

**THE RELATION BETWEEN R&D EXPENDITURES AND
CEO COMPENSATION**

Shijun Cheng
Ph.D. Candidate in Accounting
Katz Graduate School of Business
University of Pittsburgh
Pittsburgh, PA 15260
scheng@katz.pitt.edu

VERY PRELIMINARY. COMMENTS WELCOME!

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ABSTRACT

This paper addresses the issue of how firms design CEO incentives to overcome potential underinvestment in R&D. Specifically, I examine the incremental effect of R&D expenditures on CEO compensation above and beyond accounting earnings and stock returns. The results indicate that the incremental effect of R&D expenditures on CEO compensation depends on the strength of the CEO's incentive to focus on short-term accounting earnings. That is, when CEOs have particularly strong incentives to cut R&D expenditures in order to boost accounting earnings, I find that increased R&D expenditures are associated with increased CEO compensation, primarily reflecting increased stock option grants. This effect is present when the CEO is near retirement and when the firm faces an earnings decline that could potentially be reversed by reducing R&D expenditures. Finally, my results suggest that on average, firms provide CEOs with sufficient incentives to overcome the potential underinvestment in R&D.

Key Words: R&D expenditures, CEO compensation, Horizon problem, Cover-up problem.

The Relation between R&D Expenditures and CEO Compensation

I. INTRODUCTION

This paper addresses the issue of how firms design CEO incentives to overcome potential underinvestment in R&D. There have been many concerns that U.S. corporate managers have incentives to underinvest in long-term intangible projects such as R&D in order to boost short-term performance at the expense of firms' long-run welfare (e.g., Drucker 1986, Jacobs 1991, Porter 1992). The GAAP requirement of expensing R&D expenditures and the short-term focus of U.S. capital markets have been cited as the major reasons for the problem of potential underinvestment in R&D (e.g., Bushee 1998).¹ Given that CEO compensation is typically tied to accounting earnings and stock returns (e.g., Murphy 1999), it is natural to consider whether compensation schemes using these performance measures can motivate value-maximizing investment in R&D.

My empirical tests investigate whether R&D expenditures have an incremental effect on CEO compensation after controlling for accounting earnings and stock returns. That is, do firms reward CEOs for R&D expenditures in order to overcome the potential underinvestment in R&D? Potential mechanisms for relating CEO compensation to R&D expenditures include adjusting GAAP earnings to reduce the negative effect of R&D expenditures on earnings, including R&D activities in subjective evaluations of CEOs' performance, as well as incorporating nonfinancial measures such as new product development, innovations and patents into incentive plans (e.g., Bushman et al. 1996, Ittner et al. 1997). Besides affecting accounting

¹ Drucker (1986) reports that in a survey of the CEOs of major corporations, 82% of the CEOs blamed the stock market's excessive focus on short-term accounting earnings for declines in long-term investment.

earnings, R&D expenditures are also related to stock returns and the relative importance of accounting earnings-based versus stock-based incentives (e.g., Clinch 1991, Lev and Sougiannis 1996). As discussed later, the complexity of these relations makes it an empirical issue whether firms design CEO incentives in such a way that R&D expenditures have an incremental effect on CEO compensation.

Data used in this study are from a sample of 157 *Forbes 500* firms in R&D-intensive industries during the years 1984-1991. To examine the incremental effect of R&D expenditures, CEO compensation is regressed on accounting earnings, stock returns and R&D expenditures.² The potential underinvestment problem is likely to be more severe when CEOs have stronger incentives to focus on short-term accounting earnings. Therefore, I focus on the following two situations: (1) CEOs near retirement (i.e., the *horizon problem*), and (2) firms with earnings declines that could be reversed by cutting R&D expenditures (i.e., the *cover-up problem*), because prior studies have documented that CEOs have particularly strong incentives to inflate current accounting earnings in these two situations (e.g., Bushee 1998, Dechow and Sloan 1991, Murphy and Zimmerman 1993).

The empirical results confirm my general hypothesis that the relation between R&D expenditures and CEO compensation depends on the strength of CEOs' incentive to inflate short-term accounting earnings. Specifically, the results indicate that when there is a horizon or cover-up problem, greater R&D expenditures significantly increase CEO total compensation (i.e., the sum

² Because internal R&D expenditures and acquired in-progress R&D are expensed, while acquired completed R&D outputs are recognized as intangible assets and amortized, a CEO's incentive to underinvest in acquiring completed R&D projects may be weaker than the corresponding incentive to cut internal R&D expenditures or to reduce acquisition of in-progress R&D. Therefore, I focus on R&D expenditures reported by COMPUSTAT (#46), which includes both internal R&D expenditures and expenditures on acquired in-progress R&D, but excludes expenditures on acquired completed R&D outputs.

of salary, annual bonus, stock options and other long-term incentives), primarily reflecting increased stock option grants.³ Conversely, in the absence of the horizon and cover-up problems, R&D expenditures do not have a statistically significant effect on CEO compensation.

Finally, I examine whether the previously identified CEO incentives are sufficient to offset the potential horizon and cover-up problems. Consistent with Murphy and Zimmerman (1993), I find that CEOs do not reduce R&D expenditures during their final years, nor do they cut R&D expenditures when their firms face cover-up problems. These results imply that the CEO incentives described above are effective in motivating appropriate levels of investment in R&D.

This paper contributes to the literature in several ways. First, it provides empirical evidence on how firms design CEO incentives to overcome potential underinvestment in R&D. Building on prior studies that document the potential for underinvestment in R&D, I focus on how firms respond by designing incentive arrangements to deal with the potential problem of underinvestment in R&D. I also provide empirical evidence on the effectiveness of CEO incentives in overcoming potential underinvestment in R&D by documenting that firms do not reduce R&D expenditures even when they face the horizon and cover-up problems.

Second, the relation between R&D expenditures and CEO compensation is an important dimension of CEOs' incentives to invest in R&D. However, to my knowledge, Bizjak et al. (1993) is the only existing study that directly examines this relation. Without controlling for accounting earnings and stock returns, they find the counter-intuitive result that greater R&D

³ The appendix provides examples of CEO stock option grants by Chrysler and GTE in the presence of the horizon and cover-up problems during 1984-1991.

expenditures result in decreased CEO cash and total compensation. In contrast, after controlling for accounting earnings and stock returns, I find that greater R&D expenditures result in increased CEO total compensation in the presence of the horizon or cover-up problem. My results suggest that accounting earnings and stock returns are supplemented by other mechanisms in determining CEO incentives. Also, the incremental effect of R&D expenditures on CEO compensation documented in this paper is additional to the effect of R&D intensity on the relative weights on accounting earnings versus stock returns in CEO incentives.⁴

Third, while prior studies have documented that R&D-intensity affects the adoption and vesting schedules of stock option grants (e.g., Gaver and Gaver 1993, Kole 1997), I extend these studies by establishing that R&D expenditures are positively associated with the number and value of CEO stock options granted in the presence of the horizon and cover-up problems.⁵ Further, while Core and Guay (1999) emphasize that stock options are granted to optimize managerial equity incentives, my results suggest that CEO stock options are granted to optimize CEO total incentives, including career concerns.

Finally, the U.S. GAAP requirement to expense R&D has motivated studies of the roles of R&D expenditures in equity valuation (e.g., Healy et al. 1999, Kothari et al. 1999, Lev and Sougiannis

⁴ Baber et al. (1996) do not find that investment opportunities have a significant effect on CEO total compensation. Previous studies examining the effect of R&D intensity and/or investment opportunities on the relative importance of accounting-based versus stock-based incentives have found mixed results (e.g., Baber et al. 1996, Bizjak et al. 1993, Clinch 1991, Eaton and Rosen 1983, Mehran 1995, Smith and Watts 1992).

⁵ Two features of this study should be emphasized. First, I focus on the relation between R&D expenditures and CEO compensation. Rather than simply showing that the horizon and cover-up problems are associated with CEO stock options, I find that the variables that significantly increase the number and value of CEO stock options granted are the *interactions* of R&D expenditures with the horizon and cover-up problems. Neither the horizon problem nor the cover-up problem has a main effect on the number and value of CEO stock options granted. Second, I find that R&D expenditures affect the number and value of CEO stock options granted. While R&D-intensive firms are more likely to adopt stock option plans and use longer vesting schedules of stock options (e.g., Clinch 1991, Gaver and Gaver 1993, Kole 1997, Smith and Watts 1992), prior studies show that R&D expenditures do not affect the value of stock options or the sensitivity of stock options to performance (e.g., Matsunaga 1995, Yermack 1995).

1996). I extend this literature by focusing on the role of R&D expenditures in CEO compensation. While this literature asserts that R&D expenditures are different from normal expenses by documenting the value-relevance of R&D expenditures, my findings support this assertion by demonstrating the relevance of R&D expenditures to CEO compensation. Given that accounting information serves valuation and stewardship purposes (e.g., Gjesdal 1981), this study is likely to add to recent discussions on accounting standards for R&D by showing that R&D expenditures are different from normal expenses from the perspective of stewardship as well.

The rest of the paper is organized as follows. The next section develops the hypotheses. The third section describes the sample, data and method. The fourth section presents the analyses and results. The fifth section discusses sensitivity tests, followed by conclusions.

II. HYPOTHESES

Relating R&D Expenditures to CEO Compensation

The fact that R&D expenditures are typically expensed under U.S. GAAP coupled with the potential short-term focus of the U.S. capital markets create a natural tension between the firm's long-term benefits and the CEO's incentive to boost current accounting earnings (e.g., Bange and Bondt 1998, Bushee 1998, Drucker 1986, Jacobs 1991, Porter 1992). One approach to mitigating this tension is to design CEO compensation in such a way that R&D investments will increase CEO compensation after controlling for the effect of the expenditures on accounting earnings and stock returns. However, because the board of directors is unlikely to have the CEO's specialized knowledge about the profitability of R&D investments, directly contracting on the level of R&D expenditures could potentially create incentives for the CEO to overinvest in R&D

projects.⁶ Alternatively, as discussed next, there are several mechanisms that firms may use to relate R&D expenditures to CEO compensation.

Adjusting GAAP earnings. As demonstrated by Dechow et al. (1994), boards of directors are likely to shield CEOs from expenditures that have long-run benefits by effectively “adding back” the expenditures to the GAAP earnings when determining CEO compensation.

Subjective performance evaluation. Subjective evaluation can mitigate managers’ incentive to focus on tasks that can be objectively measured while sacrificing tasks that are harder to measure in a multitask environment (e.g., Baker et al. 1994). While short-term accounting earnings can be objectively measured, it is harder to measure the long-term benefits of R&D expenditures. This suggests that it is likely that firms employ subjective evaluations that consider R&D activities. For example, firms may use individual performance measures in subjective assessments of CEO performance to capture aspects that are not fully reflected in accounting and stock market-based performance measures (e.g., Bushman et al. 1996). Particularly, Aboody and Kasznik (2000) argue that the board of directors “exercises discretion over the size and timing of option awards”. That is, boards could potentially choose to award more or fewer stock options and to award stock options earlier or later, in response to their subjective assessments of CEO performance.

Nonfinancial measures. Firms use nonfinancial measures in incentive plans to motivate desirable effort allocation (e.g., Banker et al. 2000, Bushman et al. 1996, Ittner et al. 1997). Some nonfinancial measures, such as innovation, new product development and patents, are

⁶ However, the overinvestment problem is likely to be less severe than the underinvestment problem because bad R&D projects will reduce accounting earnings and stock returns simultaneously, while good R&D expenditures are likely to increase stock returns.

closely related to firms' R&D activities and have been used in CEO compensation schemes (Holthausen et al 1995, Ittner et al. 1997). Therefore, R&D expenditures are likely to be related to CEO compensation via the uses of nonfinancial measures in CEO incentive plans.

The Complexity of the Relation between R&D Expenditures and CEO Compensation

As discussed below, it is an empirical issue whether R&D expenditures have an incremental effect on CEO compensation after controlling for accounting earnings and stock returns. On the one hand, R&D expenditures have been shown to be positively related to stock returns (e.g., Lev and Sougiannis 1996, Sougiannis 1994). Thus, the negative effect of R&D expenditures on the part of CEO compensation that is related to accounting earnings are likely to be mitigated by the part of CEO compensation that is tied to stock returns. Furthermore, R&D expenditures are likely to lead to adjustments in the weights on accounting earnings and stock returns in CEO compensation (e.g., Baber et al. 1996, Clinch 1991).

On the other hand, there are several reasons why stock-based compensation may not be enough to entirely offset the negative effect of R&D expenditures on accounting earnings-based incentives. First, as discussed earlier, stock markets may have a short-term focus. Consistent with this argument, empirical evidence shows that firms have incentives to manipulate accounting earnings to meet simple earnings benchmarks so as to avoid unfavorable reactions in stock markets (e.g., Brown 1998, Burgstahler and Dichev 1997, Dechow and Skinner 2000). Second, R&D projects are usually unique to the firm that develops the projects. This implies that the R&D projects are associated with high information asymmetry between the managers and shareholders, which reduces the likelihood that stock prices fully capture the potential benefits of R&D expenditures (Aboody and Lev 2000, Barth and Kasznik 1999). Third, stock price may be

an imperfect measure of managerial performance and may be insufficient to provide guidance to managers about which tasks to focus on (e.g., Feltham and Xie 1994, Paul 1992). Finally, because stock prices are affected by factors that are not subject to CEOs' influence, increasing stock-based incentives imposes more risk on CEOs and result in higher risk premium (e.g., DeAngelo 1988, Sloan 1993, Weisbach 1988).

The marginal benefits to the firm from rewarding R&D expenditures would be higher when the CEO's incentive to boost current accounting earnings is stronger. Therefore, my general hypothesis is that the incremental effect of R&D expenditures depends on the strength of CEOs' incentive to boost current accounting earnings by cutting R&D expenditures. In this paper, I focus specifically on the horizon and cover-up problems, both of which give CEOs strong incentives to focus on short-term accounting earnings.

The Horizon Hypothesis

CEOs' career concerns are their concerns about the effects of current performance on future compensation (Gibbons and Murphy 1992). Career concerns can motivate the CEOs to exert effort on behalf of shareholders. For example, Fama (1980) argues that the managerial labor market disciplines managers by tying wages to performance. The horizon problem occurs when the CEO's career concerns diminish.

As CEOs approach retirement, their career concerns are likely to be weaker, although their career concerns do not necessarily end at retirement (Brickley et al. 1999). When CEOs' career concerns diminish, they tend to focus on short-term performance rather than long-term value creation. To optimize CEO total incentives, explicit incentives have to become stronger when

implicit incentives associated with career concerns become weaker. Consistent with this, Gibbons and Murphy (1992) find that as CEOs are closer to retirement, the sensitivity of pay to performance (measured as change in firm market value) is higher. In addition, Lewellen et al. (1987) find that stock-based incentives increase as CEOs approach retirement. While increasing the relative importance of stock-based incentives encourages profitable R&D expenditures, designing CEO compensation in such a way that profitable R&D expenditures directly increase CEO compensation can provide stronger incentives for CEOs to invest in R&D. These discussions lead to the following hypothesis.

The Horizon Hypothesis. *Ceteris paribus, it is more likely that increasing R&D expenditures leads to an increase in CEO compensation when the CEO approaches retirement.*⁷

The Cover-up Hypothesis

The cover-up problem occurs when the CEO needs to inflate current accounting earnings to cover-up the firm's deteriorating economic health (Murphy and Zimmerman 1993). CEOs have incentives to cover-up bad performance to avoid being terminated. The literature has documented that CEO turnover is generally preceded by bad firm performance (Murphy and Zimmerman 1993, Weisbach 1988). CEOs are likely to cover-up bad accounting earnings in order to meet short-term earnings targets (Bushee 1998). For example, they may inflate accounting earnings to avoid contracting costs (e.g., DeFond and Jiambalvo 1994). They may

⁷ The Horizon Hypothesis presented in this study is about the effect of the *interaction* of R&D expenditures with the horizon problem. Most of the previous studies on the effect of the horizon problem on CEO compensation examine the main effect of the horizon problem (e.g., Eaton and Rosen 1983, Lewellen et al. 1987, Yermack 1995). The only exception is Gibbons and Murphy (1992) who find that the weight placed on stock returns in CEO cash compensation is higher when the horizon problem is more serious. More recently, Dikolli (2000) shows that when the horizon problem is more severe, greater emphasis should be placed on "forward-looking" measures. If R&D-related "forward-looking" measures (e.g., innovations, new products and patents) are used in CEO compensation contracts, Dikolli's (2000) prediction is consistent with the Horizon Hypothesis.

also boost earnings to avoid earnings declines for stock market reasons (e.g., Dechow and Skinner 2000).

CEOs' incentives to cut R&D expenditures to boost current earnings are likely to be stronger when earnings decrease, and the decrease can be turned to a non-decrease or increase by cutting R&D expenditures (Bushee 1998). This is because when the firm is in such a situation, the CEO has not only the motive to inflate current accounting earnings, but also a means to increase earnings. Thus, when there is such a reversible earnings decline, it is more likely that the firm designs CEO compensation to reward profitable R&D expenditures. This suggests the following hypothesis.

***The Cover-up Hypothesis.** Ceteris paribus, it is more likely that increasing R&D expenditures leads to an increase in CEO compensation when the firm faces an earnings decline that can be reversed by cutting R&D expenditures.*

III. SAMPLE, DATA AND METHOD

Sample and Data

Similar to many prior studies, this study focuses on large firms (Dechow and Sloan 1991, Gaver and Gaver 1998, Murphy and Zimmerman 1993, Yermack 1995, 1996). To be included in my sample a firm must have been listed at least four times between 1984 and 1991 in the *Forbes 500* ranking based on sales, assets, net income, or market capitalization. For each sample firm, data are collected for each year of the period 1984-1991, including years in which the firm does not appear on any of the *Forbes 500* lists.

The sample selection procedure favors larger and more established firms, which is likely to reduce the power of the empirical tests and create survivorship bias. Following Yermack (1995, 1996), the four-year requirement represents a trade-off between the data requirement for panel data analysis and potential survivorship bias. While more consecutive fiscal year observations for each firm better facilitate panel data analysis, it is likely to create a more severe survivorship bias problem. Furthermore, the larger firms are worth examining in their own right for at least two reasons. First, larger firms usually have more severe agency problems associated with innovation (Holmstrom 1989). This implies that mitigating managerial incentive issues are likely to be more important for larger firms. Second, the *Forbes 500* firms play an important role in the U.S. economy (Sloan 1993).

Firms' proxy statements, 10-K, 8-K filings and *Forbes* annual surveys of CEO compensation are sources of data on CEO age, tenure, compensation, turnover, and board and ownership structures. Stock price and return information is collected from CRSP 1998. All financial items are collected from COMPUSTAT 1998. Firms for which the required CRSP or COMPUSTAT data are not available are excluded from the sample. Firms that changed fiscal year ends during the sample period are also excluded.

This sampling process generates a sample of 618 firms in 143 three-digit SIC code industries. Because the focus of this paper is the effect of R&D expenditures on CEO compensation, the sample is further restricted to firms that are in R&D-intensive industries. An industry is classified as R&D-intensive if it is identified by any of the following four studies as R&D-intensive, or high-tech, or intangible-intensive firms: Collins et al. (1997), Dechow and Sloan (1991), Francis and Schipper (1999) and Lev and Sougiannis (1996). The final sample consists

of 157 firms, representing 39 three-digit SIC code industries.⁸ Industries with more than 10 sample firms include telephone communication (17 firms, SIC 481), drugs (15 firms, SIC 283), computer and office equipment (12 firms, SIC 357), and aircraft and parts (11 firms, SIC 372). All monetary items are restated to constant 1991 dollars using the Consumer Price Index at the end of the fiscal year of 1991.

Measuring CEO Compensation and the Horizon and Cover-up Problems

I analyze CEO cash compensation, the value and number of CEO stock options granted, and CEO total compensation. CEO cash compensation includes salary and annual bonus. The value of CEO stock options granted is the value of new stock options granted during the fiscal year calculated using the Black-Scholes (1973) formula based on parameters at the end of the fiscal year and adjusted for dividends. The number of stock options granted is the number of shares in stock options granted in the fiscal year. CEO total compensation is the sum of CEO cash compensation, the value of stock options and other compensation, including fringe benefits and cash payouts from other long-term incentive plans.

The horizon problem occurs when the CEO approaches a known retirement or departure (Murphy and Zimmerman 1993). I use CEO age as a proxy for the horizon problem, because it is closely related to CEO retirement. Specifically, I use the dummy variable *HORIZON* to measure whether the CEO is near retirement. *HORIZON* equals 1 if the CEO is 63 or older, reflecting the fact that CEOs typically retire at the ages of 64 to 66 (Murphy 1999). To the extent that CEOs

⁸ R&D intensity, advertising intensity and capital expenditure intensity (defined as the respective expenditures scaled by sales) are indeed significantly higher for the 157 sample firms than for the other 461 firms. Firms in the three-digit SIC code industry “computer programming, data process” (SIC 737) are excluded, because these firms are allowed to capitalize the costs of software development by SFAS 86 (FASB, 1985, e.g., Aboody and Lev 1998). Part of the data used in this study is collected and used by David Yermack (1995, 1996). Other studies that have used portions of the Yermack data include Hall and Liebman (1998) and Palia (1999).

have incentives to cut R&D expenditures prior to age 63, setting 63 as a cutoff point is likely to reduce the power of the test.

Following Bushee (1998), CEOs' short-term earnings target is assumed to be maintaining earnings from the prior year. In fact, the business press typically uses last year earnings as a benchmark for evaluating the firm's current financial performance (Bushee 1998). In addition, prior research has documented that managers have incentives to avoid earnings declines (e.g., Burgstahler and Dichev 1997).

A firm-year is identified as having the cover-up problem if it qualifies as a "Small Decrease" firm-year defined by Bushee (1998). Bushee (1998, p311) classifies a firm-year as a "Small Decrease" firm-year if "earnings before R&D and taxes have declined relative to the prior year, but by an amount that can be reversed by a reduction in R&D". Specifically, a firm's cover-up problem is measured by the dummy variable *COVERUP*. *COVERUP* is equal to 1 if two conditions hold at the same time: (1) $\text{pretax income}_{it} + \text{R\&D}_{it} < \text{pretax income}_{it-1} + \text{R\&D}_{it-1}$, and (2) $\text{pretax income}_{it} + \text{R\&D}_{it} > \text{pretax income}_{it-1}$, where R&D is the firm's R&D expenditures. The first condition implies that the firm's earnings before R&D expenditures and tax has declined relative to the prior year, while the second condition implies that if the firm reduces R&D expenditures, its current pre-tax income could be larger than pre-tax income of the last year.⁹

⁹ In Murphy and Zimmerman (1993), a cover-up problem involves bad performance that may or may not be reversible by cutting discretionary expenditures (e.g., R&D, advertising and capital expenditures) or by choosing income-increasing accounting methods.

Descriptive Statistics and Correlation

Table 1 shows that the average ratio of R&D expenditures to sales (average book value of common equity) is 4% (11%). The average CEO cash compensation (i.e., salary plus annual bonus) and total compensation are \$1,043,160, and \$2,013,420 in 1991 dollars, respectively. 24% of the firm-years had the horizon problems (i.e., CEOs at the ages of 63 or older), and 18% of the firm-years had the cover-up problems (i.e., earnings declined by an amount that could be reversed by cutting R&D expenditures). These results indicate that R&D expenditures are important in the sample firms, and the horizon and cover-up problems are common.

[Table 1 about here]

Table 2 presents Pearson correlation coefficients among the variables. The results demonstrate that stock returns are positively correlated with CEO cash compensation, value of stock options granted and total compensation. Meanwhile, accounting return on equity is positively correlated with CEO cash and total compensation. Interestingly, R&D expenditures (scaled by book value of equity) is positively correlated with CEO cash and total compensation, and the number and value of CEO stock options granted. Furthermore, *HORIZON* and *COVERUP* are both positively correlated with the number and value of CEO stock options granted. The results also indicate that stock returns are positively correlated with accounting earnings, and negatively correlated with the *HORIZON* and *COVERUP* dummies. Finally, while the *COVERUP* dummy is negatively correlated with accounting return on equity, it is positively correlated with R&D expenditures.

[Table 2 about here]

IV. ANALYSES AND RESULTS

CEO Compensation

Regression Model. The model below follows the previous literature (e.g., Baber et al. 1996, Hall and Liebman 1998) while adding measures of R&D expenditures and the horizon and cover-up problems. The model controls for firm-specific fixed effects.

$$\begin{aligned} \Delta COMP_{it} = & \beta_0 + \beta_1 RET_{it} + \beta_2 \Delta ROE_{it} + \beta_3 \Delta RD_{it} + \beta_4 HORIZON_{it} + \beta_5 COVERUP_{it} + \\ & \beta_6 HORIZON_{it} \times RET_{it} + \beta_7 HORIZON_{it} \times \Delta ROE_{it} + \beta_8 HORIZON_{it} \times \Delta RD_{it} + \beta_9 COVERUP_{it} \times RET_{it} \\ & + \beta_{10} COVERUP_{it} \times \Delta ROE_{it} + \beta_{11} COVERUP_{it} \times \Delta RD_{it} + \varepsilon_{it} \quad (1) \end{aligned}$$

In Model (1), $\Delta COMP$ is the change in CEO compensation from fiscal year t-1 to t. RET is the annual stock return. ROE is accounting return on equity (pre-tax earnings (COMPUSTAT #170) divided by average book value of common equity), and ΔROE is ROE in period t minus ROE in period t-1.¹⁰ ΔRD is the difference between RD in period t and RD in period t-1, where RD is R&D expenditures (COMPUSTAT #46) scaled by average book value of common equity (COMPUSTAT #60). $HORIZON$ and $COVERUP$ are the same as defined earlier. ε is the error term.¹¹

Main Results. Table 3 reports the results about CEO cash and total compensation. The Horizon Hypothesis predicts that β_8 (the coefficient of $HORIZON_{it} \times \Delta RD_{it}$) is positive, and the Cover-up Hypothesis predicts that β_{11} (the coefficient of $COVERUP_{it} \times \Delta RD_{it}$) is positive. This paper's

¹⁰ Pre-tax earnings is used as the measure of accounting earnings to avoid introducing errors in the process of estimating marginal tax rates to obtain after-tax R&D expenditures (Bushee 1998).

¹¹ As discussed below, governance structure and other control variables are included in subsequent analyses.

primary result is that for CEO total compensation both of these coefficients, 37,599.48 and 10,895.37, respectively, are positive and statistically significant ($p < .05$). Therefore, both of the hypotheses are supported when CEO compensation is measured by CEO total compensation. These results imply that for CEOs near retirement and firms facing the cover-up problems, CEO total compensation is increasing in R&D expenditures. Importantly, the results also imply that the incremental effect of R&D expenditures on CEO total compensation is insignificant in the absence of the horizon and cover-up problems. The results are robust to the inclusion of measures of investment opportunities, CEO stock ownership and board composition.

Two other features of the results in Table 3 are noteworthy. First, consistent with prior studies, the results show that both accounting earnings and stock returns increase CEO cash compensation, while stock returns are positively associated with CEO total compensation (e.g., Baber et al. 1996, Lambert and Larcker 1987). Second, while the presence of the horizon or cover-up problem does not alter the weights on accounting earnings and stock returns in CEO total compensation, the weight on accounting earnings in CEO total compensation is significantly lower when the firm faces the cover-up problem.

[Table 3 about here]

I also estimate Model (1) by measuring CEO compensation by the value and number of CEO stock options granted. Similar to the analysis of CEO total compensation, the results indicate that R&D expenditures significantly increase the value of CEO stock options granted when the CEO is near retirement, or when the firm faces the cover-up problem. As expected, the results in Table 4 show that stock returns significantly increase the value of CEO stock options granted. A comparison of the coefficients of $HORIZON_{it} \times \Delta RD_{it}$ and $COVERUP_{it} \times \Delta RD_{it}$ in Tables 3 and 4

reveals that the increase in CEO total compensation caused by increased R&D expenditures is due mainly to CEO stock option grants.¹²

[Table 4 about here]

Moreover, the results in Table 4 indicate that in the presence of the horizon or cover-up problem, increasing R&D expenditures leads to a significant increase in the number of stock options granted. While the value of stock options granted is affected by stock price and the quantity of stock options granted, stock returns do not capture the impact of R&D expenditures on the number of stock options granted. This explains why R&D expenditures have an incremental effect on the value of CEO stock options granted and CEO total compensation after controlling for stock returns. In the presence of the horizon and cover-up problems, increased R&D expenditures serve as a signal of “good quality” of the R&D projects, and the CEO is rewarded not only by the market through higher stock returns, but also by the board of directors via increased number of stock options granted. By tying R&D expenditures to the number of CEO stock options, the board provides the CEO with incentives to invest in profitable R&D.¹³

The results in Table 4 remain qualitatively unchanged after the inclusion of such variables as investment opportunities, CEO ownership, board composition, financial leverage, the existence of large block holders and the ratio of the variance of accounting earnings to the variance of stock returns. These variables are controlled for in the additional analysis because they are

¹² This finding is consistent with Core et al.'s (2000, p.31) argument that to demonstrate the importance of non-price measures (here R&D expenditures) to CEO incentives, it is necessary to establish a link between the non-price measures and variation in restricted stock and option grants. Table 4 establishes such a link by showing that R&D expenditures are associated with the value and number of CEO stock options granted.

¹³ Additional analysis of the relation between R&D expenditures and stock returns reveals that R&D expenditures increase stock returns in the presence of the horizon problem. When there is the cover-up problem, R&D expenditures do not have significant effect on stock returns.

identified as factors that affect stock option grant (Core and Guay 1999, Yermack 1995). Also, the results are very similar when the change in the number of stock options granted is replaced by the number of stock options granted.

The results about CEO stock options differ from the findings by Gaver and Gaver (1993) and Kole (1997). While they examine the effect of R&D intensity on the adoption and vesting schedules of stock options, my results show the effect of R&D expenditures on the number and value of stock option plans by demonstrating that R&D expenditures are positively associated with the number and value of CEO stock options granted in the presence of the horizon and cover-up problems.

Yermack (1995) does not find evidence that firms increase stock-based incentives when CEOs approach retirement. Consistent with his findings, my results indicate that the horizon and cover-up dummies do not have significant main effects on the number and value of CEO stock options granted. Nor do they have significant main effects on CEO cash and total compensation.

However, I find that the interactions of R&D expenditures with the horizon and cover-up problems have significant effects on the number and value of stock options granted. Moreover, Core and Guay (1999) conclude that stock options are granted to optimize managerial equity incentives. More consistent with the findings by Gibbons and Murphy (1992), my findings seem to suggest that stock options are granted to optimize managerial total incentives including implicit incentives such as career concerns.

The results in Tables 3 and 4 are different from prior studies examining the effect of R&D on CEO compensation in three ways. First, rather than focusing on the effect of R&D expenditures

on the relative weights on accounting earnings versus stock returns (e.g., Clinch 1991) or earnings versus accounting rate-of-returns (e.g., Krolick 1999), I establish the relation between R&D expenditures and CEO compensation. Second, in the analysis of the relation mentioned above, I control for the influence of R&D expenditures on accounting earnings and stock returns. Bizjak et al. (1993) examine the relation, but they do not control for accounting earnings and stock returns. Their results show that R&D expenditures are negatively associated with CEO cash and total compensation. Finally, I focus on the horizon and cover-up problems, where CEOs' incentives to cut R&D to boost current accounting earnings are particularly strong.

The Effect of a \$1000 Increase in R&D Expenditures on CEO Compensation. Table 5 summarizes the estimated effects of a \$1000 change in R&D expenditures on CEO cash compensation and total compensation, evaluated at the mean values of market and book values of equity of all sample firms. The results are obtained by allowing one variable to change, while holding the others constant. Table 5 shows that a \$1,000 increase in accounting earnings decreases CEO total compensation by about \$2 in the presence of the cover-up problem. In contrast, a \$1,000 increase in the firm's market value always increases CEO total compensation by \$0.15 to \$0.34. A \$1,000 increase in R&D expenditures decreases CEO total compensation by \$.26 in the absence of the horizon and cover-up problems, and increases CEO total compensation by about \$3.77 to \$17.65 in the presence of the problems. The results show that the effect of R&D expenditures on CEO total compensation is much stronger than the effect of accounting earnings and stock returns.¹⁴

¹⁴ As shown in Table 1, the average market and book values of common equity are about \$ 5,863.37 and \$2,887.81 million dollars, respectively. Therefore, a \$1,000 increase in pretax accounting earnings increases *ROE* by .00004%, a \$1,000 increase in market value increases *RET* by .00002%, and a \$1,000 increase in R&D expenditures increases *RD* by .00004%. The results in Table 5 are comparable to prior studies. For example, the findings by Jensen and Murphy (1990) imply that \$1000 change in shareholder wealth leads to about \$.02 increase in CEO cash

[Table 5 about here]

R&D Investment and the Effectiveness of CEO Incentives

To the extent that the CEO incentives documented in Table 3 are effective in overcoming potential underinvestment in R&D, this underinvestment problem should be mitigated. However, many researchers and practitioners have expressed concerns about underinvestment in various expenditures (e.g., R&D) at the expense of the firms' long-term welfare (e.g., Bushee 1998, Jacobs 1991). The empirical evidence is mixed on firms' R&D investment behavior when CEOs are near retirement (Murphy and Zimmerman 1993). For example, while Dechow and Sloan (1991) find that CEOs cut R&D expenditures during their final years, Murphy and Zimmerman (1993) conclude that CEOs do not make discretionary reductions in R&D expenditures immediately before leaving their positions.

Regression Model. The following regression model is used to provide additional empirical evidence on R&D investment behavior. Similar to Model (1), Model (2) also controls for firm-specific fixed effects.

$$\Delta RD_{it} = \beta_0 + \beta_1 TURNYEAR_{it} + \beta_2 LASTYEAR_{it} + \beta_3 SECLAST_{it} + \beta_4 HORIZON_{it} + \beta_5 COVERUP_{it} + \beta_6 \Delta ROE_{it} + \beta_7 \Delta RD_IND_{it} + \varepsilon_{it} \quad (2)$$

In Model (2), the definitions of ΔRD , ΔROE , $HORIZON$ and $COVERUP$ are the same as defined before. $TURNYEAR$ is a dummy equal to 1 if there is CEO turnover, while $LASTYEAR$

compensation, and about \$.3 for CEO total pay (excluding CEO stockholdings). Note that in Table 5 the effect is orthogonal to the changes in other measures.

(*SECLAST*) is a dummy equal to 1 if the CEO is in his/her last full year (second last full year) as CEO. The dummies for the years preceding CEO turnovers can be considered as other proxies for horizon and cover-up problems (Murphy and Zimmerman 1993). ΔRD_IND is the average of ΔRD of all the sample firms in the same two-digit SIC code industry.

If CEO incentives are in general not effectively designed, then β_2 , β_3 , β_4 and β_5 in Model (2) should be negative, meaning that CEOs cut R&D expenditures in years preceding CEO turnover and in the presence of horizon and cover-up problems. Further, when the firm's accounting earnings increase, it is likely that R&D expenditures increase. Because the industry average of the change in R&D expenditures is an indication of the profitability of R&D expenditures, it is expected that R&D expenditures increase in the industry average of R&D expenditures.

Results. According to Table 6, there is no evidence that CEOs cut R&D expenditures in their final years, which is consistent with Murphy and Zimmerman (1993). Further, the impacts of the horizon and cover-up problems on R&D expenditures are not significant. Accounting return on equity and the industry average of change in R&D expenditures are positively associated with the firm's R&D expenditures. These results are consistent with firms designing CEO compensation effectively in overcoming underinvestment problems in R&D. The results remain qualitatively unchanged after including variables such as investment opportunities, CEO stock ownership, the existence of large block-holders, board composition and financial leverage.

[Table 6 about here]

V. SENSITIVITY TESTS

R&D Profitability

By focusing on the potential for underinvestment in R&D, the previous analysis has assumed that R&D expenditures are in the shareholders' interest. However, this will be true if and only if the present value of the future cash flows generated by R&D net of the R&D outlays is positive. Unlike investments in tangibles, "[a] direct relationship between research and development costs and specific future revenue generally has not been demonstrated, even with the benefit of hindsight." (SFAS No.2, p.14). However, the literature has shown that capital markets do impound the potential benefits of R&D expenditures into stock price (Chan et al. 1990, Lev and Sougiannis 1996). Thus, to examine the effect of R&D expenditures on firms' future earnings, I investigate the relation between R&D expenditures and stock returns.

Following Jensen (1993), I measure firm level R&D profitability. Specifically, I examine firm-specific regressions using time series data over the period 1979 to 1998 from COMPUSTAT. A firm is classified as R&D-profitable if and only if its R&D expenditures are positively correlated with stock returns over the period of 1979 to 1998. 155 out of the 618 *Forbes 500* firms identified earlier are classified as R&D-profitable. 97 firms of the 157 sample firms used in previous analyses are R&D-profitable.

I then analyze Model (1) using data from the 97 R&D-profitable firms that have been included in my earlier analyses. The results are very similar to the results presented in Tables 3 and 4. Specifically, R&D expenditures significantly increase the number and value of CEO stock options granted as well as CEO total compensation when the CEO is near retirement, or when the firm faces the cover-up problem. Further, I re-estimate Model (1) using data from all of the

155 R&D-profitable firms. Again, my main results remain qualitatively unchanged. Finally, I also test Model (1) using a sample of 148 Forbes 500 firms whose average R&D-intensity over 1984-1991 is at least 1% and the results are qualitatively unchanged.¹⁵

Corporate Governance and Other Control Variables

The roles of CEO compensation in mitigating agency problems depend on other control mechanisms such as CEO turnover, the structures of the board of directors and ownership (Shleifer and Vishny 1997).¹⁶ Empirical evidence demonstrates that CEO compensation and the informativeness of accounting numbers are affected by board and ownership structures (e.g., Core et al. 1999, Ke et al. 1999, Warfield et al. 1995).

To control for the effect of corporate governance, I include *board size* and *composition*, *CEO ownership*, *other director and officer ownership*, and *block-holders* in Models (1) and (2). These governance variables are measured at the beginning of the fiscal year to avoid potential endogeneity (e.g., Demsetz and Lehn 1985, Kole and Lehn 1999). The results remain qualitatively unchanged after the governance variables are included.

Other variables such as *firm size*, *variance of the performance measures*, *volatility of stock returns*, *investment opportunities* (measured by the ratio of market to book value of assets), *CEO influence* (measured by CEO tenure, whether the CEO is also the chair of the board or the

¹⁵ The literature has shown that capitalizing and amortizing R&D expenditures can enhance the value-relevance of accounting earnings (e.g., Chambers et al. 1999, Lev and Sougiannis 1996, Monahan 1999). Following Lev et al. (1999), I adopt an amortization rate of 20% per year. The change in the difference between current R&D expenditures and the amortized past R&D expenditures (scaled by the average common equity) is then used to replace *RD* in Models (1) and (2). The results are qualitatively unchanged.

¹⁶ The analysis of the relation between CEO turnover and R&D expenditures indicates that R&D expenditures do not have an incremental effect on the probability of CEO turnover after controlling for accounting earnings and stock returns.

president of the firm) are also included in the analyses of CEO compensation. The results are robust to the inclusion of these variables.

Finally, while industry-specific fixed effects are controlled for in Model (1), different industry have different emphases on performance measures in CEO incentive plans (Ely 1991).

Particularly, regulation influences CEO compensation level and structure (Murphy 1999). I extend Model (1) by allowing regulated and other firms to have different weights on performance measures. The results still show that R&D expenditures are significantly positively associated with the number and value of CEO stock options granted and CEO total compensation in the presence of the horizon and cover-up problems.

Positive vs. Negative Changes in R&D Expenditures

Following Gaver and Gaver's (1998) methodology, I also allow positive and negative changes in R&D expenditures to have different weights in CEO compensation. The results are in general the same as the results reported in Tables 3 and 4. Interestingly, the results show that CEO total compensation is positively significantly (not significantly) associated with negative (positive) changes in R&D expenditures when the CEO is near retirement. In contrast, CEO total compensation is positively significantly (not significantly) associated with positive (negative) changes in R&D expenditures when the firm faces the cover-up problem. This suggests that when the CEO is near retirement, he/she will be punished for decreasing R&D expenditures, but not rewarded for increasing R&D expenditures. Conversely, when the firm faces a cover-up problem, the CEO is rewarded for increasing R&D expenditures, but not penalized for cutting R&D expenditures.

VI. CONCLUSIONS

This paper investigates the relation between R&D expenditures and CEO compensation in order to provide empirical evidence on how firms design CEO incentives to overcome potential underinvestment in R&D projects. The results indicate that in the absence of the horizon and cover-up problems, accounting earnings and stock returns appear to be sufficient to motivate appropriate investments in R&D. In the presence of the horizon or cover-up problem, however, R&D expenditures significantly increase CEO total compensation, apparently to offset potential incentives to underinvest in R&D. The increase in CEO total compensation is due mainly to stock option grants. The analyses of R&D investments imply that the CEO incentives described above are effective in overcoming potential underinvestment in R&D. Finally, the results are robust to R&D profitability measurement and the inclusion of governance and other control variables.

This paper has focused on annual CEO compensation. Prior studies suggest that CEO holdings of stock and stock options play an important role in CEO incentives (Core and Guay 1999, Hall and Liebman 1998). While I control for CEO stock ownership in this study, I do not control for existing CEO holdings of stock options. Thus, a natural extension of this study is to measure CEO compensation more comprehensively to include the value of the CEO's portfolio of stock and stock options. Furthermore, although this study documents the relation between R&D expenditures and the number and value of CEO stock options granted, it has not identified the precise mechanisms by which firms tie R&D expenditures to CEO stock option grants.

This paper can also be extended in the following two directions.¹⁷ First, R&D, advertising and capital expenditures are considered to be long-term discretionary investments (Murphy and Zimmerman 1993). While R&D and advertising expenditures are required to be expensed in the current period, capital expenditures are not. In addition, the uncertainties associated with the potential benefits of capital expenditures are different from those associated with the potential benefits of R&D and advertising expenditures (e.g., Kothari et al. 1999). Further, the importance, significance and length of the effect of R&D and advertising expenditures are likely to be different (e.g., Abdel-khalik 1975, Bulitz and Ettredge 1989, Hirschey and Weygandt 1985). Therefore, a further study comparing the roles of R&D, advertising and capital expenditures in CEO compensation may generate new insights about CEO incentives related to discretionary long-term investments.

Second, earnings aggregate over time, and the importance of measurement errors in earnings decreases in the length of the interval over which earnings are measured (Easton et al. 1992). Particularly, the negative effect of R&D expenditures on current accounting earnings are likely to be smaller when earnings are measured over longer intervals. This suggests that it is likely that the incremental effect of R&D expenditures on CEO compensation decreases with the length of performance measurement interval. Thus, another possible extension of this paper is to examine stewardship roles of R&D expenditures over longer intervals.

¹⁷ These two extensions comprise Parts II and III of my dissertation.

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Table 1
Descriptive Statistics

Data are from 157 *Forbes 500* firms in R&D-intensive industries over 1984-1991. Compensation, turnover and governance data are from proxy statements and 10-Ks, supplemented by *Forbes* annual survey on executive compensation. Accounting data are from COMPUSTAT and stock data are from CRSP. All monetary items are restated into a constant dollar of 1991 using consumer price index at the end of the fiscal year. *CEO cash compensation* includes salary and annual bonus. *Value of CEO stock options granted* is the new stock options granted in the current year valued at the end of the fiscal year using the Black-Scholes (1973) model adjusted for dividends. *Number of CEO stock options granted* is the number of new shares of stock option granted in the current fiscal year. *CEO total compensation* includes salary, annual bonus, stock options and fringe benefits and cash payouts from other long-term incentive plans. *Horizon* is a dummy equal to 1 if the CEO is 63 or older. *Coverup* is a dummy equal to 1 if the firm's pre-tax, pre-R&D expenditures earnings declines relative to last year and the decline can be reversed by cutting R&D expenditures.

Variables	Mean	Median	Standard Deviation
Market value of equity (in millions)	5863.37	2421.22	10099.96
Book value of common equity (in millions)	2887.81	1200.82	4847.35
Market to book value of assets	1.69	1.40	0.94
Sales (in millions)	6810.98	3116.47	11793.83
Net income (in millions)	387.20	154.59	801.52
R&D intensity (R&D expenditures scaled by sales)	0.04	0.03	0.05
CEO cash compensation (in thousands)	1043.16	960.13	572.61
Value of CEO stock options granted (in thousand dollars)	737.55	261.69	1876.64
Number of CEO stock options granted	36956.11	15000.00	84505.26
CEO total compensation (in thousands)	2013.42	1461.31	2258.46
Annual stock return (RET)	0.18	0.14	0.36
Accounting return on equity (Pretax income divided by average book value of common equity, ROE)	0.30	0.24	2.02
R&D expenditures scaled by average book value of common equity (RD)	0.11	0.09	0.17
Horizon dummy	0.24	0.00	0.43
Cover-up dummy	0.18	0.00	0.39

Table 2
Pearson Correlation among the Variables

Data are from 157 *Forbes 500* firms in R&D-intensive industries over 1984-1991. Compensation, turnover and governance data are from proxy statements and 10-Ks, supplemented by *Forbes* annual survey on executive compensation. Accounting data are from COMPUSTAT and stock data are from CRSP. All monetary items are restated into a constant dollar of 1991 using consumer price index at the end of the fiscal year. *CEO cash compensation* includes salary and annual bonus. *Value of CEO stock options granted* is the new stock options granted in the current year valued at the end of the fiscal year using the Black-Scholes (1973) model adjusted for dividends. *Number of CEO stock options granted* is the number of new shares of stock option granted in the current fiscal year. *CEO total compensation* includes salary, annual bonus, stock options and fringe benefits and cash payouts from other long-term incentive plans. *Horizon* is a dummy equal to 1 if the CEO is 63 or older. *Coverup* is a dummy equal to 1 if the firm's pre-tax, pre-R&D expenditures earnings declines relative to last year and the decline can be reversed by cutting R&D expenditures. The number of observations varies from 1159 to 1207 depending on data availability (*p*-values in parentheses)

Variables	RET	ROE	RD	Horizon	Coverup
CEO cash compensation (in thousands)	0.12 (0.00)	0.18 (0.00)	0.05 (0.07)	0.09 (0.00)	-0.03 (0.25)
Value of CEO stock options granted (in thousands)	0.20 (0.00)	0.05 (0.13)	0.13 (0.00)	0.02 (0.49)	0.01 (0.66)
Number of CEO stock options granted	0.02 (0.45)	0.02 (0.48)	0.11 (0.00)	0.07 (0.02)	0.05 (0.08)
CEO total compensation (in thousands)	0.19 (0.00)	0.09 (0.00)	0.12 (0.00)	0.05 (0.11)	0.00 (0.93)
Annual Stock Return (RET)		0.10 (0.00)	-0.04 (0.15)	-0.07 (0.02)	-0.11 (0.00)
Accounting Return on Equity (ROE)			0.04 (0.19)	0.01 (0.69)	-0.05 (0.09)
R&D expenditures scaled by average book value of common equity (RD)				-0.02 (0.54)	0.17 (0.00)
Horizon					0.04 (0.20)

Table 3
Regressions of CEO Compensation on Accounting Earnings, Stock Returns and R&D Expenditures

Data are from 157 *Forbes 500* firms in R&D-intensive industries over 1984-1991. Compensation, turnover and governance data are from proxy statements and 10-Ks, supplemented by *Forbes* annual survey on executive compensation. Accounting data are from COMPUSTAT and stock data are from CRSP. All monetary items are restated into a constant dollar of 1991 using consumer price index at the end of the fiscal year. Firm-years in which CEO turnover occurred are excluded. *CEO cash compensation* includes salary and annual bonus. *CEO total compensation* includes salary, annual bonus, stock options and fringe benefits and cash payouts from other long-term incentive plans. Stock options are valued at the end of the fiscal year using the Black-Scholes (1973) model adjusted for dividends. *Horizon* is a dummy equal to 1 if the CEO is 63 or older. *Coverup* is a dummy equal to 1 if the firm's pre-tax, pre-R&D expenditures earnings declines relative to last year and the decline can be reversed by cutting R&D expenditures.

Dependent Variable	Prediction	Change in CEO Cash Compensation		Change in CEO Total Compensation	
		β	p-value	β	p-value
Intercept	?	15.84	0.30	-239.86	0.07
Annual stock return (RET)	+	268.48	0.00	1993.09	0.00
Change in accounting return on equity (Δ ROE)	+	232.01	0.00	149.82	0.69
Change in R&D expenditures scaled by average book value of common equity (Δ RD)	+	-165.09	0.46	-693.06	0.72
Horizon	+	-2.32	0.94	129.13	0.61
Coverup	-	-14.43	0.68	-243.69	0.42
Horizon \times RET	+	-157.33	0.07	-987.69	0.19
Horizon \times Δ ROE	-	-231.79	0.00	-30.60	0.93
Horizon \times Δ RD	+	885.02	0.31	37599.48	0.00
Coverup \times RET	+	-169.53	0.07	-147.37	0.86
Coverup \times Δ ROE	-	268.75	0.32	-5514.65	0.03
Coverup \times Δ RD	+	-413.18	0.43	10895.37	0.02
Sample Size		918		904	
Adjusted R ²		0.103		0.095	

Table 4
Regressions of CEO Stock Options Granted on Accounting Earnings, Stock Returns and R&D Expenditures

Data are from 157 *Forbes 500* firms in R&D-intensive industries over 1984-1991. Compensation, turnover and governance data are from proxy statements and 10-Ks, supplemented by *Forbes* annual survey on executive compensation. Accounting data are from COMPUSTAT and stock data are from CRSP. All monetary items are restated into a constant dollar of 1991 using consumer price index at the end of the fiscal year. Firm-years in which CEO turnover occurred are excluded. *Value of CEO stock options granted* is the new stock options granted in the current year valued at the end of the fiscal year using the Black-Scholes (1973) model adjusted for dividends. *Number of CEO stock options granted* is the number of new shares of stock option granted in the current fiscal year. *Horizon* is a dummy equal to 1 if the CEO is 63 or older. *Coverup* is a dummy equal to 1 if the firm's pre-tax, pre-R&D expenditures earnings declines relative to last year and the decline can be reversed by cutting R&D expenditures.

Dependent Variable		Change in the Value CEO Stock Options Granted		Change in the Number of CEO Stock Options Granted	
Independent Variables	Prediction	β	p- value	β	p- value
Intercept	?	-322.85	0.01	-162.63	0.97
Annual stock return (RET)	+	1761.47	0.00	12774.60	0.25
Change in accounting return on equity (Δ ROE)	+	-89.94	0.80	46938.72	0.00
Change in R&D expenditures scaled by average book value of common equity (Δ RD)	+	-251.88	0.89	-28943.52	0.70
Horizon	+	153.50	0.52	6424.36	0.51
Coverup	-	-140.15	0.63	-17143.03	0.15
Horizon \times RET	+	-698.20	0.33	-32992.57	0.26
Horizon \times Δ ROE	-	165.24	0.64	-39855.53	0.01
Horizon \times Δ RD	+	33310.86	0.00	2041451.75	0.00
Coverup \times RET	+	-277.10	0.72	10517.99	0.74
Coverup \times Δ ROE	-	-7439.18	0.00	-466695.61	0.00
Coverup \times Δ RD	+	12103.24	0.00	683197.21	0.00
Sample Size		904		910	
Adjusted R ²		0.087		0.130	

Table 5
The Effect of a \$1,000 Increase in R&D Expenditures on CEO Compensation

Data are from 157 *Forbes 500* firms in R&D-intensive industries over 1984-1991. Compensation, turnover and governance data are from proxy statements and 10-Ks, supplemented by *Forbes* annual survey on executive compensation. Accounting data are from COMPUSTAT and stock data are from CRSP. All monetary items are restated into a constant dollar of 1991 using consumer price index at the end of the fiscal year. Firm-years in which CEO turnover occurred are excluded. *CEO cash compensation* includes salary and annual bonus. *Value of CEO stock options granted* is the new stock options granted in the current year valued at the end of the fiscal year using the Black-Scholes (1973) model adjusted for dividends. *Number of CEO stock options granted* is the number of new shares of stock option granted in the current fiscal year. *CEO total compensation* includes salary, annual bonus, stock options and fringe benefits and cash payouts from other long-term incentive plans. *Horizon* is a dummy equal to 1 if the CEO is 63 or older. *Coverup* is a dummy equal to 1 if the firm's pre-tax, pre-R&D expenditures earnings declines relative to last year and the decline can be reversed by cutting R&D expenditures. The effect of \$1000 increase in R&D expenditures, pretax-earnings, and market value of the firm on CEO compensation is calculated using means of book and market values of common equity. The means of book and market values of common equity are \$2,887.81 million and \$5,863.37 million, respectively.

Panel A. The Effect of a \$1000 Increase in R&D Expenditures on CEO Cash Compensation

Cases	\$1000 Increase in R&D Expenditures	\$1000 Increase in Pre-tax Earnings	\$1000 Increase in Market Value
Horizon = 0, coverup = 0	-\$0.06	\$0.09	\$0.05
Horizon = 1, coverup = 0	\$0.27	\$0.00	\$0.02
Horizon = 0, coverup = 1	-\$0.21	\$0.18	\$0.02
Horizon = 1, coverup = 1	\$0.11	\$0.10	-\$0.01

Panel B. The Effect of a \$1000 Increase in R&D Expenditures on CEO Total Compensation

Cases	\$1000 Increase in R&D Expenditures	\$1000 Increase in Pre-tax Earnings	\$1000 Increase in Market Value
Horizon = 0, coverup = 0	-\$0.26	\$0.06	\$0.34
Horizon = 1, coverup = 0	\$13.63	\$0.04	\$0.17
Horizon = 0, coverup = 1	\$3.77	-\$1.98	\$0.31
Horizon = 1, coverup = 1	\$17.65	-\$1.99	\$0.15

Table 6
Regressions of R&D Expenditures on Years Preceding CEO Turnover and Horizon and Cover-up Dummies

Data are from 157 *Forbes 500* firms in R&D-intensive industries over 1984-1991. Compensation, turnover and governance data are from proxy statements and 10-Ks, supplemented by *Forbes* annual survey on executive compensation. Accounting data are from COMPUSTAT and stock data are from CRSP. All monetary items are restated into a constant dollar of 1991 using consumer price index at the end of the fiscal year. *Horizon* is a dummy equal to 1 if the CEO is 63 or older. *Coverup* is a dummy equal to 1 if the firm's pre-tax, pre-R&D expenditures earnings declines relative to last year and the decline can be reversed by cutting R&D expenditures. Industry average is calculated using all *Forbes 500* firms that are in the same two-digit SIC code industry.

Dependent Variable	Change in R&D Expenditures Scaled by Common Equity		
Independent Variables	Prediction	β	p-value
Intercept	?	0.004	0.29
Dummy equal to 1 if it is the year CEO turnover occurred	?	0.030	0.00
Dummy equal to 1 if it is the last full year of the CEO	-	0.006	0.54
Dummy equal to 1 if it is the second last full year of the CEO	-	0.008	0.47
Horizon	-	-0.010	0.16
Coverup	-	-0.007	0.37
Change in accounting return on equity (Δ ROE)	+	0.003	0.03
Industry average of change in R&D expenditures scaled by average book value of common equity (Δ RD_IND)	+	0.255	0.00
Sample Size		1149	
Adjusted R ²		0.018	

Appendix

Examples of CEO Stock Option Grants: Chrysler and GTE

Horizon is a dummy equal to 1 if the CEO is 63 or older. *Coverup* is a dummy equal to 1 if the firm's pre-tax, pre-R&D expenditures earnings declines relative to last year and the decline can be reversed by cutting R&D expenditures. *Number of CEO stock options granted* is the number of new shares of stock option granted in the current fiscal year. *Value of CEO stock options granted* is the new stock options granted in the current year valued at the end of the fiscal year using the Black-Scholes (1973) model adjusted for dividends.

Panel A. Chrysler					
Year	CEO Age	Horizon	Coverup	Number of Stock Options Granted	Value of Stock Options Granted (in thousand dollars)
1984	60	0	0	60,000	1207.142
1985	61	0	1	Data Missing	Data Missing
1986	62	0	0	60,000	837.771
1987	63	1	1	820,000	9399.988
1988	64	1	1	120,000	1169.644
1989	65	1	0	120,000	539.932
1990	66	1	1	555,000	1261.228
1991	67	1	0	175,000	703.360

Panel B. GTE					
Year	CEO Age	Horizon	Coverup	Number of Stock Options Granted	Value of Stock Options Granted (in thousand dollars)
1984	62	0	0	15,700	158.657
1985	63	1	0	22,500	346.251
1986	64	1	0	13,800	200.610
1987	65	1	0	23,600	323.898
1988	62*	0	0	35,500	418.587
1989	63	1	0	42,400	1242.631
1990	64	1	0	65,400	495.203
1991	65	1	1	375,700	2905.330

* New CEO started.