NBER WORKING PAPER SERIES

PERFORMANCE INCENTIVES WITHIN FIRMS: THE EFFECT OF MANAGERIAL RESPONSIBILITY

Rajesh K. Aggarwal
Andrew A. Samwick

Working Paper 7334
http://www.nber.org/papers/w7334

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
September 1999

We thank Sheri Aggarwal, Syd Finkelstein, Bob Gibbons, Leonhard Knoll, Margaret Meyer, and seminar participants at Boston College, Columbia, Dartmouth, the NYU Accounting and Finance Conference, and the UNH Spring Finance Conference for helpful comments. We also thank Sarah Leonard, Evan Walsh, and Yevgeny Neginsky for exceptional research assistance and Andy Halula for assistance with the ExecuComp database. Financial support from the American Compensation Association and the Presidential Scholars Program at Dartmouth College is gratefully acknowledged. Any errors are our own. The views expressed herein are those of the authors and not necessarily those of the National Bureau of Economic Research or of the American Compensation Association.

Performance Incentives Within Firms:
The Effect of Managerial Responsibility
Rajesh K. Aggarwal and Andrew A. Samwick
NBER Working Paper No. 7334
September 1999
JEL No. G3, J3

ABSTRACT

Empirical research on executive compensation has focused almost exclusively on the incentives provided to chief executive officers. However, firms are run by teams of managers, and a theory of the firm should also explain the distribution of incentives and responsibilities for other members of the top management team. An extension of the standard principal-agent model to allow for multiple signals of effort predicts that executives who have other, more precise signals of their effort than firm performance will have compensation that is less sensitive to the overall performance of the firm. We test this prediction in a comprehensive panel dataset of executives at large corporations by comparing executives with explicit divisional responsibilities to those with broad oversight authority over the firm and to CEOs. Controlling for executive fixed effects and the level of compensation, we find that CEOs have pay-performance incentives that are $5.85 per thousand dollar increase in shareholder wealth higher than the pay-performance incentives of executives with divisional responsibility. Executives with oversight authority have pay-performance incentives that are $1.26 per thousand higher than those of executives with divisional responsibility. The aggregate pay-performance sensitivity of the top management team is quite substantial, at $30.24 per thousand dollar increase in shareholder wealth for the median firm in our sample. Our work sheds light on the alignment of responsibility and incentives within firms and suggests that the principal-agent model provides an appropriate characterization of the internal organization of the firm.

Rajesh K. Aggarwal
Amos Tuck School
Dartmouth College
Hanover, NH 03755
rajesh.aggarwal@dartmouth.edu

Andrew A. Samwick
Department of Economics
Dartmouth College
Hanover, NH 03755
and NBER
samwick@dartmouth.edu

1. Introduction

Public corporations are run by teams of top managers. Each of these managers has different responsibilities. Chief operating officers, for example, have broad oversight authority for the firm as a whole. Heads of large divisions have more narrowly defined authority but bear direct responsibility for a subset of the firm's activities. As top managers have different levels and areas of authority, they will have different measures of performance that can be used to provide incentives. Using a standard principal-agent model, we show that the sensitivity of compensation to firm performance will depend on how precisely performance is measured for all areas for which the manager is responsible. In particular, managers with precise signals of effort other than firm performance will receive less exposure to overall firm performance in their compensation. We test the predictions of the model and find evidence that managers with explicit divisional responsibilities have lower pay-performance sensitivities than managers with broad oversight authority, who in turn have lower pay-performance sensitivities than do chief executive officers (CEOs).

The finding that incentives differ across job classifications is important for two reasons. First, a central issue for understanding the internal organization of the firm is the alignment of incentives and responsibilities among the top management team. An analysis based solely on CEOs cannot determine whether incentives are affected by differences in managerial responsibility. We show that pay-performance incentives differ across executives according to their responsibilities and are structured to motivate managers, subject to the shareholders' informational constraints about each manager's effort. Second, most of the existing literature on the magnitude of incentives provided by compensation contracts focuses exclusively on chief executive officers (e.g., Lambert and Larcker (1987), Jensen and Murphy (1990), and Hall and Liebman (1998)). This approach ignores the fact that there are other members of the top management team who may also have significant incentives. We show that incentives provided to the CEO are 42 percent of the aggregate incentives to the top management team (defined as the top five executives) in our data. The median pay-performance sensitivity of the top management team is \$30.24 per thousand dollar increase in shareholder wealth.

We generate predictions using the principal-agent model of Holmstrom and Milgrom (1987). In this model, the primary means for shareholders to ensure that managers take optimal actions is

to tie managers' compensation to the performance of their firms; that is, to provide high-powered incentives for managers to maximize the returns to shareholders. We use a generalization of the model that allows the shareholders to observe two potentially correlated signals about the manager's effort. The first signal continues to be the performance of the firm as a whole, as in the standard model. The second signal is an individual-specific measure of performance. For example, the second signal for a manager with divisional responsibility could be a measure of divisional performance based on accounting data. We show that the structure of incentives will depend upon the relative precision of the two signals, with more weight placed on the more precise signal.

The most informative signal for CEOs is firm performance, measured by total returns to shareholders. Firm performance is also quite informative for managers with oversight authority for the entire firm. Managers with oversight authority may also have an individual signal such as a subjective report by the CEO on their performance. By contrast, managers with divisional responsibility have a relatively more precise signal than overall firm performance. Their compensation should depend more heavily on divisional performance. We argue that the pay-*firm* performance sensitivity will be higher for CEOs than for managers with oversight authority, who will in turn have a higher sensitivity than will managers with divisional responsibility. Our focus on managerial responsibilities allows us to provide a new test of the principal-agent model of executive compensation.

We use data on executive compensation from the Standard and Poor's ExecuComp dataset. Our sample consists of comprehensive data for the top five executives (ranked annually by salary and bonus) from the S&P 500, S&P MidCap 400, and S&P SmallCap 600 companies from 1993 to 1997. The sample design allows us to consider the pay-performance sensitivities of managers based on their responsibilities within the firm. Because data on individual or divisional performance within firms are not systematically available for a large cross-section of firms, we test predictions relating to the sensitivity of compensation to firm performance rather than to individual or divisional performance measures. In general, the model can be tested without the econometrician observing the other measures of performance. As we show, the sensitivity of compensation to firm performance will be affected in a straightforward way by the presence of other performance

measures.

We classify managers into four mutually exclusive groups: CEOs, executives other than CEOs with oversight authority for the entire firm, executives with divisional responsibility, and executives with neither oversight authority nor divisional responsibility. We find evidence that incentives are structured differently for executives with different responsibilities, as predicted by the theory. In practice, optimal incentive contracts will structure managerial compensation so that it is correlated with the total return to shareholders, typically through ownership of shares of the firm's stock or grants of options on the firm's stock. This correlation is the pay-performance sensitivity. Managers with oversight authority who are not the CEO have significantly higher pay-performance sensitivities than do managers with divisional responsibility. The median pay-performance sensitivity for managers with oversight authority is \$3.14 per thousand dollar increase in shareholder wealth, 70 percent higher than the median pay-performance sensitivity of \$1.84 per thousand for managers with divisional responsibility. Both sets of managers have significantly lower pay-performance sensitivities than the median value of \$12.77 for CEOs. Top managers classified as having neither oversight authority nor divisional responsibility have a median pay-performance sensitivity of \$1.77. These results suggest that the principal-agent model describes not only the incentives for CEOs but those for other managers within a firm as well.

It is important to be clear about what our results show. Our findings do not relate to the level of pay. While it is true that the level of pay varies by job classification, this is not a surprising or novel result. Differences in the level of pay by job classification may reflect differences in the ability of managers or differences in the demands of a given job. Our findings show differences in pay-performance sensitivities or incentives by job classification, after controlling for differences in the level of pay. In addition, because we observe executives over several years and during that period, some executives change jobs, we are also able to control for executive fixed effects in our estimation. Controlling for executive fixed effects and the level of compensation, we find that the pay-performance incentives of CEOs are \$5.85 per thousand dollar increase in shareholder wealth higher than the pay-performance incentives of executives with divisional responsibility. Executives with oversight authority have pay-performance incentives that are \$1.26 per thousand higher than the pay-performance incentives of executives with divisional responsibility.

The inclusion of fixed effects demonstrates that the estimated differences in pay-performance incentives across groups reflect changes in compensation contracts that occur when executives actually switch groups. The differences cannot be the result of cross-sectional variation in executive characteristics alone. Based primarily on these results, we systematically consider and reject a number of alternative explanations for our results in Section 5. Overall, our findings are consistent with a principal-agent model in which there are differentially informative signals about managers' provision of effort.

Our paper is related to several papers that examine executive compensation in the context of the principal-agent model. Banker and Datar (1989) and Lambert and Larcker (1987) also develop a principal-agent model with two signals that predicts that compensation will be more sensitive to the more precisely measured signal. Banker and Datar (1989) conduct no empirical tests. Lambert and Larcker's (1987) analysis differs from ours in that they focus only on CEOs and use directly observable measures of stock and accounting returns as their performance measures. In contrast, in our analysis, we test for differences in compensation contracts across managers with different responsibilities within the firm. Baker, Gibbons, and Murphy (1994) note that managers will have different measures of performance that can be used to provide incentives in the context of subjective performance evaluation. Murphy (1985) shows empirically that pay-performance sensitivities do vary by job title in a sample of 461 executives at 72 firms, but he does not relate these differences to the principal-agent model.

The remainder of the paper is organized as follows. In Section 2, we present a principal-agent model in which shareholders optimally determine compensation based on multiple signals of the manager's effort. In Section 3, we describe the compensation data and discuss the managerial job classifications that we use to test the model. The econometric results are presented in Section 4. The main empirical result is that executives with specific divisional responsibility have lower pay-performance sensitivities than executives who have oversight authority for the entire firm, who in turn have lower pay-performance sensitivities than CEOs. Section 5 discusses the robustness of our results to alternative explanations and Section 6 concludes.

2. The Principal-Agent Model

In this section we illustrate how the structure of incentives will differ for managers with differentially informative signals about their performance. As in Banker and Datar (1989), we consider a setting in which there are two signals about each manager's effort choice. We show that each manager is compensated more heavily based on the more informative signal under the optimal contract. In the next section, we use this intuition to identify managers with different responsibilities who will therefore receive different incentives. The key point of this section is that managers with precise performance measures other than firm performance will receive lower pay-firm performance sensitivities.

We use a version of the Holmstrom-Milgrom (1987) linear principal-agent model. Within a firm, there are N risk-averse agents (the managers) and one risk-neutral principal (the shareholders). The agents' effort choices, e_i, yield profits (gross of compensation) of

$$\pi = \sum e_i + \varepsilon, \tag{1}$$

to the principal, where ε is a normally distributed shock to profits with variance σ_ε^2 $(\varepsilon \sim N[0, \sigma_\varepsilon^2])$. The performance measures observable to the principal are profits and a measure of individual performance x_i where

$$x_i = e_i + \theta_i, \tag{2}$$

and θ_i is an individual shock with $\theta_i \sim N\ [0, \sigma_{\theta_i}^2]$. The correlation between any θ_i and ε is ρ_i. The individual signal may be divisional performance, accounting performance, or any other measure that is informative about the individual's effort. Any measure such as accounting performance or divisional performance can be differentially informative for different managers, which is why the shock θ_i is individual-specific. For example, if x_i is an individual-specific measure of divisional performance, it will be quite informative for the divisional manager (low $\sigma_{\theta_i}^2$) but uninformative for the CEO (high $\sigma_{\theta_i}^2$). In addition, the individual-specific signal need not be the same for all managers. Shocks are not observable to the principal.

The timing is as follows. First, contracts are signed with the N agents. Next, agents make effort choices. The profit shock and the individual shocks are realized simultaneously after the agents' effort choices. Profits are realized and the principal observes both profits and the

individual-specific signals for all of the agents. Agents are then compensated based on both profits and the individual signals as specified in the contract.

Effort is costly for the agents. We assume that each manager's cost of effort function is $\frac{k}{2}e_i^2$, where k is the curvature of the disutility of effort function. Each manager's compensation contract is:

$$w_i = \alpha_{1i}\pi + \alpha_{2i}x_i + \beta_i. \tag{3}$$

α_{1i} is the weight on firm performance in the compensation contract and is what we refer to as the pay-performance sensitivity. α_{2i} is the weight on the individual performance measure. β_i is the component of compensation unrelated to performance. Each manager has negative exponential utility where r is the coefficient of absolute risk aversion. Standard results for the linear principal-agent model (e.g., Banker and Datar (1989)) show that the optimal contract for each manager i is:

$$\begin{aligned} \alpha_{1i}^* &= \frac{\sigma_{\theta_i}^2 - \sigma_\varepsilon\sigma_{\theta_i}\rho_i}{\sigma_\varepsilon^2 + \sigma_{\theta_i}^2 - 2\sigma_\varepsilon\sigma_{\theta_i}\rho_i + kr\sigma_\varepsilon^2\sigma_{\theta_i}^2(1-\rho_i^2)} \\ \alpha_{2i}^* &= \frac{\sigma_\varepsilon^2 - \sigma_\varepsilon\sigma_{\theta_i}\rho_i}{\sigma_\varepsilon^2 + \sigma_{\theta_i}^2 - 2\sigma_\varepsilon\sigma_{\theta_i}\rho_i + kr\sigma_\varepsilon^2\sigma_{\theta_i}^2(1-\rho_i^2)} \end{aligned} \tag{4}$$

These contracts exhibit the feature either that both α_{1i}^* and α_{2i}^* are positive or that one is positive and one is negative. The agent is either compensated positively for both firm performance and individual performance, or there is relative performance evaluation in which the less precise signal is used to filter the more precise signal.[1] If the performance measures are approximately equally noisy (σ_ε^2 close to $\sigma_{\theta_i}^2$) or if the correlation ρ_i between the signals is small or negative, then the optimal contracts will put a positive weight on both firm performance and individual performance.

Under the assumption that the two signals are uncorrelated ($\rho_i = 0$) the pay-firm performance

[1] Aggarwal and Samwick (1999a, b) find no evidence of relative performance evaluation using industry performance as the second signal.

sensitivity (α_{1i}^*) has the following comparative statics properties:[2]

$$\begin{aligned}\frac{\partial \alpha_{1i}^*}{\partial \sigma_\epsilon} &= \frac{-2\sigma_{\theta_i}^2 \sigma_\epsilon \left(1 + kr\sigma_{\theta_i}^2\right)}{\left(\sigma_\epsilon^2 + \sigma_{\theta_i}^2 + kr\sigma_\epsilon^2\sigma_{\theta_i}^2\right)^2} < 0. \\ \frac{\partial \alpha_{1i}^*}{\partial \sigma_{\theta_i}} &= \frac{2\sigma_{\theta_i}\sigma_\epsilon^2}{\left(\sigma_\epsilon^2 + \sigma_{\theta_i}^2 + kr\sigma_\epsilon^2\sigma_{\theta_i}^2\right)^2} > 0.\end{aligned} \tag{5}$$

The first prediction is that the the pay-firm performance sensitivity is decreasing in the standard deviation of the firm performance measure. In Aggarwal and Samwick (1999a), we show that $\frac{\partial \alpha_{1i}^*}{\partial \sigma_\epsilon} < 0$ holds for top executives. This result continues to hold if we disaggregate executives by job classification, as we show in Section 4. The second prediction is that the pay-firm performance sensitivity is increasing in the standard deviation of the individual performance measure. We focus on the second prediction ($\frac{\partial \alpha_{1i}^*}{\partial \sigma_{\theta_i}} > 0$) for the main empirical work in this paper. We use job classifications as a proxy for differing σ_{θ_i}. We claim that CEOs have higher variances of the individual performance measure than do executives with oversight authority who, in turn, have higher variances of the individual performance measure than do executives with divisional responsibility. In effect, executives with divisional responsibility have a divisional performance measure on which they can be compensated, while CEOs and those with oversight authority do not. As a result, our model predicts that executives with divisional responsibility will have lower pay-firm performance sensitivities in the optimal contract than executives with oversight authority who will have lower pay-firm performance sensitivities than CEOs.

[2] Conceptually, the individual-specific signal can always be made orthogonal to firm performance by splitting it into two components, one perfectly correlated with firm performance and the other orthogonal, and treating the orthogonal component as the individual signal. That is, redefine the individual signal to be

$$y_i = x_i - \rho_i \frac{\sigma_{\theta_i}}{\sigma_\epsilon}\pi.$$

y_i is orthogonal to π.

If the individual signal is not redefined to be orthogonal to firm performance, then the comparative static predictions are:

$$\frac{\partial \alpha_{1i}^*}{\partial \sigma_\epsilon} = \frac{-2\sigma_{\theta_i}^2\sigma_\epsilon\left(1 + kr\sigma_{\theta_i}^2\right) + \rho_i\sigma_{\theta_i}\left(\sigma_\epsilon^2 + \sigma_{\theta_i}^2 + 2kr\sigma_\epsilon\sigma_{\theta_i}^3\rho_i + kr\sigma_\epsilon^2\sigma_{\theta_i}^2\left(1-\rho_i^2\right)\right)}{\left(\sigma_\epsilon^2 + \sigma_{\theta_i}^2 - 2\sigma_\epsilon\sigma_{\theta_i}\rho_i + kr\sigma_\epsilon^2\sigma_{\theta_i}^2\left(1-\rho_i^2\right)\right)^2}$$

$$\frac{\partial \alpha_{1i}^*}{\partial \sigma_{\theta_i}} = \frac{2\sigma_{\theta_i}\sigma_\epsilon^2 - \rho_i\sigma_\epsilon\left(\sigma_\epsilon^2 + \sigma_{\theta_i}^2 - kr\sigma_\epsilon^2\sigma_{\theta_i}^2\left(1-\rho_i^2\right)\right)}{\left(\sigma_\epsilon^2 + \sigma_{\theta_i}^2 - 2\sigma_\epsilon\sigma_{\theta_i}\rho_i + kr\sigma_\epsilon^2\sigma_{\theta_i}^2\left(1-\rho_i^2\right)\right)^2}.$$

Sufficient conditions for $\frac{\partial \alpha_{1i}^*}{\partial \sigma_\epsilon} < 0$ and $\frac{\partial \alpha_{1i}^*}{\partial \sigma_{\theta_i}} > 0$ are that ρ_i is small or negative or that σ_ϵ^2 is close to $\sigma_{\theta_i}^2$. These conditions also imply that $\alpha_{1i}^* > 0$ and $\alpha_{2i}^* > 0$. As a result, the comparative static predictions on which we focus are $\frac{\partial \alpha_{1i}^*}{\partial \sigma_\epsilon} < 0$ and $\frac{\partial \alpha_{1i}^*}{\partial \sigma_{\theta_i}} > 0$.

3. Data

Our main source of data is Standard and Poor's ExecuComp dataset, a supplement to the Compustat database. We use ExecuComp to construct our measures of executive compensation and firm performance. ExecuComp contains data on all aspects of compensation for the top five executives (ranked annually by salary and bonus) at each of the firms in the S&P 500, S&P Midcap 400, and S&P SmallCap 600. Due to enhanced federal reporting requirements for fiscal years ending after December 15, 1992, the ExecuComp data for 1993 through 1997 are virtually complete.[3] The ExecuComp data are collected directly from the companies' proxy statements and related filings with the Securities Exchange Commission. We also determine the executives' managerial responsibilities based on their job title reported in ExecuComp. We calculate the variance of monthly stock returns using data from the Center for Research on Security Prices (CRSP).

3.1 Classifying Executives Based on Responsibilities

We classify executives into four groups based on their job title reported in ExecuComp. The classification scheme is designed to correspond to the relative weight that would be put on firm performance in an optimal compensation contract given the availability of other potentially informative signals of the executives' efforts. The job title reported in ExecuComp is up to thirty characters in length and corresponds most closely to the title reported by the firm in the summary compensation table of its DEF 14A filing to the SEC.[4]

The first group is chief executive officers. CEOs clearly have a responsibility for all aspects of firm performance, and the most logical measure of their efforts, broadly defined, is the total returns to their shareholders. CEO status is determined directly by ExecuComp to be the individual who held the title for the greatest extent during the year. Thus, each firm has only one CEO in each year in our sample.

For all other executives, total returns to shareholders are clearly correlated with their effort, but because of the assignment of responsibilities within the firm, this measure of performance may be relatively less informative than the individual-specific signal. Executives can be distinguished based on whether they clearly have oversight authority for the performance of the firm as a whole.

[3] See Standard and Poor's (1995) for documentation of the ExecuComp dataset. Our analysis in this paper uses the October 1998 release of the data.

[4] Recent filings are publicly available electronically at www.sec.gov.

Our second group is comprised of the most prominent examples of such executives–presidents, chairmen, vice-chairmen, chief financial officers (CFOs), and chief operating officers (COOs)–who are not the CEO. This group should have pay-performance incentives that are lower than those of the CEOs and higher than those of other executives. Table 1 shows that of the executives in this group, the percentages reporting each occupation are: president (30.28), chairman (11.02), vice-chairman (12.27), COO (27.03), and CFO (42.55). Also included are other chief executives whose reported title includes CEO but who are not identified as the CEO by ExecuComp, comprising 6.08 percent.[5] The sum of the percentages exceeds 100 because executives often have titles that include more than one of these occupations.

The most important difference between groups for our purposes is whether the executive is listed as a top executive of a division within the firm. Our third group is comprised of all executives without oversight authority who meet this criterion. Table 1 provides a distribution of executives with divisional responsibility by the aspect of the firm they manage. The top row of the Divisional group shows that 74.02 percent of the group is listed as a top executive of a subsidiary or an international division, or as being in charge of a specific product line. Examples include "Chmn. & CEO-sub.," "Chmn. & CEO-Hughes Elec.," "Exec. v-p & pres.-N. America," "Sr. v-p-Europe," and "Group v-p-wood products." The remaining 25.98 percent is listed as having production-related responsibilities. Examples of titles for these executives include "Sr. v-p-engineering," "Exec. v-p-research & dev," "Exec. v-p-manufacturing," and "Exec. v-p-steel ops." Because the executives in the Divisional group bear direct responsibility for the performance of a division within the firm, shareholders receive a fairly precise signal of their efforts in the performance of that division. As a result, the sensitivity of their pay to the overall performance of the firm is lower than it is for executives in the Oversight group.

The fourth and final group consists of executives who have neither explicit divisional responsibility nor primary oversight authority. Table 1 shows that 57.07 percent of these executives have corporate infrastructure responsibilities while 42.93 percent are simply designated vice-president, senior vice-president, or executive vice-president with no further information provided. Titles for executives with corporate infrastructure responsibilities include "Treasurer," "Secretary," "Con-

[5] This occurs in some years in which there is turnover in the CEO position. Two executives at the firm can have CEO reported in their titles, but ExecuComp will designate only one of them as the CEO of the firm. Excluding these observations from the sample does not qualitatively affect our results.

troller," "General counsel," "Sr. v-p-human resources," "V-p-corp. planning & dev," "Sr. v-p-marketing," and "Exec. v-p-acctg. & finance." The Neither group should have pay-performance sensitivities lower than those for executives with oversight authority because the overall performance of the firm is a relatively less precise signal of their efforts than it is for the Oversight group. However, there is no clear prediction for the magnitude of this group's incentives relative to those for executives with divisional responsibility.

In summary, our algorithm for allocating executives to job categories is as follows. We use ExecuComp's identifier for the CEO of each firm in each year. Any of the remaining executives who are listed as the CEO, chairman, vice-chairman, president, COO, or CFO of the overall firm are allocated to the Oversight group. Of the remaining executives, those whose titles indicate a divisional responsibility are allocated to the Divisional group. The remaining executives are allocated to the Neither group. Both authors independently checked the allocation of executives to groups, observation by observation. This ensured that all executives are correctly classified, conditional on their reported titles in ExecuComp.[6]

3.2 Calculating Incentives

Jensen and Murphy (1990) demonstrate that although incentives can be provided to executives through various forms of compensation, the majority of incentives come from holdings of stock and options. Hall and Liebman (1998) show that incentives from stock and particularly stock options have grown substantially since the sample period used by Jensen and Murphy (1990). As a result we focus primarily on incentives provided by stock and options.

ExecuComp contains precise data on annual flow compensation, including the details of options granted in the current year. It also contains precise data on executives' holdings of stock in their own companies and summary information on the value of options granted in previous years. For stock, the pay-performance sensitivity is simply the fraction of the firm that the executive owns.

[6] As a further check, we directly examined of a subset of proxy statements as they were filed by the sample firms. In a small number of cases, executives classified as Neither should have been classified as Divisional. For example, a senior vice-president may be in charge of a divisional group, but the name of the divisional group was not included in the summary compensation table of the DEF 14A filing. This executive would have been classified as Neither in our scheme. To examine the potential impact of such classification errors, we treated all of the executives in the Neither group as if they had divisional responsibilities. When we re-estimated our specifications according to this classification scheme, we found statistically significant differences between the CEO, Oversight, and the (new) Divisional groups, as we do in Section 4 below. This is not surprising given that the point estimates for the original Divisional and Neither groups in our empirical analysis are very close.

A CEO who holds 3 percent of the stock outstanding in her firm has a pay-performance sensitivity from stockholdings of $30 per thousand dollar change in shareholder wealth. In order to calculate incentives provided by options, we multiply the fraction of the firm's stock on which the options are written by the deltas of the options.

We calculate option deltas as follows. For options granted in the current year, companies must report the number of securities, the exercise price, and exercise date. Following Standard and Poor's (1995), we assume that options are exercised 80 percent (through 1994) or 70 percent (1995 and later) through their term and use the corresponding 8 and 7 year zero-coupon Treasury bond rates as the risk-free rates of return.[7] In applying the Black-Scholes formula, we use the dividend yield for the company reported by ExecuComp and calculate the standard deviation of monthly stock returns for each company using data from CRSP. We use monthly total returns to shareholders over the sixty months preceding the sample year. For example, to compute the standard deviation for a firm in 1993, we calculate the standard deviation of monthly returns from January, 1988, to December, 1992. If a firm has fewer than sixty but more than twelve months of data, then we use all of the available data. If a firm has fewer than twelve monthly return observations, then we exclude it from our sample. We multiply this value by $\sqrt{12}$ to get the standard deviation of continuously compounded annual returns.

For options granted in previous years, the proxy statement reports only the aggregate number of securities and the aggregate "intrinsic value" of the options that are in the money. The intrinsic value is the stock price at the end of the fiscal year less the option's exercise price. Following Murphy (1998), we treat all existing options as a single grant with a five year remaining term and an exercise price such that the intrinsic value is equal to that reported on the proxy statement. Apart from having to impute this exercise price and the time remaining to expiration, the method for options granted in previous years is the same as for current option grants.

Table 2 presents descriptive statistics on the compensation and incentive measures that we use in our empirical analysis. For seven variables, the mean, median, and standard deviation are reported for each group of executives. The first three are the calculated pay-performance sensitivities from stock, options, and their sum. The pay-performance sensitivities are expressed

[7] The risk-free interest rates used for 1992 through 1997 were 7.19, 5.86, 7.17, 6.50, 6.30 and 6.29 percent, respectively. The 7 and 8 year terms are based on the typical maturity of 10 years for option grants.

as percentages of the firm, so that a value of 1 corresponds to a pay-performance sensitivity of \$10 per thousand dollar increase in shareholder wealth. The next two variables are the value of executives' ownership of stock and options in their firms, also in millions of 1997 dollars. The final two variables are total flow compensation and long-term components of flow compensation, expressed in millions of 1997 dollars. Long-term components of flow compensation include grants of restricted stock, grants of stock options, long-term incentive plan payouts, gross-ups for tax liabilities, perquisites, preferential discounts on stock purchases, contributions to benefit plans, and severance payments.[8] Total flow compensation includes the long-term components as well as salary, bonus, and other annual compensation.

CEOs have mean pay-performance sensitivities of 3.99 percent of the firm, with 3.17 percent in the form of stock and 0.83 percent in the form of options. The medians are substantially lower at 1.28 percent overall, with the median option pay-performance sensitivity of 0.42 percent exceeding the median stock pay-performance sensitivity of 0.39 percent. These patterns are repeated on a smaller scale for the Oversight group. The Oversight group has higher pay-performance sensitivities than the Divisional and Neither groups, which in turn have approximately equal pay-performance sensitivities. In addition, for the Divisional group, the mean and median pay-performance sensitivity from stock is lower than the mean and median pay-performance sensitivity from options, respectively. Compared to the CEO and Oversight groups, there are fewer instances of executives with extremely high stock ownership in the Divisional and Neither groups. Similar patterns are observed in the dollar values of holdings of stock and options. CEOs have much higher dollar value holdings of stock and options than the Oversight group, who in turn have larger holdings than the Divisional and Neither groups. CEOs have mean and median compensation of \$2.74 and \$1.49 million, almost double the values of \$1.53 million and \$847,000 for the Oversight group. Both the Divisional and Neither groups have compensation of less than \$1 million at the mean and around \$600,000 at the median.

Figure 1 graphs median pay-performance sensitivities from stock holdings for each of the four groups through time. Figure 2 graphs median pay-performance sensitivities from option holdings

[8] For consistency with other work, we use the value of stock options granted as reported in the dataset in our measure of flow compensation. This application of the Black-Scholes formula is documented in Standard and Poor's (1995).

for each of the four groups through time. Three features of these graphs are noteworthy. First, CEOs have higher pay-performance sensitivities than the Oversight group, and the Oversight group has higher pay-performance sensitivities than the Divisional and Neither groups. Second, the pay-performance sensitivities for the four groups have generally been rising through time. Third, this increase in pay-performance sensitivities is entirely attributable to stock options, not stockholdings. Stockholdings have remained relatively constant as a share of firm value through time. This comparison suggests that changes in incentives over our sample period are the result of changes in holdings of options rather than stock. Along with Table 2, these figures suggest that pay-performance incentives vary quite dramatically by job classification and vary in the way predicted by the principal-agent model derived earlier. In the following sections, we establish this empirical result more formally and control for potentially confounding factors.

The remaining variables used in the econometric specifications pertain to the return to shareholders. ExecuComp provides data on the total return to shareholders in each sample year, specified in percent returns. We subtract the growth in the Consumer Price Index to get real returns.[9] Dollar returns to shareholders are equal to the percent returns multiplied by the market value of the firm at the beginning of the sample year, which is also reported in ExecuComp. The median dollar return is $92 million and the mean dollar return is $685 million. The variance of dollar returns is included in the regressions as a determinant of pay-performance incentives. The variance for each firm is calculated using the monthly dollar returns from CRSP. The standard deviations of dollar returns are $608 million at the mean and $227 million at the median in our sample.

4. Empirical Results

In this section, we test the theoretical prediction from Section 2 that the sensitivity of compensation to overall firm performance will be higher for groups of executives for whom more precise individual signals of effort are not available. We examine the pay-performance incentives for executives grouped by job classification. In this analysis, we regress the calculated pay-performance sensitivities for stock and option holdings on the indicator variables for job classification groups.

[9] The mean and median percent returns are 17.68 and 12.18, respectively.

4.1 Median and OLS Regression Results

The principal-agent model clearly predicts that the pay-performance sensitivity is decreasing in the variance of shocks to the firm's performance. We allow for this effect by including a variable that is the empirical cumulative distribution function of the dollar variances of monthly stock returns. As in Aggarwal and Samwick (1999a), using the CDF of dollar return variances allows us to calculate the pay-performance incentives at different percentiles in the distribution of variances directly from the regression coefficients.

The econometric specification for Tables 3 and 4 is:

$$\alpha_{ijt} = \gamma_0 + \gamma_1 F\left(\sigma_{jt}^2\right) + \sum_{k=1}^{3} g_i^k \left(\gamma_2^k + \gamma_3^k F\left(\sigma_{jt}^2\right)\right) + \gamma_4 w_{ijt} + \mu_t + \varepsilon_{ijt}. \tag{6}$$

This equation specifies the pay-firm performance sensitivity (α_{ijt}) of executive i, working at firm j, in year t. Divisional executives are the omitted group; the constant (γ_0) in the regression pertains to this group. We include the CDF of return variances $F\left(\sigma_{jt}^2\right)$ separately to capture the effect of risk on Divisional executives. In our framework, g_i^k is an indicator variable for the group to which the executive belongs: 1) CEOs, 2) Oversight executives, and 3) executives with neither responsibility. The variables and coefficients that are group specific are indexed by the superscript k. γ_2^k is the coefficient on the indicator variable g_i^k for group k. Significant coefficients will show differences between group k and Divisional executives. We also interact $F\left(\sigma_{jt}^2\right)$ with the indicator variables (g_i^k) to allow for differential effects of risk on pay-performance sensitivities by job classification.[10]

We also include control variables that are critical for identification of our model. Many theories predict that executives with differing job responsibilities have differing levels of pay. One way to achieve differing levels of pay may be to give executives differing pay-performance sensitivities. We wish to show that, independent of the level of pay, there is a channel between an executive's responsibilities and her pay-performance sensitivity. We include the executive's level of compensation (w_{ijt}) as an independent variable to control for any possibly confounding relationship

[10] By using the CDF, pay-performance incentives at any percentile of the distribution of variances can easily be calculated directly (conditional on the year and level of compensation) from the estimated coefficients. For example, an executive in group k at a firm with the median stock return variance has pay-performance incentives of $\gamma_0 + 0.5\gamma_1 + \left(\gamma_2^k + 0.5\gamma_3^k\right)$. CDF values of 0 and 1 correspond to the minimum and maximum observed variances in the sample, where the pay-performance incentives are $\gamma_0 + \gamma_2^k$ and $\gamma_0 + \gamma_1 + \left(\gamma_2^k + \gamma_3^k\right)$, respectively.

between the level of pay and incentives. There may also be factors that affect incentives outside of our theoretical model, such as managerial ability, that also affect the level of compensation. In addtion, these factors might vary systematically by group–executives in the Oversight group might have higher average ability than Divisional executives, for example. Including the level of compensation in the regression is a way to proxy for these factors. We also control for annual changes in average pay-performance sensitivities (such as the increase over time shown in Figures 1 and 2) by including year dummies (μ_t).

Pay-performance sensitivities have traditionally been based on median stock ownership in a sample of executives (see Jensen and Murphy (1990)). As shown in Table 2, the mean share ownership is substantially higher than the median, especially for CEOs, indicating the presence of outliers with very high ownership. We therefore present estimates of the pay-performance sensitivities using median regression in Table 3.[11] To examine the robustness of these results, we also estimate pay-performance sensitivities using ordinary least squares in Table 4.

Table 3 contains the results of equation (6) estimated using median regression.[12] The left column contains results for both stock and options. Divisional executives at the lowest variance firm ($F\left(\sigma_{jt}^2\right) = 0$) have pay-performance incentives equal to 0.3473, measured as a percentage of the firm on a scale of 0 to 100.[13] The CEO of the same firm has pay-performance incentives equal to $0.3473 + 2.5371 = 2.8844$. Oversight executives at the same firm have pay-performance incentives equal to $0.3473 + 0.3450 = 0.6923$. This increase is statistically significant given the small standard error (0.0140) on the dummy variable for the Oversight group. This increase is also economically significant as it represents a doubling in incentives (that are not due to the level of compensation or the year) relative to the Divisional group. The pay-performance incentives of the Neither group are also statistically significantly greater than those of the Divisional group, although only 10 percent higher in magnitude (0.0330) at the lowest variance firm. In addition,

[11] Median regression minimizes the sum of absolute deviations rather than the sum of squared deviations and is therefore less sensitive to outliers than is OLS. Further, since the median is a more robust measure of the center of tbe data than the mean, the precision of the estimates will also typically be higher in median regressions. See Koenker and Bassett (1982) and Buchinsky (1998) for discussions of median regression estimation.

[12] Heteroskedasticity robust standard errorrs are reported beneath each coefficient. The standard errors are calculated using the bootstrap procedure in Gould (1992) with twenty replications.

[13] Tbe pay-performance sensitivity also includes the effect of the level of compensation and the time effect, i.e. $\gamma_4 w_{ijt} + \mu_t$. In our discussion of explicit pay-performance sensitivities, we focus on comparisons between groups and so refer to the group-specific terms, $\gamma_0 + \gamma_1 F\left(\sigma_{jt}^2\right) + \sum_{k=1}^{3} g_i^k \left(\gamma_2^k + \gamma_3^k F\left(\sigma_{jt}^2\right)\right)$ as the "pay-performance incentives."

the pay-performance incentives of the CEO group are dramatically larger than the incentives of the other three groups, and these differences are statistically significant.

We have also included the effect of variance on pay-performance incentives. At the median variance ($F\left(\sigma_{jt}^2\right) = 0.5$), Divisional executives have pay-performance incentives of $0.3473 + 0.5 * (-0.4076) = 0.1435$. At the median variance, CEOs have pay-performance incentives of $0.3473 + 2.5371 + 0.5 * (-0.4076 - 2.6812) = 1.3400$ and Oversight executives have pay-performance incentives of $0.3473 + 0.3450 + 0.5 * (-0.4076 - 0.3645) = 0.3063$. As shown in Aggarwal and Samwick (1999a), the variance of firm returns has a statistically and economically significant negative effect on pay-performance incentives. The bottom part of the left column presents the results of the test that the pay-performance incentives are the same for each of the three groups (CEO, Oversight, and Neither) as for the Divisional group at the median variance. The low p-values show that we can reject equality of pay-performance incentives for the CEO group and the Divisional group, the Oversight group and the Divisional group, and the Neither group and the Divisional group at the median variance.[14]

The middle column of Table 3 presents results for holdings of stock only and the right column presents results for holdings of options only. The same general pattern as holdings of both stock and options emerges for each component separately. For CEOs, pay-performance incentives at the median variance firm come somewhat more from stock than from options: $0.0643 + 1.0281 + 0.5 * (-0.0700 - 1.0741) = 0.5204$ for stock and $0.2109 + 0.6405 + 0.5 * (-0.2615 - 0.6823) = 0.3795$ for options. For the other three groups, substantially more pay-performance incentives come from options than from stock at the median. The Neither group receives statistically significantly greater pay-performance incentives from stock than does the Divisional group at the median variance, but these incentives are economically small. The Neither group receives insignificantly lower pay-performance incentives from options than does the Divisional group.

The positive coefficients on the level of compensation in each of the three regressions shows that executives with higher levels of compensation also have higher median pay-performance incentives. For stock and options together, an increase in compensation of \$1 million increases the median

[14] The predicted values from the regressions in Table 3 can be used to compute the median pay-performance sensitivity for each group, conditional on the values of all the explanatory variables. The median conditional pay-performance sensitivity for CEOs is 1.435 percent of the firm or \$14.35 per thousand dollar increase in shareholder wealth. This corresponds to the \$14.52 per thousand estimated in Aggarwal and Samwick (1999a). The median conditional pay-performance sensitivities for the Oversight, Divisional, and Neither groups are \$3.72, \$1.98, and \$2.09 per thousand, respectively.

pay-performance sensitivity by 0.0481 percent of the firm. This association is much stronger for options (0.0366) than for stock (0.0078). Table 2 shows that average compensation levels are \$1.766 and \$0.559 million higher for CEOs and Oversight executives than for Divisional executives. Median pay-performance sensitivities reported in Table 2, expressed as a percent of the firm, are higher by 1.0934 and 0.1302 for stock and options together and 0.2993 and 0.0449 for options only. Thus, comparing CEOs and Divisional executives, differences in compensation account for $4.81 * 1.766/1.094 = 7.75$ percent of the difference in median total pay-performance sensitivity and $3.66 * 1.766/0.2993 = 21.60$ percent of the difference in pay-performance sensitivity due to options only. Comparing the Oversight and Divisional groups, the corresponding percentages are 20.61 percent for stock and options together and 45.57 percent for options only. While higher pay-performance incentives are associated with higher levels of compensation, the factors that might be proxied by the level of compensation only explain a portion of the differences in median pay-performance incentives by job classification. The differences noted above are estimated to be statistically significant, even after controlling for differences associated with different levels of compensation across the groups.

Table 4 contains the results of equation (6) estimated using ordinary least squares without fixed effects. The coefficients are larger in absolute value relative to the coefficients from the median regression, reflecting the skewness of the distribution of pay-performance sensitivities. In almost all cases, the coefficients are of the same sign and as statistically significant as the coefficients from the median regression. At the median variance, the pay-performance sensitivity for the Divisional group is $0.5867 - 0.5 * 0.6380 = 0.2677$, nearly double the estimate from the median regression (0.1435). The estimates from the OLS regression at the median variance for the CEO, Oversight, and Neither groups are 3.5406, 0.8900, and 0.0591, respectively. Relatively more of all groups of executives' pay-performance incentives come from existing stockholdings than from option holdings in the OLS specification. In the median regression specification, relatively more pay-performance incentives come from option holdings for groups other than the CEO. This latter finding is consistent with the evidence from Table 2 and suggests that the distribution of stockholdings is particularly skewed.

4.2 Fixed Effect Results

The results in Tables 3 and 4 show that there are significant differences in pay-performance incentives across groups of executives. However, there are other factors that determine incentives. For example, executives have different levels of ability, reservation wages, risk aversion, and the disutility or marginal productivity of effort. If these factors also vary systematically across the four job groups, then the results in Tables 3 and 4 might be driven by these differences rather than differences in the variances of individual-specific and firm performance measures. To control for such factors, we estimate pay-performance sensitivities including an executive fixed effect (λ_i):

$$\alpha_{ijt} = \gamma_0 + \gamma_1 F\left(\sigma_{jt}^2\right) + \sum_{k=1}^{3} g_i^k \left(\gamma_2^k + \gamma_3^k F\left(\sigma_{jt}^2\right)\right) + \gamma_4 w_{ijt} + \mu_t + \lambda_i + \varepsilon_{ijt}. \tag{7}$$

The fixed effect controls for any variation in an executive's pay-performance sensitivity that is related to a time-invariant characteristic of the executive or the firm.

The interpretation of the coefficients in the fixed effects regression is different from that of an OLS regression without fixed effects. Some executives switch from one job group to another. In our sample, 1,745 executives switch groups, representing 6,539 executive-years or about 20 percent of the original observations. What happens to the incentives of executives who switch? The coefficients in the fixed effects specification are identified primarily by changes in the pay-performance incentives that executives receive when they switch groups, such as from Divisional to Oversight. To understand why, consider a simpler specification that includes only the three dummy variables for the CEO, Oversight, and Neither groups. If no executives switch groups over the sample period, then the dummy variables will be linear combinations of the fixed effects for the executives who comprise each group. The fixed effects regression can estimate an effect of being in one group versus another only when executives switch groups. In our specification, executives who do not switch groups contribute primarily to the identification of the other variables in the regression. Any estimated differences in incentives across groups in a fixed effects regression result *only* from changes in incentives that these particular executives receive when they actually switch groups over the sample period.

Table 5 contains the results of equation (7) estimated using ordinary least squares with executive fixed effects. As in Tables 3 and 4, the pay-performance incentives of CEOs are higher

than those of the Oversight group, which are in turn higher than those of the Divisional group.[15] These differences are statistically significant when incentives from Options Only or Stock and Options together are estimated. When the incentives are estimated excluding options, the difference between the Oversight and Divisional groups is significant only at the 10.1 percent level. The incentives for the Neither group are estimated to be higher than those of the Divisional group, but this difference is not statistically significant.[16]

Most of the variation in pay-performance sensitivities in the sample is due to differences in the average pay-performance sensitivity across individuals. The R^2 for the regression, measured including the fixed effects, is 97 percent for Stock and Options together. However, the independent variables also explain 11.78 percent of the variation in pay-performance sensitivities that is not due to the fixed effects. The coefficient on the level of compensation is economically very small at 0.0015 and not statistically significant, suggesting that variation in incentives across groups that was previously captured by the level of compensation is now absorbed by the fixed effects.

The key differences between the OLS and fixed effect results concerns the size of the differences in incentives across groups. At the median variance, CEOs have pay-performance incentives that are 0.5848 higher than those of Divisional executives. When an executive from the Divisional group is promoted to CEO, her pay-performance incentives increase by approximately 0.6 percent of the firm or by $6 per thousand dollar increase in shareholder wealth. This increase in incentives is only one-sixth of the difference of 3.5406 percent of the firm reported in Table 4 for the OLS regression. Similarly, the difference of 0.1258 between the Oversight and Divisional groups in Table 5 is one-seventh of the 0.8900 difference reported in Table 4. The large difference between the fixed effects

[15] With fixed effects included, the value of γ_0 is arbitrary. The reporting convention is to choose γ_0 so that the sample average values of the fixed effects (λ_t) are equal to zero. In this case, γ_0 no longer represents the pay-performance incentives for the divisional group at the minimum variance firm (and zero compensation in the omitted year). However, comparisons of pay-performance incentives across groups based on γ_2^k and γ_3^k are analogous to the specification without fixed effects.

[16] As shown in Table 1, our Divisional group is comprised of two types of executives. The first type, making up three quarters of the group, includes all executives who manage a subsidiary, international division, or specific product line at the firm. The second type includes all executives who have responsibilities related to production but which are less specific, such as a vice-president in charge of manufacturing. It might be argued that the second group is more similar to executives with corporate infrastructure responsibilities or unspecified responsibilities in the Neither group than to the first type of executives in the Divisional group. We re-estimate the fixed effects specification with this second type of executive in the Neither group. The differences in pay-performance incentives between the Divisional group and the other three groups are quite similar to those in the first column of Table 5. Pay-performance incentives for the Oversight group are 0.1352 higher than those for the Divisional group (compared to a 0.1344 difference in Table 5). Pay-performance incentives for the CEO group are 0.6207 higher than those for the Divisional group (compared to a 0.6199 difference in Table 5). These differences are statistically significant. Thus, our main empirical results are robust to reasonable changes in the classification scheme for executives.

and OLS estimates reflects the fact that there are many individual-specific determinants of the pay-performance sensitivity. The fixed effects specification controls for any factor whose effects are not present when an executive switches job groups. The differences in estimated incentives across groups that remain after the fixed effects have been included can be attributed to the presence of individual-specific signals of effort that characterize the different groups, as predicted by our theory.

4.3 Flow Compensation Results

Our results thus far have focused exclusively on the incentives provided to executives through ownership of stock and options. Our theory can also be tested using data on flow compensation. Because annual compensation does not require direct ownership of the firm, the pay-performance sensitivity must be estimated according to the "implicit" method discussed in Murphy (1998). The implicit pay-performance sensitivity is simply the coefficient on performance in a regression with the level of compensation as the dependent variable. Determinants of the implicit pay-performance sensitivity can be analyzed by interacting variables, such as the variance of the firm's stock return or indicator variables for job group, with the firm performance variable. A drawback to the implicit method is that we cannot include a fixed effect to control for other factors that affect the pay-performance sensitivity. Our specification for flow compensation is a modification of (6):

$$w_{ijt} = \sum_{k=1}^{4} g_i^k \left\{ \gamma_0^k + \left(\gamma_1^k + \gamma_2^k F\left(\sigma_{jt}^2\right) \right) \pi_{jt} + \gamma_3^k F\left(\sigma_{jt}^2\right) + \mu_t^k \right\} + \epsilon_{ijt}. \tag{8}$$

This equation specifies the compensation (w_{ijt}) of executive i, working at firm j, in year t. In this equation, g_i^k is an indicator variable for the group to which the executive belongs: 1) CEOs, 2) Oversight executives, 3) executives with neither responsibility, and 4) Divisional executives. The variables and coefficients that are group specific are indexed by the superscript k. The other variables are firm performance, π_{jt}, and the CDF of return variances, $F\left(\sigma_{jt}^2\right)$.

The terms following the summation capture the effect of performance, return variance, and the year on the level of compensation. The parameters are all indexed by k to allow for different effects of each variable on compensation for each group of executives. The first parameter, γ_0^k, is a constant within groups to allow for the differences in average levels of compensation across groups documented in Table 2. The next two coefficients pertain to the effect of performance

on compensation. The pay-performance sensitivity for executives in group k is $\gamma_1^k + \gamma_2^k F\left(\sigma_{jt}^2\right)$, which will be decreasing in the variance of returns if γ_2^k is estimated to be negative. We also include the CDF of the variance itself as an explanatory variable.[17] The final term in braces is a group-specific year effect, μ_t^k, which controls for changes in the average level of compensation for the group in each year.

Table 6 presents the pay-performance sensitivity results using median regression. The pay-performance sensitivity for CEOs at the median variance is \$0.7642 per thousand dollar increase in shareholder wealth. The last row of the table reports the results of the test of equality between Divisional executives ($k = 4$) and all other groups at the median variance. More formally, the test is:

$$H_0 : \left(\gamma_1^4 + 0.5\gamma_2^4\right) - \left(\gamma_1^k + 0.5\gamma_2^k\right) = 0. \tag{9}$$

The pay-performance sensitivity for CEOs is significantly higher than the pay-performance sensitivities for the other groups. The pay-performance sensitivity of the Oversight executives is \$0.3188 per thousand and is significantly larger than the \$0.1617 per thousand for Divisional executives. The pay-performance sensitivity for the Neither group is \$0.1627 per thousand and is insignificantly different from the Divisional group. The results for annual flow compensation are consistent with our theory and the results for incentives from stock and options. Executives with more precise signals of their effort relative to the overall performance of the firm have lower pay-performance sensitivities than do executives with less precise individual-specific signals.

4.4 Pay-Performance Sensitivities of the Top Management Team

Our data also allow us to calculate pay-performance sensitivities for the top management team. We define the top management team to be the top five executives at a firm. This definition of the team is somewhat restrictive, but it is consistent with the SEC reporting requirements and the ExecuComp sample design. As we have demonstrated, the pay-performance sensitivity varies by job classification. For each firm in each sample year, we calculate the team pay-performance sensitivity as the pay-performance sensitivity of the CEO plus four times the average pay-performance

[17] The principal-agent model is ambiguous on the predicted sign of γ_3. The CDF of variance is included in the regressions only to ensure that the cross-sectional relationship we estimate between pay and performance, which depends explicitly on variance, is not affected by a correlation between variance and the level of compensation that may happen to exist in the data.

sensitivity of all other executives at the firm for whom pay-performance sensitivities are reported.

Group-specific and aggregate pay-performance sensitivities for the top management team are reported in Table 7. The pay-performance sensitivities are reported as dollars of compensation per thousand dollar increase in shareholder wealth, as in Table 6. This measure is simply ten times the percent of the firm owned explicitly through stock or options.[18] The first two rows report the mean and median pay-performance sensitivities from stock and options (as in Table 2), along with our estimate of the team pay-performance sensitivity. For the top management team, the mean pay-performance sensitivity is \$68.79 per thousand and the median pay-performance sensitivity is \$30.24 per thousand. The third row reports estimated pay-performance sensitivities from Table 6 for total flow compensation using median regression and conditioning on variance. In this case, we calculate the group-specific pay-peformance sensitivities at the median variance and assume that the team is comprised of a CEO and four other executives drawn at random from the other three groups. The pay-performance sensitivity for the team is \$1.61 per thousand.

Past work on compensation has focused almost entirely on the incentives provided to the CEO. As one example, the debate over whether incentives facing top management are large or small that began with Jensen and Murphy (1990) and has been recently discussed by Hall and Liebman (1998) pertains only to CEOs.[19] Our estimates show that CEOs receive between 42 and 58 percent of the incentives provided to the top management team. In addition, these calculations show that the aggregate incentives provided to the top management team are quite substantial. The mean top management team receives almost 7 percent of the dollar returns to shareholders. The median top management team receives about 3 percent of the dollar returns to shareholders. Most of these incentives come in the form of holdings of stock or stock options.

5. Alternative Explanations

Our results demonstrate that there are significant differences in pay-performance incentives across groups of executives. These differences are consistent with the predictions of a principal-agent model in which there are multiple signals about an executive's effort. In this section, we consider

[18] Tables 2 through 5 report pay-performance sensitivities as percentages of the firm owned.

[19] Schaefer (1998) examines teams of the four best-paid executives by firm in ExecuComp and relates the team's compensation to firm size.

whether other explanations are consistent with the evidence presented here. It is important to note that our results do not pertain to the level of pay. Many theories predict differences in the level of pay across categories of managers, and it is certainly true that there are such differences in the level of pay. In order to explain our empirical results, however, an alternative theory must explain differences in pay-performance incentives across groups of executives, controlling for differences in the level of compensation. The alternative explanations we consider are: risk aversion or disutility of effort, tournaments, dynamic agency, managerial entrenchment, taxes, ability or human capital, and learning and screening. In general, the inclusion of executive fixed effects, year effects, and the level of flow compensation in our econometric specification demonstrates that our results cannot be due only to these alternatives.

5.1 Risk Aversion or Disutility of Effort

The standard principal-agent model with only one measure of performance rather than two allows for differences in pay-performance sensitivities across groups of executives. The pay-performance sensitivity in a model with one measure of performance (see Holmstrom and Milgrom (1987)) is $\alpha_{1i}^{*} = \frac{1}{1+kr\sigma_{\varepsilon}^{2}}$. Since we control for the variance of firm performance in our econometric specification, differences in the pay-performance sensitivity across groups can arise only from differences in the average levels of risk aversion, r, or the disutility of effort, k. In a model with only one measure of performance, the higher pay-performance sensitivity of the Oversight group compared to the Divisional group, for example, must be a reflection of lower risk aversion or less disutility of effort by executives with oversight authority. We control for this possibility directly by including executive fixed effects in the pay-performance sensitivity regression. Any differences in the average values of individual characteristics across groups, including risk aversion and the disutility of effort, are removed by the fixed effect at the level of the individual executive, assuming that executives' tolerances for risk or disutility of effort do not change when they switch groups.

5.2 Tournaments

Lazear and Rosen (1981) argue that tournaments can provide incentives to agents. Among top executives, the CEO position is the reward. CEOs are highly compensated as an inducement for lower level managers to exert effort in order to be chosen as the next CEO. Strictly speaking,

this model's predictions are about the level of compensation rather than the pay-performance sensitivity. However, we can combine the tournaments model with a standard principal-agent model in which there is one measure of performance to generate the following empirical predictions. The CEO receives incentives through the pay-performance sensitivity. All managers below the CEO get incentives to exert effort from two sources: a pay-performance sensitivity and the probability of promotion to CEO. In this extension of the tournaments model, the probability of promotion and the pay-performance sensitivity are substitute mechanisms for providing incentives. Consequently, managers with lower probabilities of promotion should have higher pay-performance sensitivities, and managers with higher probabilities of promotion should have lower pay-performance sensitivities. We find the opposite result. Managers with oversight authority, who are closer to the CEO position, have higher pay-performance sensitivities than do managers with divisional responsibilities, who are on average farther from the CEO position.

5.3 Dynamic Agency

Holmstrom (1999) and Gibbons and Murphy (1992) note that career concerns can provide incentives to managers when they are young. As they near the end of their productive lives, stronger explicit incentives must be given to them to induce greater effort provision. If CEOs are on average older than managers with oversight authority, who are, in turn, on average older than those with divisional responsibilities, then the differences in pay-performance sensitivities that we observe might be the result of different career concerns across groups. While this story is an agency story, it is a dynamic agency story and does not rely on the presence of an individual-specific performance measure, as our two-signal agency model does. Our fixed effect specification is robust to factors that increase linearly over time, such as age and experience, because it also includes year dummies. To a first order, no individual-specific, trending variable can be generating our results. As a result, we have controlled for the dynamic agency story and still find an independent effect due to differences in managerial responsibility.

5.4 Managerial Entrenchment

As managers become more senior or spend more time on the job, they may become more entrenched in the sense that it is more difficult or costly for the firm to fire them. Shleifer and Vishny (1989)

argue that managers become entrenched by distorting the firm's investment choices toward particular projects that depend more heavily on the managers' particular skills and knowledge. Since the probability of dismissal is an incentive mechanism that substitutes for the pay-performance sensitivity, managers who are entrenched must be given compensation contracts with higher pay-performance sensitivities. According to this model, the degree to which a manager is entrenched is a function of the manager's tenure at the firm. The observed differences in pay-performance sensitivities across groups could be the result of greater entrenchment of executives who have been at their firms longer. This alternative cannot be generating our results because an executive's tenure at the firm is a characteristic solely of the individual. As such, its effects on the observed compensation contract will be removed by the inclusion of the executive fixed effects and the year dummies in the pay-performance sensitivity regressions, just as in the dynamic agency story above.

A plausible extension of the Shleifer and Vishny (1989) model is that executives can become entrenched in their particular positions. The length of time that an executive has been in the position, rather than at the firm, is what determines the degree of entrenchment. When managers switch positions, they become less entrenched and consequently have higher probabilities of dismissal. As the probability of dismissal is a substitute for the pay-performance sensitivity, the pay-performance sensitivity should decrease when an executive switches positions. To investigate this hypothesis, we examined the changes in the pay-performance sensitivity when executives change job groups over the sample period. We find a result inconsistent with this hypothesis in Table 5–executives who switch from the Divisional group to the Oversight group or the Divisional group to the CEO group get higher pay-performance sensitivities in their new positions. This result is consistent with our agency model with two signals, since the higher pay-performance sensitivity in the new position is due to a change in the performance measures available for the compensation contract.

5.5 Taxes

An alternative explanation for the differences in pay-performance sensitivities across groups of executives is that they reflect tax-minimizing behavior on the part of firms. The Internal Revenue Code requires annual compensation in excess of one million dollars to be related to performance

if it is to be tax deductible at the corporate level.[20] Table 3 shows that our ranking of groups based on the pay-performance sensitivity corresponds to their ranking based on the average level of compensation. Under the tax-motivated hypothesis, differences in pay-performance sensitivities across groups might be a consequence of firms trying to pay these executives different average levels of compensation.

There are two reasons why tax considerations are unlikely to be generating our results. First, Table 2 shows that CEOs are the only group with median flow compensation in excess of one million dollars. The other three groups have median flow compensation substantially less than one million dollars. If factors unrelated to our agency model required average compensation to be higher, then for most of the executives in these groups, flow compensation could be increased without incurring a tax penalty. Second, we also control for the level of flow compensation directly in all of our pay-performance sensitivity regressions for stock and options. Any correlation between the level of flow compensation and the pay-performance sensitivity, whether the result of taxes or some other factor, is controlled for by this variable. Comparisons of the pay-performance sensitivities across groups, especially those other than the CEO, are therefore unlikely to be distorted by tax minimizing concerns.

5.6 Ability or Human Capital

As discussed in Prendergast (1996), another important determinant of compensation is managerial ability or human capital. Executives with higher ability and better skills have higher marginal products and therefore higher reservation wages. It is also plausible that higher ability executives will be sorted into CEO or Oversight positions. If this is the case, then ability provides an explanation of why CEOs receive higher levels of compensation than do executives with oversight authority who, in turn, receive higher levels of compensation than executives with divisional responsibilities. By itself, the ability hypothesis does not explain differences in pay-performance incentives across groups. Nonetheless, even if firms choose to reward greater managerial ability with higher pay-performance sensitivities, we have directly controlled for this possibility in the econometric specification by including both the level of compensation and executive fixed

[20] See Section 162(m) of the Internal Revenue Code. Repetti (1997) provides a discussion and critique of tax policy toward executive compensation. Perry and Zenner (1997) use ExecuComp to examine the effect of tax policy on the share of compensation that is performance related.

effects. The level of compensation removes the effects of differences in compensation on the pay-performance sensitivity. The executive fixed effects control for unobserved differences in ability or skills across executives.

5.7 Learning and Screening

Differences in executive abilities may have a more direct impact on pay-performance sensitivities if some aspects of ability are imperfectly observable. For example, suppose that executives have private information about their abilities and that firms try to screen executives by ability. In such a model, accepting a positive pay-performance sensitivity would be costly for an executive (due perhaps to risk aversion) but would be less costly for more able executives. Therefore, more able executives would accept higher pay-performance sensitivities and, maintaining the assumption above, would be sorted into job classifications entailing more oversight authority. As in the ability story discussed above, the inclusion of executive fixed effects will also control for this possibility.

In the specification with executive fixed effects, we identify differences in pay-performance incentives across groups based only on the changes in pay-performance incentives that result when an executive actually switches groups. The results for this specification could not obtain unless an executive who moves from the Divisional group to the Oversight group, for example, receives a higher pay-performance sensitivity as a result of this move. The private information story works in the reverse order–an executive chooses a higher pay-performance sensitivity and is then sorted into the group with more oversight authority. The higher pay-performance sensitivity must precede the job switch if it is to serve as a signal. We investigated this issue of timing directly and found that the change in the pay-performance sensitivity for executives who switch jobs is greater in the year of the job transition than it is in the year prior to the job transition. Further, the change in the pay-performance sensitivity in the year prior to the job transition for executives who switch jobs is approximately equal to the change in the pay-performance sensitivity for executives who do not subsequently switch jobs. These results are consistent with our model but do not support the screening explanation.

As another alternative explanation, suppose that both firms and markets are learning about executives' abilities through time (see Farber and Gibbons (1996) and Prendergast (1996)). In such a model, higher ability workers would receive higher compensation, and it is possible they

receive it in the form of a higher pay-performance sensitivity. This alternative is unlikely to be driving our results because the revelation of ability is an individual-specific, trending variable. The effects of learning about ability on the observed compensation contract will be removed by the inclusion of the executive fixed effects and the year dummies, just as in the dynamic agency story above.

6. Conclusion

We study empirically the design of incentives for managers with different responsibilities within the firm. Shareholders' inferences about a manager's effort will depend on the precision of signals of various performance measures. We exploit the differences in managerial responsibilities to examine the effect of multiple performance measures on managerial incentives. Using the Holmstrom-Milgrom (1987) linear principal-agent model, we show that the sensitivity of compensation to firm performance is lower for groups of managers with precise individual-specific signals about their effort.

We classify managers into four groups: CEOs, other executives with oversight authority for the entire firm, executives with divisional responsibility, and executives with neither oversight authority nor divisional responsibility. We argue that executives with divisional responsibility have more precise individual-specific measures of performance compared to executives with oversight authority or CEOs. As a result, executives with divisional responsibility should have lower pay-performance sensitivities. We document that CEOs have higher pay-performance sensitivities than do executives with oversight authority, who in turn have higher pay-performance sensitivities than those with divisional responsibility. Our empirical evidence supports the view that the sensitivity of compensation to the overall measure of firm performance is lower for executives for whom a more precise individual signal of effort is available. This result provides direct support for the principal-agent model as a determinant of executive pay deeper in the firm than just the CEO. We also show that the magnitude of the aggregate incentives of the top management team is quite substantial.

These results have implications for the theory of the firm and the internal economics of organizations. Our results support the principal-agent model's prediction that compensation is structured to share risk between shareholders and managers. More importantly, the degree of

risk-sharing inherent in the pay-performance sensitivity varies according to the manager's responsibilities. Our results suggest an important role for performance-related incentives in the compensation of top managers other than the CEO of a firm. These performance-related incentives are constrained by the principal-agent considerations of information and risk-sharing. The principal-agent problem should be thought of as pertaining to top management rather than just to a CEO.

REFERENCES

Aggarwal, Rajesh K. and Andrew A. Samwick (1999a). "The Other Side of the Tradeoff: The Impact of Risk on Executive Compensation." *Journal of Political Economy* 107: 65-105.

Aggarwal, Rajesh K. and Andrew A. Samwick (1999b). "Executive Compensation, Strategic Competition, and Relative Performance Evaluation: Theory and Evidence." Forthcoming, *Journal of Finance.*

Baker, George, Robert Gibbons, and Kevin J. Murphy (1994). "Subjective Performance Measures in Optimal Incentive Contracts." *Quarterly Journal of Economics.* 109: 1125–56.

Banker, Rajiv and Srikant Datar (1989). "Sensitivity, Precision, and Linear Aggregation of Signals for Performance Evaluation." *Journal of Accounting Research.* 27: (1) 21-39.

Buchinsky, Moshe (1998). "Recent Advances in Quantile Regression Models: A Practical Guideline for Empirical Research." *Journal of Human Resources.* 33: (1) 88-126.

Farber, Henry and Robert Gibbons (1996). "Learning and Wage Dynamics." *Quarterly Journal of Economics* 111: (4) 1007-48.

Gibbons, Robert and Kevin J. Murphy (1992). "Optimal Incentive Contracts in the Presence of Career Concerns." *Journal of Political Economy.* 100: 468-505.

Gould, W. W. (1992). "Quantile Regression with Bootstrapped Standard Errors," *Stata Technical Bulletin.* 9: 19-21.

Hall, Brian J. and Jeffrey B. Liebman (1998). "Are CEOs Really Paid Like Bureaucrats?" *Quarterly Journal of Economics* 113: (3) 653-691.

Holmstrom, Bengt (1999). "Managerial Incentive Problems: A Dynamic Perspective." Forthcoming, *Review of Economic Studies.*

Holmstrom, Bengt and Paul Milgrom (1987). "Aggregation and Linearity in the Provision of Intertemporal Incentives." *Econometrica.* 55: 303-28.

Jensen, Michael and Kevin J. Murphy (1990). "Performance Pay and Top Management Incentives." *Journal of Political Economy.* 98: 225-64.

Koenker, R. and G. Bassett, Jr. (1982). "Robust Tests for Heteroscedasticity Based on Regression Quantiles." *Econometrica* 50, 43-61.

Lambert, Richard and David Larcker (1987). "An Analysis of the Use of Accounting and Market Measures of Performance in Executive Compensation Contracts." *Journal of Accounting Research.* 25: Suppl., 85-125.

Lazear, Edward and Sherwin Rosen (1981). "Rank Order Tournaments as Optimal Labor Contracts." *Journal of Political Economy.* 89: 841-64.

Murphy, Kevin J. (1985). "Corporate Performance and Managerial Remuneration - An Empirical Analysis." *Journal of Accounting and Economics.* 7: 11-42.

Murphy, Kevin J. (1998). "Executive Compensation," Forthcoming in Orley Ashenfelter and David Card (eds.) *Handbook of Labor Economics* Vol. 3, North Holland.

Perry, Tod and Marc Zenner (1997). "Pay for Performance? Government Regulation and the Structure of Compensation Contracts." Manuscript, University of North Carolina, August.

Prendergast, Canice (1996). "What Happens Within Firms? A Survey of Empirical Evidence on Compensation Policies." NBER Working Paper 5802, October.

Repetti, James R. (1997). "Management Incentives, Needless Tax Complexity, and Capital Gains." *Tax Notes*. 75: 981-991.

Schaefer, Scott (1998). "The Dependence of CEO Pay-Performance Sensitivity on the Size of the Firm." *Review of Economics and Statistics*. 80: 436-443.

Shleifer, Andrei and Robert Vishny (1989). "Management Entrenchment–The Case of Manager-Specific Investments." *Journal of Financial Economics*. 25: (1) 123-139.

Standard and Poor's (1995). *S&P Compustat ExecuComp: The Executive Compensation Database*. Englewood, CO: McGraw-Hill, November.

</ref_section>

Figure 1
Median Pay-Performance Sensitivities from Stock

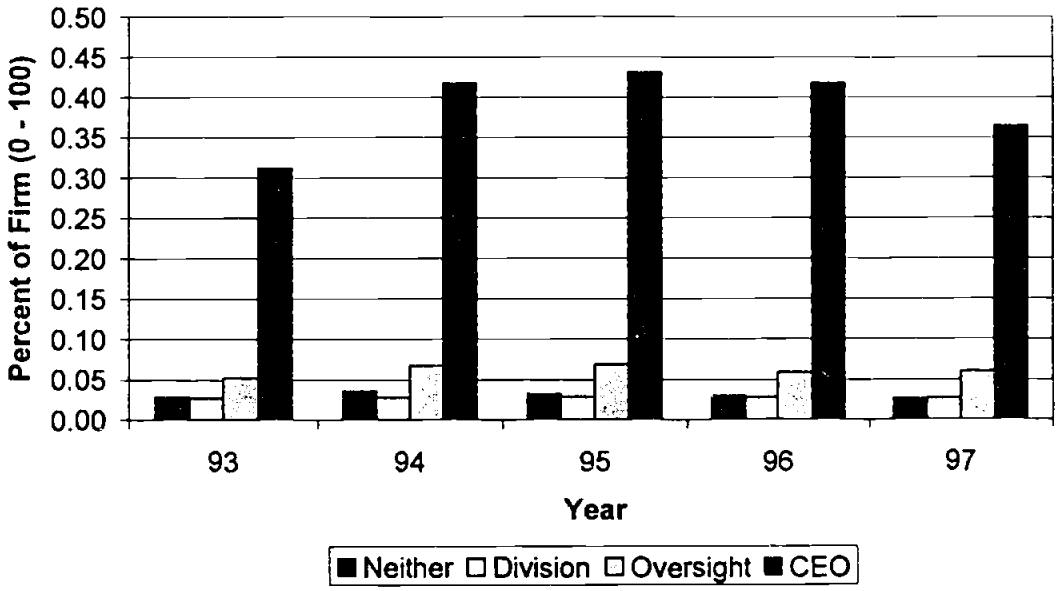

Figure 2
Median Pay-Performance Sensitivities from Options

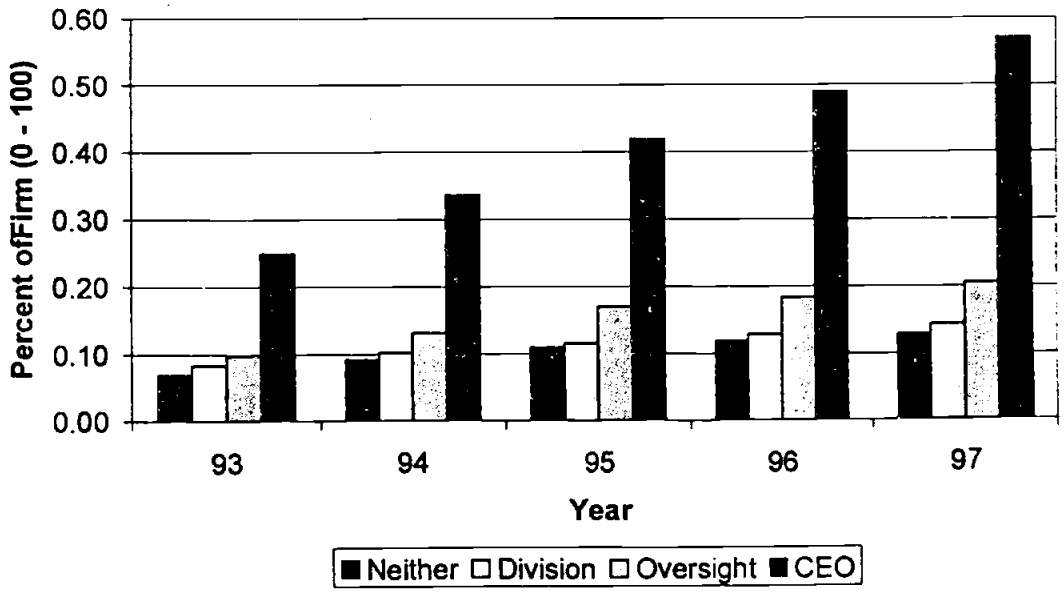

Table 1
Summary Information on Job Categories based on Reported Titles

Job Category	Percent of Job Category	Number of Observations (Percent of Sample)
Chief Executive Officers		6,804 (20.25%)
Oversight Responsibilities		8,642 (26.66%)
President	30.28	
Chairman	11.02	
Vice-Chairman	12.27	
Chief Operating Officer	27.03	
Chief Financial Officer	42.55	
Other Chief Executives	6.08	
Divisional		8,959 (25.71%)
Management of Subsidiaries, International Divisions, and Specific Product Lines	74.02	
Production-Related Responsibilities	25.98	
Neither		9,202 (27.38%)
Corporate Infrastructure Responsibilities	57.07	
Other Vice-President	42.93	

Notes:
1) The Oversight and Neither groups are comprised of executives not designated by ExecuComp to be the CEO of the firm and who are not identified by our classification procedure as having divisional responsibilities.
2) The sum of the percentages for the categories within the Oversight group exceeds 100 due to the instances in which executives carry more than one title, e.g., President and COO.
3) In the Oversight group, "Other Chief Executives" are executives who carry the title of CEO but are not designated by ExecuComp as the CEO of the firm in that year. These executives are typically CEOs who were replaced early in the year or new CEOs hired or promoted late in the year.

Table 2
Descriptive Statistics on Compensation and Incentives, by Job Classification

Group and Variable	Mean	Median	Standard Deviation
Stock and Option PPS			
CEO	3.9941	1.2769	7.1526
Oversight	1.2504	0.3137	3.5974
Divisional	0.3750	0.1835	0.8289
Neither	0.4336	0.1765	1.0910
Stock PPS			
CEO	3.1658	0.3883	7.0067
Oversight	0.9112	0.0622	3.5339
Divisional	0.1626	0.0281	0.0307
Neither	0.2245	0.0307	1.0000
Option PPS			
CEO	0.8283	0.4153	1.2027
Oversight	0.3393	0.1609	0.5867
Divisional	0.2124	0.1160	0.3805
Neither	0.2092	0.1048	0.3641
Holdings of Stock (Millions of 1997 dollars)			
CEO	74.606	5.801	722.605
Oversight	17.039	1.079	117.583
Divisional	2.496	0.422	15.908
Neither	4.898	0.475	98.923
Holdings of Options (Millions of 1997 dollars)			
CEO	7.968	2.218	22.664
Oversight	3.151	0.887	11.320
Divisional	2.018	0.583	7.964
Neither	1.776	0.578	4.514

Note:
Pay-performance sensitivities (PPS) reflect the executives' percentage ownership of the firm on a scale of 0 to 100.

Table 2, Continued
Descriptive Statistics on Compensation and Incentives, by Job Classification

Group and Variable	Mean	Median	Standard Deviation
Total Flow Compensation (Millions of 1997 dollars)			
CEO	2.739	1.494	5.183
Oversight	1.532	0.847	3.461
Divisional	0.973	0.605	1.324
Neither	0.873	0.555	1.254
Long-Term Components of Flow Compensation (Millions of 1997 dollars)			
CEO	1.571	0.543	4.381
Oversight	0.879	0.296	3.252
Divisional	0.488	0.190	1.054
Neither	0.417	0.170	0.985

Note:
Long-term compensation is comprised of the following components of flow compensation: grants of restricted stock, grants of stock options, long-term incentive plan payouts, gross-ups for tax liabilities, perquisites, preferential discounts on stock purchases, contributions to benefit plans, and severance payments.

Table 3

Median Regressions of Pay-Performance Sensitivities on Job Classification

Variable	Stock and Options	Stock Only	Options Only
Constant	0.3473	0.0643	0.2109
	(0.0069)	(0.0018)	(0.0057)
CDF of Variance	-0.4076	-0.0700	-0.2615
	(0.0079)	(0.0025)	(0.0080)
CEO	2.5371	1.0281	0.6405
	(0.0695)	(0.0597)	(0.0222)
CEO x CDF	-2.6812	-1.0741	-0.6823
	(0.0797)	(0.0674)	(0.0252)
Oversight	0.3450	0.0851	0.1249
	(0.0140)	(0.0046)	(0.0087)
Oversight x CDF	-0.3645	-0.0840	-0.1386
	(0.0161)	(0.0049)	(0.0114)
Neither	0.0330	0.0109	-0.0035
	(0.0094)	(0.0027)	(0.0070)
Neither x CDF	-0.0394	-0.0106	0.0033
	(0.0113)	(0.0031)	(0.0095)
Compensation	0.0481	0.0078	0.0366
	(0.0025)	(0.0009)	(0.0020)
Pseudo R-Squared	0.1040	0.0341	0.1185
	Tests for Equality with Divisional Group at Median Variance		
CEO	1.1965	0.4910	0.2993
	[0.000]	[0.000]	[0.000]
Oversight	0.1627	0.0430	0.0555
	[0.000]	[0.000]	[0.000]
Neither	0.0133	0.0056	-0.0019
	[0.001]	[0.000]	[0.453]

Notes:

1) The omitted category of executives is the Divisional group. Coefficients on other groups pertain to differences between those groups and the Divisional group. Each specification also includes year effects (not reported).
2) Heteroskedasticity robust standard errors based on 20 bootstrap replications are reported in parentheses under each coefficient.
3) Test statistics are the difference in the pay-performance sensitivity between the specified group and the Divisional group at the median variance firm and the p-value in brackets for the null hypothesis that the difference is zero.
4) The sample size is 13,109 executives in 33,607 executive-years.

Table 4

OLS Regressions of Pay-Performance Sensitivities on Job Classification

Variable	Stock and Options	Stock Only	Options Only
Constant	0.5867	0.3033	0.2834
	(0.0568)	(0.0556)	(0.0109)
CDF of Variance	-0.6380	-0.2802	-0.3578
	(0.0385)	(0.0363)	(0.0176)
CEO	5.8768	4.8710	1.0058
	(0.1944)	(0.1911)	(0.0327)
CEO x CDF	-4.6723	-3.7337	-0.9387
	(0.3051)	(0.3001)	(0.0522)
Oversight	1.4681	1.2123	0.2558
	(0.0898)	(0.0877)	(0.0166)
Oversight x CDF	-1.1563	-0.8722	-0.2841
	(0.1282)	(0.1252)	(0.0242)
Neither	0.0967	0.0817	0.0150
	(0.0344)	(0.0317)	(0.0107)
Neither x CDF	-0.0752	-0.0455	-0.0297
	(0.0516)	(0.0477)	(0.0168)
Compensation	0.0205	-0.0192	0.0396
	(0.0074)	(0.0078)	(0.0065)
R-Squared	0.1509	0.1088	0.1983
	Tests for Equality with Divisional Group at Median Variance		
CEO	3.5406	3.0041	0.5365
	[0.000]	[0.000]	[0.000]
Oversight	0.8900	0.7762	0.1138
	[0.000]	[0.000]	[0.000]
Neither	0.0591	0.0589	0.0001
	[0.000]	[0.000]	[0.982]

Notes:

1) The omitted category of executives is the Divisional group. Coefficients on other groups pertain to differences between those groups and the Divisional group. Each specification also includes year effects (not reported).
2) Heteroskedasticity robust standard errors are reported in parentheses under each coefficient.
3) Test statistics are the difference in the pay-performance sensitivity between the specified group and the Divisional group at the median variance firm and the p-value in brackets for the null hypothesis that the difference is zero.
4) The sample size is 13,109 executives in 33,607 executive-years.

Table 5

Fixed Effect Regressions of Pay-Performance Sensitivities on Job Classification

Variable	Stock and Options	Stock Only	Options Only
Constant	1.4233	1.1215	0.3017
	(0.0907)	(0.0680)	(0.0636)
CDF of Variance	-0.5643	-0.4192	-0.1451
	(0.1656)	(0.1201)	(0.1209)
CEO	1.3113	0.9113	0.4000
	(0.1819)	(0.1674)	(0.0789)
CEO x CDF	-1.4529	-1.1282	-0.3247
	(0.2423)	(0.2184)	(0.1140)
Oversight	0.3080	0.1988	0.1092
	(0.0989)	(0.0883)	(0.0465)
Oversight x CDF	-0.3643	-0.2813	-0.0829
	(0.1262)	(0.1104)	(0.0635)
Neither	0.0292	0.0199	0.0093
	(0.0672)	(0.0512)	(0.0451)
Neither x CDF	-0.0088	-0.0219	0.0131
	(0.0842)	(0.0612)	(0.0591)
Compensation	0.0015	-0.0028	0.0044
	(0.0039)	(0.0033)	(0.0031)
R-Squared			
Excl. Fixed Effects	0.1178	0.0696	0.1729
Incl. Fixed Effects	0.9709	0.9729	0.8623
	Tests for Equality with Divisional Group at Median Variance		
CEO	0.5848	0.3472	0.2376
	[0.000]	[0.000]	[0.000]
Oversight	0.1258	0.0581	0.0677
	[0.002]	[0.101]	[0.000]
Neither	0.0248	0.0090	0.0158
	[0.394]	[0.680]	[0.436]

Notes:

1) The omitted category of executives is the Divisional group. Coefficients on other groups pertain to differences between those groups and the Divisional group. Each specification also includes year effects (not reported).
2) Heteroskedasticity robust standard errors are reported in parentheses under each coefficient.
3) Test statistics are the difference in the pay-performance sensitivity between the specified group and the Divisional group at the median variance firm and the p-value in brackets for the null hypothesis that the difference is zero.
4) The sample size is 13,109 executives in 33,607 executive-years.

Table 6

Median Regression Estimates of Implicit Pay-Performance Sensitivities, by Job Classification

	CEO	Oversight	Divisional	Neither
		Total Flow Compensation		
γ_1 Performance	1.2897	0.5244	0.2487	0.2597
	(0.1889)	(0.0732)	(0.0364)	(0.0493)
γ_2 Performance *	-1.0511	-0.4113	-0.1740	-0.1939
CDF of Variance	(0.2281)	(0.0800)	(0.0425)	(0.0555)
γ_3 CDF of	2548	1323	913	822
Variance	(47)	(29)	(18)	(13)
	Pay-Performance Sensitivity and Hypothesis Tests at the Median Variance			
α_1 Pay-Performance	0.7642	0.3188	0.1617	0.1627
Sensitivity	(0.0795)	(0.0339)	(0.0160)	(0.0221)
P-value for Equality	[0.000]	[0.000]	-----	[0.974]
with Divisional				
Number of Obs.	6,779	8,812	8,709	9,357
Pseudo R-Squared	0.2191			

Notes:

1) Compensation is measured in thousands and dollar returns are measured in millions of 1997 dollars. The pay-performance sensitivity is therefore specified in dollars of compensation per thousand dollar increase in shareholder wealth.
2) The regression includes year, group, and year-group interaction effects (not reported).
3) Heteroskedasticity robust standard errors based on 20 bootstrap replications are reported in parentheses under each coefficient and estimate of the pay-performance sensitivity.
4) Test statistics are p-values for the null hypothesis that the difference in the pay-performance sensitivity between the specified group and the Divisional group at the median variance firm is zero.

Table 7
Pay-Performance Sensitivities of the Top Management Team

Type of Regression	CEO	Oversight	Divisional	Neither	Team
Stock and Options					
Mean	39.94	12.50	3.75	4.34	68.79
Median	12.77	3.14	1.84	1.77	30.24
Flow Compensation					
Median	0.76	0.32	0.16	0.16	1.62

Notes:

1) For stock and options, the pay-performance sensitivity for each group is reported in Table 2. The pay-performance sensitivity for the top management team is defined to be the pay-performance sensitivity for the CEO plus four times the average pay-performance sensitivity for all other executives in a given year.
2) For flow compensation, the pay-performance sensitivity for each group is reported in Table 6. The pay-performance sensitivity for the top management team is the pay-performance sensitivity of the CEO group plus four times the sample weighted average pay-performance sensitivity of the other three groups.
3) The number of observations in each category is given in Table 1 for the stock and option estimates and in Table 6 for the flow compensation estimates.
4) All estimates are in dollars of compensation perthousand dollar increase in shareholder wealth.