC model includes the next three years of returns and firm earnings, we use data up to the year 2010. The data related to CEO compensation are collected from ExecuComp. The financial statement data are obtained from Compustat, and the stock price and return data are collected from Center for Research in Security Prices. The management forecasts and analyst coverage data are collected from First Call. After combining all of the datasets, we obtain 13,197 firm-year observations that have all of the variables used in the regression models. As in previous studies of the FERC (e.g. Choi et al., 2011; Tucker & Zarowin, 2006), we delete observations in the top and bottom 1% of the sample distributions of past, current, and future earnings and current and future returns to minimize the effect of outliers. After deleting these outliers, we obtain the final sample of 12,213 firm-year observations.

Table 1 presents the distribution of our sample. The yearly distribution in Panel A of Table 1 indicates that our sample firms are evenly spread across the research period. Panel B of Table 1 presents the distribution by industry. Nearly 40% of our sample firms belong to the manufacturing industry, and the remaining firms are distributed across various industries.

Panel A of Table 2 reports the descriptive statistics of the variables used in our analyses. The mean of EQ_COMP is 0.4155, suggesting that approximately 42% of the CEOs' total annual compensation in our sample firms is in the form of options and restricted stocks. Furthermore, we observe a large variation in EQ_COMP. Although the stock-based compensation is only 15%

Table 1. Sample description

Panel A. Yearly Distribution

Year	# of firm years	% of total
1995	825	6.76
1996	788	6.45
1997	832	6.81
1998	901	7.38
1999	923	7.56
2000	983	8.05
2001	993	8.13
2002	978	8.01
2003	976	7.99
2004	999	8.18
2005	978	8.01
2006	1066	8.73
2007	971	7.95
Total	12,213	100.00

Panel B. Industry Distribution

Two-digit SIC	Industry title	# of firm years	% of total
01–09	Agriculture, forestry, and fishing	19	0.16
10–14	Mining	604	4.95
15–17	Construction	146	1.20
20–34, 37–39	Manufacturing except for machinery and equipment	4880	39.96
35–36	Industrial machinery and equipment	2153	17.63
40–49	Transportation, communications, and utilities	659	5.40
50–51	Wholesale trade	507	4.15
52–59	Retail trade	1268	10.38
70–89	Service	1933	15.83
91–99	Public administration and others	44	0.36
Total		12,213	100.00

Notes: This table describes the sample used in the empirical analysis. The sample consists of ExecuComp firms, excluding those in the financial industry during the 1995–2007 period. Note that because a FERC analysis requires a firm to have return and earnings data for the next three years, we use the data up to 2010. Panel A presents the sample distribution by year. Panel B displays the distribution by industry.

at the bottom 25% of the distribution, it is over 65% at the top 25%. On average, our sample firms have an annual stock return (RET_t) of 17%. In addition, the firms have cumulative future earnings over the next three years of 14% compared with the market value of equity at the beginning of the current year (X_{t3}), on average. Such positive firm performance can be attributed to our sample selection criteria, as they relate to S&P 1500 firms. We note that the distribution of other firm characteristics in our sample is similar to that in previous studies using the FERC (e.g. Choi et al., 2011).[3]

Panel B of Table 2 presents the Pearson (Spearman) correlation coefficients in the above diagonal (below diagonal) among the variables. As expected, the earnings variables (X_{t-1}, X_t, and X_{t3}) are highly correlated, as are the future cumulative returns and future earnings variables (R_{t3} and X_{t3}). The correlation coefficients among the control variables are low or modest,

[3]In particular, the mean and median of PMDTA are similar in magnitude to those reported in previous studies such as Cohen, Dey, and Lys (2008) and Kothari et al. (2005).

Table 2. Descriptive statistics and correlations

Panel A. Descriptive Statistics ($N = 12{,}213$)

Variable	Mean	STD	P5	Q1	Median	Q3	P95
EQ_COMP_t	0.4155	0.2925	0.0000	0.1478	0.4421	0.6519	0.8700
RET_t	0.1669	0.4545	−0.4526	−0.1216	0.1103	0.3717	0.9821
X_{t-1}	0.0334	0.0690	−0.0716	0.0237	0.0445	0.0631	0.1008
X_t	0.0404	0.0669	−0.0742	0.0262	0.0505	0.0715	0.1163
X_{t3}	0.1435	0.2393	−0.2728	0.0564	0.1559	0.2512	0.4865
RET_{t3}	0.2693	0.7902	−0.6904	−0.2591	0.1148	0.5898	1.7889
$SIZE_t$	7.3656	1.5462	5.1151	6.2449	7.1646	8.3282	10.2626
$LOSS_t$	0.1730	0.3783	0.0000	0.0000	0.0000	0.0000	1.0000
$GROWTH_t$	0.3130	0.5253	−0.2172	0.0196	0.1809	0.4345	1.3543
STD_EARN_t	0.0514	0.0758	0.0055	0.0128	0.0246	0.0535	0.2034
AC_t	1.9959	0.7626	0.6931	1.6094	2.0794	2.5649	3.0910
NUM_MF_t	2.9374	4.0331	0.0000	0.0000	1.0000	5.0000	11.0000
$PMDTA_t$	−0.0240	0.1025	−0.1615	−0.0697	−0.0237	0.0187	0.1119

Panel B. Correlation matrix: Pearson (above diagonal) and Spearman (below diagonal)

		1	2	3	4	5	6	7	8	9	10	11	12	13
EQ_COMP_t	1		−0.0124	**−0.0620**	**−0.0961**	**−0.0852**	**−0.0322**	**0.2697**	**0.0483**	**0.0833**	0.0032	**0.3052**	**0.1259**	**−0.0576**
RET_t	2	**−0.0345**		−0.0095	**0.2687**	**0.2914**	**−0.0711**	**−0.1003**	**−0.1514**	**0.3036**	**−0.1605**	**0.0242**	**−0.0651**	**−0.0277**
X_{t-1}	3	**−0.1375**	**0.0875**		**0.4540**	**0.2285**	**0.0253**	**0.1138**	**−0.2215**	**0.0660**	**−0.1583**	**0.0580**	**0.0755**	**−0.0809**
X_t	4	**−0.1642**	**0.3860**	**0.5197**		**0.4018**	0.0167	**0.0782**	**−0.3212**	**0.1727**	**−0.2847**	**0.0504**	**0.0509**	0.0148
X_{t3}	5	**−0.1162**	**0.4047**	**0.2885**	**0.4633**		**0.4252**	**0.0336**	**−0.6891**	**0.1283**	**−0.5449**	**0.0569**	**0.0303**	**−0.0534**
RET_{t3}	6	**−0.0369**	**−0.0484**	**0.0901**	**0.0651**	**0.5203**		**−0.0493**	**−0.2887**	**−0.0275**	**−0.1976**	−0.0129	**−0.0213**	**−0.0350**
$SIZE_t$	7	**0.2743**	**−0.0556**	−0.0057	**−0.0213**	−0.0039	−0.0020		**−0.1585**	**−0.0258**	**−0.1776**	**0.6881**	**0.2358**	**−0.1159**
$LOSS_t$	8	**0.0505**	**−0.1975**	**−0.1861**	**−0.2736**	**−0.6552**	**−0.3714**	**−0.1581**		**−0.0661**	**0.6109**	**−0.1122**	**−0.0720**	**0.0896**
$GROWTH_t$	9	**0.0536**	**0.2952**	**0.0222**	**0.2255**	**0.2238**	−0.0058	0.0074	**−0.1697**		**−0.0996**	**0.1139**	**−0.0382**	**−0.0317**
STD_EARN_t	10	**−0.0208**	**−0.1859**	**−0.0506**	**−0.1399**	**−0.4119**	**−0.2626**	**−0.2862**	**0.5405**	**−0.1964**		**−0.1189**	**−0.0671**	**0.0642**
AC_t	11	**0.3090**	**0.0318**	**−0.0846**	**−0.0559**	**0.0195**	0.0064	**0.7223**	**−0.1073**	**0.1349**	**−0.1938**		**0.2349**	**−0.1196**
NUM_MF_t	12	**0.1522**	**−0.0963**	**0.0380**	**−0.0217**	−0.0147	−0.0049	**0.2368**	**−0.0529**	**−0.0451**	**−0.1198**	**0.2372**		**−0.0751**
$PMDTA_t$	13	**−0.0787**	**−0.0560**	−0.0046	**0.0397**	**−0.0461**	**−0.0532**	**−0.1202**	**0.0992**	**−0.0511**	**0.1537**	**−0.1168**	**−0.1005**	

Notes: This table reports the descriptive statistics for the variables used in the study. See Appendix 1 for the variable definitions. All of the continuous variables are winsorized at the 1% and 99% levels. Panel B displays the correlations among the variables. The correlation coefficients at the 5% significance level are presented in boldface.

except those for analyst coverage and firm size (0.6881) and the loss and volatility of earnings (0.6109).

4. Empirical Results

4.1. Overall Effect of Stock-Based Compensation on the FERC: Test of H1

To test H1, we estimate the OLS regression expressed in equation (2). The results are presented in Table 3. All of the *p*-values are two-sided and are based on standard errors adjusted for firm and year clustering to address any potential correlations across observations (within the same firm or year). In Panel A of Table 3, which is based on the percentile rank variable of stock-based compensation, the coefficient of the interaction term, $X_{t3} \times \text{EQ\_COMP}_t$, is positive and significant at the 10% level. This result supports the alternative hypothesis, H1a, suggesting that stock-based compensation, on average, improves the informativeness of stock prices in relation to future earnings.

Consistent with previous studies of the FERC (e.g. Ayers & Freeman, 2003; Choi et al., 2011; Lundholm & Myers, 2002), we find that both of the coefficients of X_t (ERC) and X_{t3} (FERC) are significantly positive at the 1% level. In addition, the results for the control variables are largely consistent with those found in the literature. The FERC is found to be lower

Table 3. Stock-based compensation and FERC

Panel A: Using the percentile rank variable of Stock-based Compensation

Variables	Coefficient	*p*-Value
X_{t-1}	−0.4235**	.041
X_t	1.0766***	.000
X_{t3}	1.1712***	.000
RET_{t3}	−0.1460***	.000
EQ_COMP_t	0.0004*	.085
$X_{t-1} \times \text{EQ\_COMP}_t$	−0.0072***	.000
$X_t \times \text{EQ\_COMP}_t$	0.0032**	.040
$X_{t3} \times \text{EQ\_COMP}_t$	0.0020*	.070
$\text{RET}_{t3} \times \text{EQ\_COMP}_t$	−0.0001	.592
SIZE_t	−0.0405***	.002
$X_{t3} \times \text{SIZE}_t$	−0.0016	.946
LOSS_t	0.0160	.570
$X_{t3} \times \text{LOSS}_t$	−1.6930***	.000
GROWTH_t	0.1735***	.000
$X_{t3} \times \text{GROWTH}_t$	−0.1968***	.000
STD_EARN_t	−0.7625***	.000
$X_{t3} \times \text{STD\_EARN}_t$	−0.0240	.958
AC_t	0.0593***	.001
$X_{t3} \times \text{AC}_t$	−0.0096	.768
NUM_MF_t	−0.0091***	.001
$X_{t3} \times \text{NUM\_MF}_t$	0.0168***	.009
Industry Fixed Effects	Included	
Year Fixed Effects	Included	
N	12,213	
Adj. R^2	.3657	

(*Continued*)

Table 3. Continued

Panel B: Using the continuous variable of stock-based Compensation		
Variables	Coefficient	*p*-Value
X_{t-1}	−0.5042**	.014
X_t	1.0988***	.000
X_{t3}	1.1924***	.000
RET_{t3}	−0.1469***	.000
EQ_COMP_t	0.0348*	.086
$X_{t-1} \times EQ\_COMP_t$	−0.6939***	.000
$X_t \times EQ\_COMP_t$	0.3343**	.028
$X_{t3} \times EQ\_COMP_t$	0.1940*	.085
$RET_{t3} \times EQ\_COMP_t$	−0.0157	.562
$SIZE_t$	−0.0405***	.002
$X_{t3} \times SIZE_t$	−0.0015	.950
$LOSS_t$	0.0159	.573
$X_{t3} \times LOSS_t$	−1.6918***	.000
$GROWTH_t$	0.1736***	.000
$X_{t3} \times GROWTH_t$	−0.1967***	.000
STD_EARN_t	−0.7616***	.000
$X_{t3} \times STD\_EARN_t$	−0.0240	.957
AC_t	0.0595***	.001
$X_{t3} \times AC_t$	−0.0096	.767
NUM_MF_t	−0.0091***	.001
$X_{t3} \times NUM\_MF_t$	0.0168***	.009
Industry Fixed Effects	Included	
Year Fixed Effects	Included	
N	12,213	
Adj. R^2	.3656	

Notes: This table reports the results from the OLS regression analysis in terms of the effect of stock-based compensation on the FERC. Panel A displays the results using the percentile rank variable of stock-based compensation. Panel B presents the results using the continuous variable of stock-based compensation. See Appendix 1 for the variable definitions. All of the continuous variables are winsorized at the 1% and 99% levels. All of the *p*-values are two-sided and are based on standard errors adjusted for firm and year clustering.
***Two-tailed significance at the 1% level.
**Two-tailed significance at the 5% level.
*Two-tailed significance at the 10% level.

for loss-making firms (LOSS) and higher for firms with a higher management forecast frequency (NUM_MF).[4]

Panel B of Table 3 presents the results of the OLS regression based on the continuous variable of stock-based compensation. Similar to the results displayed in Panel A, the coefficient on the interaction between future earnings and stock-based compensation is significantly positive. Our results indicate that stock-based compensation improves the market's ability to anticipate future firm performance, thereby making stock prices incorporate more information about future earnings. Moreover, these results suggest that the informative disclosure incentive, on average, outweighs the earnings management motivation as the proportion of equity-based pay in CEO total compensation increases.

[4]Because the coefficients on $X_{t3} \times GROWTH$ are negative, which is inconsistent with our expectation, we conduct a test using the market-to-book ratio (MTB) as an alternative proxy for growth. The coefficient on $X_{t3} \times MTB$ is positive and significant, as expected, while our main findings are qualitatively unchanged (untabulated).

4.2. *Cross-Sectional Variation in the Effect of Stock-Based Compensation on the FERC: Test of H2*

H2 predicts that stock-based compensation has a weaker effect for firms with a higher level of earnings management than other firms. To test this cross-sectional variation in the effect of stock-based compensation on the FERC, we estimate regression model (3).

Table 4 presents the H2 test results using the percentile rank variable and the continuous variable of EQ_COMP_t in Panels A and B, respectively. For both variables, we find that the coefficient on the interaction term, $X_{t3} \times EQ\_COMP_t$, is positive and significant at the 5% level, which is consistent with the results in Table 3. This interaction term is significantly negative for the highest group of earnings management, as indicated by the coefficients on $X_{t3} \times EQ\_COMP_t \times HIGH\_EM_t$ in Panels A and B (p-values = .014 and 0.015, respectively). This result supports the opportunistic manipulation argument. That is, stock-based compensation has a less pronounced effect on the FERC when managers engage in more aggressive earnings management than in other cases. In addition, according to the F-test result, the total effect of equity-based compensation on the group of firms with a high level of earnings management (i.e. the sum

Table 4. Stock-based compensation and FERC: effect of earnings management

Panel A: Using the percentile rank variable of stock-based

Variables	Coefficient	p-Value
X_{t-1}	−0.4377**	.030
X_t	1.0929***	.000
X_{t3}	1.1656***	.000
RET_{t3}	−0.1457***	.000
EQ_COMP_t	0.0003	.133
$X_{t-1} \times EQ\_COMP_t$	−0.0071***	.000
$X_t \times EQ\_COMP_t$	0.0029*	.063
$X_{t3} \times EQ\_COMP_t$	0.0029**	.024
$RET_{t3} \times EQ\_COMP_t$	−0.0002	.544
$SIZE_t$	−0.0412***	.002
$X_{t3} \times SIZE_t$	−0.0026	.909
$LOSS_t$	0.0170	.545
$X_{t3} \times LOSS_t$	−1.6683***	.000
$GROWTH_t$	0.1749***	.000
$X_{t3} \times GROWTH_t$	−0.1944***	.000
STD_EARN_t	−0.7297***	.000
$X_{t3} \times STD\_EARN_t$	−0.0151	.973
AC_t	0.0592***	.001
$X_{t3} \times AC_t$	−0.0105	.747
NUM_MF_t	−0.0092***	.001
$X_{t3} \times NUM\_MF_t$	0.0167***	.008
$HIGH\_EM_t$	−0.0230*	.093
$X_{t3} \times HIGH\_EM_t$	0.0155	.829
$X_{t3} \times EQ\_COMP_t \times HIGH\_EM_t$	−0.0024**	.014
Industry Fixed Effects	Included	
Year Fixed Effects	Included	
F-test		
$X_{t3} \times EQ\_COMP_t + X_{t3} \times EQ\_COMP_t \times HIGH\_EM_t = 0$	0.0005	.652
N	12,213	
Adj. R^2	.3675	

(*Continued*)

Table 4. Continued

Panel B: Using the continuous variable of stock-based Compensation

Variables	Coefficient	*p*-Value
X_{t-1}	−0.5173**	.010
X_t	1.1115***	.000
X_{t3}	1.1967***	.000
RET_{t3}	−0.1469***	.000
EQ_COMP_t	0.03101	.133
$X_{t-1} \times \text{EQ\_COMP}_t$	−0.6830***	.000
$X_t \times \text{EQ\_COMP}_t$	0.3089**	.042
$X_{t3} \times \text{EQ\_COMP}_t$	0.2726**	.031
$\text{RET}_{t3} \times \text{EQ\_COMP}_t$	−0.0178	.520
SIZE_t	−0.0412***	.002
$X_{t3} \times \text{SIZE}_t$	−0.0026	.910
LOSS_t	0.0169	.548
$X_{t3} \times \text{LOSS}_t$	−1.6672***	.000
GROWTH_t	0.1749***	.000
$X_{t3} \times \text{GROWTH}_t$	−0.1943***	.000
STD_EARN_t	−0.7290***	.000
$X_{t3} \times \text{STD\_EARN}_t$	−0.0158	.971
AC_t	0.0593***	.001
$X_{t3} \times \text{AC}_t$	−0.0105	.746
NUM_MF_t	−0.0092***	.001
$X_{t3} \times \text{NUM\_MF}_t$	0.0167***	.008
HIGH_EM_t	−0.0230*	.093
$X_{t3} \times \text{HIGH\_EM}_t$	−0.0108	.867
$X_{t3} \times \text{EQ\_COMP}_t \times \text{HIGH\_EM}_t$	−0.2223**	.015
Industry Fixed Effects	Included	
Year Fixed Effects	Included	
F-test		
$X_{t3} \times \text{EQ\_COMP}_t + X_{t3} \times \text{EQ\_COMP}_t \times \text{HIGH\_EM}_t = 0$	0.0503	.657
N	12,213	
Adj. R^2	.3674	

Notes: This table reports the results from the cross-sectional analysis in terms of the effect of stock-based compensation on the FERC, conditional on the magnitude of earnings management. Panel A displays the results using the percentile rank variable of stock-based compensation. Panel B presents the results using the continuous variable of stock-based compensation. HIGH_EM is an indicator variable representing the highest quintile group of performance-matched discretionary total accruals. See Appendix 1 for the other variable definitions. All of the continuous variables are winsorized at the 1% and 99% levels. All of the *p*-values are two-sided and are based on standard errors adjusted for firm and year clustering.

***Two-tailed significance at the 1% level.

**Two-tailed significance at the 5% level.

*Two-tailed significance at the 10% level.

of the coefficients on $X_{t3} \times \text{EQ\_COMP}_t$ and $X_{t3} \times \text{EQ\_COMP}_t \times \text{HIGH\_EM}_t$) is not significantly different from zero, implying that additional stock compensation would not improve firms' information environments.[5]

[5]We repeat the tests in Table 4 using the absolute discretionary accrual measure instead of our signed discretionary accrual measure. The coefficient for the highest earnings management group is still negative but is not significant when the absolute measure is employed. This result, together with that from the analysis in Section 5.3, indicates that the reported negative impact of EM on the FERC is mainly driven by managers who engage in temporary income-boosting for their future selling activities.

4.3. Robustness Tests

While the following section discusses how we address endogeneity issues regarding stock-based compensation, we provide a brief summary of the results obtained from several untabulated robustness tests. First, because the coverage of management forecasts in the First Call database is limited in the early 1990s and becomes more comprehensive starting in 1998 (see e.g. Chuck, Matsumoto, & Miller, 2013), regression models (2) and (3) are re-estimated after excluding observations before 1998. We find that the results basically echo those obtained from the whole sample, indicating that our findings are not adversely affected by the incomplete coverage of the First Call database.

Second, we examine the effect of the revised FAS123 (FAS123R) on our main results. Effective beginning in 2005, FAS123R requires firms to expense stock-based compensation at its fair value instead of intrinsic value. While this new accounting standard has been considered to eliminate certain benefits of accounting treatment for granting stock options, it is not clear how the new change affects the positive effect of stock-based compensation on the FERC. Based on a test comparing the pre-adoption period and the post-adoption period of FAS123R, we find that stock-based compensation remains positively associated with the FERC even in the post-adoption period, although its effect is weaker than that in the pre-adoption period.[6]

Third, we examine whether the positive effect of stock-based compensation on the FERC is observed for near-term earnings, long-term future earnings, or both. Because managers' incentive to manipulate earnings induced by stock-based compensation is likely to be temporary, for example, only prior to insider sales, the positive effect of stock-based compensation on the FERC should be stronger for the long-term component than for the short-term component of future earnings, consistent with the informative disclosure argument.[7] We confirm this conjecture by finding that stock-based compensation actually improves the FERC for long-term earnings (i.e. two-year and three-year ahead earnings) but not for short-term earnings (i.e. current and one-year forward earnings).

5. Additional Analyses

5.1. Controlling for the Endogeneity of Stock-Based Compensation

Similar to previous studies on executive compensation, our study is subject to the potential endogeneity of stock-based compensation. In particular, according to the traditional compensation literature, the principal is likely to put more weight on a performance measure that can better capture the agent's efforts. If stock prices better represent managerial efforts to improve future earnings, it is expected that firms with more informative stock prices are more likely to compensate their managers with equity. Kang and Liu (2008) find that pay-to-performance sensitivity increases when a stock price aggregates more information (either private or public) because a more informative stock price enables more effective monitoring to improve

[6]We posit that this weaker effect for the post-adoption period could be due to the small sample size in the post-adoption period. In addition, the post-adoption period overlaps with the economic downturn of the financial crisis, during which stock prices and earnings were very volatile. The high volatility associated with these great uncertainties may not have been fully anticipated by managers in 2007, for which the current stock return data are collected. While it would be interesting to further examine the implications of the new accounting standard related to stock-based compensation on managers' disclosure behaviors, we propose that such an examination be conducted in a future study due to the sample limitation and scope of the present study. Further implications are discussed in the conclusion.

[7]We appreciate the referee's suggestion to conduct this analysis to strengthen our inferences.

managerial incentives. Jayaraman and Milbourn (2011) similarly demonstrate that the proportion of stock-based compensation in total compensation increases with a firm's stock liquidity.

To address the potential endogeneity between managerial compensation and the informativeness of stock prices, we re-estimate regressions (2) and (3) using a two-stage regression analysis. The predicted level of stock-based compensation in year t is calculated based on the model of stock-based compensation used by Dikolli, Kulp, and Sedatole (2009). To the extent that some of the instrumental variables used in the first-stage estimation model are not directly associated with the FERC of the current year, we can mitigate the potential endogeneity of stock-based compensation. We estimate the model as follows:

$$\begin{aligned}\text{EQ\_COMP}_t = {} & c_0 + c_1 \times Q_{t-1} + c_2 \times \text{ROA}_{t-1} + c_3 \times \text{CFO}_{t-1} + c_4 \times \text{RET}_t + c_5 \times \text{RET}_{t-1} \\ & + c_6 \times \text{STD\_ROA}_{t-1} + c_7 \times \text{STD\_CFO}_{t-1} + c_8 \times \text{RET\_VOL}_{t-1} \\ & + c_9 \times \text{LOG(SALES)}_{t-1} + c_{10} \times \text{NOL}_{t-1} + c_{11} \times \text{SF\_CASH}_{t-1} \\ & + c_{12} \times \text{CONSTR\_DIV}_{t-1} + \text{Industry Dummies} + \text{Year Dummies} + \zeta_t,\end{aligned} \tag{4}$$

where Q_{t-1} is the Tobin's Q ratio at the end of year $t-1$, CFO_{t-1} is the cash flow from operations for year $t-1$, ROA_{t-1} is the return on assets for year $t-1$, STD_ROA_{t-1} (STD_CFO_{t-1}) is the standard deviation of ROA (CFO) from years $t-5$ to $t-1$, RET_VOL_{t-1} is the standard deviation of annual stock returns from years $t-5$ to $t-1$, and LOG(SALES)_{t-1} is the natural logarithm of sales for year $t-1$. NOL_{t-1} is an indicator variable representing the net operating loss carried forward from year $t-1$. SF_CASH_{t-1} is a variable representing the cash shortfall for year $t-1$. CONSTR_DIV_{t-1} is an indicator variable for the dividend constraint for year $t-1$. The exact definitions of these variables are provided in Appendix 1. While previous studies identify these explanatory variables, particularly NOL_{t-1}, SF_CASH_{t-1}, and CONSTR_DIV_{t-1}, as determinants of stock-based compensation, researchers have not established whether these three variables are systematically associated with the FERC.

Appendix 2 displays the results of the estimation of regression (4). As indicated in the table, the variables, such as Q_{t-1}, STD_ROA_{t-1}, RET_VOL_{t-1}, LOG(SALES)_{t-1}, NOL_{t-1}, SF_CASH_{t-1},and CONSTR_DIV_{t-1}, have significant coefficients with the expected signs. This finding is consistent with those of previous studies (e.g. Dikolli et al., 2009). Given that we are interested in the effect of stock-based compensation on the FERC, not solely its effect on the dependent variable (i.e. current stock return) in the second-stage regression, we cannot directly evaluate the validity of the three instrumental variables (NOL_{t-1}, SF_CASH_{t-1}, and CONSTR_DIV_{t-1}) based on Stock-Yogo statistics. Instead, we test the validity of these instrumental variables following the suggestions of Larcker and Rusticus (2010). The F-test for the joint explanatory power of the three instruments is 28.86, which is above the suggested value for three instruments of 12.83, thus representing a low possibility of weak instrument problems. In addition, the three instruments collectively improve the explanatory power of the regression model of stock-based compensation by 1.0 percentage point, that is, from 12.2% to 13.2%.[8]

[8]In addition, we test whether the three instruments are associated with the FERC by estimating the FERC model augmented with these three variables and their interaction terms with future earnings. The untabulated results depict that all of the coefficients on the interaction terms (between the three instrumental variables and future earnings) are not significant, indicating that these variables are not associated with the FERC. This result provides additional evidence for the validity of our instruments.

The results of the second-stage regressions using the predicted value of stock-based compensation are presented in Panel A of Table 5. In accordance with our hypothesis, both Columns (1) and (2) demonstrate that the coefficient on the interaction term between X_{t3} and EQ_COMP$_t$ remains positive. The coefficient is marginally insignificant (p-value = .143) in Column (1) but is statistically significant at the 5% level in Column (2) (p-value = .050). The earnings management results provide inferences that are similar to those displayed in the previous section. Column (2) indicates that the coefficient on $X_{t3} \times$ EQ_COMP$_t \times$HIGH_EM$_t$ is significantly negative (p-value = .018).[9]

To further alleviate the endogeneity concern, we conduct a change analysis by considering two events of granting stock-based compensation during our sample period: (i) the initiation of equity-based compensation and (ii) a substantial increase in such payments. If the enhanced informativeness of stock prices is a result of changes in equity-based compensation schemes rather than other causes, we expect to observe a higher FERC in the periods after such changes. First, to isolate the initiation cases, we identify those firms that started equity-based compensation schemes over our research period. Then, we set three years after the event, including the year of initiation, as the post-period and three years before the event year as the pre-period. Second, we also identify the group of firms that experienced a substantial increase in equity-based compensation based on an annual change in EQ_COMP. Specifically, those firm-years that belong to the top quintile of annual change in EQ_COMP are defined as the group with a high increase. Again, the three-year period after the change (inclusive of the event year) is classified as the post-period and is compared with the three-year period before the change.[10] The dummy variable *Post* is set to one for the post-period and zero for the pre-period.

Panel B of Table 5 shows the results of the change analysis. As shown in Columns (1) and (2), the coefficient on the interaction variable, $X_{t3} \times$POST, is positive and significant at the 5% level for both the initiation and high increase cases. This enhanced FERC for the post-period suggests that our results are not likely to be driven by inverse causality or by uncontrolled firm characteristics that may affect both the FERC and a firm's choice of CEO remuneration package. As a further check, we repeat the tests by changing the event period from three years to one year. The untabulated results are similar to those in Panel B of Table 5, indicating an improved FERC after firms initiate stock-based compensation or experience a significant increase in such payments.

5.2. *Effect of Management Forecast Frequency*

In an additional analysis, we examine a specific channel through which stock-based compensation can affect the informativeness of current stock prices in relation to future earnings. Equity-incentivized CEOs can use management forecasts to communicate their private information about future earnings to shareholders (Nagar et al., 2003). Trueman (1986) argues that the release of a forecast itself can affect firm value. A manager who detects any changes in a firm's economic environment is expected to make optimal business decisions based on the

[9]Alternatively, we also employ the lagged variable of stock-based compensation as an explanatory variable. To the extent that stock-based compensation from the previous year is based on determinants that are available only before the current year, the previous year's stock-based compensation is more likely to be exogenous to the factors that potentially affect the FERC in the current year. The inferences from the test using the lagged variable of stock-based compensation are similar to those from the main analyses (untabulated).

[10]To obtain a meaningful inference, for both events, we only consider cases in which a firm has at least two observations in both the pre- and post-periods.

Table 5. Stock-based compensation and FERC: controlling for endogeneity of stock-based compensation

Panel A: Using the predicted variable of stock-based compensation

	Test of H1 (1)		Test of H2 (2)	
Variables	Coefficient	*p*-Value	Coefficient	*p*-Value
X_{t-1}	−0.5036**	.017	−0.5098**	.014
X_t	1.0428***	.000	1.0541***	.000
X_{t3}	1.2111***	.000	1.2198***	.000
RET_{t3}	−0.1427***	.000	−0.1421***	.000
EQ_COMP_t	0.0003	.110	0.0002	.178
$X_{t-1} \times EQ\_COMP_t$	−0.0066***	.000	−0.0066***	.000
$X_t \times EQ\_COMP_t$	0.0052**	.035	0.0050**	.047
$X_{t3} \times EQ\_COMP_t$	0.0016	.143	0.0025**	.050
$RET_{t3} \times EQ\_COMP_t$	−0.0002	.501	−0.0002	.450
$SIZE_t$	−0.0378***	.004	−0.0382***	.003
$X_{t3} \times SIZE_t$	0.0001	.995	−0.0019	.943
$LOSS_t$	0.0194	.456	0.0201	.436
$X_{t3} \times LOSS_t$	−1.6894***	.000	−1.6612***	.000
$GROWTH_t$	0.1669***	.000	0.1677***	.000
$X_{t3} \times GROWTH_t$	−0.2086***	.000	−0.2049***	.000
STD_EARN_t	−0.7306***	.000	−0.6939***	.000
$X_{t3} \times STD\_EARN_t$	−0.0028	.995	0.0046	.992
AC_t	0.0593***	.002	0.0593***	.002
$X_{t3} \times AC_t$	−0.0288	.414	−0.0298	.401
NUM_MF_t	−0.0088***	.001	−0.0089***	.001
$X_{t3} \times NUM\_MF_t$	0.0169**	.011	0.0169***	.008
$HIGH\_EM_t$			−0.0151	.283
$X_{t3} \times HIGH\_EM_t$			−0.0091	.903
$X_{t3} \times EQ\_COMP_{t-1} \times HIGH\_EM_t$			−0.0023**	.018
Industry Fixed Effects	Included		Included	
Year Fixed Effects	Included		Included	
F-test:				
$X_{t3} \times EQ\_COMP_t + X_{t3} \times EQ\_COMP_t \times HIGH\_EM_t = 0$			0.0002	.860
N	11,415		11,415	
Adj. R^2	.3686		.3704	

Panel B: Initiation and increase of stock-based compensation

	Initiation (1)		Increase (2)	
Variables	Coefficient	*p*-Value	Coefficient	*p*-Value
X_{t-1}	−0.8341***	.007	−1.2285***	.000
X_t	1.3581***	.001	1.4611***	.000
X_{t3}	1.3498***	.008	1.8140***	.000
RET_{t3}	−0.1626***	.000	−0.1738***	.000
POST	0.038	.271	−0.0244	.254
$X_{t-1} \times POST$	0.0099	.977	0.8099***	.001
$X_t \times POST$	−0.6457	.140	−0.5909**	.014
$X_{t3} \times POST$	0.2683**	.029	0.1920**	.042
$RET_{t3} \times POST$	−0.0391	.390	−0.0713**	.025
$SIZE_t$	−0.0349	.179	−0.0456**	.014

(*Continued*)

Table 5. Continued

Panel A: Using the predicted variable of stock-based compensation				
	Test of H1 (1)		Test of H2 (2)	
Variables	Coefficient	*p*-Value	Coefficient	*p*-Value
$X_{t3} \times \text{SIZE}_t$	−0.0523	.574	−0.0744	.199
LOSS_t	0.1041	.200	−0.0265	.349
$X_{t3} \times \text{LOSS}_t$	−1.3160**	.037	−2.0919***	.000
GROWTH_t	0.2308***	.000	0.1152***	.000
$X_{t3} \times \text{GROWTH}_t$	−0.4976***	.000	−0.3446***	.003
STD_EARN_t	−0.5845	.307	−0.4914	.188
$X_{t3} \times \text{STD\_EARN}_t$	−1.3887	.441	0.3189	.772
AC_t	−0.0088	.843	0.0761***	.000
$X_{t3} \times \text{AC}_t$	0.2722*	.093	0.0458	.571
NUM_MF_t	−0.0099*	.065	−0.0078**	.034
$X_{t3} \times \text{NUM\_MF}_t$	0.0282	.274	0.0186*	.067
Industry Fixed Effects	Included		Included	
Year Fixed Effects	Included		Included	
N	1104		4337	
Adj. R^2	.3752		.3889	

Notes: This table presents additional tests to control for the potential endogeneity of stock-based compensation. Panel A shows the results based on the predicted variable of stock-based compensation for year *t*, estimated from the model in Appendix 2. H1 is addressed in Column 1 and H2 in Column 2. Panel B reports the results for firms that initiate the equity based-compensation or experience a substantial increase in such payments. The OLS regression analysis is conducted. The top quintile group of the annual change in EQ_COMP is selected as firms with high increases in equity-based payments. The three-year period after the event (inclusive of the event year) is classified as a post-period (POST) and compared with a three-year period before the event. See Appendix 1 for the variable definitions. All of the continuous variables are winsorized at the 1% and 99% levels. All of the *p*-values are two-sided and are based on standard errors adjusted for firm and year clustering.

***Two-tailed significance at the 1% level.

**Two-tailed significance at the 5% level.

*Two-tailed significance at the 10% level.

new situation. Investors consider this factor when evaluating a firm; thus, their perceptions of the firm manager's capabilities become value relevant. However, as investors cannot directly observe a CEO's skills, an equity-incentivized manager with a high level of ability attempts to signal that she has noticed such changes by voluntarily providing management forecasts. Based on Trueman's (1986) model, Baik et al. (2011) report empirical findings that management forecast frequency is positively associated with CEO ability. They also confirm that more useful information is transmitted to the market by CEOs with a high level of ability than by CEOs with a low level of ability, as forecasts issued by the former are more accurate and impactful than those issued by the latter. Choi et al. (2011) further find that more frequent management earnings forecasts increase stock prices' informativeness about future earnings. In line with these studies, we conjecture that the association between stock-based compensation and the FERC is lower for firms that provide less frequent management forecasts than for firms that provide more frequent management forecasts.

To test this association, we include an additional variable, LOW_MF_t, and its interaction term with the earnings and return variables in equation (2). LOW_MF_t is defined as a dummy variable for the lowest frequency group of management forecasts. It takes the value of one if a firm belongs to the lowest quintile group for the number of management forecasts made in year *t*.

Table 6. Effect of management forecast frequency

Variables	Coefficient	*p*-Value
X_{t-1}	−0.4096**	.043
X_t	1.0889***	.000
X_{t3}	1.1125***	.000
RET_{t3}	−0.1451***	.000
EQ_COMP_t	0.0003*	.092
$X_{t-1} \times EQ\_COMP_t$	−0.0073***	.000
$X_t \times EQ\_COMP_t$	0.0027*	.085
$X_{t3} \times EQ\_COMP_t$	0.0033***	.002
$RET_{t3} \times EQ\_COMP_t$	−0.0002	.490
$SIZE_t$	−0.0426***	.001
$X_{t3} \times SIZE_t$	0.0044	.852
$LOSS_t$	0.0176	.535
$X_{t3} \times LOSS_t$	−1.6856***	.000
$GROWTH_t$	0.1725***	.000
$X_{t3} \times GROWTH_t$	−0.1965***	.000
STD_EARN_t	−0.7547***	.000
$X_{t3} \times STD\_EARN_t$	−0.0361	.937
AC_t	0.0633***	.001
$X_{t3} \times AC_t$	−0.0088	.793
NUM_MF_t	−0.0055*	.062
$X_{t3} \times NUM\_MF_t$	0.0103	.203
LOW_MF_t	0.0556**	.012
$X_{t3} \times LOW\_MF_t$	0.1092	.175
$X_{t3} \times EQ\_COMP_{t-1} \times LOW\_MF_t$	−0.0041***	.001
Industry Fixed Effects	Included	
Year Fixed Effects	Included	
F-test		
$X_{t3} \times EQ\_COMP_t + X_{t3} \times EQ\_COMP_t \times LOW\_MF_t = 0$	−0.0008	.556
N	12,213	
Adj. R^2	.3676	

Notes: This table reports the results from the cross-sectional analysis of the effect of stock-based compensation on the FERC, conditional on management forecast frequency. LOW_MF is an indicator variable for the lowest quintile group of management forecast frequency. See Appendix 1 for other variable definitions. The continuous variables are winsorized at the 1% and 99% levels. All of the *p*-values are two-sided and are based on standard errors adjusted for firm and year clustering.

***Two-tailed significance at the 1% level.

**Two-tailed significance at the 5% level.

*Two-tailed significance at the 10% level.

The results are presented in Table 6. The coefficient on the interaction term $X_{t3} \times EQ\_COMP_t$ is positive and significant at the 1% level, which is consistent with the results shown in Table 3. This interaction term is significantly negative for the lowest group of management forecast frequency, as exhibited by the coefficient on $X_{t3} \times EQ\_COMP_t \times LOW\_MF_t$ (*p*-value = .001). The total effect of stock-based compensation for firms with a low forecast frequency (i.e. $X_{t3} \times EQ\_COMP_t + X_{t3} \times EQ\_COMP_t \times LOW\_MF_t$) is insignificant according to the *F*-test result (*p*-value = .556). In other words, additional equity-based compensation in such firms does not improve shareholders' ability to predict future performance. A low level of forecast frequency may indicate a CEO's lower ability to precisely predict future earnings. In this case, stock price informativeness about future earnings does not increase, as less accurate information about future firm value is conveyed to the market through corporate disclosures. In our analysis, improvement in the price informativeness associated with equity-based incentives is only

observed in firms with a moderate or relatively high forecast frequency (i.e. firms not belonging to the low forecast frequency group). This result is in line with Nagar et al.'s (2003) notion that managers who receive a high level of stock-based compensation can alleviate disclosure agency problems by making disclosures more frequently. Managers in the low forecast frequency group may not be sufficiently motivated to frequently update investors' earnings expectations due to high levels of uncertainty about future earnings or high proprietary costs.

5.3. *Future Net Sales by a CEO*

As discussed in H2, the presence of earnings management may capture two incentives of managers: one to distort earnings to maximize their remuneration and the other to communicate their private information to shareholders. In the latter case, the FERC will be increased rather than harmed by equity-incentivized managers, which may weaken the results from earnings management in our main tests. In this section, we identify a subset of firms where the former incentive of managers is more likely to dominate.[11] Prior studies suggest that when managers with a high level of equity-based incentives plan to sell their shares in the near future, they tend to engage in earnings management by meeting or beating analysts' forecasts and reporting high discretionary accruals (e.g. Bergstresser & Philippon, 2006; Cheng & Warfield, 2005; Cheng et al., 2011). Based on these studies, we identify two opposing cases of firms within the group of high earnings management based on the level of net sales by the CEO in the subsequent year as follows: one group with a high level (H_NET_SALES) and the other with a low level of future net sales (L_NET_SALES). The former (latter) group includes firms within the top (bottom) quintile of the high earnings management group. Net sales are calculated in dollar amounts as open market sales minus open market purchases minus any options exercised and then divided by the CEO's total shareholdings.

The results are shown in Table 7. The coefficient on $\text{H\_Net\_Sales} \times X_{t3} \times \text{EQ\_COMP}_t$ is significantly negative, indicating that the negative effect of high levels of earnings management on price informativeness is mainly observed for firms with high future net sales. In addition, the positive coefficient on $\text{L\_Net\_Sales} \times X_{t3} \times \text{EQ\_COMP}_t$ suggests that in firms that have a high level of earnings management, if the level of future net sales is low, rewarding the manager based on equity value still improves the FERC. This result, together with those for the other groups ($X_{t3} \times \text{EQ\_COMP}_t$), supports our overall findings that stock-based compensation, on average, improves the informativeness of stock prices about future earnings.[12]

5.4. *Alternative Measure of the Information Environment*

In this section, we test our hypotheses by conducting an alternative analysis based on a measure of a firm's information environment. While the FERC measure is mainly intended to capture the informativeness of stock prices about future earnings, it is possible to expect that managerial disclosures induced by a higher amount of stock-based compensation can make a firm's overall information environment more transparent.[13] Thus, we examine an index of firm opacity

[11]We thank the anonymous referee for suggesting this argument and the test.

[12]We obtain qualitatively similar results if we use an alternative measure of net sales that uses the market value of equity as the deflator instead of total shareholdings, following Cheng and Warfield (2005).

[13]Holding other factors constant, the FERC is likely to be positively associated with the transparency of a firm's information environment because many determinants of the FERC (such as analysts following, institutional trading, and corporate disclosures) relate to information flows in the market. However, individual factors may not capture the overall transparency due to the existence of private information and other external market factors. The opacity measure

Table 7. Earnings management and future net sales

Variables	Coefficient	*p*-Value
X_{t-1}	−0.4147**	.042
X_t	1.0719***	.000
X_{t3}	1.2023***	.000
RET_{t3}	−0.1454***	.000
EQ_COMP_t	0.0004*	.089
$X_{t-1} \times EQ\_COMP_t$	−0.0073***	.000
$X_t \times EQ\_COMP_t$	0.0031**	.037
$X_{t3} \times EQ\_COMP_t$	0.0022*	.061
$RET_{t3} \times EQ\_COMP_t$	−0.0002	.562
$SIZE_t$	−0.0396***	.003
$X_{t3} \times SIZE_t$	−0.0066	.780
$LOSS_t$	0.0167	.559
$X_{t3} \times LOSS_t$	−1.6806***	.000
$GROWTH_t$	0.1722***	.000
$X_{t3} \times GROWTH_t$	−0.1971***	.000
STD_EARN_t	−0.7513***	.000
$X_{t3} \times STD\_EARN_t$	−0.0501	.912
AC_t	0.0574***	.002
$X_{t3} \times AC_t$	−0.0021	.947
NUM_MF_t	−0.0090***	.001
$X_{t3} \times NUM\_MF_t$	0.0158**	.015
H_Net_Sales	0.0669***	.003
L_Net_Sales	−0.0181	.473
H_Net_Sales × X_{t3}	0.0132	.895
L_Net_Sales × X_{t3}	−0.2825***	.004
H_Net_Sales × X_{t3} × EQ_COMP_t	−0.0031**	.029
L_Net_Sales × X_{t3} × EQ_COMP_t	0.0031*	.062
Industry Fixed Effects	Included	
Year Fixed Effects	Included	
F-test:		
H_Net_Sales × X_{t3} × EQ_COMP_t = L_Net_Sales × X_{t3} × EQ_COMP_t	−0.0062	.013
N	12,213	
Adj. R^2	.367	

Notes: This table reports the effect of stock-based compensation on the FERC, conditional on the magnitude of earnings management. H_NET_SALES (L_NET_SALES) is set to one if a CEO's net sales in year $t + 1$ are in the top (bottom) quintile among the high earnings management group. See Appendix 1 for the other variable definitions. All of the continuous variables are winsorized at the 1% and 99% levels. All of the *p*-values are two-sided and are based on standard errors adjusted for firm and year clustering.

***Two-tailed significance at the 1% level.

**Two-tailed significance at the 5% level.

*Two-tailed significance at the 10% level.

developed by Anderson et al. (2009). They combine four commonly used proxies for information opacity and develop an index as the sum of the decile ranks divided by 40. The four proxies are (i) trading volume (inverse ranking), (ii) the bid-ask spread, (iii) the number of analysts following (inverse ranking), and (iv) the analyst forecast error. The first measure, trading volume, is a proxy for information uncertainty and asymmetry (Leuz & Verrecchia, 2000; Lo, Mamaysky, & Wang, 2004), while the bid-ask spread captures the information asymmetry

developed by Anderson et al. (2009) provides a composite index of the transparency of a firm's information environment by combining four commonly used proxies for information uncertainty and asymmetry.

Table 8. Stock-based compensation and firm opacity

	Main analysis (1)		Earnings management (2)		Management forecasts (3)	
Variables	Coefficient	*p*-Value	Coefficient	*p*-Value	Coefficient	*p*-Value
$LOG(ASSETS)_t$	−0.0679***	.000	−0.0676***	.000	−0.0673***	.000
RET_VOL_t	0.0027***	.000	0.0027***	.000	0.0026***	.000
ROA_{t-1}	−0.3216***	.000	−0.3168***	.000	−0.3145***	.000
$FIRM\_AGE_t$	0.0416***	.000	0.0414***	.000	0.0408***	.000
$R\&D_t$	−0.3482***	.000	−0.3455***	.000	−0.3491***	.000
$LEVERAGE_t$	0.1837***	.000	0.1826***	.000	0.1828***	.000
EQ_COMP_t	−0.0024***	.000	−0.0024***	.000	−0.0025***	.000
$EQ\_COMP_t \times HIGH\_EM_t$			0.0001**	.047		
$EQ\_COMP_t \times LOW\_MF_t$					0.0005***	.000
Industry Fixed Effects	Included		Included		Included	
Year Fixed Effects	Included		Included		Included	
F-test						
$EQ\_COMP_t + EQ\_COMP_{t-1} \times HIGH\_EM_t = 0$			−0.0023***	.000		
$EQ\_COMP_t + EQ\_COMP_{t-1} \times LOW\_MF_t = 0$					−0.0020***	.000
N	14,850		14,850		14,850	
Adj. R^2	.5702		.5704		.5732	

Notes: This table reports the results from the OLS regression analysis in terms of the effect of stock-based compensation on firm opacity. Column 1 displays the main analysis results. Columns 2 and 3 present the results from the cross-sectional analyses, conditional on the magnitude of earnings management (Column 2) and management forecast frequency (Column 3). See Appendix 1 for the variable definitions. The continuous variables are winsorized at the 1% and 99% levels. All of the *p*-values are two-sided and are based on standard errors adjusted for firm and year clustering.
***Two-tailed significance at the 1% level.
**Two-tailed significance at the 5% level.
*Two-tailed significance at the 10% level.

among investors (Diamond & Verrecchia, 1991). Anderson et al. (2009) further explain that the number of analysts following represents the intensity of market scrutiny and that analyst forecast errors capture the availability of information about the firm (Barry & Brown, 1985; Botosan, Plumlee, & Xie, 2004). To the extent that more disclosures by equity-incentivized managers help to improve the transparency of the information environment, we expect to observe a negative effect of stock-based compensation on firm opacity. We specifically estimate the following OLS regressions:

$$\begin{aligned} OPACITY_t = {} & d_0 + d_1 \times LOG(ASSETS)_t + d_2 \times RET\_VOL_t + d_3 \times ROA_{t-1} \\ & + d_4 \times FIRM\_AGE_t + d_5 \times R\&D_t + d_6 \times LEVERAGE_t + d_7 \times EQ\_COMP_t \\ & + \text{Industry Dummies} + \text{Year Dummies} + \eta_t, \end{aligned} \tag{5}$$

$$\begin{aligned} OPACITY_t = {} & d_0 + d_1 \times LOG(ASSETS)_t + d_2 \times RET\_VOL_t + d_3 \times ROA_{t-1} \\ & + d_4 \times FIRM\_AGE_t + d_5 \times R\&D_t + d_6 \times LEVERAGE_t + d_7 \times EQ\_COMP_t \\ & + d_8 \times EQ\_COMP_t \times HIGH\_EM_t (\text{or } EQ\_COMP_t \times LOW\_MF_t) \\ & + \text{Industry Dummies} + \text{Year Dummies} + \eta_t, \end{aligned} \tag{6}$$

where $OPACITY_t$ is a variable representing the opacity of the firm's information environment for year t, standardized to a range from 0 to 1; $LOG(ASSETS)_t$ is the natural logarithm of total assets at the end of year t; $FIRM\_AGE_t$ is the number of years a firm has been listed on COMPUSTAT as of the end of year t; $R\&D_t$ is the research and development expenses (divided by total assets) for year t; and $LEVERAGE_t$ is the ratio of total liabilities to total assets at the end of year t.[14]

Table 8 displays the results of the regression estimations. Column (1) indicates that the coefficient of the main variable of interest, EQ_COMP_t, is negative and statistically significant (p-value $< .001$), indicating that a firm's information environment is less opaque (i.e. more transparent) when the firm gives its CEO more stock-based compensation. This result basically echoes those obtained from the previous tests in terms of the FERC. In addition, the inferences made in the cross-sectional analyses displayed in Columns (2) and (3) are similar to those indicated in the previous sections as well. The coefficient of $EQ\_COMP_t \times HIGH\_EM_t$ is significantly positive (p-value $= .047$) in Column (2), and the coefficient of $EQ\_COMP_t \times LOW\_MF_t$ is also significantly positive (p-value $< .001$).

6. Conclusion

This paper examines the association between CEO stock-based compensation and the market's ability to anticipate future earnings using a sample of S&P 1500 firms during the 1995–2007 period. We find a positive effect of CEO stock-based compensation on the FERC. This result implies that stock prices are more reflective of future earnings as the proportion of equity-based pay in CEO total compensation increases. In addition, this positive relationship is weakened for firms with a high level of discretionary accruals or a low management forecast frequency. These results remain robust to different stock-based compensation measures (i.e. percentile rank and continuous variables) and in various additional tests. Possible endogeneity issues are addressed through a two-stage analysis and a change analysis.

Although we conduct various tests to check the sensitivity of our main findings, we acknowledge the following limitations of this study. First, we do not test situations in which equity-compensated managers are likely to temporarily depress their firms' stock prices before the option award date (Baker et al., 2003, 2009; McAnally et al., 2008). Whereas these studies examine stock prices before the stock grant date on a quarterly basis or over an even shorter period, the FERC model adopted in the current study focuses on one-year returns and, thus, likely neutralizes such temporary changes to a stock price.[15]

Second, although we treat management forecasts as homogeneous, shareholders may perceive the credibility of disclosures differently depending on who makes the disclosure. When estimating future stock prices, shareholders are more likely to rely on information from managers who have a history of accurate forecasts (Yang, 2012). Managers may intentionally choose to report positive news forecasts more precisely than negative news forecasts before insider sales (Cheng, Luo, & Yue, 2013). In our analysis, we consider only management forecast frequency as a conditioning variable.[16]

Finally, despite various tests conducted to address the endogeneity concern, we cannot completely rule out the possibility of endogeneity. Certain unobservable firm characteristics may

[14]The other variables are as defined earlier, and their exact measurements are provided in Appendix A.

[15]Although stock movement has an effect, it should strengthen the results in the opposite direction of our main findings (i.e. a negative association between stock-based compensation and the FERC).

[16]However, in testing for earnings management, we explore cases in which managers are more likely to engage in earnings management (i.e. high insider sales in the following period).

affect a firm's tendency to provide stock-based compensation and its information environment simultaneously. For example, high-growth firms tend to offer more stock options to their managers. At the same time, the equity value of such firms is more closely related to reported earnings, especially future earnings (see e.g. the valuation model by Zhang (2000)).[17] It is worthwhile to note that although we control for various firm characteristics, including firm growth, and conduct alternative tests, these approaches may not completely resolve the endogeneity issue.

Despite these limitations, our study provides empirical evidence that offering stock-based pay to managers improves the informativeness of stock prices in relation to future earnings. Of particular importance is this study's confirmation of the role played by stock-based compensation in mitigating disclosure-related agency costs. The enhanced information flow from managers can benefit shareholders by reducing their information costs, such as collecting and processing the information. In this sense, providing stock compensation will be particularly beneficial for shareholders of companies with scarce information sources or high uncertainty in predicting future earnings. Furthermore, when designing employee remuneration schemes, the additional costs resulting from tying pay to firm equity value need to be carefully compared with the benefits. This study suggests that the benefits in terms of shareholders' improved ability to predict future firm performance may partially offset the costs, such as a higher level of risk premium demanded by a risk-averse manager when her pay is based on a risky stock rather than a cash payment. Thus, our findings should be of interest to shareholders and boards of directors with respect to their executive compensation policies.

Accounting policies on how to report employee compensation may also affect a firm's preference for providing equity-based compensation and the behaviors of equity-incentivized managers. For example, the adoption of FAS123R is reported to result in significant decreases in the usage of stock options (Hayes, Lemmon, & Qiu, 2012). However, only modest changes in pay-to-performance sensitivity are found, as most firms have substituted stock options with other forms of compensation, such as restricted stocks. A future study could investigate the impact of the standard change on equity-incentivized managers' disclosure behaviors and on the market's ability to predict future firm performance.

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[17]We thank the editor for suggesting this case.

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Appendix 1. Variable Descriptions

Variables	Description
EQ_COMP_t	Proportion of CEO's compensation tied to her firm's share price for year t, defined as the sum of the stock option and restricted stock grant values, divided by the total compensation
RET_t	Cumulative stock return for year t
RET_{t3}	Cumulative stock return for years $t+1$ through $t+3$
X_t	Earnings for year t, defined as the income available to common shareholders before extraordinary items for year t, deflated by the market value of equity at the beginning of year t
X_{t-1}	Earnings for year $t-1$
X_{t3}	Sum of earnings for years $t+1$ through $t+3$, measured as the income available to common shareholders before extraordinary items for years $t+1$ through $t+3$, deflated by the market value of equity at the beginning of year t
$SIZE_t$	Natural logarithm of the market value of equity at the beginning of year t
$LOSS_t$	Indicator variable for negative future earnings, set to one if X_{t3} is negative and zero otherwise
$GROWTH_t$	Growth of total assets in percentage from years $t-1$ to $t+1$
STD_EARN_t	Standard deviation of earnings (X) from years t to $t+3$
AC_t	Analyst coverage, defined as the natural logarithm of one plus the number of analysts who follow a firm in the month before the earnings announcement for year t, where the number of analysts is taken from the First Call Analyst Forecast database
NUM_MF_t	Number of management forecasts issued in year t, where the management forecast data are taken from the First Call Company Issued Guidance files
LOW_MF_t	Indicator variable of the group of low frequency management forecasts, set to one if a firm belongs to the lowest quintile group of the number of management forecasts in year t
$PMDTA_t$	Performance matched discretionary total accruals (Kothari et al., 2005) for year t
$HIGH\_EM_t$	Indicator variable of the group of firms with a high level of earnings management, set to one if a firm belongs to the highest quintile group of the performance matched discretionary total accruals in year t
Q_{t-1}	Tobin's Q ratio at the end of year $t-1$, defined as the market value divided by the book value of assets
CFO_{t-1}	Cash flow from operations for year $t-1$, divided by the total assets at the end of year $t-1$
ROA_{t-1}	Income before extraordinary items for year $t-1$, scaled by the total assets at the end of year $t-1$
STD_CFO_{t-1}	Standard deviation of CFO from years $t-5$ to $t-1$
STD_ROA_{t-1}	Standard deviation of ROA from years $t-5$ to $t-1$
RET_VOL_{t-1}	Standard deviation of annual stock returns from years $t-5$ to $t-1$
$LOG(SALES)_{t-1}$	Natural logarithm of sales for year $t-1$
NOL_{t-1}	Indicator variable for the net operating loss carried forward, set to one if a firm has a net operating loss carried forward in any of the three years $t-4$ through $t-1$
SF_CASH_{t-1}	Cash shortfall variable, calculated as the average of (common and preferred dividends plus cash flows from investing activities minus cash flows from operations) divided by the total assets from years $t-3$ to $t-1$
$CONSTR\_DIV_{t-1}$	Indicator variable for dividends constraint, defined as one if in any of the previous three years (i.e. years $t-3$ to t22121) (the retained earnings at year-end plus the cash dividends and stock repurchases made during the year) divided by (the previous year's cash dividends and stock repurchases) is less than two or if the denominator is zero for all three years. Otherwise, this variable is set to zero

(*Continued*)

Appendix 1. Continued

Variables	Description
$OPACITY_t$	Firm opacity for year t, defined as the sum of the decile ranks of four individual proxies for trading volume (reverse ranking), the bid-ask spread, the number of analysts following (reverse ranking), and the analyst forecast error, standardized to a range between 0 and 1
$LOG(ASSETS)_t$	Natural logarithm of the total assets at the end of year t
$FIRM\_AGE_t$	Number of years a firm has been listed on COMPUSTAT at the end of year t
$R\&D_t$	Research and development expenses for year t, divided by the total assets at the end of year t
$LEVERAGE_t$	Total liabilities divided by the total assets in year t

Appendix 2. Estimation of Stock-Based Compensation

Variables	Coefficient	*p*-Value
Q_{t-1}	0.0340***	.000
ROA_{t-1}	0.0042	.873
CFO_{t-1}	0.0291	.540
RET_t	0.0074	.503
RET_{t-1}	−0.0086	.244
STD_ROA_{t-1}	0.1408**	.031
STD_CFO_{t-1}	−0.0430	.646
RET_VOL_{t-1}	0.0380***	.000
$LOG(SALES)_{t-1}$	0.0483***	.000
NOL_{t-1}	0.0254***	.000
SF_CASH_{t-1}	0.1958***	.000
$CONSTR\_DIV_{t-1}$	0.0503***	.000
Industry Fixed Effects	Included	
Year Fixed Effects	Included	
Joint *F*-test for NOL_{t-1}, SF_CASH_{t-1}, $CONSTR\_DIV_{t-1}$	28.86	
p-Value	.000	
N	15,945	
Adj. R^2	.1321	

Notes: This table reports the results from the OLS regression of a CEO's stock-based compensation for year t on its determinants from year $t-1$. See Appendix 1 for the variable definitions. All of the continuous variables are winsorized at the 1% and 99% levels. All of the *p*-values are two-sided and based on standard errors adjusted for firm and year clustering.

***Two-tailed significance at the 1% level.

**Two-tailed significance at the 5% level.

*Two-tailed significance at the 10% level.