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Author(s): Rajesh K. Aggarwal and Andrew A. Samwick

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Performance Incentives within Firms: The Effect of Managerial Responsibility

RAJESH K. AGGARWAL and ANDREW A. SAMWICK *

ABSTRACT

We show that top management incentives vary by responsibility. For oversight executives, pay–performance incentives are \$1.22 per thousand dollar increase in shareholder wealth higher than for divisional executives. For CEOs, incentives are \$5.65 higher than for divisional executives. Incentives for the median top management team are substantial at \$32.32. CEOs account for 42 to 58 percent of aggregate team incentives. For divisional executives, the pay–*divisional* performance sensitivity is positive and increasing in the precision of divisional performance and the pay–*firm* performance sensitivity is decreasing in the precision of divisional performance. These results support principal–agent models with multiple signals of managerial effort.

MUCH OF THE ACADEMIC LITERATURE and popular discussion of executive compensation focuses on the incentives provided to chief executive officers (CEOs). However, public corporations are run by teams of top managers, and each of these managers has different responsibilities. For example, chief operating officers have broad oversight authority for the firm as a whole. In contrast, heads of large divisions have more narrowly defined authority but bear direct responsibility for a subset of the firm's activities. The focus on CEOs ignores important issues in the internal organization of the firm.

As top managers have different levels and areas of authority, they will have different measures of performance that can be used to provide incentives. The sensitivity of compensation to firm performance will depend on how precisely

* Aggarwal is at the McIntire School of Commerce, University of Virginia, and Samwick is at Dartmouth College and the NBER. We thank Sheri Aggarwal, Matt Clayton, Syd Finkelstein, Bob Gibbons, Jay Hartzell, Lorin Hitt, Leonhard Knoll, Margaret Meyer, Michael Weisbach, seminar participants at Boston College, Columbia, Dartmouth, Michigan, Oregon, Purdue, Vanderbilt, the American Finance Association Meetings, the American Economic Association Meetings, the NYU Accounting and Finance Conference, the UNH Spring Finance Conference, and the Western Finance Association Meetings, and especially Rick Green and the referee for helpful comments. We also thank Sarah Leonard, Yevgeny Neginsky, Evan Walsh, and Paul Wolfson for exceptional research assistance and Andy Halula for assistance with the ExecuComp database. This is a completely revised version of our 1999 NBER working paper of the same title. Financial support from the American Compensation Association and the Presidential Scholars Program at Dartmouth College is gratefully acknowledged. The views expressed are solely ours and do not reflect the views or opinions of the American Compensation Association. Any errors are our own.

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. Using a panel data set of 33,607 executive-year observations, we 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 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. Recent work by Garen (1994), Haubrich (1994), Aggarwal and Samwick (1999, 2002), Himmelberg, Hubbard, and Palia (1999), Garvey and Milbourn (2002), and Jin (2002) demonstrates that the principal-agent model explains differences in incentives across firms. However, an analysis based solely on interfirm comparisons 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 precision with which shareholders can measure each manager's effort.

Second, much of the existing literature on the magnitude of incentives provided by compensation contracts focuses on chief executive officers (e.g., Lambert and Larcker (1987), Jensen and Murphy (1990), and Hall and Liebman (1998)). However, there are other members of the top management team who may also have significant incentives. We show that incentives provided to the CEO are 42–58 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 \$32.32 per thousand dollar increase in shareholder wealth.

We test predictions from the principal-agent models of Holmstrom and Milgrom (1987) and Banker and Datar (1989). In these models, 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. Suppose that shareholders observe two potentially correlated signals about the manager's effort. The first signal is the performance of the firm as a whole. 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. The structure of incentives will depend upon the relative precision of the two signals, with more weight placed on the more precise signal.

Because the CEO is at the top of the corporate hierarchy, the CEO will have responsibility for all areas of corporate performance. 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.

In contrast, managers with divisional responsibility have a relatively more precise signal than overall firm performance. Their compensation should depend more heavily on divisional performance. 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. Similarly, the pay–*divisional* performance sensitivity will be higher for managers with divisional responsibility than it will be for CEOs or managers with oversight authority. 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 data set. Our sample consists of 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. There are 13,109 different executives and 33,607 executive-year observations. The sample is designed to be representative of the corporate sector and is large enough to allow us to make precise comparisons of the pay–performance sensitivities of managers based on their responsibilities within the firm. We start by testing predictions relating to the sensitivity of compensation to firm performance. Next, for a subsample of our firms and executives, we can match divisional level executives from ExecuComp to the areas of the firm for which they bear direct responsibility in COMPUSTAT's Industry Segment file. For these observations, we are able to provide a direct test of how strongly pay is linked to divisional performance as well as how this link varies with the precision of the performance measures.

We classify managers into four mutually exclusive groups: (1) CEOs, (2) executives other than CEOs with oversight authority for the entire firm, (3) executives with divisional responsibility, and (4) executives with neither oversight authority nor divisional responsibility. In practice, optimal incentive contracts will structure executive 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–*firm* performance sensitivity. Executives with oversight authority who are not the CEO have significantly higher pay–*firm* performance sensitivities than do executives with divisional responsibility. The median pay–*firm* performance sensitivity from stock and options for executives with oversight authority is \$3.26 per thousand dollar increase in shareholder wealth, 67 percent higher than the median pay–*firm* performance sensitivity of \$1.71 per thousand for executives with divisional responsibility. Both sets of executives have significantly lower pay–*firm* performance sensitivities than the median value of \$13.08 per thousand for CEOs. Top executives classified as having neither oversight authority nor divisional responsibility have a median pay–*firm* performance sensitivity of \$1.99 per thousand.

For the subsample of divisional executives whom we can match with the segments that they manage, we estimate a positive pay–*divisional* performance sensitivity between annual salary and bonus and the growth in divisional sales. We estimate that a one percent increase in divisional sales increases short-term compensation by 0.28 percent. This point estimate is higher than the estimated pay–*divisional* performance sensitivities for CEOs and executives with broad

oversight responsibilities at the same firms. We show that the pay–divisional performance sensitivity is decreasing in the volatility of the divisional performance measure for divisional executives matched to their divisions. We further show that the pay–*firm* performance sensitivities for these executives are lower when the divisional performance measures are less volatile. These findings suggest that firms optimally rely less on incentives based on the performance of the firm as a whole when more precise signals of managerial effort are available. Overall, our findings are consistent with a principal–agent model in which there are multiple differentially informative signals about managers’ provision of effort.

Our results showing differences in incentives by managerial responsibility are not driven by differences in executive-specific characteristics, such as ability or experience, or differences in the level of compensation by job classification. Executive fixed effects absorb much of the variation in incentives across job classifications, because characteristics such as average ability and experience differ across job classifications. Our primary results focus on the differences between executives with oversight authority and those with divisional responsibility. Controlling for executive fixed effects, the level of compensation, and variables related to the firm’s contracting environment, executives with oversight authority have pay–*firm* performance incentives that are \$1.22 per thousand dollar increase in shareholder wealth higher than the pay–*firm* performance incentives of executives with divisional responsibility. For completeness, we also present results for CEOs. We find that the pay–*firm* performance incentives of CEOs are \$5.65 per thousand higher than the pay–performance incentives of executives with divisional responsibility. These differences in pay–*firm* performance incentives across groups reflect the properties of the job, and not the characteristics of the person in the job. They are identified econometrically by changes in incentives that are observed when executives actually switch groups. These differences are not the result of cross-sectional variation in executive characteristics.

Our work is related to several other papers that link compensation contracts to managerial responsibility. 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. Bushman, Indjejikian, and Smith (1995) examine bonuses and long-term compensation for group CEOs, divisional CEOs, and plant managers. Using survey data encompassing a cross section of 472 observations from 246 firms, they find that incentives depend on performance both at the manager’s level (e.g., divisional performance) and performance above her level (e.g., corporate performance). They show that the relative weight placed on performance above the manager’s level depends on factors such as product and geographic diversification. Keating (1997) surveys 78 firms in a single year and asks how important firm accounting performance, firm stock price performance, and division accounting performance are in evaluating division managers. He finds that firm-wide performance measures matter more in divisional manager evaluations for relatively larger divisions and for divisions with greater firm-wide impact. Murphy and Oyer (2001) examine the role of discretionary bonuses based on subjective assessments of managerial performance. Using a survey of 280 bonus plans gathered by a large compensation-consulting

firm, they find that discretion is less important in determining CEO pay than the pay of other executives and that more diversified firms are relatively less likely to compensate their business unit managers based on firm-wide performance. Relative to these other studies, the advantage of our approach is the ability to study compensation at a much broader panel of firms and executives.

Barron and Waddell (2003) also use the ExecuComp panel to study differences in incentives for executives. They rank executives by compensation and find that higher-paid executives receive more equity-based incentives. They argue that this is because it is more costly to the firm for a higher ranking executive to make mistakes in project evaluation. Their explanation is complementary to ours. By controlling for the level of compensation, we control for the possibility that executive rank based on compensation is driving our findings.

The remainder of the paper is organized as follows. In Section I, we describe the compensation data and discuss the managerial job classifications that we use. The econometric results comparing incentives across groups of executives are presented in Section II. The main empirical result is that executives with specific divisional responsibility have lower pay–firm performance sensitivities than executives who have oversight authority for the entire firm. In Section III, we describe the matching of divisional executives to industry segments and present our empirical results on pay–divisional performance sensitivities. Section IV concludes.

I. Data

Our main source of data is Standard and Poor's ExecuComp data set, 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 years beginning in 1993 are virtually complete. Our sample extends from 1993 to 1997. It consists of 33,607 executive-year observations for 13,109 executives.¹ The ExecuComp data are collected directly from the companies' proxy statements and related filings with the Securities and Exchange Commission (SEC). 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).

¹ Our analysis in this paper uses the October 1998 release of the data. The complete data set includes 49,764 executive-year observations between 1993 and 1997. We exclude 4,932 observations because their firms' data on monthly stock returns is either missing from the Center for Research on Security Prices database or includes fewer than 12 months of returns needed to calculate the variance. Of the remaining observations, 9,030 do not have reported job titles, 1,800 do not have all the information necessary to compute incentives from stock and options, and 395 do not have compensation data. See Standard and Poor's (1995) for documentation of the ExecuComp data set.

A. Classifying Executives Based on Responsibilities

We argue that managerial responsibilities provide a good indicator for performance measures and hence incentives for executives. As an example, consider the case of Discovery Communications. Discovery introduced a bonus program in which the president and two other top officers receive bonuses based entirely on overall company performance. By contrast, the four division presidents receive bonuses based 40 percent on overall company performance, 40 percent on division performance, and 20 percent on individual performance. Corporate vice-presidents without divisional responsibility receive bonuses based 40 percent on overall company performance and 60 percent on individual performance. Divisional employees receive bonuses based 10 percent on overall corporate performance, 10 percent on divisional performance, and 80 percent on individual performance (Glater (2001)). The point of this bonus scheme is to link pay to performance in those areas for which the manager is responsible. As a result, for executives such as divisional presidents, there are multiple performance measures available and these performance measures all enter the compensation contract. Ultimately, we will show that, in our sample, the extent to which each of these performance measures is used is influenced by how informative the performance measure is.

To do so, we classify executives into four groups based on their reported job titles, as shown in Table I. 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 for each executive in ExecuComp is up to 30 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.

The first group is chief executive officers. CEOs clearly have responsibility for all aspects of firm performance, and the most logical measure of their efforts, broadly defined, is the total returns to their shareholders. There are unlikely to be other precise signals that contain incremental information about a CEO's effort, relative to the signals available for other top executives. CEO status is determined by ExecuComp to be the individual who held the title for the longest time 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, and this correlation will be reflected in their pay-performance sensitivities. Because of the assignment of responsibilities within the firm, however, this measure of performance may be relatively less informative than individual-specific signals about an executive's effort. As a result, other executives will have lower pay-firm performance sensitivities than the CEO. These executives can be further distinguished based on whether they have oversight authority for the performance of the firm as a whole.

Our second group is comprised of the most prominent examples of executives with oversight authority—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

Table I
Summary Information on Job Categories Based on Reported Titles

Our classification scheme for executives is as follows. The CEO group is comprised of executives who are designated by ExecuComp to be the CEO of the firm in a given year. CEO status is determined by ExecuComp to be the individual who held the title for the longest time during the year. The Oversight group is comprised of all other executives who carry the titles of president, chairman, vice-chairman, chief operating officer (COO), and chief financial officer (CFO). 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. 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, for example, President and COO. The Divisional group is comprised of all executives without oversight authority who are listed as a top executive of a division with the firm. The Neither group is comprised of all remaining executives for whom a job title is reported—those with neither explicit divisional responsibility nor primary oversight authority.

Job Category	Percent of Job Category	Number of Observations (Percent of Sample)
Chief Executive Officers		6,804 (20.25%)
Oversight Responsibilities		8,959 (26.66%)
President	30.28	
Chairman	11.02	
Vice-Chairman	12.27	
COO	27.03	
CFO	42.55	
Other Chief Executives	6.08	
Divisional		6,397 (19.03%)
Management of Subsidiaries, International Divisions, and Specific Product Lines		
Neither		11,447 (34.06%)
Production-related responsibilities	19.61	
Corporate infrastructure responsibilities	45.88	
Other Vice-President	34.51	

CEOs and higher than those of other executives. Individual-specific signals for executives with oversight authority include a performance evaluation by the CEO as well as indications of performance in any areas of the firm for which the executive has management responsibilities. Given the division of responsibilities in the firm, these signals may provide incremental information on the executive's effort beyond the total return to shareholders. Table I 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.² 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 I shows that there are 6,397 executives with divisional responsibility. The executives in the Divisional group are 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." 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 I shows that 19.61 percent are 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." Of the executives in the Neither group, 45.88 percent have corporate infrastructure responsibilities. Titles for executives with corporate infrastructure responsibilities include "Treasurer," "Secretary," "Controller," "General counsel," "Sr. v-p-human resources," "v-p-corp. planning & dev.," "Sr. v-p-marketing," and "Exec. v-p-acctg. & finance." Of the executives in the Neither group, 34.51 percent are simply designated vice-president, senior vice-president, or executive vice-president with no further information provided. The Neither group should have pay-performance sensitivities lower than those for the Oversight group because the overall performance of the firm is a relatively less precise signal of their efforts than it is for oversight executives. However, there is no clear prediction for the magnitude of the Neither group's incentives relative to those for the Divisional group.

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.

²This 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 for that year. Excluding these observations from the sample does not qualitatively affect our results.

B. 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. As a result, we focus primarily on incentives provided by holdings of stock and options. For completeness, in Section II.C., we present results on incentives from annual flow compensation and discuss the total pay–performance sensitivities of the top management team. In addition, in Section III.B., we consider incentives from salary and bonus.

ExecuComp contains precise data on annual flow compensation, including the details of options granted in the sample 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 years prior to the sample year. For stock, the pay–performance sensitivity is simply the fraction of the firm that the executive owns. A CEO who holds three percent of the stock outstanding in her firm has a pay–performance sensitivity from stockholdings of \$30 per thousand dollar change in shareholder wealth. 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. As noted above, there are two types of option holdings in the data set: (1) those granted in the sample year and (2) those granted in years prior to the sample year. For options granted in the sample year, companies must report the number of securities, the exercise price, and the exercise date. This information is sufficient to apply the Black–Scholes model directly when combined with data on volatility, interest rates, dividend yields, and stock prices. We follow the assumptions in Standard and Poor's (1995) about when options will be exercised. For option grants in sample year 1994 and earlier, we assume they will be exercised 80 percent through their term. For example, if the term of the options is 10 years, we assume that the options are exercised after 8 years. For option grants in sample year 1995 and later, we assume the options will be exercised 70 percent through their term. The term structure of interest rates is obtained by interpolating the year-end Treasury yields for the 1-, 2-, 3-, 5-, 7-, 10-, and 30-year constant maturity series. 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 60 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 60 but more than 12 months of data, then we use all of the available data. If a firm has fewer than 12 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 years prior to the sample year, the proxy statement does not list each option separately. It 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 (1999), 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 assuming a five-year term remaining to expiration, the method for options granted in previous years is the same as for option grants in the sample year.

Table II presents descriptive statistics on the compensation and incentive measures that we use in our empirical analysis. For each group of executives, the mean, median, and standard deviation are reported for seven variables. The first three variables are the calculated pay–performance sensitivities from stock, options, and their sum. The pay–performance sensitivities are expressed as percentages of the firm, so that a value of one 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, expressed in millions of 1997 dollars. The final three variables are total flow compensation and the long- and short-term components of flow compensation, also expressed in millions of 1997 dollars. Total flow compensation includes salary, bonus, 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, severance payments, and all other compensation. For consistency with other work, we use ExecuComp’s Black–Scholes value of stock options granted in our measure of flow compensation (see Standard and Poor’s (1995)). Short-term compensation is defined as salary and bonus. Long-term compensation is equal to total flow compensation less short-term compensation.

CEOs have mean pay–performance sensitivities of 4.03 percent of the firm, with 3.17 percent in the form of stock and 0.86 percent in the form of options. The medians are substantially lower at 1.31 percent overall, with the median option pay–performance sensitivity of 0.44 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. For the Divisional group, the mean and median pay–performance sensitivities from stock are lower than the mean and median pay–performance sensitivities from options. Compared to the CEO and Oversight groups, there are fewer instances of executives with extremely high stock ownership in the Divisional and Neither groups, although in all cases, the medians are substantially lower than the means. 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. The same patterns are evident in flow compensation.

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 for each of the four groups through time. Three

Table II

Descriptive Statistics on Incentives and Compensation, by Job Classification

In the following table, pay-performance sensitivities (PPS) reflect the executives' percentage ownership of the firm. Holdings of stock and options and flow compensation are denominated in millions of 1997 dollars. Short-term compensation is equal to the sum of salary and bonus. Long-term compensation is comprised of the remaining 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, severance payments, and all other compensation. The number of observations for each group is: CEO = 6,804, Oversight = 8,959, Divisional = 6,397, and Neither = 11,447.

Group and Variable	Mean	Median	Standard Deviation
Stock and option PPS			
CEO	4.026	1.308	7.163
Oversight	1.269	0.326	3.599
Divisional	0.347	0.171	0.795
Neither	0.452	0.199	1.063
Stock PPS			
CEO	3.166	0.388	7.007
Oversight	0.911	0.062	3.534
Divisional	0.156	0.028	0.720
Neither	0.216	0.030	0.944
Option PPS			
CEO	0.860	0.435	1.240
Oversight	0.357	0.169	0.608
Divisional	0.190	0.106	0.262
Neither	0.236	0.123	0.428
Holdings of stock			
CEO	74.616	5.801	722.605
Oversight	17.039	1.079	117.583
Divisional	2.711	0.501	17.938
Neither	4.307	0.425	88.763
Holdings of options			
CEO	7.873	2.198	22.412
Oversight	3.115	0.878	11.247
Divisional	1.933	0.580	7.720
Neither	1.835	0.571	5.357
Total flow compensation			
CEO	2.739	1.494	5.183
Oversight	1.532	0.847	3.461
Divisional	1.054	0.653	1.419
Neither	0.847	0.539	1.205
Short-term compensation			
CEO	1.127	0.825	1.869
Oversight	0.629	0.468	0.654
Divisional	0.513	0.405	0.487
Neither	0.424	0.330	0.417
Long-term compensation			
CEO	1.612	0.565	4.406
Oversight	0.903	0.312	3.267
Divisional	0.541	0.213	1.139
Neither	0.423	0.173	0.963

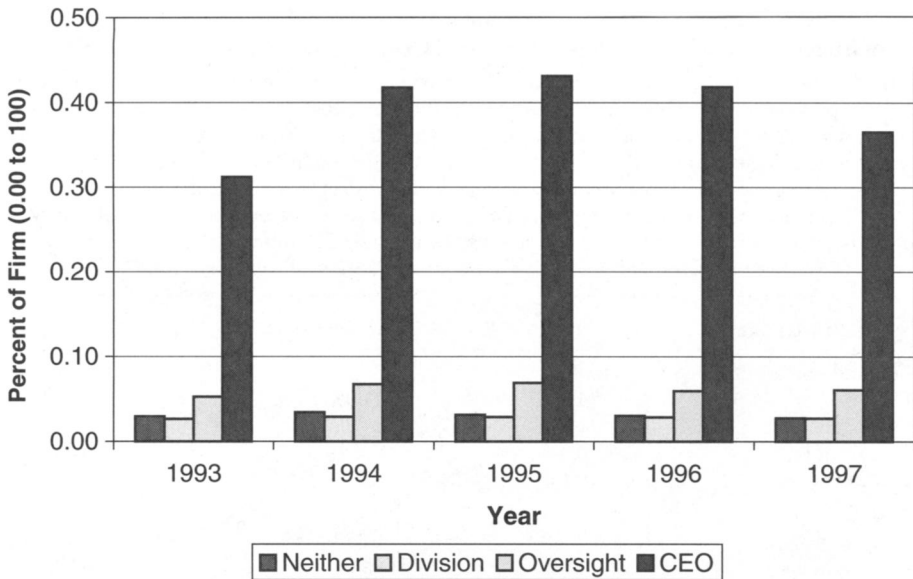


Figure 1. Median pay-performance sensitivities from stock.

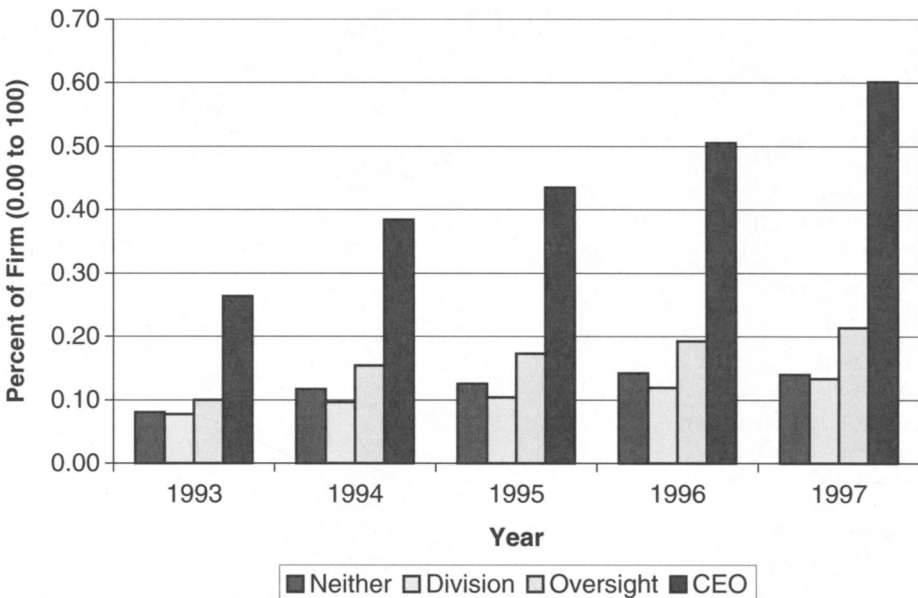


Figure 2. Median pay-performance sensitivities from options.

features of these graphs are noteworthy. First, in all years, 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 almost entirely attributable to stock options, not stockholdings. Stockholdings have remained relatively constant as a share of firm value through time.

These results are different from the existing empirical evidence from Murphy (1985). While he shows that higher ranking executives receive greater compensation than lower ranking executives, he also finds that higher ranking executives do not receive greater pay–performance incentives. The key difference between our paper and his paper is that he focuses on incentives from flow compensation and does not consider existing holdings of stock and stock options.

Figures 1 and 2 along with Table II suggest that pay–performance incentives vary quite dramatically by job classification. In general, the observed variation in pay–performance incentives can be attributed to two types of factors: (1) executive-specific characteristics and (2) the precision of performance measures associated with jobs as suggested by the theory. In the next section, we establish econometrically how much of the variation in incentives is attributable to the precision of performance measures associated with jobs.

Our main econometric specifications require data on 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. The mean and median percent returns are 18.47 and 12.29, respectively. 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 \$696 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 \$612 million at the mean and \$228 million at the median in our sample. Other variables included in our specifications come from COMPUSTAT. We include sales with a sample mean of \$3.7 billion and a median of \$1.1 billion, dividend yield with a mean of 1.64 percent and a median of 1.15 percent, and the ratio of debt to assets with a mean of 0.23 and a median of 0.22.

II. Empirical Results

The structure of incentives will differ for managers with differentially informative signals about their performance. Banker and Datar (1989) show that, under the optimal contract, managers are compensated more heavily based on the more informative signal. The key implication is that managers with precise performance measures other than firm performance will receive lower pay–firm performance sensitivities. As we discussed in greater detail in Section I.A., we use job classifications as a proxy for differing precision of performance measures. The relevant distinction across job classifications is that some executives have explicit divisional responsibilities and therefore precise individual performance measures. Other executives have broad oversight authority and less precise

individual performance measures. The average pay–firm performance sensitivity should be lower for executives with divisional responsibility than for executives with oversight authority.

In this section, we test the prediction that the sensitivity of compensation to overall firm performance will be lower for groups of executives for whom more precise individual signals of effort are 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 indicator variables for job classification groups. We begin with median, ordinary least squares, robust, and firm fixed effects regressions. These regressions formalize the results in Table II while controlling for the effects of the level of compensation, firm size (the log of sales), and sample year. We then estimate regressions with executive fixed effects to further control for the effects of executive-specific characteristics. We also estimate the executive fixed effects regression with additional control variables for payout policy (the dividend yield) and capital structure (the ratio of debt to assets). These variables are related to the firm’s contracting environment, as suggested by Himmelberg et al. (1999).

A. Initial Regression Results

The econometric specification for Table III is

$$\begin{aligned} \alpha_{it} = & \gamma_0 + \gamma_1 F(\sigma_{jt}^2) + \gamma_2 s_{jt} + \gamma_3 CEO_{it} + \gamma_4 CEO_{it} F(\sigma_{jt}^2) + \gamma_5 CEO_{it} s_{jt} \\ & + \gamma_6 OVS_{it} + \gamma_7 OVS_{it} F(\sigma_{jt}^2) + \gamma_8 OVS_{it} s_{jt} + \gamma_9 NEI_{it} \\ & + \gamma_{10} NEI_{it} F(\sigma_{jt}^2) + \gamma_{11} NEI_{it} s_{jt} + \beta' x_{it} + \mu_t + \delta_j + \varepsilon_{it}. \end{aligned} \quad (1)$$

The dependent variable is the pay–firm performance sensitivity (α_{it}) from holdings of stock and options of executive i in year t . The first two explanatory variables control for the effect of both firm risk and firm size on incentives. Following Aggarwal and Samwick (1999), we measure firm risk as the empirical cumulative distribution function (CDF) of the variance of dollar returns for all executives at firm t in year t , denoted by $F(\sigma_{jt}^2)$. The use of the CDF allows the pay–performance incentives at different points in the distribution of firm risk to be easily compared.

Baker and Hall (1998) and Schaefer (1998) discuss the relationship between pay–performance incentives and firm size. Following Himmelberg et al. (1999), Jin (2002), and Aggarwal and Samwick (2002), we control for a possible relationship between firm size and managerial incentives by including the log of sales for firm j in year t , denoted by s_{jt} .³ In addition, including the log of sales controls for

³ Our data set is missing data on the log of firm sales for a handful of observations. To avoid having to drop these observations from the sample, we follow Himmelberg et al. (1999) by recoding the missing observations to zero and including a dummy variable for whether the data were originally missing. We interact these dummies with the group dummy variables as well. We also follow this procedure with capital structure below.

Table III
Regressions of Pay-Performance Sensitivities from Stock and Options on Job Groups

The following table presents coefficient estimates from the regression:

$$\alpha_{it} = \gamma_0 + \gamma_1 F(\sigma_{jt}^2) + \gamma_2 s_{jt} + \gamma_3 CEO_{it} + \gamma_4 CEO_{it} F(\sigma_{jt}^2) + \gamma_5 CEO_{it} s_{jt} + \gamma_6 OVS_{it} + \gamma_7 OVS_{it} F(\sigma_{jt}^2) + \gamma_8 OVS_{it} s_{jt} + \gamma_9 NEI_{it} + \gamma_{10} NEI_{it} F(\sigma_{jt}^2) + \gamma_{11} NEI_{it} s_{jt} + \beta' x_{it} + \mu_t + \delta_j + \varepsilon_{it}$$

The omitted category of executives is the Divisional group. Coefficients on other groups pertain to differences between those groups and the Divisional group. Coefficients for the year effects (μ_t), the interactions between the three compensation variables and the four group variables, and the interactions between the dummy variable for missing data on sales and the four group variables are not reported. Heteroskedasticity robust standard errors are reported in parentheses under each coefficient (based on 200 replications for the median regression using the bootstrap procedure in Gould (1992)). Fixed effects at the firm level (δ_j) are included only in the fourth column. The bottom panel reports test statistics that are the difference in the pay-performance sensitivity between the specified group and the Divisional group at a firm with median variance and median sales. The p -value in brackets is for the null hypothesis that the difference is zero. The sample size is 13,109 executives in 33,607 executive-years, representing 1,778 firms. There are 42 observations with missing data on sales.

Variable	Median	OLS	Robust	Firm Fixed Effects
Constant	0.836 (0.022)	1.503 (0.111)	0.929 (0.025)	0.109 (0.683)
CDF of variance	- 0.320 (0.015)	- 0.662 (0.069)	- 0.325 (0.018)	- 0.216 (0.415)
Ln(sales)	- 0.058 (0.003)	- 0.114 (0.012)	- 0.065 (0.004)	0.102 (0.104)
CEO	4.162 (0.176)	7.909 (0.458)	1.211 (0.030)	8.482 (0.400)
CEO $\times$ CDF	- 1.171 (0.150)	- 0.619 (0.520)	- 0.587 (0.025)	- 0.913 (0.429)
CEO $\times$ Ln(sales)	- 0.371 (0.033)	- 0.563 (0.080)	- 0.104 (0.005)	- 0.675 (0.069)
Oversight	0.646 (0.048)	1.587 (0.258)	0.312 (0.029)	1.888 (0.307)
Oversight $\times$ CDF	- 0.260 (0.029)	- 0.330 (0.251)	- 0.094 (0.023)	- 0.400 (0.287)
Oversight $\times$ Ln(sales)	- 0.053 (0.007)	- 0.137 (0.040)	- 0.027 (0.005)	- 0.200 (0.048)
Neither	0.158 (0.029)	0.255 (0.114)	0.092 (0.028)	0.837 (0.253)
Neither $\times$ CDF	- 0.018 (0.019)	0.110 (0.089)	- 0.031 (0.022)	0.019 (0.236)
Neither $\times$ Ln(sales)	- 0.016 (0.004)	- 0.030 (0.015)	- 0.007 (0.004)	- 0.110 (0.041)
R-squared	0.126	0.171		0.164
Tests for Equality with Divisional Group at Median Variance and Sales				
CEO	0.981 [0.000]	3.659 [0.000]	0.189 [0.000]	3.302 [0.000]
Oversight	0.144 [0.000]	0.461 [0.000]	0.072 [0.000]	0.290 [0.001]
Neither	0.040 [0.001]	0.097 [0.017]	0.025 [0.008]	0.078 [0.386]

the possibility that firm size impacts the composition of our groups. For example, we are more likely to have divisional executives in our sample at larger firms, and executives at larger firms generally have lower incentives.

In this regression, γ_0 is the coefficient on the constant, γ_1 is the coefficient on the CDF of the variance, and γ_2 is the coefficient on the log of sales. Divisional executives are the omitted group—the first three terms in the regression, $\gamma_0 + \gamma_1 F(\sigma_{jt}^2) + \gamma_2 s_{jt}$, give the pay–performance incentives of this group. The next three triplets of terms are the *differential* pay–performance incentives of the other three groups relative to the Divisional group. The variable CEO_{it} is an indicator for whether the executive is CEO, OVS_{it} is an indicator variable for whether the executive is in the Oversight group, and NEI_{it} is an indicator variable for whether the executive is in the Neither group. The principal–agent model predicts that γ_1 , $\gamma_1 + \gamma_3$, $\gamma_1 + \gamma_5$, and $\gamma_1 + \gamma_7$ will be negative. For any group of executives, those at firms with higher variances have lower pay–performance incentives than those at firms with lower variances. We interact the log of sales with all of the group indicators so that the effect of firm size is differentially estimated for all of the groups. By allowing the effects of firm size to differ by group, we can more precisely estimate the incentives for executive groups at a firm of median size.

For example, an executive in the Oversight group at a firm with the median stock return variance ($F(\sigma_{jt}^2) = 0.5$) and the median log of firm sales (denoted by s) has pay–performance incentives of $\gamma_0 + 0.5\gamma_1 + s\gamma_2 + (\gamma_6 + 0.5\gamma_7 + s\gamma_8)$. The pay–performance incentives of the same executive at a firm with the minimum and maximum variances are calculated analogously by substituting $F(\sigma_{jt}^2) = 0$ and $F(\sigma_{jt}^2) = 1$, to obtain $\gamma_0 + s\gamma_2 + (\gamma_6 + \gamma_8s)$ and $\gamma_0 + \gamma_1 + s\gamma_2 + (\gamma_6 + \gamma_7 + s\gamma_8)$, respectively. Our focus here is on differences in incentives across job groups. For example, the difference in pay–performance incentives between the Oversight and Divisional groups is $\gamma_6 + \gamma_7 F(\sigma_{jt}^2) + \gamma_8 s_{jt}$. If firm performance is less informative for divisional executives than it is for oversight executives, this difference will be positive. In our empirical results below, we test for the significance of this difference for all groups at the median values of both variance and firm size.

We also include control variables that are necessary for identification of our model. Many theories predict that executives with different job responsibilities have different levels of compensation. One way to achieve different levels of compensation may be to give executives different pay–performance sensitivities. We wish to show that, *after controlling for the level of compensation*, there is a channel between an executive's responsibilities and her pay–performance sensitivity. We include the logarithm of the executive's total compensation ($\ln w_{it}$) as an independent variable. To prevent observations in which the wage is zero from being dropped from the sample, we add 0.01 to the wage variables before taking the logarithm. We also include separately the executive's short-term compensation (w_{it}^{ST}) and long-term compensation (w_{it}^{LT}), where $w_{it} = w_{it}^{ST} + w_{it}^{LT}$. We further interact these three variables with dummy variables for the job groups. These 12 variables are represented by the vector $\mathbf{x}_{it}$ and the associated 12 coefficients are represented by the vector $\boldsymbol{\beta}'$ in equation (1). These compensation variables control for

a possibly confounding relationship between compensation and incentives, as well as any differences in that relationship across groups.

We also control for yearly differences in average pay–performance sensitivities (such as the increase over time shown in Figures 1 and 2) by including year dummies μ_t (interactions between the group dummies and the year dummies were jointly insignificant). In the fourth specification in Table III, we also control for firm level fixed effects (δ_j). Firm level fixed effects control for any variation in an executive's pay–performance sensitivity that is related to a time-invariant characteristic of the executive's firm j . In the first three specifications in Table III, δ_j is set equal to zero for all firms j .

Within firms, there may be factors that affect incentives that vary systematically by group. For example, executives in the Oversight group might have higher average ability than executives in the Divisional group. To the extent that these factors also influence the level of compensation (e.g., executives with higher ability receive higher compensation), including compensation in the regression proxies for the effect of these factors on incentives. In the next subsection, we expand the fixed effects to the executive level, rather than the firm level, to more directly control for these factors as well.

Pay–performance sensitivities have traditionally been based on median stock ownership in a sample of executives (such as Jensen and Murphy's (1990) estimate for CEOs of \$3.25 per thousand dollar increase in shareholder wealth). As shown in Table II, the mean share ownership is substantially higher than the median, indicating the presence of outliers with very high ownership. We therefore present estimates of the pay–performance sensitivities from equation (1) using median regression in the first column of Table III.⁴ For comparison, we present OLS estimates in the second column of Table III. As an alternative means of lessening the impact of outliers, we also present estimates from a robust regression (see Hamilton (1992)) in the third column. In the fourth column, we present estimates from an OLS regression that includes firm level fixed effects.

In the median regression, divisional executives at the firm with median firm variance ($F(\sigma_{jt}^2) = 0.5$) and median sales ($s_{jt} = 7$) have pay–performance incentives of $0.836 + 0.5(-0.320) + 7(-0.058) = 0.270$. At the same firm, oversight executives have pay–performance incentives of $0.270 + 0.646 + 0.5(-0.260) + 7(-0.053) = 0.415$, and CEOs have pay–performance incentives of $0.270 + 4.162 + 0.5(-1.171) + 7(-0.371) = 1.250$.⁵ As shown in Aggarwal and Samwick (1999, 2002), the dollar variance of firm returns has a statistically and economically

⁴Median 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 the 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.

⁵In our discussion of pay–performance sensitivities, we focus on comparisons between groups controlling for compensation levels and so refer to these group-specific terms as the “pay–performance incentives” for that group, for example, $\gamma_0 + \gamma_1 F(\sigma_{jt}^2) + \gamma_2 s_{jt} + \gamma_3 CEO_{it} + \gamma_4 CEO_{it} F(\sigma_{jt}^2) + \gamma_5 CEO_{it} s_{jt}$ for CEOs. The actual pay–performance sensitivity also includes the effects of the compensation, time, and firm variables, that is, $\beta' x_{it} + \mu_t + \delta_j$.

significant negative effect on pay-performance incentives. This is true for all four groups of executives.⁶

The bottom part of each 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 and the median firm sales. Oversight executives have pay-performance incentives that are \$1.44 per thousand dollar increase in shareholder wealth higher than the pay-performance incentives of divisional executives. CEOs have pay-performance incentives that are \$9.81 per thousand higher, and executives in the Neither group have incentives that are \$0.40 per thousand higher. These differences in pay-performance incentives at the median variance are statistically significant.

The 12 estimated coefficients on the compensation variables (not reported) are jointly significant and show a generally positive relationship between pay-performance incentives and compensation. While higher pay-performance incentives are associated with higher levels of compensation, the factors that are proxied by the level of compensation only explain a portion of the differences in median pay-performance incentives by job classification. The differences in pay-performance incentives across groups are estimated to be statistically significant, even after controlling for differences in compensation across the groups.

For the OLS regression, we find the same general pattern of coefficients as we find for the median regression. The bottom panel shows that the differences in incentives for all three groups relative to the Divisional group are positive and significant. Consistent with the disparity in mean and median incentives shown in Table II, the magnitudes of incentives are higher for the OLS regression than for the median regression. For the robust regression, all of the coefficients on the group, variance, and sales terms are of the same sign as in the median regression. The bottom panel shows that the differences in incentives for all three groups relative to the Divisional group are positive and significant. The magnitudes of these differences are lower than for the median regression. Lastly, in the firm fixed effects regression, the tests for equality with the Divisional group show that the Oversight group and CEOs have significantly higher pay-performance incentives than the Divisional group. The Neither group has insignificantly higher incentives than the Divisional group. Taken together, these four specifications show that there are significant differences in pay-performance incentives across groups of executives.

B. Executive Fixed Effect Results

The estimates in Table III in the previous subsection control for observable differences in executives that are related to the level of compensation, the sample year, and, in the fourth column, firm-specific characteristics. However, executives may have different pay-performance sensitivities based on individual-specific characteristics that are unobservable to the econometrician. For example,

⁶ The increment to the dollar return variance for the Neither group, -0.018 , is not significant, but the aggregate effect of the dollar return variance on the incentives of the Neither group, $-0.320 - 0.018 = -0.338$, is negative and significant.

executives may have different levels of productivity, risk aversion, disutility of effort, ability, and human capital as well as differing in age, experience, gender, and educational background. If these factors vary systematically across the executives in the four job categories (e.g., executives with higher ability receive more incentives and are sorted into higher job categories), then the results in Table III might be influenced by these differences in addition to differences in the variances of the individual performance measures.

To control for such executive-specific characteristics, we augment equation (1) by including an executive fixed effect (δ_i) instead of the firm fixed effect (δ_j). The interpretation of the coefficients in the executive fixed effects regression is different from that of an OLS regression without fixed effects. The coefficients in the executive fixed effects specification are identified primarily by changes in the pay-performance incentives that executives receive when they switch groups, such as moving from Divisional to Oversight.⁷ In our sample, we observe 1,977 transitions between groups made by 1,766 executives. These executives are observed in 6,602 executive-years, or about 20 percent of the observations. The fixed effects coefficients reflect the difference in average incentives across groups over the sample period for this subset of executives. In our executive fixed effects specification, executives who do not switch groups contribute primarily to the identification of the other variables in the regression, such as the compensation variables, the year effects, and the variance and sales interactions. In addition, we augment the specification to include other possible determinants of incentives. Himmelberg et al. (1999) note that it is important to control for aspects of a firm's contracting environment when estimating the determinants of incentives. We include payout policy (the dividend yield) and capital structure (the ratio of debt to assets).

The first column of Table IV contains the results estimated using ordinary least squares with executive fixed effects. Incentives are negatively and significantly related to the variance of returns for all groups.⁸ In addition, incentives are negatively and significantly related to the log of firm sales for all groups. For the additional control variables, pay-performance incentives are lower for firms with higher dividend yields. Capital structure does not have a significant effect on incentives. The bottom panel of the table shows that the pay-performance incentives of the Oversight group are significantly higher than those of the Divisional group. The pay-performance incentives of CEOs are significantly higher than both. The incentives for the Neither group are also estimated to be higher than those of the Divisional group, but this difference is not statistically

⁷With fixed effects included, the value of γ_0 is arbitrary. The reporting convention is to choose γ_0 so that the sample average value of the fixed effects (δ_i) is equal to zero. In this case, γ_0 no longer represents the pay-performance incentives for the omitted group. However, comparisons of pay-performance incentives across groups based on the other coefficients are analogous to the specification without fixed effects.

⁸The increments to the dollar return variance for the Oversight and Neither groups relative to the Divisional group are not significant, but the aggregate effects of the dollar return variance on the incentives of the Oversight and Neither groups are negative and significant.

Table IV
Executive Fixed Effects Regressions of Pay-Performance Sensitivities on Job Groups

The following table presents coefficient estimates from the regression:

$$\alpha_{it} = \gamma_0 + \gamma_1 F(\sigma_{jt}^2) + \gamma_2 s_{jt} + \gamma_3 CEO_{it} + \gamma_4 CEO_{it} F(\sigma_{jt}^2) + \gamma_5 CEO_{it} s_{jt} + \gamma_6 OVS_{it} + \gamma_7 OVS_{it} F(\sigma_{jt}^2) + \gamma_8 OVS_{it} s_{jt} + \gamma_9 NEI_{it} + \gamma_{10} NEI_{it} F(\sigma_{jt}^2) + \gamma_{11} NEI_{it} s_{jt} + \beta' x_{it} + \mu_t + \delta_i + \varepsilon_{it}$$

The omitted category of executives is the Divisional group. Coefficients on other groups pertain to differences between those groups and the Divisional group. Coefficients for the year effects (μ_t), the interactions between the three compensation variables and the four group variables, and the interactions between the dummy variable for missing data on sales and the four group variables are not reported. The robust regression in the second column is estimated using the deviations from within-executive means of all variables. The standard errors are adjusted to account for the degrees of freedom used to estimate the within-executive means. For all other columns, fixed effects at the executive level (δ_i) are included and heteroskedasticity robust standard errors are reported in parentheses under each coefficient. The bottom panel reports test statistics that are the difference in the pay-performance sensitivity between the specified group and the Divisional group at a firm with median variance and median sales. The p -value in brackets is for the null hypothesis that the difference is zero. The sample size is 13,109 executives in 33,607 executive-years, representing 1,778 firms. There are 42 observations with missing data on sales and 1,954 observations with missing data on debt/assets.

Variable	Stock and Options		Stock Only	Options Only
	OLS	Robust	OLS	OLS
Constant	2.311 (0.263)	− 0.000 (0.000)	1.721 (0.237)	0.589 (0.130)
CDF of variance	− 0.402 (0.172)	− 0.151 (0.013)	− 0.297 (0.149)	− 0.105 (0.094)
Ln(sales)	− 0.134 (0.033)	− 0.042 (0.003)	− 0.097 (0.029)	− 0.037 (0.017)
CEO	2.139 (0.347)	0.334 (0.018)	0.857 (0.308)	1.282 (0.162)
CEO × CDF	− 1.043 (0.349)	− 0.074 (0.015)	− 1.018 (0.322)	− 0.025 (0.136)
CEO × Ln(sales)	− 0.150 (0.056)	− 0.032 (0.003)	0.001 (0.049)	− 0.151 (0.026)
Oversight	0.584 (0.231)	0.121 (0.017)	0.103 (0.211)	0.481 (0.102)
Oversight × CDF	− 0.310 (0.204)	0.007 (0.014)	− 0.325 (0.190)	0.015 (0.074)
Oversight × Ln(sales)	− 0.044 (0.031)	− 0.014 (0.003)	0.015 (0.027)	− 0.059 (0.016)
Neither	0.033 (0.150)	0.017 (0.016)	− 0.049 (0.131)	0.082 (0.077)
Neither × CDF	0.021 (0.144)	− 0.010 (0.013)	− 0.052 (0.127)	0.073 (0.072)
Neither × Ln(sales)	0.000 (0.020)	0.001 (0.003)	0.011 (0.017)	− 0.011 (0.011)
Dividend yield	− 0.011 (0.004)	− 0.005 (0.000)	− 0.001 (0.003)	− 0.010 (0.005)

Table IV—Continued

Variable	Stock and Options		Stock Only OLS	Options Only OLS
	OLS	Robust		
Debt/assets	0.073 (0.114)	0.030 (0.006)	0.098 (0.101)	– 0.025 (0.054)
Missing debt/assets	0.016 (0.078)	0.019 (0.007)	0.001 (0.073)	0.015 (0.026)
R-squared (excl. fixed effects)	0.110		0.062	0.289
Tests for Equality with Divisional Group at Median Variance				
CEO	0.565 [0.000]	0.075 [0.000]	0.353 [0.000]	0.212 [0.000]
Oversight	0.122 [0.002]	0.028 [0.000]	0.044 [0.155]	0.078 [0.002]
Neither	0.044 [0.148]	0.020 [0.000]	0.003 [0.900]	0.041 [0.019]

significant.⁹ In the second column of Table IV, we estimate robust regression on the fixed effect residuals. As in Table III, the robust method yields smaller magnitudes of the coefficients compared to OLS but statistically significant differences in pay–performance incentives across the groups at the median variance and firm size. In the robust specification, the additional control variables are significant.

The key difference between the OLS results in Table III and the executive fixed effect results in Table IV concerns the size of the differences in incentives across groups. At the median variance firm, CEOs have pay–performance incentives that are \$5.65 per thousand dollar increase in shareholder wealth higher than those of divisional executives. This increase in incentives is 15 percent of the difference of

⁹ As shown in Table I, our Neither group is comprised of three types of executives. The first type, making up 20 percent of the group, includes executives who have responsibilities related to production, such as a vice-president in charge of manufacturing. These responsibilities are less specific than those of executives in our Divisional group, who all manage a designated subsidiary, division, or product line. However, it might be argued that the first subset of the Neither group is more similar to the Divisional group than it is to the rest of the Neither group (comprised of executives with corporate infrastructure responsibilities or unspecified responsibilities). To investigate this possibility, we estimate the fixed effects specification with this subset of executives reclassified to the Divisional group. The differences in pay–performance incentives between the (new) Divisional group and the other three groups are similar to those in the first column of Table IV. Pay–performance incentives for the Oversight group are 0.126 higher than those for the Divisional group (compared to a 0.122 difference in Table IV). Pay–performance incentives for the CEO group are 0.570 higher than those for the Divisional group (compared to a 0.566 difference in Table IV). These differences are statistically significant. The difference between the Divisional group and the Neither group continues to be insignificant. Thus, our main empirical results are robust to a reasonable change in the classification scheme for executives.

\$36.59 per thousand reported in Table III for the OLS regression. Similarly, the difference of \$1.22 per thousand between the Oversight and Divisional groups in Table IV is 26 percent of the \$4.61 per thousand difference reported in Table III. The differences in estimated incentives across groups that remain after the executive 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 the theory. Including the executive fixed effects increases the R^2 for the regression to 97.1 percent. Clearly, much of the variation in pay-performance sensitivities in the sample is due to differences in executive-specific characteristics.¹⁰ The very high R^2 leaves little variation left to be explained by any omitted factor. The R^2 excluding fixed effects is 11.0 percent, which is comparable to the R^2 values shown in Table III.

As an additional robustness check, in the third and fourth columns of Table IV, we estimate the executive fixed effects specification separately for holdings of Stock Only and Options Only. Holdings of stock are to some extent voluntary and may be the result of idiosyncratic factors rather than optimal contracting. This conjecture is borne out in the results, as the R^2 including fixed effects is higher for Stock Only than for Options Only, indicating that executive-specific factors explain more of the variation in stock holdings across executives. In contrast, the R^2 excluding fixed effects is higher for the Options Only than for Stock Only, indicating that the economic control variables (variance, sales, and compensation) explain more of the residual variation in incentives from options.

Examining each component of total incentives in isolation can be misleading in a fixed effects specification in which the coefficients are identified based on within-executive changes in stock and option holdings. Executives often retain the stock in their company after exercising options, and compensation committees also make new stock option grants with some regard to executive's holdings of stock. As a result, year-to-year changes in either component in isolation provide a very noisy estimate of the change in total incentives. The salient feature of the two columns is that they partition the result for Stock and Options combined in the first column into components for stock and options individually. Note that for each variable, the sum of the coefficients in the two columns equals the coefficient in the first column.

Focusing on the bottom panel, for Stock Only, the group differences relative to the Divisional group are significant only for CEOs. For Options Only, the group differences are positive and significant for all groups. Options account for 64 ($=0.078/0.122$) percent of the difference in total pay-performance incentives between the Oversight and Divisional groups. Options account for 38 ($=0.212/0.565$) percent and 93 ($=0.041/0.044$) percent of the difference in total pay-performance incentives for CEOs and Neither relative to Divisional, respectively. This decomposition shows that the key comparisons are due primarily to differences

¹⁰ The R^2 for the firm level fixed effects specification in Table III is 39.76 percent (including the fixed effects). Thus, most of the unobserved variation pertains to the executive rather than the firm.

in the incentives from options. This is consistent with the greater ease with which option incentives can be adjusted as part of an optimal compensation policy.

There are several potential alternative explanations for the differences we observe in pay–performance incentives across job groups. First, it may simply be the case that some positions are more important than others. For example, oversight positions might be more productive than divisional positions. In this case, an executive's productivity changes when she switches groups, and this change is not absorbed by executive fixed effects. Executives in more productive positions will optimally be given higher pay–performance incentives to induce more effort. Because they have greater incentives, they also have greater exposure to risk. As a result of both greater effort and greater exposure to risk, the optimal contract gives more productive executives higher total flow compensation. This is borne out in Table II, which shows that CEOs have more incentives and flow compensation than do executives with oversight authority, who in turn have more incentives and flow compensation than do executives with divisional responsibility. We include compensation variables in all of our explicit pay–performance sensitivity regressions (Tables III and IV) as a proxy for the productivity of the executive in the job. Executive fixed effects remove executive-specific differences in productivity. To the extent that there are still productivity differences left due to job or position, they will be correlated with the level of compensation. Even after controlling for executive fixed effects and the level of compensation, we find that there are statistically significant differences in pay–performance incentives across job classifications. These differences are unlikely to be related to differences in the average productivity of the executives across groups.

Second, career concerns may explain differences in pay–performance incentives across job groups. Gibbons and Murphy (1992) and Holmstrom (1999) 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. Our executive fixed effect specification is robust to factors that increase linearly over time for all executives, such as age and experience, because it also includes year dummies. As a result, we have controlled for career concerns and still find an independent effect due to differences in managerial responsibility.

A third 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. 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 II 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. Rose and Wolfram (2002) find no evidence that the tax-deductibility cap on executive compensation has had any impact on executives' pay-performance sensitivities. Second, we also control for the level of compensation directly in all of our pay-performance sensitivity regressions for stock and options, allowing the relationship between compensation and incentives to differ across the groups. Comparisons of the pay-performance sensitivities across groups, especially the main comparison between the Oversight and Divisional groups, are therefore unlikely to be distorted by tax minimizing concerns.

C. 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 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 V. The first two rows report the mean and median pay-performance sensitivities from stock and options (as in Table II), along with our estimate of the team pay-performance sensitivity. For the top management team, the mean pay-performance sensitivity is \$69.42 per thousand dollar increase in shareholder wealth and the median pay-performance sensitivity is \$30.80 per thousand.

The next two rows report the estimated pay-performance sensitivities from flow compensation. Because flow compensation does not require direct ownership of the firm, the pay-performance sensitivity must be estimated according to the "implicit" method discussed in Murphy (1999). The implicit pay-performance sensitivity is simply the coefficient on firm 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.

The table presents the pay-performance sensitivities at the median variance for each of the groups using median regression and ordinary least squares controlling for executive fixed effects. The pay-performance sensitivities are positive and significant for all groups in both regressions. The table also reports the test of equality between the pay-performance sensitivities of the Divisional group and all other groups calculated at the median variance.

Focusing on the median regressions, the pay-performance sensitivity for CEOs is \$0.70 per thousand dollar increase in shareholder wealth, significantly higher than the pay-performance sensitivities for the other groups. The pay-performance sensitivity of the Oversight group is \$0.29 per thousand and is

Table V
Pay-Performance Sensitivities of the Top Management Team

All estimates are in dollars of compensation per thousand-dollar increase in shareholder wealth. For stock and options, the pay-performance sensitivity for each group is reported in Table II. 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 sensitivity of all other executives at the firm for whom pay-performance sensitivities are reported. The table reports the mean and median team pay-performance sensitivities across all firms. For flow compensation, the pay-performance sensitivity for each group is reported for executives at a firm with the median variance. 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. The number of observations in each group is given in Table I for the stock and option estimates. Due to missing data on total return to shareholders, the number of observations in each group in the regressions for flow compensation are: CEO = 6,793, Oversight = 8,940, Divisional = 6,391, and Neither = 11,432.

Type of Regression	CEO	Oversight	Divisional	Neither	Team
Stock and options					
Mean	40.26	12.69	3.47	4.52	69.42
Median	13.08	3.26	1.71	1.99	30.80
Flow compensation					
Mean	0.96 (0.361) [0.048]	0.22 (0.102) [0.957]	0.21 (0.090)	0.09 (0.036) [0.182]	1.60
Median	0.70 (0.065) [0.000]	0.29 (0.029) [0.000]	0.17 (0.021)	0.15 (0.015) [0.000]	1.52
Total					
Mean	41.22	12.91	3.68	4.61	71.02
Median	13.78	3.65	1.88	2.14	32.32

significantly larger than the \$0.17 per thousand for the Divisional group. The pay-performance sensitivity for the Neither group is \$0.15 per thousand and is insignificantly different from the Divisional group. The results for flow compensation are consistent with our results from holdings of stock and options, as 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. For flow compensation, we 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 from flow compensation for the team is \$1.52 per thousand using median regression and \$1.60 per thousand using fixed effect regressions. Adding the figures for flow compensation to those for stock and options gives total incentives of \$32.32 and \$71.02 per thousand at the median and mean, respectively.

Past work on compensation has largely focused 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 (a notable exception is Schaefer (1998), who examines teams of the four best-paid executives by firm in ExecuComp and relates the team's compensation to firm size). Our estimates show that CEOs receive only 42 to 58 percent of the incentives provided to the top management team, even when the team is limited to the next four highest paid executives. In addition, these calculations show that the aggregate incentives provided to the top management team are quite substantial. Combining stock, options, and flow compensation, the mean top management team receives about seven percent of the dollar returns to shareholders. The median top management team receives more than three percent of the dollar returns to shareholders. Most of these incentives come in the form of holdings of stock and stock options—the pay-performance sensitivity from stock and options is 20 times that from flow compensation.

III. Results for Divisional Performance Measures

To further understand the role of managerial responsibilities in determining the pay-performance sensitivities, we next consider more direct evidence on the way that divisional performance affects the compensation of divisional executives. To do so, we match divisional executives in ExecuComp to the segments of their companies for which they have management responsibility. Firms are required to report disaggregated accounting information on their proxy statements for any segment comprising 10 percent of the firm's sales. For these purposes, segments are defined to be components of an enterprise that provide a group of related products or services primarily to customers for a profit. Segments may be defined with respect to a line of business, a geographic region, or set of operations. We use the segment data from the COMPUSTAT Industry Segment database.

A. Executive-Segment Matches

We first construct all pairwise combinations of our 6,397 divisional executives in ExecuComp and their companies' segments. This generates 26,371 potential matches. For each potential match, we compare the job title in ExecuComp (based on the company's DEF 14A filing) with the segment name in the Industry Segment database (based on the company's 10-K filing). Each author compared the names separately, and then discrepancies were resolved. For each executive whose title did not correspond exactly to any of the firm's segments, we searched the company's 10-K (via the EDGAR system at www.sec.gov), the company's Web site, and Lexis-Nexis for further information to identify the segment for which the executive is responsible. This procedure yields 3,278 matches, of which 2,504, or 76 percent, are business segments and 774 are geographic segments.¹¹

¹¹ There are 39,876 segment-year observations between 1993 and 1997, of which 17,090 (43 percent) are business segments and 22,786 are geographic segments. The probability of matching a segment to a divisional executive was 14.65 percent for business segments and 3.40 percent for geographic segments.

A single executive might match with one or more business segments as well as one or more geographic segments. Our 3,278 executive–segment matches correspond to 2,937 unique divisional executives. We are therefore able to match 46 percent of our sample of 6,397 divisional executives. There are three principal reasons why we are unable to match the remaining 54 percent of the divisional executives. First, we are not able to locate segment information for some companies in the COMPUSTAT Industry Segment database. Second, the job title, 10-K, company Web site, and Lexis-Nexis search are too vague to match some executives with a segment, although specific enough to classify the executive in the divisional group (e.g., “ceo-sub.”). Third, some segments for which executives are responsible are too small to meet the reporting requirement.

We focus on two empirical relationships. First, for divisional executives, is the pay–divisional performance sensitivity positive and does it decrease in the variance of the divisional performance measure? Second, is the pay–*firm* performance sensitivity higher when the divisional performance measure is more volatile? To estimate these relationships, we require both a measure of divisional performance and its volatility. We use data on segment sales to proxy for divisional performance.¹² Divisional performance in a given sample year is the change in the log of sales from the previous year, and the volatility of divisional performance is the variance of the change in log of sales over the 1991 through 1999 period. This period includes our sample period, plus two years on both sides, to allow more precise calculations of variance. To distinguish divisional sales from sales at the firm as a whole, we also include the change in the log of firm-level sales as an additional performance measure in our analyses, with performance and volatility constructed analogously to divisional sales.

B. Pay–Divisional Performance Sensitivities

In this subsection, we focus on short-term compensation. We do this because stock and option holdings are explicitly related to the stock market performance of the firm as a whole. As a result, the primary way for firms to reward executives for good divisional performance is through the annual bonus and changes in salary. We estimate an implicit pay–performance sensitivity by regressing the log of short-term compensation, defined as salary plus bonus, on our three measures of performance: (1) the total percent return to shareholders (as opposed to the dollar returns specification we used in Section II), (2) the change in log divisional sales, and (3) the change in log firm sales. A positive pay–divisional performance sensitivity is consistent with our argument that the lower pay–*firm* performance sensitivity for divisional executives estimated above is due to the use of divisional performance as an additional signal of managerial effort.

It is important that we consider the relationship between divisional performance and incentives not just for divisional executives paired with their own segments, but for every possible combination of segments and executives at the same

¹² Although the COMPUSTAT Industry Segment database contains information on measures of profitability (e.g., operating profit) that may correspond more closely to performance, the profitability data are not as reliably and consistently available.

firm in a given year. We have two types of segments—those matched to a divisional executive and those unmatched. We have four groups of executives. This generates eight categories of group–segment matches. Within the category of matched segments and divisional executives, a further split needs to be made. This category includes the divisional executive who manages the matched segment, as well as all of the other divisional executives at the firm. We treat these two possibilities as separate categories. Thus, there are nine possible combinations of executive–segment matches. First, segments paired with the divisional executives who manage them. Second through fifth, these same segments paired with other executives at the same firms in the same years in each of the Neither, Divisional, Oversight, and CEO groups. Sixth through ninth, unmatched segments paired with executives at the same firms in the same years in each of the Neither, Divisional, Oversight, and CEO groups.

This set of nine combinations is exhaustive—it includes all categories of executives and both matched and unmatched segments. The nine combinations allow us to consider two potential sources of endogeneity. First, divisional executives managing a segment may not be the only executives for whom that segment's performance is relevant in determining optimal incentives. Second, segments that are matched to a divisional executive who is among the top five at a firm may be different than segments that are not matched to such an executive. We estimate separate pay–performance sensitivities for these nine categories.

For an executive i working at firm j in year t , whom we have classified into one of the nine categories (indexed by the superscript, k), the specification we estimate is

$$\ln w_{it}^{ST} = \sum_{k=1}^9 z_{it}^k \left[\gamma_0^k + \gamma_1^k r_{jt} + \gamma_2^k F(\sigma_{r_{jt}}^2) r_{jt} + \gamma_3^k d_{it} + \gamma_4^k F(\sigma_{d_{it}}^2) d_{it} + \gamma_5^k f_{jt} + \gamma_6^k F(\sigma_{f_{jt}}^2) f_{jt} + \mu_t^k \right] + \beta' \mathbf{x}_{it} + \varepsilon_{it}^k. \quad (2)$$

The dependent variable w_{it}^{ST} is short-term compensation. The variable z_{it}^k is an indicator variable for whether executive i is in category k in year t . The variable γ_0^k is a category-specific intercept. We include three performance measures. We denote total percentage return to shareholders at firm j by r_{jt} (with variance $\sigma_{r_{jt}}^2$), the change in the logarithm of segment sales for executive i 's division as d_{it} (with variance $\sigma_{d_{it}}^2$), and the change in the logarithm of total sales at firm j by f_{jt} (with variance $\sigma_{f_{jt}}^2$). We interact the performance measures with the CDFs of their variances, indicated by the function $F(\cdot)$. Note that because the explanatory variable in this regression is the percentage return to shareholders, we interact it with the variance of percentage returns. This variance is calculated using monthly percentage returns over the preceding five years. For the changes in log segment and firm sales, variances are calculated using annual changes over as much of the 1991 through 1999 period for which the segment reports data. The regression also includes the three CDFs interacted with the nine category variables to control for a possibly confounding relationship between the level of

compensation and variance. These variables are represented by the vector, $\beta'x_{it}$, in equation (2). The equation also includes category-specific year effects, μ_t^k . The *pay-divisional performance sensitivity* at the median variance, where $F(\sigma_{d_i}^2) = 0.5$, is given by $\gamma_3^k + 0.5\gamma_4^k$. Similarly, the performance sensitivities with respect to total return to shareholders and the log of firm sales are given by $\gamma_1^k + 0.5\gamma_2^k$ and $\gamma_5^k + 0.5\gamma_6^k$, respectively, at the median variance.¹³

Table VI reports the median regression estimates of equation (2). The rows of the table distinguish the nine categories of executive-segment pairings, starting with divisional executives paired with the segments that they manage. The first column identifies the category and the number of observations. In total, there are 101,522 executive-segment-year observations from 10,646 unique executives, 34,383 unique executive-segment pairings, and 27,726 unique executive-years. The next four columns pertain to the total return to shareholders, the middle four columns pertain to the divisional performance measure, and the last four columns pertain to the firm sales measure. Within each group of four columns, the first two columns show the coefficients on performance and performance interacted with the CDF of variance of the performance measure. The third column combines these two coefficients to obtain the pay-performance sensitivity at the median variance, and the fourth column reports the *p*-value for the test of equality between the pay-performance sensitivity in the third column for the specified category and the divisional executives managing their own segments (the first row).

For divisional executives paired with their own segments, we find that pay-performance sensitivities are positive and significant for both the total return to shareholders and the change in log segment sales. A key feature of the results is that these pay-performance sensitivities decline with the volatility of the performance measure. A one percentage point increase in total return to shareholders increases short-term compensation by 0.307 percent at the median variance. Similarly, for the pay-divisional performance sensitivity, a one percent increase in segment sales growth increases short-term compensation by 0.283 percent at the median variance. For change in log firm sales as the performance measure, the pay-performance sensitivity is negative and marginally significant (at the six percent level), though the decline with the variance of the performance measure is not statistically significant. A one percent increase in firm sales growth decreases short-term compensation by 0.260 percent at the median variance. The negative pay-performance sensitivity to firm sales growth is

¹³ The unit of observation in equation (2) is an executive-segment-year. A given divisional executive in a given year can appear in up to three of the nine different categories (and multiple times within each category). For example, if the firm reports three segments that year, the executive can be managing the first; a colleague in the sample could be managing the second; and a colleague not in the sample could be managing the third. (Nondivisional executives can show up in the latter two types of categories only.) Thus, the error term in the regression, ε_{it}^k , is category specific, but the error terms for the same executive in a given year cannot be assumed to be independent across the several segments. We account for the effect of this dependence on our standard errors by sampling all observations from a given executive-year, rather than individual executive-segment-years, in our bootstrap procedure.

Table VI
Median Regression Estimates of Divisional Pay-Performance Sensitivities, by Group and Segment Type

The following table presents coefficient estimates from the regression:

$$\ln w_{it}^{ST} = \sum_{k=1}^9 \alpha_k^T \left[\gamma_0^k + \gamma_1^k r_{it} + \gamma_2^k F(\sigma_{r_n}^2) r_{it} + \gamma_3^k d_{it} + \gamma_4^k F(\sigma_{d_n}^2) d_{it} + \gamma_5^k f_{it} + \gamma_6^k F(\sigma_{f_i}^2) f_{it} + \mu_t^k \right] + \beta' x_{it} + \varepsilon_{it}^k$$

Coefficients for the interactions between the nine categories and the constant, year effects, and CDFs of the variances of each of the three performance measures are not reported. Heteroskedasticity robust standard errors are reported in parentheses under each coefficient based on 200 bootstrap replications using the procedure in Gould (1992), controlling for dependence among executive-segment-year observations derived from the same executive-year. The *p*-value in the fourth column of each panel is for the null hypothesis that the pay-performance sensitivity at the median variance is equal to the pay-performance sensitivity of divisional executives paired with the segments they manage (the first row). The sample size is 101,522 executive-segment-years, comprised of 10,646 unique executives, 34,383 unique executive-segment pairings, and 27,726 unique executive-years. The pseudo *R*-squared of the regression is 0.1859.

Group and Obs.	Total Return to Shareholders			Change in Log Segment Sales			Change in Log Firm Sales		
	Perf.	Perf. × CDF	PPS at Median	Perf.	Perf. × CDF	PPS at Median	Perf.	Perf. × CDF	PPS at Median
Divisional Executives, Matched to Their Own Segments									
Divisional [2,660]	0.547 (0.096)	− 0.480 (0.130)	0.307 (0.055)	0.533 (0.205)	− 0.499 (0.248)	0.283 (0.090)	− 0.515 (0.307)	0.510 (0.375)	− 0.260 (0.137)

Segments Matched to a Divisional Executive in ExecuComp

Neither	0.486	-0.401	0.285	0.776	0.652	-0.644	0.330	0.734	-0.465	0.386	-0.272	0.958
[2,278]	(0.120)	(0.159)	(0.061)		(0.237)	(0.270)	(0.111)		(0.411)	(0.463)	(0.193)	
Divisional	0.472	-0.428	0.257	0.374	0.242	-0.243	0.120	0.246	0.218	-0.368	0.034	0.074
[3,232]	(0.107)	(0.146)	(0.046)		(0.187)	(0.204)	(0.092)		(0.327)	(0.400)	(0.144)	
Oversight	0.706	-0.725	0.344	0.648	0.107	0.052	0.133	0.174	-0.383	0.524	-0.121	0.487
[2,847]	(0.142)	(0.165)	(0.066)		(0.167)	(0.233)	(0.066)		(0.371)	(0.462)	(0.158)	
CEO	0.782	-0.700	0.432	0.190	0.429	-0.432	0.213	0.641	-0.876	0.975	-0.389	0.592
[2,628]	(0.145)	(0.176)	(0.074)		(0.258)	(0.305)	(0.116)		(0.414)	(0.499)	(0.191)	

Segments Not Matched to a Divisional Executive in ExecuComp

Neither	0.620	-0.541	0.349	0.479	0.034	-0.036	0.0160	0.005	-0.260	0.277	-0.121	0.372
[31,556]	(0.069)	(0.081)	(0.031)		(0.059)	(0.065)	(0.028)		(0.140)	(0.149)	(0.069)	
Divisional	0.616	-0.507	0.362	0.268	-0.185	0.174	-0.097	0.000	0.303	-0.342	0.132	0.001
[15,361]	(0.065)	(0.088)	(0.033)		(0.091)	(0.099)	(0.044)		(0.193)	(0.234)	(0.087)	
Oversight	0.557	-0.411	0.352	0.495	0.065	-0.061	0.034	0.011	0.309	-0.270	0.174	0.008
[23,066]	(0.080)	(0.105)	(0.035)		(0.086)	(0.098)	(0.039)		(0.198)	(0.228)	(0.092)	
CEO	0.810	-0.655	0.483	0.010	0.087	-0.096	0.039	0.016	-0.145	0.081	-0.104	0.365
[17,894]	(0.086)	(0.107)	(0.038)		(0.098)	(0.106)	(0.046)		(0.212)	(0.229)	(0.102)	

consistent with relative performance evaluation of divisional managers—their short-term compensation increases with divisional performance only to the extent that the growth exceeds the growth in firm-level sales. For divisional executives matched to the segments they run, the extent to which they are compensated on a performance measure depends on the precision of that measure.

The next four rows of the table show the coefficients and pay–performance sensitivities for pairings of other executives with these matched segments. All four categories have positive and statistically significant pay–performance sensitivities with respect to the total return to shareholders at the median variance. The point estimates of the pay–firm performance sensitivities are smaller for the Neither and Divisional categories and larger for the Oversight and CEO categories relative to the divisional executives paired to their own segments, but these differences are not statistically significant. For segment sales growth, the point estimates for the pay–performance sensitivities at the median variance are positive for all categories, though significant only for the Neither and Oversight categories and (marginally) for the CEO category. In addition, the variance of the divisional performance measure is significant only for the Neither category. Although none of the differences in the pay–divisional performance sensitivities relative to divisional executives paired with their own segments are statistically significant (p -values of 0.734, 0.246, 0.174, and 0.641), the point estimates suggest that the matched segment’s performance is less important for other divisional executives—who have a different individual-specific signal—as well as the Oversight and CEO categories, for whom total return to shareholders is more indicative of the full range of their efforts. For firm sales growth, the pay–performance sensitivities at the median variance are statistically significant only for CEOs.

The last four rows of the table show the coefficients and pay–performance sensitivities for pairings of executives with segments that were not matched to a divisional executive in ExecuComp. The pay–firm performance sensitivities at the median variance for total return to shareholders are positive and significant for all categories. The magnitudes are larger than for divisional executives matched to their own segments, and this difference is significant for CEOs. For segment sales growth, only the pay–divisional performance sensitivity for the Divisional category is significantly different from zero, but this sensitivity is negative, again suggesting the possibility of relative performance evaluation across divisional managers. All of the pay–divisional performance sensitivities are estimated to be significantly lower than observed for the divisional executives matched to their own segments (p -values of 0.005, 0.000, 0.011, and 0.016). For firm sales growth, the point estimates of the pay–performance sensitivities are less negative than in the categories paired with matched segments. When there is less positive weight placed on a segment’s sales growth, there is more positive weight placed on the firm’s sales growth.

The results in Table VI lead to three conclusions. First, segment performance has a positive and significant effect on the short-term compensation of divisional executives who have management responsibility for those segments. Second, this pay–divisional performance sensitivity is decreasing in the variance of divisional performance, consistent with the view that divisional performance provides an alternative, informative performance measure for divisional

executives. Third, in general, for the other categories of executives, the pay-divisional performance sensitivity is smaller than for divisional executives matched to segments, though these differences are not significant in comparisons of other executives paired with the matched segments. The magnitudes of the differences suggest that divisional performance is a less informative measure for managers of other divisions, as well as for the Oversight and CEO categories. One caveat to note is that there are large differences between the segment pay-performance sensitivities for all categories estimated for matched versus unmatched segments. Consequently, some of the significance of the positive result for the divisional executives with management responsibilities for matched segments may be due to the importance of the matched segments at the firm. Matched segments are important enough to the firm as a whole to be managed by an executive who is among the top five highly compensated executives at the firm.

C. Incentives from Stock and Options, Revisited

We now reconsider the incentives provided from holdings of stock and options. Having established that firms use divisional performance measures to determine the short-term compensation of their executives, we determine whether these alternative performance measures allow the firm to provide weaker incentives on the performance of the firm as a whole through stock and options. We augment equation (1) from Section II.A. to include the CDFs of the variances of the two additional performance measures, divisional (segment) sales and firm sales, as well as the additional executive categories. Because we have added the CDF of the variance of firm sales, we omit the log of firm sales from this specification. The new specification is

$$\alpha_{it} = \sum_{k=1}^9 z_{it}^k \left[\gamma_0^k + \gamma_1^k F(\sigma_{jt}^2) + \gamma_2^k F(\sigma_{d_t}^2) + \gamma_3^k F(\sigma_{f_t}^2) \right] + \beta' \mathbf{x}_{it} + \mu_t + \varepsilon_{it}^k. \quad (3)$$

As in equation (1), the dependent variable is the pay-firm performance sensitivity (α_{it}) from holdings of stock and options of executive i in year t . Also as in equation (1), γ_1^k is predicted to be negative. Because $\sigma_{d_t}^2$ and $\sigma_{f_t}^2$ reflect the variances of alternative performance measures, γ_2^k and γ_3^k are predicted to be positive for executives for whom these measures are an important determinant of incentives. They are predicted to be positive because, as the variance of the alternative performance measures increases (i.e., the alternative performance measures become less informative), firms will rely more heavily on total return to shareholders in the optimal contract.

Median regression estimates of equation (3) are presented in Table VII. The rows correspond to each of the nine categories of executive-segment matches.¹⁴

¹⁴ There are approximately 6,000 more observations in Table VII than Table VI because the implicit pay-performance sensitivity estimates in Table VI require that the change in the log of sales be available in the sample year, rather than simply enough times between 1991 to 1999 to compute a variance. If the segment first appears during the estimation sample period, for example, the first year is available to estimate the results in Table VII but not in Table VI.

Table VII
Median Regression of Pay-Performance Sensitivities on Performance Measure Volatilities

The following table presents coefficient estimates from the regression:

$$\alpha_{it} = \sum_{k=1}^9 z_{it}^k \left[\gamma_0^k + \gamma_1^k \left(\sigma_{jt}^2 \right) + \gamma_2^k F \left(\sigma_{dt}^2 \right) + \gamma_3^k F \left(\sigma_{ft}^2 \right) \right] + \beta' x_{it} + \mu_t + \varepsilon_{it}^k$$

Coefficients for the year effects and the interactions between the nine categories and the three compensation variables are not reported. Heteroskedasticity robust standard errors are reported in parentheses under each coefficient based on 200 bootstrap replications using the procedure in Gould (1992), controlling for dependence among executive-segment-year observations derived from the same executive-year. The sample size is 107,454 executive-segment-years, comprised of 10,692 unique executives, 35,963 unique executive-segment pairings, and 27,856 unique executive-years. The pseudo *R*-squared of the regression is 0.1160.

Group and Number of Obs.	Intercept	CDF of Dollar Return Variance	CDF of Segment $\Delta \text{Ln}(\text{Sales})$ Variance	CDF of Firm $\Delta \text{Ln}(\text{Sales})$ Variance
Divisional Executives, Matched to Their Own Segments				
Divisional [2,776]	0.431 (0.018)	− 0.439 (0.020)	0.049 (0.012)	− 0.015 (0.012)
Segments Matched to a Divisional Executive in ExecuComp				
Neither [2,388]	0.493 (0.032)	− 0.458 (0.023)	0.061 (0.012)	− 0.010 (0.011)
Divisional [3,359]	0.400 (0.018)	− 0.416 (0.018)	0.051 (0.009)	− 0.009 (0.010)
Oversight [2,979]	0.729 (0.042)	− 0.788 (0.041)	0.049 (0.019)	− 0.000 (0.021)
CEO [2,742]	1.832 (0.101)	− 2.242 (0.129)	0.265 (0.079)	− 0.109 (0.067)
Segments Not Matched to a Divisional Executive in ExecuComp				
Neither [33,407]	0.550 (0.016)	− 0.578 (0.014)	0.015 (0.003)	0.057 (0.007)
Divisional [16,199]	0.461 (0.016)	− 0.480 (0.014)	0.009 (0.005)	0.026 (0.008)
Oversight [24,635]	0.845 (0.024)	− 0.976 (0.026)	0.009 (0.007)	0.072 (0.014)
CEO [18,969]	2.866 (0.098)	− 3.285 (0.116)	0.000 (0.030)	0.249 (0.064)

The columns show the coefficients for the intercept and the CDFs of the variances of the three performance measures. The coefficients on the CDF of Dollar Return Variance are all negative and highly significant. An increase in the variance of dollar returns has a larger effect on the categories comprised of unmatched segments compared to those comprised of matched segments. The coefficients on the CDF of the variance of segment sales growth are all positive. The coefficients are

statistically significant for divisional executives paired with the segments for which they have management responsibilities, as well as for all other categories of executives matched with these same segments. Other things equal, a divisional executive managing the least volatile segment has pay-performance incentives from stock and options that are 0.049 lower than those of a divisional executive managing the most volatile segment. Comparisons of divisional executives paired with the segments they manage to other categories of executives paired with those segments do not show a significantly larger effect for the divisional executives paired to their own segments. For unmatched segments, the coefficients on the CDF of the variance of segment sales growth are insignificantly different from zero for the Oversight and CEO categories. The coefficients are positive and significant but small for the Neither and Divisional categories. The coefficients on the CDF of the variance of firm sales growth are negative and insignificant for pairings of executives with matched segments and positive and significant for pairings of executives with unmatched segments.

The differences in the results for matched and unmatched segments are also consistent with the results in Table VI, which showed that matched segments have a greater impact on the pay-performance incentives in short-term compensation. They indicate a contracting environment in which there is a more reliable alternative performance measure than when the segment is not matched. For an executive with a more reliable alternative measure (i.e., matched segment), total pay-performance incentives are lower (column 1) and decline less rapidly with increased dollar return volatility (column 2). When the alternative measure is more reliable for an executive (i.e., matched segment), increases in the alternative measure's volatility lead to greater reliance on stock and options to provide incentives (column 3). Finally, when the alternative measure is reliable for an executive (i.e., matched segment), firms do not provide strong incentives based on the change in firm sales, and changes in firm sales growth volatility do not affect the use of stock and options to provide incentives (column 4). When the alternative measure is not reliable for an executive (i.e., unmatched segment), firms provide stronger incentives based on the change in firm sales, and Table VII shows that the volatility of firm sales growth does affect the use of stock and options to provide incentives. As in Table VI, the results show an effect of divisional (segment) performance measures on the incentives provided to the divisional executives who have management responsibility for those segments.

IV. Conclusion

We study 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. 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: (1) CEOs, (2) other executives with oversight authority for the entire firm, (3) executives with divisional responsibility, and (4) 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.

We recognize that there are many potential explanations for differences in pay-performance incentives across job groups. We control for these possibilities by including executive fixed effects, year effects, the level of compensation, and variables related to the firm's contracting environment in our empirical work. After controlling for these factors, we find that executives with oversight authority have incentives that are \$1.22 per thousand dollar increase in shareholder wealth higher than those of executives with divisional responsibility. CEOs have incentives that are \$5.65 per thousand higher than those of executives with divisional responsibility. These differences are substantial and demonstrate that the pay-firm performance sensitivity is lower for executives for whom a more precise individual signal of effort is available. We also show that the aggregate incentives of the top management team are quite substantial.

As a final test, we examine how incentives are influenced by the presence of divisional performance measures. We find that the pay-firm performance sensitivity for executives with divisional responsibility is decreasing in the precision of the divisional performance measure. For short-term compensation, we find that the pay-divisional performance sensitivity is positive and increasing in the precision of the divisional performance measure for divisional executives.

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 balance risk sharing against incentives. 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. The principal-agent problem should be thought of as pertaining to the top management team rather than just to a CEO.

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