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CORPORATE PERFORMANCE AND MANAGERIAL REMUNERATION
An Empirical Analysis

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Economic theories of efficient compensation predict a positive relationship between executive pay and corporate performance, and yet efforts to document this relationship have been largely unsuccessful. In this paper, we argue that previous cross-sectional studies have omitted important variables which seriously bias their results. Using data that focus on individual executives over time, we find that executive compensation is strongly positively related to corporate performance as measured by shareholder return and growth in firm sales. The results are robust to the stock market performance measure utilized.

1. Introduction

In recent years, attention has been devoted to studying compensation contracts with explicit or implicit application to the managerial labor market. Early research by Ross (1973), Stiglitz (1975) and Mirrlees (1976), and more recent work by Holmstrom (1979), Diamond and Verrechia (1982) and Murphy (1984), have examined optimal piece-rate compensation schemes when firm performance depends on unobservable executive effort. Lazear and Rosen (1981) base contracts on ordinal rankings of executives and argue that (under certain conditions) these contracts are preferred to piece rates. Freeman (1977), Ross, Taubman and Wachter (1981), and Harris and Holmstrom (1982) consider situations where the ability of an executive is unknown and revealed only by observing performance over time.

Since the various theories of managerial remuneration are based on diverse assumptions regarding states of nature, capital markets, and managerial characteristics, it is not surprising that competing models offer different sets of theoretical and empirical implications. Common to all theories, however, is the

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important result that, to some extent, compensation must be tied to observed productivity.

Efforts to document a pronounced effect of firm performance on executive compensation have generally been unsuccessful. Periodicals such as *Fortune* and *The Wall Street Journal* have repeatedly reported the apparent *lack* of correlation between managerial earnings and various measures of corporate performance.[1] Typical of the prevailing view is Augustine's (1982) conclusion:

> There are many highly successful organizations in the United States. There are also many highly paid executives. The policy is not to intermingle the two.

Econometric studies have typically indicated that firm size (e.g., sales) is the only important determinant of executive compensation: performance (e.g. return on equity, profits) plays at best a minor role.[2]

However, these results can be criticized for several reasons. First, most have concentrated only on the most visible aspect of remuneration – the sum of salary and bonus. This method omits potentially performance-sensitive compensation components – such as stock-options, deferred compensation, and stock awards – and ignores interesting differences in the extent to which the individual components of remuneration are affected by firm performance.

Second, most previous results are based on cross-sectional analysis of remuneration and performance data. Economic theories of efficient compensation suggest that, in addition to current performance, contracts will depend on other factors such as entrepreneurial ability, managerial responsibility, firm size, and past performance. Absent a theory indicating the relevant variables, and data on these variables, these cross-sectional models are inherently subject to a serious omitted variables problem. However, if these omitted factors are unchanging over time for individual executives, we can correctly assess the relationship between compensation and performance by analyzing time-series regressions for individual executives.[3]

The purpose of this paper is to re-examine the relationship between firm performance and managerial pay, using data that focus on individual executives over time. Five hundred executives from seventy-three of the largest U.S. manufacturing firms were analyzed over the 1964–1981 sample period. These data, the associated collection process, and a discussion of the econometric methodology are contained in section 2. The empirical evidence relating compensation to performance is reported in section 3. The various components

[1] See, for example, Loomis (1982) and Drucker (1984).

[2] For a survey of the literature, see Ciscel and Carroll (1980).

[3] Studies that focus on cross-sectional comparisons of first differences in compensation and firm variables [e.g., Masson (1971) and Coughlan and Schmidt (1985)] will correctly assess the compensation–performance relationship if the relationship is constant across firms.

of compensation are analyzed separately, and alternative measures of performance are examined and compared.

Top executives typically own large quantities of their firm's common stock, and in addition hold large quantities of previously-granted shares of restricted stock and stock options. The focus of this paper is not on the value of these previously-held assets, which vary systematically and predictably with the firm's stock market performance, but rather is on the remuneration received in the current year where the relationship with performance is subtle and indirect. Consequently, the remuneration variables considered in this analysis have been purged of any direct or mechanical linkage with the price of the firm's common stock. However, because of inside and restricted stock ownership and outstanding stock options, the wealth of an executive will be tied to the wealth of the firm's shareholders even in the absence of a positive relationship between performance and the analyzed components of remuneration.[4] Documentation of a pronounced positive compensation–performance relationship will therefore constitute strong evidence that executives are rewarded (or punished) for taking actions that benefit (or harm) shareholders. Although the general concluding remarks are deferred until section 4, the primary conclusion of this paper is succinct and incontrovertible – corporate performance, as measured by the rate of return realized by shareholders, is strongly and positively related to managerial remuneration.

2. The data and methodology

2.1. Introduction

The primary source of executive compensation data is the corporate proxy statement, issued annually to shareholders of publicly-held corporations. An eighteen-year times series (1964–1981) of these reports was solicited from all publicly held corporations in the Fortune 500.[5] More than one hundred corporations provided complete or nearly complete records; missing proxy statements for corporations supplying incomplete data were generally available from the Chicago and Washington branches of the Securities and Exchange Commission. Firm data for the sample period were taken from Standard & Poor's Compustat Expanded Annual File, the University of Chicago's CRSP Monthly Stock Returns Tape, and the CRSP Daily Excess Returns Tape; these data were supplemented, when necessary, by the corporate 10-K's.

[4] Changes in the value of an executive's inside stockholdings are often many times greater than his cash remuneration. See table 3 and the corresponding discussion below.

[5] *Fortune Magazine*, May 4, 1981. Since the firms were selected from the 1981 Fortune 500 and not the 1964 listing, the sample collection process introduces a bias towards successful firms. However, we do not expect this to lead to a serious systematic bias in the estimated relationship between compensation and performance since there is considerable variation in performance across the sample corporations.

Table 1

Number of observations in executive sample, by corporation. One hundred and five Fortune 500 manufacturing firms provided proxy statements covering the period 1964–1981. Executives were included in the sample if they appeared on the proxy statements prior to 1971 and remained on these statements for at least five years; thirty-two firms with fewer than two executives meeting these criteria were excluded from the full and reduced samples. In addition, the reduced sample excludes observations corresponding to non-officer directors, mid-year retirements, and incomplete corporate data.

Corporation	Full sample		Reduced sample	
	Execs	Exec-years	Execs	Exec-years
1. Allied Corp.	5	44	5	44
2. American Home Products	4	48	4	46
3. Amsted Industries	5	75	5	75
4. Anchor Hocking Corp.	2	24	2	23
5. Avon Products	4	47	4	45
6. Baxter Travenol Laboratories	5	50	4	34
7. Beatrice Foods Co.	7	74	7	65
8. Bethlehem Steel Corp.	9	93	9	86
9. Boeing Co.	7	77	7	76
10. Bucyrus-Erie Co.	5	57	5	57
11. Burlington Industries Inc.	6	47	6	43
12. Burroughs Corp.	4	45	4	44
13. Campbell Soup Co.	5	47	5	47
14. Carpenter Technology	5	41	5	41
15. Castle & Cooke Inc.	4	55	4	52
16. Champion International Corp.	13	78	12	69
17. Consolidated Papers Inc.	4	49	0	0
18. Cooper Industries Inc.	5	51	4	43
19. Cummins Engine	7	79	7	66
20. Dan River Inc.	5	60	5	57
21. Deere & Co.	17	194	15	172
22. Donnelley (R.R.) & Sons Co.	7	74	7	62
23. Du Pont (E.I.) de Nemours	13	123	13	113
24. Emerson Electric Co.	6	57	6	54
25. Exxon Corp.	13	121	13	119
26. Firestone Tire & Rubber Co.	11	101	9	85
27. GAF Corp.	4	39	4	38
28. General Mills Inc.	9	81	9	78
29. Gerber Products Co.	5	57	5	53
30. Goodyear Tire & Rubber Co.	9	77	9	76
31. Gulf Oil Corp.	4	35	4	34
32. Heinz (H.J.) Co.	13	126	12	106
33. Hershey Foods Corp.	6	70	6	69
34. Interco Inc.	14	130	11	108
35. Intl. Harvester Co.	6	64	6	58
36. Intl. Telephone & Telegraph	9	93	7	78
37. Joy Mfg. Co.	4	51	4	51

Table 1 (continued)

Corporation	Full sample Execs	Full sample Exec-years	Reduced sample Execs	Reduced sample Exec-years
38. Kimberly-Clark	14	125	13	114
39. Koppers Co.	5	61	5	61
40. Lone Star Industries	5	42	4	32
41. Marathon Oil Co.	9	74	8	66
42. Merck & Co.	4	37	3	26
43. Midland-Ross Corp.	4	41	4	39
44. Mohasco Corp.	3	36	2	27
45. Murphy Oil Corp.	4	47	3	38
46. Nalco Chemical Co.	6	64	6	62
47. Newmont Mining Corp.	5	57	4	43
48. Norris Industries Inc.	6	52	6	52
49. Norton Co.	6	78	6	78
50. Nucor Corp.	4	49	4	43
51. Outboard Marine Corp.	5	74	5	70
52. Phelps Dodge Corp.	6	64	4	44
53. Philip Morris Inc.	12	140	11	126
54. Phillips Petroleum Co.	9	89	9	80
55. Pillsbury Co.	10	65	9	55
56. Raytheon Co.	4	53	4	50
57. Rexnord Inc.	5	57	5	52
58. Reynolds (R.J.) Inds.	11	118	11	97
59. Sperry Corp.	6	53	5	47
60. Stokely-Van Camp Inc.	6	61	5	55
61. Sun Co. Inc.	17	126	15	101
62. Textron Inc.	4	33	4	33
63. Thiokol Corp.	4	47	4	46
64. Timken Co.	10	111	8	92
65. Todd Shipyards Corp.	7	72	6	63
66. Trinity Industries	4	58	3	29
67. United Merchants & Mrfs. Inc.	10	107	9	98
68. U.S. Industries	5	40	4	31
69. U.S. Steel Corp.	6	50	5	37
70. Westvaco Corp.	6	69	6	69
71. Whirlpool Corp.	7	80	7	80
72. Williams Cos.	6	62	5	50
73. Wrigley (Wm.) Jr. Co.	5	50	5	47
TOTALS	501	5076	461	4500

Executives were included in the sample if they appeared on the proxy statements at the beginning of the sample period (1964–1970), and remained on the statements for at least five years. Thirty-two corporations with fewer than two executives meeting these criteria were excluded from the sample. This collection process yielded remuneration and corporate data for 501 executives, representing 73 of the largest U.S. manufacturing firms. This full sample includes an average of ten observations for each executive, or 5,076 executive-years. The results reported here are based on a somewhat smaller sample. Compensation data of directors who were not officers of the firm were excluded from the sample, as were observations for executives who served as officers in the firms' subsidiaries. Data reflecting mid-year retirements were dropped from the sample, and three executives with only one remaining observation each were excluded. Finally, observations with incomplete firm data were dropped from the sample. This reduced sample consists of 72 firms, 461 executives, and 4,500 executive-years. Table 1 presents the number of executives and executive-years of data for each of the sample corporations. This table shows, for example, that Deere & Company and Sun Company are represented by fifteen executives in the reduced sample; Anchor Hocking Corp and Mohasco Corp are represented by only two sample executives.[6]

2.2. *Variable definitions*

The empirical analysis below focuses on six components of remuneration – Salary, Bonus, Salary + Bonus, Deferred Compensation, ex-ante Value of Stock Options, and Total Compensation. Total Compensation is the sum of these plus other types of compensation, such as fringe benefits and savings plans, but does *not* include annual accruals of pension benefits. Remuneration magnitudes were computed on a before-tax basis; therefore the tests ignore the effect of taxation on the compensation structure.

Additional variables considered include four broadly defined position classifications and various firm characteristics. All compensation, sales and market value variables have been deflated by the Consumer Price Index to represent 1983-constant dollars. Definitions and descriptive statistics are presented in table 2; it is evident that there is significant variation across executive-years in all the analyzed variables. Mean logarithms are reported since, in the subsequent analysis, compensation and firm variables are transformed into logarithms.[7]

[6]Since CRSP data are not available for stocks traded over-the-counter, Consolidated Papers was excluded from the reduced sample.

[7]To make the logarithmic transformation possible, we have assumed that executives receive at least one 1967 dollar annually in the form of bonuses, deferred compensation, and stock options. Experiments indicate that the qualitative results are robust and are not sensitive to the one-dollar assumption.

Table 2

Variable definitions and selected statistics for 4,500 executive-years (461 executives) in the 1964–1981 executive compensation sample. All monetary variables are in thousands (M$) or millions (MM$) of CPI-deflated 1983-constant dollars.[a]

			Selected statistics			
Variable	Units	Definition	Mean	Min	Max	Mean(log)
Compensation Data						
Salary	M83$	Base salary of executive.	271.4	48.7	943.1	5.488
Bonus	M83$	Bonus and incentive remuneration.	129.1	0.0	1,042.4	3.370[b]
Salary + Bonus	M83$	The sum of salary and bonus is always reported; however, its components are not always reported separately.	360.5	60.9	1,969.7	5.756
Deferred	M83$	Deferred and contingent compensation, and restricted shares of stock.	25.0	0.0	5,169.5	−3.397[b]
Option Value	M83$	Value of stock options granted using Black–Scholes valuation formula.	50.4	0.0	4,961.5	−2.369[b]
Other	M83$	Other compensation, fringe benefits, savings plans, unconditional stock awards, etc.	14.0	−3.6	766.3	
Total	M83$	All remuneration exclusive of pensions.	450.0	73.2	6,882.8	5.931
Position Dummies						
Chairman (Non-CEO)	0, 1	Chairman (or Vice Chairman) of the board, but not CEO (mean value of dummy variable corresponds to fraction in sample).	0.089			
Chief Executive (CEO)	0, 1	Chief Executive Officer (CEO).	0.210			
President (Non-CEO)	0, 1	President, but not also CEO.	0.114			

Table 2 (continued)

Variable	Units	Definition	Selected statistics Mean	Min	Max	Mean(log)
Vice President	0,1	Vice President; includes VP, Senior VP, Executive VP, etc. Also includes General Counsels, Treasurers, and Secretaries.	0.587			
Firm Variables						
Sales	MM83$	Total sales.	4,965.8	55.8	119,117.4	7.717
Stock Index	83$	Current value (in any given year) of $100 invested in common stock in 1963, including appreciation, dividends, splits, etc.	217.0	23.6	1,671.0	5.133
Stock Variance		Variance of stock returns for 60-month period preceding first day of current fiscal year.	0.0067	0.0012	0.0447	

[a] Selected statistics are based on a sample size of 2,067 executive-years for salary and bonus, and 4,500 executive-years for all other individual and firm variables.

[b] To make the logarithmic transformation possible, executives are assumed to receive at least one 1967 dollar in the form of bonuses, deferred compensation, and stock options.

2.2.1. *Salary and bonus*

The SEC requires firms to report the sum of salary and bonus for each executive but does not require reporting of the respective components. Separate salary and bonus data were available for only 2,067 of the 4,500 sample observations. The majority of the non-reporters consist of firms that have no bonus plans in effect, although some bonus-paying firms choose not to report their salaries and bonuses separately. Bonus-reporting sample firms tend to be much larger than non-reporting firms.

2.2.2. *Deferred compensation*

Deferred compensation represents the sum of various types of contingent remuneration and also includes awards of restricted shares of common stock. Changes in the value of an executive's holdings of previously-awarded deferred compensation are often directly related to current stock market performance.

To avoid estimating this systematic relationship, we consider only *current* awards of contingent remuneration and restricted stock.[8] This is equivalent to assuming that claims to deferred compensation are completely marketable and that previously-granted awards were sold at their initial value. However, in general these claims are non-transferable and are subject to forfeiture. To the extent that these non-marketability restrictions are binding,[9] deferred compensation awarded in previous years will have an effect on current managerial effort, and we will have underestimated the effect of firm performance on this component of remuneration.

2.2.3. Stock option value

Stock options are contracts granted to executives allowing the purchase of shares of common stock in the future at a fixed 'exercise price.' This type of remuneration can be evaluated as the value of stock options awarded during the current fiscal year, or as the change in the value of total (current and previously awarded) stock option holdings. As in the case of deferred compensation, we evaluate *current* awards of options at their date of grant to avoid the mechanical relationship that exists between stock price performance and the realizable value of previously awarded options. Once again, we implicitly assume that the options are marketable and are sold at their initial value. Consequently, we ignore the incentive effects of previously-granted options and will underestimate the relationship between firm performance and an executive's total holdings of stock options.

Stock options granted to executives differ from conventional call options and warrants in several respects. However, Noreen and Wolfson (1981) have shown that warrant valuation formulas are fairly accurate in predicting prices for their sample of warrants with characteristics similar to executive stock options.

To value executive stock options at the time they are granted, we use a version of the Black–Scholes (1973) valuation formula which allows for continuously paid dividends. The formula is simplified because the sample executives were always granted options at an exercise price equal to the market price on the date of the grant.

$$\begin{aligned} \textit{Value of Options} = (\textit{Price}) \times (\textit{Shares}) \\ \times \left(e^{-dT}\Phi(Z) - e^{-rT}\Phi(Z - \sigma\sqrt{T})\right), \end{aligned} \tag{1}$$

[8] Executives typically accrue interest and dividend income relating to their holdings of cash-based and stock-based deferred compensation, respectively. Therefore, as a simplification, we evaluated contingent remuneration at face value and restricted stock at market value rather than to follow Lewellen (1968) and Masson (1971) in using complicated algorithms to compute present values.

[9] Miller and Scholes (1982) argue that these restrictions are little more than legal 'boilerplate' incorporated for tax deferral purposes, since claims with a readily ascertainable market value are taxed as current managerial income.

where

Price = exercise price (from Proxy Statement);
Shares = number of shares with respect to which options were granted;
$\Phi(\cdot)$ = cumulative standard normal distribution function;
T = amount of time to expiration; $T = 60$ or $T = 120$ for five- and ten-year options, respectively;
r = risk-free interest rate, measured as $\ln(1+R)/12$, where R is the annual five- and ten-year average market yield on U.S. Government Securities (*source*: Federal Reserve Bulletin, various monthly editions, and the Federal Reserve Board's Banking and Monetary Statistics);
d = dividend yield defined as
$$\ln\left(1 + \frac{\textit{Dividends-per-Share}}{\textit{Closing Stock Price}}\right) \div \left(\begin{array}{c}\textit{Months in}\\ \textit{fiscal year}\end{array}\right);$$
this variable was estimated using the dividends paid in the *previous* fiscal year to avoid a mechanical relationship between performance and the value of stock options (*source*: Dividends-per-Share, Compustat; Closing Price, CRSP Monthly Returns Tape);
σ^2 = estimated monthly stock return variance for the sixty-month period preceding the first day of the current fiscal year (*source*: CRSP Monthly Stock Returns Tape);
Z = $(r - d + \sigma^2/2)\cdot(T/\sigma\sqrt{T})$.

The valuation formula (1) has not been adjusted for the dilution upon exercise of a warrant. This leads to only a slight upward bias, since outstanding options rarely exceed more than one or two percent of the outstanding common stock, and many of these options expire unexercised.

Because of imperfections in the market for executive stock options (non-transferability, employment restrictions, short-selling prohibitions, etc.), the Black–Scholes formula will overestimate the true value of the option. Smith and Zimmerman (1976) suggest an alternative valuation scheme which represents a lower bound on the true value. However, the qualitative empirical results are generally robust to the valuation formula employed.[10]

2.2.4. *Firm performance measures*

According to the economic theories of compensation, firm performance should affect an executive's remuneration only to the extent that it serves as a

[10]Although not reported here, logistic regressions were estimated where the value of the dependent variable was one for executives receiving stock options and zero for executives not receiving stock options. The independent variables were the same as in tables 5 and 6 below. In all cases, the signs and degrees of significance of the estimated coefficients from the logistic specifications were similar to those reported below using the Black–Scholes valuation formula.

proxy for unobservable managerial effort or productivity. Although these theories uniformly suggest a relationship between compensation and observed performance, most analyses are silent about the measure of performance. Since firm shareholders are generally considered to be the principals in executive agency theories, it seems appropriate to define performance in terms of shareholder returns rather than in terms of accounting profits. The performance measure utilized in this analysis is based on the return realized by the firm's common shareholders. This rate of return for year t is defined as

$$R_t = \frac{P_t + DPS_t}{P_{t-1}} - 1,$$

where P_t and DPS_t are the closing stock price and dividends-per-share paid in fiscal year t, adjusted for stock dividends and splits.

Although it is reasonable to assume that R_t influences *changes* in managerial remuneration, we do not expect that this realized rate of return is the sole determinant of the magnitude of compensation. An executive's remuneration in a given year, whether set at expected marginal product or updated through a complicated long-term contracting process, will depend in part on past performance as well as current performance. At the risk of oversimplification, the performance index used in this analysis is constructed to represent the cumulative stock market performance of each sample firm. In particular, the Stock Index for year t, S_t, is defined as the price of one share of common stock, normalized to be worth \$100 in 1963, the beginning of the sample, which is adjusted to include all dividends and splits. Thus,

$$S_t = S_{t-1}(1 + R_t).$$

This expression for firm performance has several advantages. First, the nominal rates of return, R_t, can be converted into real rates of return by deflating the Stock Index, S_t, by the Consumer Price Index (CPI).[11] Second, in the subsequent empirical analysis, the dependent variable (*Compensation*) and the independent variable (*Stock Index*) are both converted into logarithms. Regression coefficients are interpreted as the change in the dependent variable that corresponds to a small change in the independent variable. Consequently, these coefficients are interpreted as the effect of current real stock market return, $\Delta \ln(\textit{Stock Index})$, on percentage changes in real compensation, $\Delta \ln(\textit{Compensation})$. Finally, other measures of performance (e.g., industry-relative performance) can be readily constructed and analyzed by redefining the rate of return, R_t.

[11] Note that $\Delta \ln(\textit{Deflated Stock Index}) = r^* - \Delta \ln(CPI)$, where Δ represents first-differences and $r^* = \ln(1 + R)$ is the continuously compounded nominal rate of return.

It is important to note that, although R_t is a valid measure of shareholder return, it is only an imperfect proxy for an executive's effort or productivity. Holmstrom (1979) has argued that a corporate board of directors, unable to observe managerial effort directly, will base an executive's compensation not only on stock performance, but on *any other variable* that provides incremental information about the true productivity of the executive. In addition to stock performance, firm size or growth may yield information relevant for determining levels of managerial effort. Indeed, several theories of managerial production suggest that compensation should be partially determined by firm size or growth, reflecting the quantity of resources controlled by the individual executive and the scope of managerial responsibilities.[12] For comparisons with previous literature, we have chosen sales and percentage change in sales as proxies for firm size and growth. Experiments with other highly correlated measures (book value, market value, etc.) have yielded nearly indistinguishable results.

2.3. Econometric methodology

Consider an individual executive denoted by the subscript i. We predict that executive i's compensation, *Comp*, will be affected by performance over time, *Perform*, and it seems reasonable to propose the simplified econometric specification

$$Comp_{it} = a_i + b_i \, Perform_{it} + e_{it}. \tag{2}$$

Of course, this single measure of performance will not be sufficient to explain all earnings received by executive i; his contracted compensation likely depends on his opportunity cost which in turn will depend on factors such as education and training, perceived ability, performance in previous jobs, managerial responsibilities, size of firm, etc. However, to the extent that these other factors are constant through time for executive i, they are captured in the intercept term, a_i, and eq. (2) can be appropriately used to determine the effect of performance on compensation.

Alternatively, suppose that (2) is estimated across executives at a particular point in time. In this case, the exclusion of the individual-specific factors, a_i's, will lead to an omitted variables problem, reflecting factors which are fixed for an executive over time but vary across executives at a point in time. Correlations between the performance index and these omitted variables will bias the estimated performance coefficient in a cross-sectional regression.

As an illustrative example, consider two well-documented cross-sectional empirical regularities – the positive relationship between sales and executive

[12] For example, Rosen (1982) shows that larger firms will employ better quality executives when entrepreneurial ability and capital are complementary factors of production.

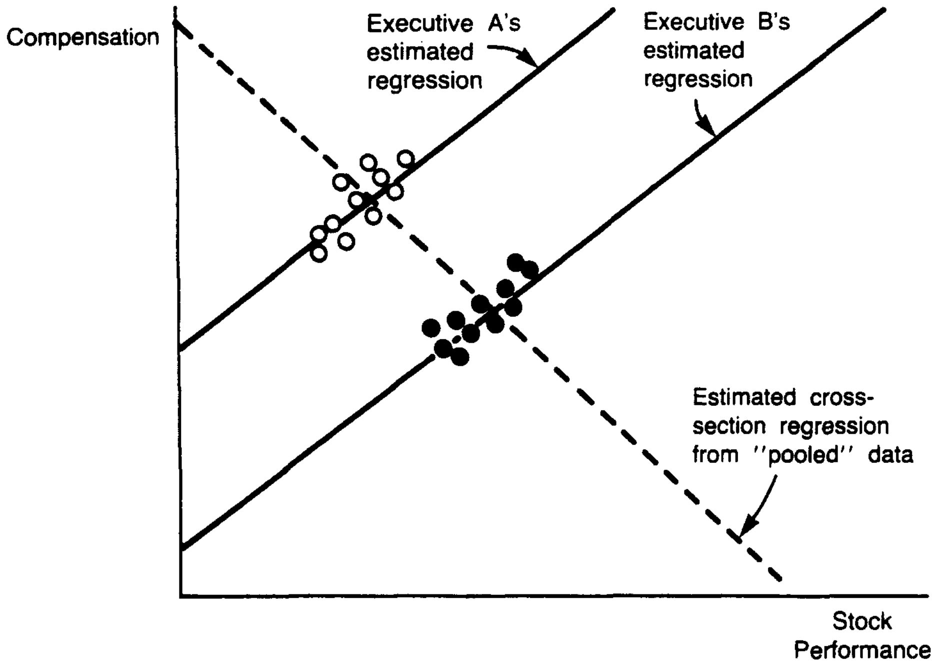

Fig. 1. Scatter plots and regression lines portraying the relation between compensation and stock market performance for two hypothetical executives. Executive A, whose observations are denoted by ○, is a highly paid executive in a large, low-performance firm. Executive B, whose observations are denoted by ●, is a lower-paid executive in a small, high-performance firm. Separate time-series regressions (solid lines) indicate a positive relationship between compensation and performance. However, in a pooled cross-sectional regression (dashed line), which ignores the size differences between firms, the estimated relationship between compensation and performance is negative.

compensation, and the negative relationship between firm size and the average rate of return realized by shareholders.[13] These relationships imply that large, low-performance firms employ highly-paid executives, while smaller, high-performance firms employ relatively lower-paid executives. A cross-sectional examination, omitting the variable firm size, will reveal a negative relationship between compensation and firm performance. This is true even if the pay of individual executives and the performance of their firms over time were strongly positively related.

Fig. 1 portrays the situation described in the preceding example. It contains scatter plots from hypothetical time-series observations on two executives. Executive A is a highly-paid corporate executive in a large, low-performance firm, while Executive B is a lower-paid executive in a small, high-performance firm. Separate time-series regressions for each executive indicate a positive effect of performance on compensation. However, when the data are pooled and analyzed cross-sectionally without controlling for differences in firm size,

[13] The compensation–sales relationship is reported by Fox (1982). Evidence relating firm size and shareholder return is presented in the Symposium on Size and Stock Returns, published in the *Journal of Financial Economics* 12, June 1983.

the estimated regression indicates a negative effect of firm performance on executive compensation.

2.3.1. *Combining cross-sectional and time-series executive data*

Since we only have an average of ten observations for each executive, it would be tedious and not very informative to estimate and report separate regressions for each of the 461 executives in the sample. Although we believe that the regression intercepts – representing ability, firm size, historical performance, etc. – should vary systematically across executives, we have no ex-ante reason for suspecting that the performance coefficient will be different for different individuals. Therefore, we estimate (2) under the assumption that the sensitivity of pay to performance is the same for all executives ($b_i = b$). Consequently, the regression to be estimated is[14]

$$Comp_{it} = a_i + b\ Perform_{it} + u_{it}. \tag{3}$$

2.3.2. *Cross-sectional comparisons*

For purposes of comparison, the cross-sectional relationship between performance and compensation is also estimated. This is accomplished by averaging the compensation and firm variables over time for each executive. The resulting data set, containing only one observation for each sample executive, can be used to analyze the effect of performance on compensation *across* executives. Defining $\overline{Comp_i}$ as the *average* compensation level in the sample for executive i (and defining the other variables accordingly), the cross-sectional estimates are determined by estimating

$$\overline{Comp_i} = c + d\ \overline{Perform_i} + v_i. \tag{4}$$

Since (4) is estimated using only one 'average' observation for each executive, the resulting estimates will clearly depend only on the variation in average compensation and performance levels *across* executives, and will not utilize the variation over time in these variables for individual executives. In contrast, estimates from (3) will depend only on the variation over time in compensation and performance for each individual executive, and will not utilize the variation in variables across executives.[15]

[14]As a practical matter, the coefficient estimate for b is obtained by ordinary least squares after transforming the data into deviations around individual means. The results are, of course, exactly the same as if (3) had been estimated directly [see Judge et al. (1980)]. However, the computed standard errors and test statistics must be adjusted for the lost degrees of freedom.

[15]The cross-sectional estimates in (4) are often called the 'between' estimates, while the cross-sectional time-series estimates in (3) are called the 'within' estimates.

The cross-sectional estimates from (4) are representative of most of the empirical results in the executive compensation literature. Alternative cross-sectional estimates could be achieved by estimating separate regressions for each year in the sample, or by pooling all data and implicitly forcing equal intercepts.

2.3.3. *Other empirical considerations*

In the following analysis we have used the logarithms of the compensation, sales, and performance variables. This transformation facilitates comparisons with previous studies, yields easily interpretable regression coefficients, and reduces the skewness of the size distribution of sample firms.

The sample includes managers serving in, and being promoted into, various corporate capacities. Although the individual-specific intercepts, a_i in eq. (3), capture the compensation effects of executive and firm characteristics that are constant over time, they do not capture the compensation effects of promotions and other variables that change during the sample period. The 461 sample executives served in over 30 reported capacities. For simplicity, we have grouped these job categories into four general classifications – Chairman (Non-CEO), Chief Executive Officer (CEO), President (Non-CEO), and Vice President. During the sample period, roughly one-third of the executives switched categories. Therefore, the regressions include position dummy variables to estimate the average compensation differentials that correspond to promotions or demotions between various corporate positions. The vice presidential classification is impounded in the individual-specific intercepts.

3. Empirical results

3.1. *Introduction*

In this section, we examine the effects of performance on the six types of remuneration described in section 2. Most of the subsequent discussion concentrates on Total Compensation and its largest component, Salary + Bonus. However, performance tends to interact non-uniformly with the various types of remuneration, and these differences are interesting. We begin by analyzing compensation summary statistics, grouped by stock market return and executive position. Next, using regression analysis, we examine the relation between shareholder return and the various components of compensation. Then, we include firm sales as an additional measure of performance, and analyze the effects of firm size and growth on executive compensation. Finally, we compare and contrast the results obtained with two alternative indices of stock market performance, as measured by industry-relative and abnormal returns.

3.2. Stock performance and compensation: Summary statistics

The previous section suggests that, because executives and firms differ in many dimensions, positive cross-sectional correlations between levels of compensation and firm performance are unlikely to be observed. However, since we expect an executive's compensation to vary with the performance of his firm over time, we might also expect to find a positive cross-sectional relationship between firm performance and *changes* in remuneration.

Table 3 presents summary statistics depicting the relationship between shareholder return and compensation, as measured by Salary + Bonus and Total Pay, changes in compensation, and changes in the value of the executive's inside stock holdings. The data, representing sample averages, are grouped by executive position and the stock price performance of the company ranging from returns less than −30% to more than 30%.

Consider, for example, the 943-executive-year subsample of Chief Executive Officers, who were paid an average Salary + Bonus of $520,400 during the 1964–1981 sample period (1983 dollars) and received average annual increases in Salary + Bonus of 3.9%. Table 3 indicates a pronounced monotonic relationship between performance and percentage changes in Salary + Bonus. Chief executives received pay *decreases* of 1.2% when returns were less than −30%; when performance exceeded +30% pay was increased by 8.7%. In contrast, a comparison of compensation *levels* and firm performance suggests that no relationship exists; compensation is *highest* for returns between −10% and +10%, and is *lowest* for returns exceeding +30%.

It is beyond the scope of this paper to analyze statistically executive inside stockholdings. However, Benston (1985) argues that these shares constitute a large portion of the executive's individual wealth, and that changes in the value of these stockholdings are often many times greater than their salary and bonus.[16] After having read his paper, we analyzed similar stock ownership data available for the 4,500-executive-year sample. The 461 executives in our sample held an average of $4.7 million (1983 dollars) in shares of their firm's common stock. Table 3 shows that chief executives of firms with returns less than −30%, for example, lost $1,563,300 on their stockholdings (compared to an average salary and bonus of $479,000) and chief executives with returns of more than +30% gained $2,493,500 on their stockholdings (compared to an average salary and bonus of $474,200). These amounts are more than three and five times their respective salaries and bonuses. These results support Benston's (1985) conclusion that, even in the absence of a direct link between performance and compensation, an executive's wealth is tied to his firm's stock market performance. The establishment of an empirical relationship between corporate performance and managerial remuneration strengthens the hypothe-

[16] See Lewellen (1971) for a similar discussion.

Table 3

Compensation summary statistics, by executive position and shareholder realized rate of return for 4,500 executive-years (461 executives) in the 1964–1981 sample of 72 manufacturing firms.[a]

Shareholder return	Number in sample	Average compensation (1983 $) Salary + Bonus	Average compensation (1983 $) Total pay	Average compensation change Salary + Bonus	Average compensation change Total pay	Average change in value of inside stock holdings
All Executives						
Entire sample	4500	$360,500	$450,000	+3.7%	+7.0%	$ +114,100
Return < −30%	426	$335,700	$438,500	−2.9%	+2.3%	$−2,892,900
−30% < Return < −10%	947	$346,500	$431,100	+0.6%	+4.8%	$ 926,500
−10% < Return < 0%	669	$385,600	$488,300	+3.4%	+4.0%	$ −223,900
0% < Return < +10%	630	$384,200	$508,700	+5.6%	+14.4%	$ +211,000
+10% < Return < +30%	981	$373,400	$441,700	+5.5%	+5.2%	$ +855,200
+30% < Return	847	$336,300	$412,500	+7.6%	+11.0%	$+2,317,600
Chairmen (Non-CEO)						
Entire subsample	401	$348,500	$388,300	−3.9%	−3.7%	$ +487,400
Return < −30%	31	$335,500	$385,600	−6.1%	−9.6%	$−9,448,300
−30% < Return < −10%	103	$332,500	$361,500	−5.7%	−6.7%	$−3,681,800
−10% < Return < 0%	62	$377,300	$429,800	−4.3%	−5.5%	$−1,045,200
0% < Return < +10%	51	$359,400	$415,600	−5.1%	−1.6%	$+1,211,100
+10% < Return < +30%	84	$361,000	$408,600	−7.0%	−3.7%	$+3,161,100
+30% < Return	70	$329,100	$348,000	+3.8%	+2.3%	$+8,698,200
Chief Executives						
Entire subsample	943	$520,400	$688,900	+3.9%	+11.2%	$ +208,800
Return < −30%	101	$479,000	$659,900	−1.2%	+6.8%	$−1,563,300
−30% < Return < −10%	196	$507,800	$667,600	+0.2%	+7.4%	$−1,162,300
−10% < Return < 0%	152	$560,600	$743,000	+4.1%	+7.2%	$ −212,100
0% < Return < +10%	125	$559,600	$799,400	+4.8%	+16.9%	$ +199,500
+10% < Return < +30%	182	$543,700	$656,000	+5.1%	+5.8%	$ +826,500
+30% < Return	187	$474,200	$641,200	+8.7%	+22.0%	$+2,493,500
Presidents (Non-CEO)						
Entire subsample	514	$458,900	$587,600	+3.9%	+8.1%	$ +1,300
Return < −30%	44	$420,000	$566,200	−3.3%	+1.4%	$−3,372,000
−30% < Return < −10%	104	$436,100	$606,700	+1.8%	+10.8%	$ −569,700
−10% < Return < 0%	87	$466,800	$595,700	+5.1%	+2.7%	$ −93,000
0% < Return < +10%	63	$541,700	$737,100	+8.8%	+26.4%	$ +110,900
+10% < Return < +30%	122	$458,400	$554,600	+3.7%	+6.2%	$ +774,400
+30% < Return	94	$439,800	$511,400	+5.1%	+3.5%	$+1,425,900
Vice Presidents						
Entire subsample	2642	$286,200	$347,300	+4.6%	+6.7%	$ +34,600
Return < −30%	250	$263,000	$333,100	−3.2%	+1.7%	$−2,520,300
−30% < Return < −10%	544	$273,800	$325,500	+1.5%	+4.7%	$ −327,100
−10% < Return < 0%	368	$295,400	$367,500	+3.7%	+4.1%	$ −108,300
0% < Return < +10%	391	$306,000	$391,200	+6.8%	+13.8%	$ +83,500
+10% < Return < +30%	593	$305,400	$357,300	+7.5%	+6.0%	$ +504,800
+30% < Return	496	$265,700	$316,600	+8.0%	+9.2%	$+1,374,000

[a]All monetary variables in 1983-constant dollars. Inside stockholdings include only shares held directly and do not include shares held by family members or trusts. Compensation change represents average annual percentage change, and does not include changes subsequent to inter-subsample promotions.

Table 4

Average percentage changes in Salary + Bonus realized upon promotion or other job change for 4,500 executive-years (461 executives) in the 1964–1981 sample of 72 manufacturing firms.[a]

		New position			
Old position	Not promoted	Chairman (Non-CEO)	Chief Executive	President (Non-CEO)	Vice President
Chairman (Non-CEO)	−3.9% (284)	–	–	–	–
Chief Executive	+3.5% (738)	−16.1% (36)	+7.7% (78)	–	–
President (Non-CEO)	+3.9% (381)	−5.6% (31)	+14.3% (67)	–	–
Vice President	+3.3% (2053)	+12.3% (28)	+42.9% (19)	+20.9% (85)	+16.7% (216)

[a]Sample size (executive-years) in parentheses. Position changes with less than six observations have been omitted. Examples of *intra-position* job changes are Vice President to Executive Vice President, or CEO-President to CEO-Chairman.

sis that executives are rewarded (or punished) for taking actions that benefit (or harm) their shareholders.

Table 3 also indicates that changes in Salary + Bonus are strongly related to stock market performance for Vice Presidents and for the combined sample of top executives. The remuneration of board chairmen is only weakly tied to shareholder return, but the large inside stockholdings of chairmen clearly suggest that their wealth is significantly affected by stock market performance.

The analysis presented in this paper focuses on the effect of firm performance on the compensation of an executive, over time. However, firm performance is not the only factor affecting compensation; promotions and other executive position changes are important. Unfortunately, the magnitude and frequency of these promotion pay-revisions are not well documented in the literature; most existing evidence is either anecdotal or incorrect.[17] The sample analyzed in this paper follows individual executives over time, and covers 583 individual position changes, within and between the four broadly-defined position categories. The average percentage changes in Salary + Bonus realized upon promotion or other position change are presented in table 4. For example, the table shows that presidents promoted to chief executive officer received one-time salary increases of 14.3%, and vice presidents promoted to president or chief executive officer received average increases of 20.9% and

[17]For example, Lazear and Rosen (1981) contend that on 'the day that a given individual is promoted from vice president to president, his salary may triple'. However, in the 4,500-executive-year sample, the 85 vice presidents who were promoted to president received average pay increases of only 20.9%; the maximum increase observed was 133%.

42.9%, respectively. A promotion within the chief-executive rank (usually a CEO-President gaining the additional title of Chairman) corresponds to an increased Salary + Bonus of 7.7%. An executive who loses his CEO status but remains as chairman of the board receives, on average, a 16.1% cut in pay.

3.3. Stock performance and compensation: Regression results

Table 5 presents estimates from time-series and cross-sectional regressions using ln(*Stock Index*) and the position dummies as the only explanatory variables.[18] The time-series estimates, reported in panel A, suggest a pronounced positive effect of performance on compensation. As an example, consider the panel A Total Compensation regression, which include a separate intercept for each of the 461 executives in the 4,500-executive-year sample. Since changes in the logarithmic performance variable, Δ ln(*Stock Index*), equals the (continuously accrued) shareholder rate of return, the Stock Index coefficient of 0.2125 implies that a firm realizing a 10% return will increase the total remuneration paid to its executives by 2.1%. Moreover, this estimate is statistically significant, as indicated by the t-statistic of 18.6. The coefficients of the position dummies in the time-series regressions correspond to approximate changes in compensation realized upon promotion from vice president.[19] Thus, the CEO dummy coefficient of 0.5903 in the Total Compensation regression implies that a promotion from vice president to CEO corresponds to an increase in total compensation of 59%. Similarly, a promotion from president to CEO corresponds to a total remuneration increase of (0.5903 − 0.3668) 22%.

The panel A time-series estimates also suggest that the individual components of remuneration are sensitive to the shareholder's realized rate of return. Salary, Bonus, Salary + Bonus, and Deferred Compensation are all positively and significantly affected by firm performance. The time-series coefficients of ln(*Stock Index*) indicate that a firm realizing a 10% rate of return will increase executive salaries by 0.7%, bonuses by 14%, the sum of salary and bonus by 1.8%, and deferred compensation by 4.9%.

The time-series Option Value regression in table 5 indicates a negative relationship between performance and the ex-ante value of options granted in the current fiscal year. This seemingly anomalous result may reflect that corporate boards of directors are more likely to award options during low-per-

[18] Following Plosser and Schwert (1978), the time-series regressions for Total Compensation and Salary + Bonus were also estimated after transforming the variables into first differences. The resulting estimates, reported in the appendix, table 9, are very similar to those reported in tables 5 and 6, although the R-squareds are reduced.

[19] Since the primary objective of this study is to analyze the relationship between performance and compensation, and *not* to explain pay-revisions corresponding to promotions, we have introduced position dummy variables as a simple way to control for the effects of position changes. Since this simplification introduces a possible misspecification, the position dummy coefficients represent only approximate estimates of the effect of promotions on compensation.

Table 5

Estimated coefficients from time-series and cross-sectional regression models using data from the 1964–1981 sample of 461 executives in 72 manufacturing corporations. Time-series regressions (panel A) include a separate intercept for each executive. Cross-sectional estimates (panel B) are based on one 'average' observation for each executive. The performance variable, Stock Index, is based on the rate of return realized by shareholders.[a]

	Dependent variable (in logarithms)					
Independent variable	Total	Salary	Bonus	Salary + Bonus	Deferred	Option Value
Panel A: Time-series estimates						
ln(*Stock Index*)	0.2125	0.0653	1.429	0.1786	0.4926	−0.3600
	(18.6)	(5.5)	(8.3)	(20.4)	(4.9)	(−2.1)
Position dummies						
Chairman	0.2479	0.2076	0.5109	0.2823	−0.2388	−1.018
	(10.3)	(7.9)	(1.4)	(15.4)	(−1.1)	(−2.9)
Chief Exec	0.5903	0.4922	0.7863	0.5855	0.4490	0.0810
	(28.5)	(21.4)	(2.4)	(37.0)	(2.4)	(0.3)
President	0.3668	0.2929	0.2796	0.3598	0.4238	0.0735
	(18.8)	(14.9)	(1.0)	(24.1)	(2.5)	(0.3)
Sample size	4,500	2,067	2,067	4,500	4,500	4,500
Number of individual-specific intercepts	461	280	280	461	461	461
R^2	0.798	0.880	0.551	0.849	0.704	0.376
F	304.9	129.4	18.9	468.3	9.5	4.1
Panel B: Cross-sectional estimates						
ln(*Stock Index*)	−0.0470	−0.1215	0.6895	−0.1085	1.721	−0.1431
	(−1.2)	(−3.3)	(2.4)	(−3.1)	(5.6)	(−0.6)
Position dummies						
Chairman	−0.0098	0.1926	−2.777	0.1049	−1.871	−3.028
	(−0.1)	(2.1)	(−3.8)	(1.3)	(−2.7)	(−5.1)
Chief Exec	0.6947	0.5758	0.8800	0.6287	1.265	0.0778
	(11.1)	(9.5)	(1.9)	(10.9)	(2.5)	(0.2)
President	0.7765	0.5397	0.4617	0.6973	−0.1013	1.436
	(8.2)	(5.5)	(0.6)	(8.0)	(−0.1)	(2.2)
Sample size	461	280	280	461	461	461
Number of individual-specific intercepts	–	–	–	–	–	–
R^2	0.294	0.312	0.089	0.293	0.096	0.064
F	47.4	31.2	6.7	47.2	12.1	7.8

[a] t-statistics in parentheses. F-statistic tests joint significance of ln(*Stock Index*) and the three position dummies. An F-statistic greater than 3.3 is significant at the 1 percent level.

formance years, and will often re-issue previously-granted options at a lower exercise price. Furthermore, recall that we have intentionally eliminated the systematic positive relationship that exists between performance and changes in the value of previously-granted options.

Executive compensation contracts typically stipulate a base salary to be paid in equal installments over the course of a year. At the end of the year, managerial performance is evaluated and a bonus is awarded. Consequently, although we would expect bonuses to be strongly affected by shareholder return, we would not expect executive salaries to be highly sensitive to measures of current performance. It is interesting and reassuring to note that our expectations are supported by the empirical evidence: the time-series estimates of the compensation–performance relationships are 'small' for salaries and relatively large for bonuses [with ln(*Stock Index*) coefficients of 0.0653 and 1.429, respectively].

For purposes of comparison, panel B of table 5 presents estimates from cross-sectional regressions of compensation on ln(*Stock Index*) and the position dummies; many of the results are anomalous and counter-intuitive. For example, these estimates indicate that there is a significant *negative* relationship between Stock Index and Salary and Salary + Bonus; only the components Bonus and Deferred appear to be positively affected by firm performance. The Stock Index coefficient in the cross-sectional Salary + Bonus regression of -0.1085 suggests that a firm realizing a 10% rate of return will pay its executives an average of 1.1% *less* than a firm realizing a zero return. The estimated coefficients for the CEO and President dummy variables in the Total Compensation regression (0.6947 and 0.7765, respectively) imply that CEOs earn, on average, 69% more than vice presidents, while non-CEO presidents earn 78% more than vice presidents. It follows then, that corporate presidents must earn more than their chief executive officers. This implausible result, by itself, suggests that the cross-sectional regressions are seriously misspecified.

The high unadjusted R-squareds in the table 5 time-series regressions are not surprising since these regressions include nearly five hundred individual dummy variables (280 for Salary and Bonus). However, the dramatic differences in sign and magnitude between the panel A time-series and panel B cross-sectional estimated coefficients indicate that it *is* important to allow the regression intercepts to vary across individuals, thereby controlling for individual and firm characteristics which are unchanging over time for a given executive but vary across executives. Indeed, the hypothesis of equal intercepts is rejected for all components of remuneration in table 5 and in all subsequent time-series regressions.[20] The cross-sectional estimates of the relation between compensa-

[20] As a representative example, the F-statistic for equal intercepts in the time-series Salary + Bonus regression is 34.7, compared to a critical value (at essentially any level of significance with 460 and 4,035 degrees of freedom) of slightly over 1.0.

tion and performance, which do not control for the effects of important corporate and individual-specific variables, are biased and misleading.

3.4. *Stock performance, sales, and executive compensation*

Since shareholder return is an imperfect proxy for true individual managerial effort, additional measures of performance will be incorporated in determining an executive's compensation contract. Consequently, and in the spirit of the existing literature, the regressions in table 5 were reestimated after including firm sales as an additional explanatory variable. Time-series and cross-sectional regressions including Sales and Stock Index are reported in table 6.

In the time-series regressions, individual and firm characteristics, including average firm size, are captured in the individual-specific intercept. In these regressions, the sales variable for a given firm reflects deviations from that firm's average sales, or sales growth.[21] The coefficients of ln(*Stock Index*) and ln(*Sales*) in the table 6 panel A time-series regressions show that Total, Salary, Bonus, and Salary + Bonus are positively and significantly related to both stock market performance and growth in firm sales. Deferred compensation is positively related to the Stock Index, but is not significantly affected by the growth in firm sales. Holding sales constant, a firm realizing a 10% rate of return will increase the total compensation paid to its executives by 1.6%. The corresponding t-statistic of 13.2 indicates that this estimated increase is significantly different from zero. Similarly, a 10% return implies that Salaries, Bonuses, Salaries + Bonuses, and Deferred Compensation will be increased by 0.4%, 12%, 1.1%, and 4.8%, respectively. Holding stock market performance constant, a firm realizing a 10% growth in sales will increase total compensation by 2.1%, while increasing the Salaries, Bonuses, and Salaries + Bonuses paid to its executives by 1.2%, 9.5%, and 2.5%, respectively. Stock options are not positively related to stock market performance or sales, but the analysis in the previous section suggests that this result is not anomalous.

A standard result in the executive compensation literature is a cross-sectional elasticity of compensation to sales of about 0.3; that is, a 10% larger firm will pay its executives an average of 3% more. The surprising result from the time-series regressions is that this empirical regularity remains basically intact when analyzing individual wages over time: a firm that *grows* by 10% will *increase* the total compensation paid to its executives by about 2%. This result clearly indicates that, in addition to shareholder return, sales growth is an important determinant of executive compensation.

In the table 6 cross-sectional regressions, presented in panel B, the sales variable represents a proxy for firm size and the scope of managerial responsi-

[21] Similarly, the ln(*Sales*) variable reflects deviations from average ln(*Sales*), or percentage growth. Although Sales and the Stock Index are negatively correlated in the sample, logarithmic changes in Sales and the Stock Index are significantly positively correlated with a correlation coefficient of +0.13.

Table 6

Estimated coefficients from time-series and cross-sectional regression models using data from the 1964–1981 sample of 461 executives in 72 manufacturing corporations. Time-series regressions (panel A) include a separate intercept for each executive. Cross-sectional estimates (panel B) are based on one 'average' observation for each executive. Sales represents total annual firm revenues, and Stock Index is based on the rate of return realized by shareholders.[a]

	Dependent variable (in logarithms)					
Independent variable	Total	Salary	Bonus	Salary + Bonus	Deferred	Option Value
Panel A: Time-series estimates						
ln(*Sales*)	0.2054	0.1192	0.9452	0.2494	0.0643	−0.5280
	(12.0)	(7.0)	(3.8)	(19.5)	(0.4)	(−2.0)
ln(*Stock Index*)	0.1592	0.0408	1.236	0.1139	0.4760	−0.2230
	(13.2)	(3.3)	(6.9)	(12.7)	(4.4)	(−1.2)
Position dummies						
Chairman	0.1474	0.1578	0.1163	0.1603	−0.2702	−0.7602
	(5.9)	(5.9)	(0.3)	(8.6)	(−1.2)	(−2.0)
Chief Exec	0.5136	0.4480	0.4355	0.4924	0.4250	0.2781
	(24.1)	(19.0)	(1.3)	(31.0)	(2.2)	(0.9)
President	0.3265	0.2708	0.1049	0.3108	0.4112	0.1771
	(16.8)	(13.7)	(0.4)	(21.5)	(2.3)	(0.6)
Sample size	4,500	2,067	2,067	4,500	4,500	4,500
Number of individual-specific intercepts	461	280	280	461	461	461
R^2	0.805	0.884	0.554	0.862	0.704	0.377
F	281.1	116.3	18.2	486.3	7.7	4.1
Panel B: Cross-sectional estimates						
ln(*Sales*)	0.2828	0.2283	0.3181	0.2579	−0.1742	0.9129
	(22.0)	(16.4)	(2.1)	(21.7)	(−1.2)	(7.6)
ln(*Stock Index*)	0.1033	0.0030	0.8630	0.0286	1.628	0.3421
	(3.8)	(0.1)	(2.9)	(1.1)	(5.2)	(1.4)
Position dummies						
Chairman	0.1396	0.2891	−2.642	0.2412	−1.963	−2.546
	(2.3)	(4.3)	(−3.7)	(4.3)	(−2.8)	(−4.5)
Chief Exec	0.7580	0.6526	0.9871	0.6864	1.226	0.2821
	(17.3)	(15.1)	(2.1)	(16.9)	(2.4)	(0.7)
President	0.7117	0.5252	0.4414	0.6382	−0.0614	1.227
	(10.8)	(7.5)	(0.6)	(10.4)	(−0.1)	(2.0)
Sample size	461	280	280	461	461	461
Number of individual-specific intercepts	–	–	–	–	–	–
R^2	0.657	0.653	0.103	0.652	0.099	0.170
F	174.5	103.3	6.3	170.4	10.0	18.7

[a] t-statistics in parentheses. F-statistic tests joint significance of ln(*Sales*), ln(*Stock Index*), and the three position dummies. An F-statistic greater than 3.0 is significant at the 1 percent level.

bilities. In the Total Compensation regression, the cross-sectional ln(*Stock Index*) coefficient of 0.1033 indicates that, after controlling for firm size, a firm realizing a 10% return will pay its executives, on average, 1% more than a firm realizing a zero return. Similarly, the ln(*Sales*) coefficient of 0.2828 suggests that, holding average stock market performance constant, a 10% larger firm will pay its executives an average of 2.8% more, thus replicating the empirical regularity mentioned in the preceding paragraph.

The cross-sectional Total Compensation regression in panel B of table 5, which did *not* control for firm size, indicates a *negative* relationship between performance and total compensation, and also suggests that (non-CEO) presidents are paid more, on average, than chief executive officers. In contrast, the cross-sectional table 6 Total Compensation regression indicates a positive compensation–performance relationship, suggests a plausible ordering for the position dummy coefficients, and generates estimates that are similar in sign and magnitude to the corresponding time-series estimates. The cross-sectional table 5 regressions were seriously misspecified since they omitted important factors that determine the variation in pay among executives of a given firm, and among executives across firms. Although we lack theory and data describing all the relevant variables, it seems plausible that firm size is an important determinant of these individual differences. Consequently, it is not surprising that the inclusion of sales as an explanatory variable produces cross-sectional estimates of the compensation–performance and compensation–position relationships that are relatively similar to the estimates from the time-series regressions.[22]

In the cross-sectional Salary + Bonus regression, the coefficient of ln(*Sales*) is large (0.2579) and significant ($t = 21.7$), while the coefficient of ln(*Stock Index*) is small (0.0286) and insignificant ($t = 1.1$). These results replicate those in many previous studies, which have generally concluded that firm size is the only important determinant of executive compensation. Lewellen and Huntsman (1970) asserted that it was sufficient to consider only Salary + Bonus in analyzing executive compensation, arguing that the difference between Salary + Bonus and Total Compensation consisted mostly of 'noise' reflecting short-term fluctuations and random influences. However, the cross-sectional Total Compensation regression suggests a much stronger effect of performance on compensation than was evident from the Salary + Bonus regression, indicating that it is important to consider more broadly-defined measures of remuneration when estimating the compensation–performance relationship.

The results in the preceding tables have been implicitly based on the assumption that the effects of Sales and Stock Index on compensation are

[22] The position-dummy anomaly can be explained easily by the omitted variable, firm size. The larger (and better-paying) sample firms were more likely to employ presidents who were not also CEO's; these presidents were paid considerably more, on average, than the chief executive officers in smaller firms. Consequently, the cross-sectional regressions that do not control for firm size indicate that presidents earn more than CEOs.

constant across the executive hierarchy. It can be reasonably argued, however, that the inclusion of position dummies does not sufficiently capture performance–compensation relationships that may differ across corporate positions. If each executive served in one, and only one, capacity throughout the sample period, we could explore this issue by estimating separate time-series regressions for each of the four position categories, after grouping executives according to their position. However, since many executives changed positions, we cannot estimate separate position regressions and maintain a unique intercept for each individual executive. We can, however, allow for different compensation–performance slopes across positions by including position–performance interaction variables, such as $(Chairman) \times \ln(Stock\ Index)$, $(CEO) \times \ln(Stock\ Index)$, $(President) \times \ln(Stock\ Index)$, and $(Vice\ President) \times \ln(Stock\ Index)$. Estimates from these expanded time-series regressions, which include separate intercepts for each executive as well as separate Sales and Stock Index slopes for each position, are reported in table 7. Estimated coefficients of the position–performance interaction terms have been grouped by corporate position. For example, the coefficient of $(CEO) \times \ln(Sales)$ in the $\ln(Total)$ regression, shown in panel A, is 0.2046 with an associated t-statistic of 10.4. This estimate implies that a 10% increase in sales will be rewarded by a 2% increase in total compensation.

The table 7 estimates indicate that shareholder return is positively and significantly related to Total Compensation (panel A), Bonus (panel C), and Salary + Bonus (panel D) for all four corporate capacities. Furthermore, sales growth is positively related to Total Compensation and Salary + Bonus for the four positions. Salaries (panel B) are positively related to performance for all but the Chief Executive Officer, where the effect is zero or weakly negative.

Stock market performance and sales should affect compensation only to the extent that they yield information regarding the true levels of managerial effort or productivity. Since a firm's performance is presumedly more closely tied to the actions of the chief executive officer than to the actions of the vice presidents and other subordinates, we might expect that the estimated compensation–performance relationship should decline as we descend the hierarchical ladder. However, the Total Compensation regression in panel A of table 7 indicates that this is not the case. Although the differences are not statistically significant, the $\ln(Sales)$ and $\ln(Stock\ Index)$ coefficients for Vice Presidents (0.2149 and 0.1628, respectively), are larger than the corresponding coefficients for Chairmen, CEOs, and Presidents.

The F-statistic reported in table 7 tests the hypothesis of equal $\ln(Stock\ Index)$ and $\ln(Sales)$ slopes across positions. According to these results, this hypothesis can be accepted only for Total Compensation and Bonus, and must be rejected for the other components of remuneration. However, the estimated $\ln(Stock\ Index)$ coefficients range from $+0.12$ to $+0.16$ for Total Compensation, and from $+0.09$ to $+0.14$ for Salary + Bonus. Therefore, even though the previous regressions may have been misspecified, our results remain intact for

Table 7

Estimated coefficients from time-series regression models that allow the compensation–performance relationship to vary across corporate positions. Regressions include position–sales and position–performance interaction variables as well as individual-specific intercepts. The reported F-statistic tests the hypothesis that the coefficients of ln(*Sales*) and ln(*Stock Index*) are constant across positions. Data are from the 1964–1981 sample of 461 executives in 72 manufacturing corporations. Sales represents total annual firm revenues, and Stock Index is based on the rate of return realized by shareholders.[a]

Independent variable	*Panel A* Dependent variable: ln(*Total*)				*Panel B* Dependent variable: ln(*Salary*)			
	Chairman	CEO	Pres.	Vice Pres.	Chairman	CEO	Pres.	Vice Pres.
ln(*Sales*)	0.1438	0.2046	0.2066	0.2149	0.0836	0.1111	0.1253	0.1197
	(5.3)	(10.4)	(9.5)	(11.5)	(3.1)	(5.9)	(6.1)	(6.4)
ln(*Stock Index*)	0.1236	0.1605	0.1424	0.1628	0.1313	−0.0199	0.0455	0.0598
	(4.5)	(8.5)	(5.8)	(11.1)	(4.6)	(−1.0)	(2.0)	(4.1)
Position dummies	0.8278	0.5945	0.4848	0	0.0157	0.9225	0.3040	0
	(3.6)	(3.8)	(2.7)		(0.1)	(5.5)	(1.8)	
	$F = 1.8$		$R^2 = 0.805$		$F = 5.6$		$R^2 = 0.886$	

Independent variable	*Panel C* Dependent variable: ln(*Bonus*)				*Panel D* Dependent variable: ln(*Salary* + *Bonus*)			
	Chairman	CEO	Pres.	Vice Pres.	Chairman	CEO	Pres.	Vice Pres.
ln(*Sales*)	0.3567	1.079	1.222	0.7650	0.1923	0.2556	0.2669	0.2444
	(0.9)	(3.9)	(4.1)	(2.8)	(9.6)	(17.5)	(16.5)	(17.6)
ln(*Stock Index*)	1.875	1.331	1.329	1.117	0.1410	0.0907	0.0954	0.1232
	(4.5)	(4.7)	(4.0)	(5.2)	(6.9)	(6.5)	(5.2)	(11.3)
Position dummies	−1.133	−2.820	−4.144	0	0.4149	0.5889	0.3049	0
	(−0.3)	(−1.2)	(−1.7)		(2.4)	(5.1)	(2.3)	
	$F = 2.0$		$R^2 = 0.557$		$F = 4.6$		$R^2 = 0.863$	

Independent variable	*Panel E* Dependent variables: ln(*Deferred*)				*Panel F* Dependent variable: ln(*Option Value*)			
	Chairman	CEO	Pres.	Vice Pres.	Chairman	CEO	Pres.	Vice Pres.
ln(*Sales*)	−0.2913	−0.0633	0.0439	0.3199	0.0249	−0.8719	−0.8426	−0.2915
	(−1.2)	(−0.4)	(0.2)	(1.9)	(0.1)	(−3.0)	(−2.6)	(−1.0)
ln(*Stock Index*)	−0.5125	0.4566	0.3067	0.6122	−0.2562	0.3564	−0.9722	−0.4075
	(−2.1)	(2.7)	(1.4)	(4.6)	(−0.6)	(1.3)	(−2.6)	(−1.8)
Position dummies	9.669	3.728	3.767	0	−3.617	0.1857	6.697	0
	(4.7)	(2.7)	(2.4)		(−1.0)	(0.1)	(2.5)	
	$F = 4.9$		$R^2 = 0.706$		$F = 3.6$		$R^2 = 0.380$	

[a] t-statistics in parentheses. Sample size is 4,500 (461 intercepts) for panels A, D, E, & F, and 2,067 (280 intercepts) for panels B and C. An F-statistic of 2.8 or greater is sufficient to reject the hypothesis (at the 1 percent level) that the ln(*Sales*) and ln(*Stock Index*) coefficients do not vary across corporate positions.

these aggregate compensation categories – market performance is an important determinant of executive compensation.

3.5. Alternative performance indices

In the preceding analysis, we defined performance in terms of the raw rate of return realized by shareholders. Since this measure of performance depends on industry and market factors as well as managerial productivity, we now consider two alternative definitions of market performance measured relative to other firms in the same industry and to other firms in the same 'risk class'.

The Industry-Relative performance index was constructed for Compustat firms grouped on the basis of their two-digit industrial classification.[23] Define I_t as the value-weighted-average industry rate of return realized by Compustat firms, *excluding* the sample corporation.[24] Then, the industry-relative rate of return, R_t^{I}, defined as

$$R_t^{\mathrm{I}} = (R_t - I_t)/(1 + I_t),$$

which implies

$$1 + R_t^{\mathrm{I}} = (1 + R_t)/(1 + I_t).$$

The denominator, equal to one plus the industry average return, $1 + I_t$, was included to make R_t^{I} a true relative rate of return. Having defined R_t^{I}, the Industry-Relative Index, S_t^{I}, is defined as

$$S_t^{\mathrm{I}} = S_{t-1}^{\mathrm{I}}(1 + R_t^{\mathrm{I}}).$$

Therefore, the Industry Relative Index is defined as the price of one share of common stock, normalized to be worth $100 at the beginning of the sample, which is adjusted to include all splits and dividends and is measured *relative* to the return realized by other firms in the same industry.

The Abnormal Performance Index, S_t^{A}, reflects stock market performance measured relative to other firms in the same 'risk class'. The rate of return used in constructing S_t^{A} was available directly from the Daily Excess Returns Tape provided by the Center for Research in Security Prices (CRSP) at the University of Chicago. In constructing this return, CRSP separates all NYSE and AMEX stocks into ten portfolios based on a ranking of estimated betas, and defines R_t^{β} as the equally-weighted-average return for all firms in a particular β-ranked portfolio. Then, the abnormal return realized by the sample firm,

[23] The Industry-Relative Index was also constructed using four-digit SIC industrial groups, and the associated results were nearly identical to those obtained using the two-digit industries.

[24] Compustat reports the end-of-calendar-year stock prices rather than the end-of-fiscal-year prices. In constructing the Industry-Relative Index, the own stock return R_t was re-calculated using the Compustat data, but the caveat remains the index is not precise since some firms have fiscal closings in months other than December.

R_t^{A}, is defined by CRSP as

$$R_t^{\mathrm{A}} = R_t - R_t^{\beta}.$$

A preferred measure of R_t^{A} (not computed by CRSP) would include the denominator $1 + R_t^{\beta}$. The Abnormal Performance Index, S_t^{A}, is defined as

$$S_t^{\mathrm{A}} = S_{t-1}^{\mathrm{A}}\left(1 + R_t^{\mathrm{A}}\right).$$

Since the three performance indices are all highly correlated,[25] the Stock, Industry-Relative, and Abnormal Performance indices all perform about equally well when entered separately into compensation regressions as measures of performance. These estimates (omitted here for brevity) indicate that the pronounced positive effect of performance on remuneration is robust to the stock market index utilized. In order to analyze the *relative* statistical importance of the alternative indices, the time-series regression equations in table 6 were re-estimated after including the Industry-Relative Index and the Abnormal Performance Index as additional explanatory variables; these results are reported in table 8.[26]

Panel A of table 8 presents estimates from time-series regressions that include both the Stock Index and the Industry-Relative Index as explanatory variables representing stock market performance. Considering first the Salary + Bonus regression, it is clear that the Stock Index, constructed using raw rates of shareholder return, has more explanatory power than the Industry-Relative Index. The estimates of the Sales, Stock Index, and position dummy coefficients are essentially identical to those originally reported in table 6, and the Industry-Relative Index coefficient is negligible.

For Total Compensation, the Industry-Relative Index does seem to have some explanatory power (with an estimated coefficient of 0.0558), and the Stock Index coefficient is reduced to 0.1172 from its table 6 estimate of 0.1592. These results indicate that, holding the industry-relative rate of return constant, a firm realizing a 10% raw return will increase the total compensation paid to its executives by 1.2%. Similarly, holding the *raw* rate of return constant, a firm realizing a return that is 10% higher than the average return realized by other firms in the same industry will increase managerial remuneration by 0.6%.

The panel A regressions indicate that salaries are positively affected by the Stock Index, but *negatively* affected by the Industry-Relative Index, ceteris paribus. That is, holding the raw rate of return constant, a firm realizing a 10%

[25] Correlation coefficients among logarithmic changes (continuous rates of return) in the three indices range from +0.61 to +0.69. In addition, logarithmic changes in the Industry-Relative and Abnormal Performance Indices are correlated with $\Delta \ln(Sales)$; the associated (highly significant) correlation coefficients are +0.22 and +0.26, respectively.

[26] The Industry Index is not deflated by the CPI since $(1 + R_t)/(1 + I_t)$ is already in real terms. However, S_t^{A} must be deflated since $1 + R_t^{\mathrm{A}} = 1 + R_t - R_t^{\beta}$ is a nominal magnitude.

Table 8

Estimated coefficients from time-series regression models with executive-specific intercepts using data from the 1964–1981 sample of 461 executives in 72 manufacturing corporations. The Stock Index is based on the rate return realized by shareholders. The Industry-Relative Index (panel A) is based on shareholder return measured relative to other firms in the same industry, and the Abnormal Performance Index (panel B) is based on shareholder return measured relative to other firms in the same risk class.[a]

Independent variable	Dependent variable (in logarithms): Total	Salary	Bonus	Salary + Bonus	Deferred	Option Value
Panel A: Regressions with Industry-Relative Performance						
ln(*Sales*)	0.2716	0.1088	1.287	0.2536	0.2279	−0.4475
	(12.4)	(6.3)	(5.1)	(19.4)	(1.4)	(−1.7)
ln(*Stock Index*)	0.1172	0.0780	0.0141	0.0997	−0.0849	−0.4991
	(6.5)	(4.2)	(0.1)	(7.5)	(−0.5)	(−1.8)
ln(*Industry-Relative Performance Index*)	0.0558	−0.0503	1.653	0.0188	0.7452	0.3668
	(3.2)	(−2.6)	(6.0)	(1.4)	(4.7)	(1.4)
Position dummies						
Chairman	0.1607	0.1476	0.4524	0.1648	−0.0918	−0.6724
	(6.3)	(5.4)	(1.2)	(8.7)	(−0.4)	(−1.8)
Chief Exec	0.5247	0.4380	0.7619	0.4962	0.5729	0.3508
	(24.3)	(18.4)	(2.2)	(30.9)	(2.9)	(1.1)
President	0.3304	0.2652	0.2891	0.3121	0.4634	0.2028
	(17.0)	(13.4)	(1.0)	(21.5)	(2.6)	(0.7)
Sample size	4,500	2,067	2,067	4,500	4,500	4,500
Number of individual-specific intercepts	461	280	280	461	461	461
R^2	0.805	0.884	0.563	0.863	0.706	0.377
F	236.5	98.4	21.5	405.7	10.1	3.7
Panel B: Regressions with Abnormal Performance Index						
ln(*Sales*)	0.2071	0.0944	1.550	0.2482	0.0082	−0.2161
	(11.1)	(5.2)	(6.0)	(17.9)	(0.0)	(−0.8)
ln(*Stock Index*)	0.1575	0.0677	0.5828	0.1152	0.5324	−0.5365
	(11.1)	(4.8)	(2.9)	(10.9)	(4.2)	(−2.5)
ln(*Abnormal Performance Index*)	0.0021	−0.0350	0.8525	−0.0016	−0.0692	0.3845
	(0.2)	(−3.9)	(6.6)	(−0.2)	(−0.8)	(2.8)
Position dummies						
Chairman	0.1491	0.1305	0.7810	0.1590	−0.3271	−0.4443
	(5.7)	(4.7)	(2.0)	(8.2)	(−1.4)	(−1.1)
Chief Exec	0.5151	0.4224	1.059	0.4913	0.3762	0.5492
	(23.1)	(17.3)	(3.0)	(29.7)	(1.9)	(1.6)
President	0.3271	0.2561	0.4631	0.3103	0.3896	0.2972
	(16.6)	(12.8)	(1.6)	(21.2)	(2.2)	(1.0)
Sample size	4,500	2,067	2,067	4,500	4,500	4,500
Number of individual-specific intercepts	461	280	280	461	461	461
R^2	0.805	0.885	0.565	0.863	0.704	0.378
F	234.2	100.2	22.7	405.1	6.5	4.7

[a] t-statistics in parentheses. F-statistic tests joint significance of ln(*Sales*), ln(*Stock Index*), the relative index, and the three position dummies. An F-statistic greater than 2.8 is significant at the 1 percent level.

return in excess of the average industry return will *decrease* executive salaries by 0.5%. Bonuses and deferred compensation are positively related to industry-relative returns but are *not* related to raw returns; a firm realizing a 10% industry-relative return will increase the bonuses and deferred compensation paid to its executives by 17% and 7.5%, respectively. Stock options are not significantly related to either the Stock Index or the Industry-Relative Index when both are included as explanatory variables.

Panel B of table 8 presents time-series estimates from regressions that include the Abnormal Performance Index (*API*) as well as the Stock Index. Total compensation and its largest component, Salary + Bonus, are affected by raw returns but not by abnormal returns; the *API* coefficients are negligible and the Sales, Stock Index and position-dummy coefficients are unchanged from their table 6 estimates. Salaries are positively related to raw returns, but negatively related to abnormal returns, ceteris paribus. Bonuses are positively affected by both raw returns and abnormal returns, and stock options are negatively related to the Stock Index, but positively related to abnormal performance. These results imply that a firm realizing a 10% return, holding abnormal returns constant, will increase salaries by 0.7%, bonuses by 5.8%, deferred compensation by 5.3%, and will decrease the value of options currently granted by 5.4%. Similarly, holding the raw rate of return constant, a firm realizing a return that is 10% higher than the average return realized by other firms in the same risk class will decrease salaries by 0.4%, increase bonuses by 8.5%, and increase the value of options by 3.8%.

To summarize, the evidence seems to support the use of raw stock returns in predicting levels (and changes in levels) of overall compensation. However, there are important differences in the way alternative measures of performance relate to the various components of remuneration. In particular, salaries are positively related to raw returns and negatively related to relative returns, ceteris paribus. Bonuses are not related to raw returns but are positively related to relative returns. These results suggest that firms with formal bonus plans may explicitly or implicitly tie bonus rewards and salary revisions to measures of relative performance.

4. Conclusion

The primary and indisputable conclusion of this paper is that firm performance, as measured by the shareholder's realized return, is strongly and positively related to managerial remuneration. This result, which comes as no surprise to economists but may shock editors of many popular business periodicals, is verified in all regressions and seems generally robust to the stock market performance index utilized. Moreover, growth of firm sales – another measure of performance – is also strongly related to executive compensation.

The striking differences in sign and magnitude between the time-series and cross-sectional regression estimates indicate that it is important to control for firm and individual-specific variables when assessing the effect of performance on remuneration. Consequently, previous cross sectional estimates of the compensation–performance relationship are biased and misleading.

The results in this paper also suggest that estimates of the compensation–performance relationship based only on the sum of salary and bonus omit important performance-sensitive components of remuneration, and therefore understate the full effect of performance on compensation. Raw stock returns are the best predictor of changes in aggregate measures of remuneration (Salary + Bonus and Total Compensation), but bonuses and deferred compensation are more strongly affected by industry-relative rates of return.

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Appendix

Table 9

Estimated coefficients from first-difference regressions models using data from the 1964–1981 sample of 461 executives in 72 manufacturing corporations.[a]

	Panel A Dependent variable (changes in logarithms)		*Panel B* Dependent variable (changes in logarithms)	
Independent variable	Total	Salary + Bonus	Total	Salary + Bonus
Intercept	0.0105 (2.0)	0.0169 (5.8)	−0.0027 (−0.5)	0.0024 (0.8)
Δ ln(*Sales*)	–	–	0.2321 (5.7)	0.2549 (11.2)
Δ ln(*Stock Index*)	0.0851 (5.3)	0.1002 (11.1)	0.0722 (4.5)	0.0860 (9.5)
Changes in position dummies				
Chairman	0.1136 (2.9)	0.0824 (3.8)	0.1165 (3.0)	0.0856 (4.0)
Chief Exec	0.3200 (8.4)	0.2896 (13.5)	0.3212 (8.5)	0.2909 (13.8)
President	0.2261 (7.5)	0.1735 (10.2)	0.2240 (7.5)	0.1712 (10.3)
R^2	0.028	0.077	0.036	0.105
F	29.1	84.5	30.0	94.9

[a] t-statistic in parentheses. F-statistic tests joint significance of Δ ln(*Sales*) (panel B), Δ ln(*Stock Index*), and the three position-change dummies. F-statistics greater than 3.3 and 3.0 are significant at the 1 percent level for the panel A and panel B regressions, respectively. Sample size is $N = 4039$ for all regressions.