DOES PERFORMANCE-BASED MANAGERIAL COMPENSATION AFFECT CORPORATE PERFORMANCE?

JOHN M. ABOWD*

The author, using 1981–86 data on more than 16,000 managers at 250 large corporations, investigates whether the sensitivity of managerial compensation to corporate performance in one year is positively related to corporate performance in the next year. Accounting-based measures of performance yield only weak evidence of such an association, but economic and market measures yield stronger evidence. Payment of an incremental 10% bonus for good economic performance is associated with a 30 to 90 basis point increase in the expected after-tax gross economic return in the following fiscal year; and payment of an incremental raise of 10% following a good stock market performance is associated with a 400 to 1200 basis point increase in expected total shareholder return.

In order to quantify the potential gains from performance-based managerial compensation, in this study I specify and estimate two related models of the connection between increased performance-sensitivity in compensation and increased subsequent corporate performance. These models control for the historical levels of both compensation and performance so that it is possible to focus on the extent to which changes in the correlation between current compensation and current performance affect future performance.

The first model, a discrete formulation, focuses on the conditional probability of good future corporate performance given current corporate performance and the current association between pay and performance. In this model increased performance-sensitivity is accomplished by increasing the probability of high pay when there is high performance and low pay when there is low performance.

The second model, a continuous formulation, focuses on the conditional expectation of future corporate performance given an elaborate, nonlinear function of current performance and compensation.

* John M. Abowd is Professor of Labor Economics and Management at Cornell University and Research Associate at the National Bureau of Economic Research. The author is grateful to George Milkovich and a major compensation consulting company for providing the data for this study. The author also thanks Ronald Ehrenberg, Robert Gibbons, Edward P. Lazear, and Kevin J. Murphy for extensive comments on earlier drafts. The Alfred P. Sloan Foundation and the National Science Foundation (grant number SES-8813847) provided financial support. The data were converted to research files with the support of the Center for Advanced Human Resource Studies at Cornell University.

A data appendix describes the procedures used to assemble the managerial compensation data base used in this study. The compensation data are confidential but the author's access is not exclusive. The executive compensation data used by Jonathan Leonard (this issue) are substantially the same as those used in this study. The financial data used in this study may be licensed from Standard and Poor's COMPUSTAT service.

Industrial and Labor Relations Review, Vol. 43, Special Issue (February 1990).
0019-7939/90/43SP $01.00

In this model performance-sensitivity in the compensation system can be varied continuously. The effects of this performance-sensitivity are captured by two interaction terms that measure the association between future performance and current compensation when current performance is below average and when current performance is above average.

The models are specified and interpreted using a general principal-agent framework in which the stockholders' compensation contract with the managers varies across companies and years in the extent of performance-sensitivity. The data used to test the models, obtained from a survey conducted by a major compensation consulting firm, cover some 25,000 managers at 600 corporations for the period from 1981 to 1986.

The Essential Features of Principal-Agent Models

Performance-based managerial compensation has recently attracted considerable attention in the professional literatures of economics, accounting, and human resource management. (See Ehrenberg and Milkovich 1987 for a comprehensive review.) This interest is justified by the belief that contingent, performance-based compensation provides a viable solution to the problem of aligning the interests of managers with those of the owners of the corporations that they manage. In the conventional agency cost formulation, the shareholders of the corporation are the principals and the managers are their agents. Manipulating the degree of performance-sensitivity in the manager's compensation contract is the principal's method of controlling the tradeoff between better management and increased compensation costs.

Ross (1973) first posed the basic principal-agent problem as it pertains to corporate managers. In his formulation the compensation contract is chosen so as to elicit actions by the agent that maximize the principal's utility subject to the constraints of a reservation utility level for the agent (feasibility) and private optimality of the agent's action (incentive compatibility). Becker and Stigler (1974) and Lazear (1979) recast the problem in terms of implementing a long-term implicit contract in which the manager's compensation over time provides the correct incentives. Holmström (1979) and Grossman and Hart (1983) analyzed in considerable detail the theoretical structure of performance-based compensation systems designed to mitigate single-period principal-agent problems. (See Hart and Holmström 1987 for a comprehensive review.)

The Grossman-Hart model solves the agency problem by showing that there are two conceptual steps to an optimal program. First, the principal chooses a different contingent compensation plan relating pay to performance outcomes for each action the agent might take. Second, by choosing a particular plan, the principal chooses an optimal action for the agent that maximizes the principal's utility net of the expected cost of the chosen pay plan.

It is the Grossman-Hart formulation of the problem that makes clear the fundamental tradeoffs involved in performance-based compensation. Actions that the agent dislikes (relative to their alternatives) are more costly to implement and require a greater degree of performance-sensitivity in the compensation plan. The expected cost of a compensation system must increase as it becomes more performance-based—expected payroll costs and the degree of performance-sensitivity in the compensation plan are positively correlated. By the same token, the expected performance of the corporation also increases as the degree of performance-sensitivity in the compensation plan increases—expected corporate performance and the slope of the pay-for-performance relation are positively correlated. Because expected payroll costs and expected managerial performance are both increasing as the degree of performance-sensitivity in the compensation contract increases, the solution to the principal-agent problem generally occurs when the incremental payroll costs just equal the value of the incremental performance gains associated with the chosen level of performance-sensitivity.

In the financial economics literature, Jensen and Meckling (1976) and Fama and Jensen (1983a, 1983b) demonstrated that the agency costs associated with running a large corporation are intrinsic to organizations in which ownership and control are separated. Furthermore, it is efficient to encourage the separation of ownership and control because the limited wealth of all individual investors prevents undertaking large positive net present value investments unless investors pool resources, thus creating organizational control problems. Agency costs reduce the gains from the separation of ownership and control but do not eliminate them.

The principal-agent literature, in spite of its apparent applicability to the design of compensation systems, has not been easy to translate into empirically tractable models. There are two basic problems. Lazear (1986) showed that the appropriateness (optimality) of contingent performance-based managerial compensation contracts depends critically on the assumption that direct monitoring of the agent's actions is prohibitively costly. When a relatively inexpensive monitoring system is available, both managers and principals will prefer noncontingent (salary-based) compensation systems with performance appraisals based on the information generated by the monitoring system. To the extent that monitoring costs vary across firms the predicted positive relation between strong incentive pay and corporate performance may not hold. The present study cannot control for differential monitoring costs in any meaningful way.

A second problem in testing principal-agent models of managerial compensation, identified by Miller and Scholes (1982) and also studied in Lewellen et al. (1987), is that many apparently performance-based compensation systems are actually designed to minimize the total tax burden of the principal and the agent. Hence, the measured performance-sensitivity in the compensation system is a veil for tax avoidance. Contingent, performance-based compensation that is specifically designed to increase the joint tax liability of the corporation and the managers may be explained on incentive grounds alone. Most contingent compensation systems, however, reduce the joint tax liability of the corporation and its managers, so that the tax consequences of the compensation system must be controlled before the incentive effects can be determined. The present study considers only annual corporate performance and annual cash compensation (including amounts that the manager elects to defer). This focus reduces the potential for tax-related considerations to confound the results.

Most studies of managerial compensation have investigated the empirical relation between the level or rate of change of managerial compensation and corporate financial, economic, and market performance indicators. (See, for example, Lewellen 1968; Lewellen and Huntsman 1970; Masson 1971; Murphy 1985, 1986; Antle and Smith 1986; Jensen and Murphy 1987, 1988; Baker et al. 1988; Leonard, this issue; and Gibbons and Murphy, this issue.) When current compensation is shown to be sensitive to these performance indicators, the system is declared performance-based, whether or not an explicit formula exists that links current compensation to the indicators. Disputes arise as to whether or not the observed degree of sensitivity of compensation to performance is adequate to solve the principal-agent problem between the owners and the managers. (See Baker, Jensen, and Murphy 1988.)

In contrast to the fairly large number of studies investigating the sensitivity of managerial compensation to corporate performance measures, comparatively little research exists on the efficacy of performance-based compensation systems. The notable exception is Larker's (1983) study of the returns on investment decisions made by managers paid with different types of executive compensation systems. Masson (1971) also attempted to address this question as a part of his analysis of executive compensation and common stock performance. In financial economics the event study methodology has been used to assess the performance effects of some kinds of contingent compensation. (See Bhagat et al. 1985; Brickley et al. 1985; Coughlan and Schmidt 1985; Lambert and Larker 1985; and Tehranian and Waegelein 1985.) Recent work in compensation (Gomez-Mejia et al. 1987; Rabin 1986, 1987), accounting (Lambert and Larker 1987), and financial economics (Lewellen et al. 1987) also begins to address these issues. Healy (1985) considered the agency cost–related problem of manipulation of accounting quantities when contingent compensation is based on accounting performance measures rather than on economic or market measures.

Tests of Compensation System Design and Effectiveness

When the sensitivity of compensation to performance measures is increased, under what conditions does the subsequent performance of the corporation improve, worsen, or remain the same? Since an optimal compensation system balances the gain from additional performance-sensitivity, which takes the form of incremental corporate performance, against the cost of additional performance-sensitivity, which takes the form of higher average compensation, the answer to this question is at the heart of the study of the design and effectiveness of compensation systems. The gains are achieved because the manager's extra effort induced by the greater return to performance in the compensation system increases the probability of favorable corporate outcomes. The costs are incurred because a feasible performance-based compensation system must deliver greater expected total compensation the greater the effort level the system tries to induce from the managers. Neither the expected total cost of the compensation system nor the expected corporate performance improvement can be calculated without quantitative measures of the relation between the performance-sensitivity of compensation and future corporate outcomes.

It may be that the apparent complexity of determining the optimal compensation design and then validating that design by quantifying the improvements in performance that it caused has obscured the important and practical implications of quantifying the relationship between characteristics of the current managerial pay system and subsequent corporate performance. If the existence of this relationship and some estimate of its magnitude could be inferred from the sensitivity of corporate performance to the pattern of performance-based contingencies in a sample of corporate compensation plans, then compensation designers could use the estimated change in corporate performance from such a sample to justify a modification of the structure of a particular plan. The ability to evaluate existing compensation plans using formulas that reflect the consequences of incentives would greatly facilitate the comparison of such plans.

Statistical Models for Contingent Compensation Effects on Performance

Any statistical model of the relation between compensation and current performance must begin with the equation describing pay for the individual manager. To specify that function, define:

y_{ijt} = the compensation measure for manager i in company j for year t;

x_{ijt} = the personal characteristics of manager i (including job level at company j) for year t.

Since corporate performance does not vary for managers within a particular company, a general form for the compensation equation is:

$$(1) \qquad y_{ijt} = \alpha_{jt} + (x_{ijt} - \bar{x})\beta + u_{ijt}$$

where α_{jt} = the effects on compensation of being at company j for year t, called the company · year effects on compensation; β = the effect of x_{ijt} on compensation; u_{ijt} = the statistical error term associated with (1); and $\bar{x}$ = the grand mean of x_{ijt}. The individual characteristics are expressed as deviations from the grand mean in order to force the estimated α_{jt} through the grand mean of y_{ijt}.

Because all the information about the link between corporate pay and performance is contained in the company · year effects α_{jt}, I specify a statistical model relating these effects to annual performance. Let q_{jt} = the estimated α_{jt} from equation (1) and p_{jt} = the performance of company j for year t. Then the implications of principal-agent models for compensation design and annual performance reviews are:

$$\text{(2a)} \qquad q_{jt} = a_{jt} + b_{jt}p_{jt} + v_{jt}$$

$$\text{(2b)} \qquad p_{jt+1} = \theta_0 + \theta_1 a_{jt} + \theta_2 b_{jt} + \theta_3 p_{jt} + e_{jt+1}$$

where a_{jt} = the intercept of the compensation-performance relation (2a); b_{jt} = the slope of the compensation-performance relation (2a); v_{jt} = the statistical error in equation (2a); θ_k = the parameters of the future performance relation (2b); and e_{jt+1} = the statistical error in equation (2b). A pay system is performance-based if the slope b_{jt} is positive. A performance-based system is consistent with a solution to the principal-agent problem if, as b_{jt} increases, the intercept a_{jt} falls. The payoff to low performance outcomes must be lower and the payoff to high performance outcomes must be higher the greater the work effort the compensation contract induces. The performance-based pay system is valid if $\theta_1 < 0$ or $\theta_2 > 0$, indicating that increasing the performance-sensitivity in compensation does increase subsequent performance.

It is not possible to test equation (2b) directly, because we do not have repeated observations on the p_{jt} and q_{jt} variables for each company year; hence, equation (2a) cannot be estimated. The predictions regarding the system in equations (2) can be explored under the maintained hypothesis that comparison of the pair (p_{jt}, q_{jt}) with the median outcomes for performance and pay for all companies in year t provides information about the values of a_{jt} and b_{jt}.

Figure 1 illustrates this maintained hypothesis. In the figure, performance is

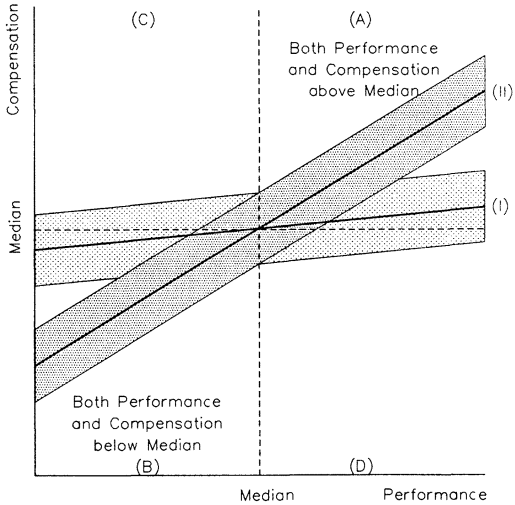

Figure 1. An Illustration of the Maintained Hypothesis About the Location of More vs. Less Performance-Sensitive Outcomes.

plotted along the horizontal axis and compensation along the vertical axis. The graph is divided into four regions by the dashed lines at the medians of performance and compensation. Region (A) contains points that are above both medians. Region (B) contains points that are below both medians. Regions (C) and (D) contain points that are above one median but below the other. The maintained hypothesis is that systems in which compensation is more performance-based are more likely to produce outcomes in regions (A) and (B).

The argument, which can be made rigorous for certain conditional probability distributions of the error term v_{jt}, is illustrated by the lines (I) and (II) and the shaded areas surrounding them. Line (I) represents a pay-for-performance relation that is not very sensitive (high intercept a_{jt} and low slope b_{jt}); line (II), a pay-for-performance relation that is very sensitive (low intercept, high slope). In both cases the shaded area around the lines contains the likely scatter of outcomes around the basic relation. The proportion of the outcomes for line (II) that lie in regions (A) and (B) is greater than the similar proportion of outcomes for line (I). Hence, an outcome in region (A) or (B) is more likely to have come from a highly performance-sensitive compensation system than is an outcome in region (C) or (D).

The Discrete Model

The following model incorporates the maintained hypothesis in a test of the efficacy of certain pay-for-performance systems. The test has the advantage of being simple and direct. It has the disadvantage of being difficult to translate into an estimate of the magnitude of the effect of increasing performance-sensitivity on future performance. This problem is handled in the continuous model.

Let:

$$p^*_{jt} = \begin{cases} 1 \text{ when } p_{jt} > \text{median over } j \text{ for year} \\ t \text{ of all } p_{jt}\text{; 0 otherwise.} \end{cases}$$

$$q^*_{jt} = \begin{cases} 1 \text{ when } q_{jt} > \text{median over } j \text{ for year} \\ t \text{ of all } q_{jt}\text{; 0 otherwise.} \end{cases}$$

$$x^*_{jt} = \begin{cases} \text{1 when the total assets of company} \\ j \text{ for year } t \text{ exceed the median total} \\ \text{assets for year } t \text{ on the New York} \\ \text{Stock Exchange; 0 otherwise.} \end{cases}$$

The test of the average sensitivity of compensation to performance is based on the following log linear model for the probabilities:

$$\text{(3)} \qquad \log \Pr\{q^*_{jt} = 1 \mid p^*_{jt}, x^*_{jt}\} = \phi_0 + \phi_1 p^*_{jt} + \phi_2 x^*_{jt}.$$

Equation (3) is called the compensation equation in the discrete model. The parameter ϕ_1 measures the average sensitivity of compensation to the particular performance measure specified. Since I cannot verify that every performance measure I consider is appropriate, the compensation equation is used as a test that the average effect of a particular performance measure on compensation is actually positive. Such a test is germane because the average b_{jt} from equation (2a) over all companies and years must be positive, which implies that the parameter ϕ_1 will be positive. The variable x^*_{jt} is included to control for sample design problems in the statistical analysis.[1]

The test of whether greater sensitivity of compensation to performance is associated with increased future performance is based on the following log linear model for the conditional probability of next year's performance given this year's compensation, performance, and size control.

$$\text{(4)} \qquad \log \Pr\{p^*_{jt+1} = 1 \mid p^*_{jt}, q^*_{jt}, x^*_{jt}\} = \delta_0 + \delta_1 p^*_{jt} + \delta_2 p^*_{jt} q^*_{jt} + \delta_3 (1 - p^*_{jt}) \cdot (1 - q^*_{jt}) + \delta_4 x^*_{jt}.$$

Equation (4) is called the performance equation in the discrete model. The parameter δ_2 should be positive because it captures the effect of being above the median for both performance and compensation in the current year (region (A) in Figure 1). The parameter δ_3 should also be positive, since it captures the effect of being below the median for both performance and compensation in the current year. The parameter δ_1 will generally be positive for most accounting, economic, and market performance measures. It is included in the model because performance measures, especially those based on accounting data, are known to possess positive serial correlation for a variety of reasons unrelated to the compensation system design (Foster 1986). The sign of δ_4 is unknown *a priori,* since the variable x^*_{jt} is included as a control for sampling design problems in the analysis sample.[2]

The Continuous Model

In order to calculate an estimate of the

[1] This variable is introduced because the analysis sample is not a random sample of companies from the comparison group. Larger companies are more apt to be in the sample. In a discrete model, inclusion of this size variable adequately controls for the selectivity bias created by this sampling plan.

[2] It is important to note that equation (4) is saturated in the p^*_{jt} and q^*_{jt} effects as specified because there are only four possible combinations of outcomes for these variables and three independent effects (δ_1, δ_2, and δ_3) are included. The remaining outcome ($p^*_{jt}=0$, $q^*_{jt}=1$) is the reference point for the contrasts.

magnitude of the effect of increasing the sensitivity of managerial compensation to performance, I specify the following system, which also incorporates the maintained hypothesis. The model is specified in terms of the conditional expectations of the estimated company · year effects in compensation and performance next year, given the appropriate controls.

The compensation equation for the continuous model is:

$$(5)\quad \mathrm{E}[q_{jt} \mid p_{jt}, x_{jt}] = \phi_0 + \phi_1 p_{jt} + \phi_2 x_{jt}$$

where x_{jt} is total assets for company j in year t, and the other variables are defined above. The parameters ϕ_k have the same interpretation as in equation (3), so I have not used new symbols. In particular, $\phi_1 > 0$ is required for compensation to be performance-based, on average.

The performance equation for the continuous model is:

$$(6)\quad \mathrm{E}[p_{jt+1} \mid p_{jt}, q_{jt}, x_{jt}] = \delta_0 + \delta_1 p_{jt} + \delta_2 T^{+}(p_{jt} - m_t)q_{jt} + \delta_3 T^{-}(p_{jt} - m_t)q_{jt} + \delta_4 x_{jt} + \delta_5 q_{jt}$$

where m_t is the median of p_{jt} over j for year t; the function $T^{+}(z) = z$ if $z > 0$ and 0 otherwise; and the function $T^{-}(z) = z$ if $z < 0$ and 0 otherwise. The interpretation of the parameters is similar to the interpretation in equation (4), so I have not changed the symbols. In particular, if performance is above the median, then increasing compensation is associated with increasing the sensitivity of pay to performance (region (A) in Figure 1); therefore, δ_2 should be positive. If performance is below the median, then decreasing compensation is associated with increasing the sensitivity of pay to performance (region (B) in Figure 2); therefore, δ_3 should also be positive (because $T^{-}(p_{jt} - m_t) < 0$ in this case).[3]

[3] Notice that since equation (6) is not saturated by the inclusion of δ_1, δ_2, and δ_3, it is possible for current compensation to have an independent effect, δ_5, that is not modeled.

The Managerial Compensation and Financial Data

The managerial compensation data used in this study were derived from the annual cash compensation survey of a major compensation consulting firm. The data cover approximately 75 top management employees for the period from 1981 to 1986 for each of about 600 corporations. The company, executive, and position are all identified in the survey data. Therefore, it is possible to follow both individuals and positions across years within a single company. All financial data used in this study were derived from Standard and Poor's COMPUSTAT data base (1988). The data appendix contains a detailed description of the methods used to create the analysis file.

Two important selection rules were applied to the companies in the original survey to derive the analysis file. First, a company must appear in the compensation survey at least three years (not necessarily consecutive) to have sufficient data for my analysis. Second, I used only publicly held U.S. companies for which the COMPUSTAT financial data and the respondent's self-reported financial data matched exactly. The strenuous requirement of an exact match on total assets was imposed to guarantee that the financial data used were always from the most recently completed fiscal year prior to the March 1 survey reference date and to guarantee that the position of the managers within the corporate hierarchy was comparable across companies (see the data appendix). Only about 225 companies and 99,200 executive years were used in each of the basic statistical analyses, with slight variations depending on the particular analysis. Fewer executive years but the same number of companies were available for the analyses involving changes.

Since the data were originally collected by a compensation consulting firm, it is appropriate to discuss the implicit sampling frame used to generate the survey responses. The original data were collected from client submissions to the consulting firm. A human resource management professional employed by the respondent company completed the survey form for each executive the company wished to have appraised. Unlike normal social science surveys, but consistent with industry practice in compensation surveys, the respondent company paid a fee to be included in the survey. The company controlled how often it participated and which executive positions were submitted in a given year. The consulting company had an active client relationship with many of the participating companies; the primary product of the survey, however, was an analysis of the competitive position of the respondent company's managers with respect to the managers of a comparison group of companies. The consulting company did not design most of the compensation systems in the survey.

Because the managers and companies in the sample are self-selected, it is important to know how representative they are of various populations. The companies in the sample I analyzed, all of which had public financial data, are primarily large U.S. corporations. On average, they have total assets 2.7 times greater than the average New York Stock Exchange company followed in the COMPUSTAT files (in 1986). For this reason, I included a company size control based on total assets in all analyses.

The compensation survey includes salary and annual bonus. The annual bonus was defined as any cash payment earned during the previous twelve months that was based exclusively on performance during a single year. Cash bonuses for meeting multiyear performance goals were not included in the annual bonus. (The information is actually collected in a different survey.) Cash that was received during the last twelve months but that was earned during an earlier period (with payment deferred) was not included in the bonus. Hence, the bonus data really are for annual performance. Long-term incentive pay was not available. For this reason, I tried to design the empirical analysis so that it focuses on annual performance criteria. To the extent that annual performance influences long-term incentive pay, I am not able to capture the effect of performance on compensation. To the extent that there is a substantial difference between the performance-sensitivity of annual pay and long-term incentive pay, the annual pay for performance analysis is inappropriate.

Consider next the dating of the financial and compensation variables. In the theoretical framework, current compensation is based on current performance, that is, current compensation is paid at the end of the current period when current performance can be observed. In the empirical analysis, current performance is defined as the financial data for the most recently completed fiscal year prior to March 1 of the survey year, the reference date for the base salary. Future performance is defined as the performance during the fiscal year that includes March 1 of the survey year. Current compensation is defined as the base salary as of March 1 of the survey year and the most recently awarded bonus prior to March 1. I have made every effort to ensure that the bonus used in the statistical analysis was determined when the results of the most recently concluded fiscal year prior to March 1 were known. The data appendix describes the method for checking the dating of the financial information vis-à-vis the compensation data.

I used four distinct financial performance variables. Two of the performance measures, after-tax return on assets and after-tax return on equity, are conventional accounting measures of asset profitability, generically called return on investment. Actual definitions of these ratios differ greatly from one application to the next. Since there is no commonly agreed-upon method for calculating the ratios, I used the formulas in Bernstein (1983, Chapter 19).

The numerator of after-tax return on assets is net income plus the interest expense, adjusted to an after-tax basis at the marginal corporate tax rate. The denominator is average total assets over the fiscal year.

After-tax return on equity was defined for common stock equity, adjusted for unconsolidated minority interests. The numerator of after-tax return on equity is net income less income to minority interests less preferred stock dividends paid. The denominator is average common stock equity over the fiscal year.

The third performance measure I used is a measure of gross cash flow, net of taxes, divided by an estimate of the replacement cost of total assets. This ratio is called after-tax gross economic return. The numerator, operating income less income taxes, corresponds approximately to the after-tax cash flow into the business. The denominator, an estimate of the current replacement cost of total assets at the beginning of the fiscal year, corresponds approximately to the wealth tied up in the business at the beginning of the fiscal year. The data appendix contains a detailed description of the calculation of this variable.

The final performance measure is a market measure—total shareholder return, which is the calendar year holding period return per share of common stock. The numerator of total shareholder return is dividends per share earned over the calendar year plus the capital gain per share between the end of last year and the end of the current year. The denominator is the price per share of common stock at the end of the previous calendar year. Stock prices and dividends per share were adjusted to reflect the effects of stock splits and stock dividends during the calendar year.

Table 1 contains a summary of all variables used in my statistical analyses. The table shows that the average executive in the sample earned $106,689 per year in total cash compensation over the period from 1981 to 1986. The executives were employed by companies that had an average of $3,334 million in total assets and earned an average of 6.7% per year in after-tax return on assets. The shareholders of these companies earned an average of 17.3% per year total return. The notes to the table contain the short definitions of all variables; the data appendix contains long definitions.

Statistical Results

The first requirement of the empirical analysis is to estimate the company · year effects in equation (1) for each of the compensation variables used in the analysis. Table 2 contains a summary of the results for the four compensation measures—log of total salary, percent increase in total salary, log of base salary, and bonus as a percent of base salary.[4] The table contains no surprises and is presented to show that the adjustment to the various compensation measures is consistent with analysis of individual compensation data from many sources.[5]

Table 3 presents the results of the discrete model using the annual percentage increase in total salary as the compensation measure and using after-tax return on assets (ROA), after-tax return on equity (ROE), after-tax gross economic return (ERET), and total shareholder return (TSR) as the performance measures. The compensation equation clearly shows that compensation is performance-based with respect to each of the performance measures, on average.

The performance equation gives mixed results for the two accounting measures (ROA and ROE), indicating that increased performance sensitivity is not always associated with increased performance. The coefficients on the "Current Performance and Current Compensation Both Above Median" variable for the two accounting measures are both positive, although the coefficient in the ROE equation is impre-

---

[4] Throughout the paper, the exact form of the percent increase in total salary is 100 · (log(total salary current year) − log(total salary previous year)); only consecutive years are used. The exact form of the bonus-to-base ratio is 100 · log(1 + bonus/base). This form was chosen because it makes the decomposition of the logarithm of total salary into the logarithm of base salary plus the bonus/base ratio exact, except for the multiplication by 100, which facilitates comparison of statistical models using the bonus-to-base ratio with models using the percentage change in total salary.

[5] The company · year effects from the "Log of Total Salary" and "Log of Base Salary" columns are never used as dependent variables in a compensation equation. They are used as control variables in the continuous model.

Table 1. Summary of the Managerial Compensation and Corporate Performance Data for All Firms Used in the Analysis (1981 to 1986).

Definition of Variable	*Mean*	*Std. Dev.*	*Sample Size*
Individual Data			
Base Salary[a]	85,599	61,513	99,219
Logarithm of Base Salary	11.2	.5	99,219
Bonus Payment[b]	21,090	39,321	99,219
Total Salary[c]	106,689	94,826	99,219
Logarithm of Total Salary	11.4	.6	99,219
Percentage Increase in Total Salary[d]	9.2%	1.4%	60,227
Bonus as a Percent of Base[e]	16.0%	15.1%	99,219
Years of Education[f]	16.4	1.8	99,219
Years of Labor Force Experience[g]	26.2	9.0	99,219
Years at Employer[h]	14.7	10.4	99,219
Percentage Job Level 1[i]	1.2%	na	99,219
Percentage Job Level 2[j]	6.6%	na	99,219
Percentage Job Level 3[k]	19.9%	na	99,219
Percentage Job Level 4[l]	30.6%	na	99,219
Company Data			
Average Adjusted Log Total Salary[m]	11.4	.3	863
Average Adjusted Increase in Total Salary[n]	8.8%	10.5%	863
Average Adjusted Log Base Salary[o]	11.2	.3	1,114
Average Adjusted Bonus/Base (percent)[p]	15.5%	10.7%	1,114
After-Tax Return on Assets[q]	6.7%	5.7%	1,107
After-Tax Return on Equity[r]	10.8%	13.7%	1,104
After-Tax Gross Economic Return[s]	11.4%	5.6%	1,052

Definition of Variable	*Mean*	*Std. Dev.*	*Sample Size*
Total Shareholder Return[t]	17.3%	35.1%	1,114
Total Assets at Beginning of Year[u]	3,334	6,814	1,117
Log of Total Assets (Beg. of Year)	7.2	1.3	1,117
Proportion of Companies with Adj. Average Increase Above Median	.497	na	857
Proportion of Companies with Bonus as a Percent of Base Above Median	.498	na	1,107
Proportion of Companies with After-Tax Return on Assets Above Median	.554	na	1,107
Proportion of Companies with After-Tax Return on Equity Above Median	.505	na	1,104
Proportion of Companies with After-Tax Gross Economic Return Above Median	.560	na	1,052
Proportion of Companies with Total Shareholder Return Above Median	.493	na	1,114
Proportion of Companies with Total Assets (Beginning of Year) Above Median	.873	na	1,107

[a] Base Salary is the annual salary (exclusive of bonus and long-term incentive compensation) in effect on March 1 of the survey year.

[b] Bonus is the most recent payment (prior to March 1 of the survey year) determined by an annual review cycle. Bonus payments determined on review cycles longer than one year are considered long-term incentive compensation and are not included.

[c] Total salary is the sum of base salary and bonus.

[d] Percentage increase in total salary is 100 · (log(total salary as of March 1 of the survey year) − log(total salary as of March 1 of the previous year)), for consecutive surveys only. The variable is only available when the same executive is surveyed in two consecutive years.

[2] Bonus as a percent of base is 100 · log(1 + Bonus/Base).

[f] Years of education is imputed for survey year 1986 using the history of the executive, when available, or the value 16.4 if there is no history.

[g] Years of labor force experience is Current age − Years of Education − 5.

[h] Years at employer is the executive's actual tenure with the surveyed company.

(table notes continue)

[i] Job level 1 is the highest position in the corporate hierarchy (usually Chairman and Chief Executive Officer) as reported on the survey.
[j] Job level 2 reports to the CEO (usually President and Chief Operating Officer).
[k] Job level 3 reports to the level 2 position.
[l] Job level 4 reports to the level 3 position. All other positions are level 5 or below.
[m] Average adjusted log total salary is the estimated company · year effect from the regression of log total salary on years of education, labor force experience, labor force experience squared, years at employer, indicators for job levels 1, 2, 3, and 4 (level 5 and above is the reference group), and unrestricted year within company fixed effects. The estimated company · year effects were forced through the grand mean of log total salary. See Table 2.
[n] Average adjusted increase in total salary is the estimated company · year effect from the regression of the percentage increase in total salary on the variables listed in note m (except labor force experience squared). See Table 2.
[o] Average adjusted log base salary is the estimated company · year effect from the regression of log base salary on the variables listed in note m. See Table 2.
[p] Average adjusted bonus/base (percent) is the estimated company · year effect from the regression of 100·log(1 + bonus/base) on the variables listed in note m. See Table 2.
[q] After-tax return on assets: 100 · (Net Income + Interest (1 − Tax Rate)) divided by (Beginning Total Assets + Ending Total Assets)/2.
[r] After-tax return on equity: 100 · (Net Income) divided by (Beginning Shareholder's Equity + Ending Shareholder's Equity)/2.
[s] After-tax economic return is operating income less taxes as a percentage of beginning of period total assets, valued at replacement cost: 100 · (Operating Income − Taxes) divided by (Beginning Total Assets, valued at replacement cost).
[t] Total shareholder return: 100 · (Dividends per beginning share + Capital gain per beginning share) divided by (Beginning price per share).
[u] Total assets at the beginning of the year is the book value of all assets at the end of the previous fiscal year (in millions of dollars). In all cases, this value is for a fiscal year that ended prior to March 1 of the compensation survey year.
Sources: (1.) All financial data are from Standard and Poor's COMPUSTAT service for fiscal years 1980 to 1986 based on the September 1988 annual industrial tape. Only the 2,423 New York Stock Exchange companies available during this period were used for comparisons. (2.) All compensation data are from the annual surveys of a major compensation consulting firm (1981 to 1986 surveys). Surveys were conducted in March and April of the survey year.

cise. The coefficients on the "Current Performance and Current Compensation Both Below Median" variable for the two accounting measures are both negative, although both coefficients are imprecise. The results are also mixed for total shareholder return (TSR), although, given the rapidity with which the stock market moves, it is always possible that the effect of the incentive compensation was capitalized during the current year and not during the next year. The performance equation indicates a very substantial effect of increased performance-sensitivity, in the predicted positive direction, when the performance measure is after-tax gross economic return (ERET).

Table 4 presents a parallel analysis of a discrete model using as the compensation measure the bonus as a percent of base. The results are not substantially different from the results in Table 3. Compensation is performance-related for all performance measures. Only the after-tax gross economic return shows evidence of a performance improvement when performance-sensitivity in the compensation equation increases.

Table 5 shows the results for a continuous model in which the compensation measure is the percentage increase in total salary. All compensation equations indicate that pay is performance-related, on average. The performance equations for after-tax return on assets and after-tax gross economic return give mixed evidence for an effect of increased performance-sensitivity on future performance. There is no evidence that sensitivity to after-tax return on equity affects future performance, but substantial evidence that total shareholder return has such an effect.

In the total shareholder return performance equation in Table 5, the estimated δ_2 is .0109 ($\pm$.0034) and the estimated δ_3 is

Table 2. Summary of the Regression Models Used to Adjust the Various Compensation Measures Defined at the Company Level Estimated by Least Squares with Fixed Company · Year Effects.[a]

Independent Variable[b]	*Log of Total Salary*	*Percent Increase in Total Salary*	*Log of Base Salary*	*Bonus as a Percent of Base*
Years of Education	.0429	−.2260	.0377	.5136
	(.0006)	(.0278)	(.0006)	(.0209)
Years at Employer	.0033	−.0356	.0016	.1620
	(.0001)	(.0059)	(.0001)	(.0044)
Years of Experience	.0379	−.1774	.0325	.5323
	(.0006)	(.0069)	(.0005)	(.0195)
Years of Experience Squared	$-.479 \cdot 10^{-3}$	na	$-.397 \cdot 10^{-3}$	−.0082
	$(.116 \cdot 10^{-4})$	na	$(.965 \cdot 10^{-5})$	(.0004)
Job Level 1	1.9145	3.60	1.7126	20.18
	(.0010)	(.3765)	(.0083)	(.3109)
Job Level 2	1.0478	3.98	.9014	14.65
	(.0048)	(.1930)	(.0040)	(.1511)
Job Level 3	.5505	2.34	.4647	8.58
	(.0033)	(.1352)	(.0027)	(.1020)
Job Level 4	.2737	1.28	.2284	4.54
	(.0027)	(.1166)	(.0023)	(.0857)
Standard Error of Equation	.333	10.86%	.277	10.40%
R^2	.697	.395	.713	.528
Degrees of Freedom for Company Year Effects	1,151	896	1,151	1,151
Sample Size	99,219	60,227	99,219	99,219

[a] Coefficients are shown with standard errors in parentheses.
[b] Table 1 contains variable definitions and summary statistics.
Source: All data are from the annual surveys of a major compensation consulting firm (1981 to 1986 surveys).

.0095 (±.0058). These coefficients translate into rather substantial performance effects. A one standard deviation increase in the raise (an extra 10.5% of last year's salary) delivered when current total shareholder return is one standard deviation above the median (3,510 basis points above the median) yields a 400 basis point expected increase in next year's total shareholder return. The estimated effect is only 11% of the standard deviation of total shareholder return, which would be difficult, but not impossible, to detect in a sample of total shareholder returns for which there was only compensation announcement information. The expected effect of delivering the same incremental raise when total shareholder return is three standard deviations above average is 1,200 basis points of additional total shareholder return, which is about one-third of the standard deviation. These results suggest that general managerial compensation policy may affect the stock market value of a company on a year-to-year basis. This conclusion is surprising in view of the timing difficulties associated with measuring the effects of managerial and other compensation policy changes on stock returns (see Abowd, Milkovich, and Hannon, this issue); it is not inconsistent, however, with efficient capital markets. If the compensation policies are announced after the current fiscal year results, the reported effects could legitimately be associated with the performance-sensitivity of compensation.

Table 6 reports the results for a continuous model in which the compensation measure is the bonus as a percent of base. The compensation equations indicate that pay is performance-related, on

Table 3. Summary of the Statistical Analysis of the Discrete Model Using the Annual Percentage Increase in Total Salary as the Compensation Measure and a Variety of Performance Measures. (Standard Errors in Parentheses)[a]

Performance Measure	*ROA*[b]	*ROE*[c]	*ERET*[d]	*TSR*[e]
	Compensation Equation[f]			
Performance Measure	.614	.701	.777	.908
	(.140)	(.139)	(.145)	(.140)
Total Assets at Beginning of Year	.598	.579	.655	.488
	(.219)	(.220)	(.234)	(.222)
Intercept	−.876	−.866	−1.027	−.866
	(.226)	(.222)	(.243)	(.218)
	Performance Equation[g]			
Current Performance Measure	1.704	1.857	2.931	.534
	(.233)	(.238)	(.287)	(.221)
Current Performance & Current Compensation Both Above Median	.437	.218	.624	−.098
	(.208)	(.217)	(.266)	(.203)
Current Performance & Current Compensation Both Below Median	−.404	−.479	.365	.277
	(.245)	(.241)	(.273)	(.196)
Total Assets at Beginning of Year	−.375	−.360	−.593	.247
	(.248)	(.251)	(.304)	(.214)
Intercept	−.665	−.723	−.994	−.512
	(.292)	(.291)	(.355)	(.248)
Number of Observations	857	853	814	863
Number of Firms	227	228	214	228

[a] The reported results are maximum likelihood estimates of the logistic regression coefficients for an equation that estimates the conditional probability of a one for the dependent variable, given the variables shown in the rows of the table. Summary statistics are reported in Table 1.

[b] ROA is after-tax return on assets, defined in Table 1.

[c] ROE is after-tax return on equity, defined in Table 1.

[d] ERET is after-tax gross economic return (cash flow) as a percentage of beginning of period total assets, valued at replacement cost, defined in Table 1.

[e] TSR is total shareholder return, defined in Table 1.

[f] The dependent variable in the compensation equation is based on the average adjusted value of $100 \cdot (\log(\text{total salary year } t) - \log(\text{total salary year } t\text{-}1))$, called the average adjusted increase in total salary. These are the company · year effects implied by the "percent increase in total salary" column of Table 2. If the average adjusted increase in total salary for a particular company exceeds the median average adjusted increase in total salary for all the firms in the sample, then the compensation measure is one for that company; otherwise, zero. The performance measure on the right-hand side of the equation is described in note g. The variable total assets at beginning of year equal one if total assets for the company exceed the median of total assets for the New York Stock Exchange companies listed on COMPUSTAT; otherwise, zero.

[g] The dependent variable is a performance measure based on the next fiscal year's value of the performance variable indicated by the column heading relative to the median of the New York Stock Exchange companies listed on COMPUSTAT for that year. If the performance variable for a particular company exceeds the annual median performance on the NYSE, then the performance measure equals one for that company; otherwise, zero. Current performance and current compensation both above median equals one when the performance measure is above the median for NYSE companies in the current fiscal year and the compensation measure is above the median for the compensation sample companies for the current year; otherwise, zero. Current performance and current compensation both below median is defined similarly when both measures are below the appropriate medians.

Sources: (1.) Annual median ROA, ROE, ERET, and TSR, Total Assets at Beginning of Year, and all other financial data are from the 2,423 New York Stock Exchange companies in Standard and Poor's COMPUSTAT for the fiscal years 1980 to 1986 (September 1988 annual industrial tape). (2.) All compensation data are from the annual surveys of a major compensation consulting firm (1981 to 1986 surveys).

Table 4. Summary of the Statistical Analysis of the Discrete Model Using the Bonus as a Percentage of Base Salary as the Compensation Measure and a Variety of Performance Measures. (Standard Errors in Parentheses)[a]

Performance Measure	*ROA*[b]	*ROE*[c]	*ERET*[d]	*TSR*[e]
		Compensation Equation[f]		
Performance Measure	.817	.938	.882	.489
	(.126)	(.126)	(.130)	(.126)
Total Assets	1.191	1.185	1.250	1.090
	(.203)	(.204)	(.216)	(.200)
Intercept	−1.518	−1.510	−1.611	−1.186
	(.212)	(.208)	(.226)	(.198)
		Performance Equation[g]		
Current Performance Measure	1.796	1.993	2.753	.065
	(.214)	(.221)	(.252)	(.182)
Current Performance & Current Compensation Above Average	.045	.164	.533	.029
	(.191)	(.199)	(.228)	(.173)
Current Performance & Current Compensation Below Average	−.470	−.389	.012	−.071
	(.210)	(.212)	(.245)	(.172)
Current Total Assets	−.487	−.351	−.654	.255
	(.221)	(.220)	(.262)	(.185)
Intercept	−.236	−.652	−.805	−.272
	(.265)	(.264)	(.321)	(.215)
Number of Observations	1107	1104	1052	1114
Number of Firms	228	227	216	229

[a] The reported results are maximum likelihood estimates of the logistic regression coefficients for an equation that estimates the conditional probability of a one for the dependent variable, given the variables shown in the rows of the table. Summary statistics are reported in Table 1.

[b] ROA is after-tax return on assets, defined in Table 1.

[c] ROE is after-tax return on equity, defined in Table 1.

[d] ERET is after-tax gross economic return (cash flow) as a percentage of beginning of period total assets, valued at replacement cost, defined in Table 1.

[e] TSR is total shareholder return, defined in Table 1.

[f] The dependent variable in the compensation equation is based on the average adjusted value of 100 · log(1 + Bonus/Base), called bonus as a percent of base. These are the company·year effects from the "Bonus as a Percent of Base" column of Table 2. If the adjusted average bonus as a percent of base for a particular company exceeds the median adjusted average bonus as a percent of base for all the companies in the sample, then the compensation measure is one for that company; otherwise, zero. The performance measure on the right-hand side of the equation is described in note f. The variable total assets at beginning of year equal one if total assets for the company exceed the median of total assets for the New York Stock Exchange companies listed on COMPUSTAT; otherwise, zero.

[g] The dependent variable is a performance measure based on the next fiscal year's value of the performance variable indicated by the column heading relative to the median of the New York Stock Exchange companies listed on COMPUSTAT for that year. If the performance variable for a particular company exceeds the annual median performance on the NYSE, then the performance measure equals one for that company; otherwise, zero. Current performance and current compensation both above median equals one when the performance measure is above the median for NYSE companies in the current fiscal year and the compensation measure is above the median for the compensation sample companies for the current year; otherwise, zero. Current performance and current compensation both below median is defined similarly when both measures are below the relevant medians.

Sources: (1.) Annual median ROA, ROE, ERET, and TSR, Total Assets at Beginning of Year, and all other financial data are from the 2,423 New York Stock Exchange companies in Standard and Poor's COMPUSTAT for the fiscal years 1980 to 1986 (September 1988 annual industrial tape). (2.) All compensation data are from the annual surveys of a major compensation consulting firm (1981 to 1986 surveys).

Table 5. Summary of the Statistical Analysis of the Continuous Model Using the Annual Percentage Increase in Total Salary as the Compensation Measure and a Variety of Performance Measures. (Standard Errors in Parentheses)[a]

Performance Measure	*ROA*[b]	*ROE*[c]	*ERET*[d]	*TSR*[e]
	Compensation Equation[f]			
Performance Measure	.353 (.061)	.182 (.028)	.306 (.066)	.048 (.010)
Total Assets Beginning of Year	.654 (.267)	.518 (.265)	.601 (.290)	.561 (.267)
Intercept	1.547 (2.061)	2.909 (1.985)	.891 (2.335)	3.898 (1.992)
Standard Error of Eqn.	10.367	10.261	10.513	10.388
R^2	.042	.051	.029	.032
	Performance Equation[g]			
Current Performance Measure	.463 (.036)	.551 (.042)	.685 (.033)	−.203 (.044)
Current Adjusted Log of Total Salary	1.046 (.866)	3.854 (2.008)	1.562 (.648)	−7.109 (5.363)
(Current Performance Above Median, if > 0) · Current Increase[h]	.0066 (.0031)	−.0020 (.0024)	.0043 (.0022)	.0109 (.0034)
(Current Performance below Median, if < 0) · Current Increase[i]	−.0140 (.0043)	.0012 (.0037)	−.0065 (.0042)	.0095 (.0058)
Total Assets Beginning of Year	−.373 (.209)	−.772 (.478)	−.404 (.160)	−2.219 (1.289)
Intercept	−6.406 (8.799)	−34.761 (20.388)	−11.727 (6.509)	87.484 (54.682)
Standard Error of Eqn.	5.354	12.597	3.947	34.694
R^2	.228	.235	.516	.028
Number of Observations	857	853	814	863
Number of Firms	227	228	214	228

[a] The reported results are least squares estimates of the regression coefficients for an equation that estimates the conditional expectation of the dependent variable, given the variables in the rows of the table. Summary statistics are reported in Table 1.

[b] ROA is after-tax return on assets, defined in Table 1.

[c] ROE is after-tax return on equity, defined in Table 1.

[d] ERET is after-tax gross economic return (cash flow) as a percentage of beginning of period total assets, valued at replacement cost, defined in Table 1.

[e] TSR is total shareholder return, defined in Table 1.

[f] The compensation measure is the average adjusted increase in total salary based on the company · year effects implied by the "percent increase in total salary" column of Table 2.

[g] The performance measure is the value of the variable indicated by the column heading for the next fiscal year.

[h] The current performance above median · compensation interaction is (the value of the performance variable minus the annual median of New York Stock Exchange companies for this performance variable, if this is positive; zero, otherwise) times the adjusted average increase in total salary.

[i] The current performance below median · compensation interaction is (the value of the performance variable minus the annual median of New York Stock Exchange companies for this performance variable, if this is negative; zero, otherwise) times the adjusted average increase in total salary.

Sources: (1.) Annual median ROA, ROE, ERET, and TSR, Total Assets at Beginning of Year, and all other financial data are from the 2,423 New York Stock Exchange companies in Standard and Poor's COMPUSTAT for the fiscal years 1980 to 1986 (September 1988 annual industrial tape). (2.) All compensation data are from the annual surveys of a major compensation consulting firm (1981 to 1986 surveys).

Table 6. Summary of the Statistical Analysis of the Continuous Model Using the Bonus as a Percentage of Base Salary as the Compensation Measure and a Variety of Performance Measures. (Standard Errors in Parentheses)[a]

Performance Measure	*ROA*[b]	*ROE*[c]	*ERET*[d]	*TSR*[e]
	Compensation Equation[f]			
Performance Measure	.540 (.051)	.304 (.024)	.577 (.053)	.029 (.008)
Total Assets Beginning of Year	2.303 (.221)	2.138 (.217)	2.433 (.240)	2.179 (.233)
Intercept	−5.354 (1.698)	−3.762 (1.620)	−8.848 (1.937)	−.901 (1.730)
Standard Error of Eqn.	9.660	9.533	9.871	10.238
R^2	.154	.195	.158	.081
	Performance Equation[g]			
Current Performance Measure	.563 (.039)	.518 (.046)	.635 (.035)	−.201 (.040)
Current Adjusted Log of Base Salary	−1.321 (.805)	−1.364 (1.950)	.732 (.638)	−.298 (5.523)
(Current Performance Above Median, if > 0) Current Bonus/Base[h]	.0075 (.0025)	−.0020 (.0025)	.0050 (.0017)	.0005 (.0028)
(Current Performance Below Median, if < 0) Current Bonus/Base[i]	−.0217 (.0030)	.0048 (.0051)	.0031 (.0036)	.0187 (.0047)
Total Assets Beginning of Year	−.095 (.165)	−.181 (.402)	−.301 (.136)	.160 (1.143)
Intercept	17.489 (8.197)	20.934 (19.842)	−2.265 (6.482)	25.907 (56.158)
Standard Error of Eqn.	4.918	11.961	3.834	34.526
R^2	.301	.241	.538	.036
Number of Observations	1,107	1,104	1,052	1,114
Number of Firms	228	229	216	228

[a] The reported results are least squares estimates of the regression coefficients for an equation that estimates the conditional expectation of the dependent variable, given the variables in the rows of the table. Summary statistics are reported in Table 1.

[b] ROA is after-tax return on assets, defined in Table 1.

[c] ROE is after-tax return on equity, defined in Table 1.

[d] ERET is after-tax gross economic return (cash flow) as a percentage of beginning of period total assets, valued at replacement cost, defined in Table 1.

[e] TSR is total shareholder return, defined in Table 1.

[f] The compensation measure is the average adjusted bonus as a percent of base implied by the "Bonus as a Percent of Base" column in Table 2.

[g] The performance measure is the value of the variable indicated by the column heading.

[h] The current performance above median · compensation interaction is (the value of the performance variable minus the annual median of New York Stock Exchange companies for this performance variable, if this is positive; zero, otherwise) times the adjusted average bonus as a percent of base.

[i] The current performance below median · compensation interaction is (the value of the performance variable minus the annual median of New York Stock Exchange companies for this performance variable, if this is negative; zero, otherwise) times the adjusted average bonus as a percent of base.

Sources: (1.) Annual median ROA, ROE, ERET, and TSR, Total Assets at Beginning of Year, and all other financial data are from the 2,423 New York Stock Exchange companies in Standard and Poor's COMPUSTAT for the fiscal years 1980 to 1986 (September 1988 annual industrial tape). (2.) All compensation data are from the annual surveys of a major compensation consulting firm (1981 to 1986 surveys).

average. The performance equation for after-tax return on assets gives mixed evidence for an effect of increased performance-sensitivity on future performance. There is no statistical evidence that increasing performance-sensitivity for after-tax return on equity affects future performance. The evidence that after-tax gross economic return and total shareholder return have an effect, however, is substantial.

I will illustrate the magnitude for the gross economic return. The estimated δ_2 is .0050 ($\pm$.0017) and the estimated δ_3 is .0031 ($\pm$.0036). Only δ_2 is statistically precise. The effect of increasing the bonus-to-base ratio by one standard deviation (10.7% of the base salary) when after-tax gross economic return is one standard deviation above the median (560 basis points) is an expected 30 basis points of economic return. The expected effect is 5% of the standard deviation of economic return. The expected effect from the same change in the bonus-to-base ratio when economic return is three standard deviations above the median (1680 basis points) is 90 basis points, which is 16% of the standard deviation of after-tax gross economic return. The estimated magnitudes of the effects of increasing the performance-sensitivity based upon the economic return measure are slightly smaller than the estimated effects for total shareholder return after standardizing. Given the variability of the estimates, however, the results are basically comparable.

Conclusions

I have specified an internally consistent framework for measuring the degree of performance-sensitivity in a compensation system and assessing the validity of the performance-base. The method shows clearly that measuring the effects of a change in the extent to which compensation is related to performance requires an analysis of the effects of interactions between current performance and current compensation on subsequent performance.

The estimated models produce some weak results and some fairly strong results. It is perhaps surprising that the accounting performance measures did not fare as well as the economic measure or the market measure. Accounting-based performance measures are widely used in businesses as a basis for compensation. There are two reasonable explanations for the weak results I obtained. First, most corporate performance plans explicitly using accounting data are multiyear plans, which have been excluded from my data. Second, since after-tax return on assets, after-tax return on equity, and after-tax gross economic return are all correlated (in all cases > .6), using any one of these measures as the basis for pay could produce the desired results on after-tax gross economic return, which is a better measure of the profitability of the assets than either of the usual accounting ratios.

This study suggests that pay-for-performance systems based on after-tax gross economic return and total shareholder return may be effective, since I find evidence that increasing the sensitivity of compensation to either of these measures may be associated with better performance on that measure in the future. None of the estimated equations approached the degree of precision that would warrant uncritical adoption of the plans under study. The results do lend credence, however, to claims that benefits can be gained by increasing the pay-for-performance component of managerial compensation.

Data Appendix

This appendix describes the sources and methods used to assemble the managerial compensation and corporate performance data used in this study. The appendix discusses the variables derived from the compensation surveys, Standard and Poor's COMPUSTAT database service, the U.S. Department of

Commerce Bureau of Economic Analysis time series, and miscellaneous additional sources. To improve the readability of this appendix I have not used acronyms for the variables. Instead, variable names are set in italics when first defined and capitalized throughout.

Compensation Variables

The managerial compensation data were developed using the cash compensation survey of a major compensation consulting company. The survey collects data for both the corporation and the individual manager. Data for individual managers are identified by company, person, and year. Thus, any particular executive who appears in the survey more than once can be followed over time. The respondent company decides how many executives to include and how often to participate. For this reason, sample mobility of the managers does not reflect career mobility. Exits from the sample do not imply either separations or promotions. Data on individual managers are available for survey years 1981 to 1986, inclusive. Corporate data are identified by company and year, making it possible to follow companies over time.

Variables from the Compensation Survey Individual Data

Annual Base Salary: Salary (exclusive of long- and short-term bonuses) as of March 1 of the survey year.

Bonus: The dollar amount of any short-term incentive granted for the latest bonus period (prior to March 1 of the survey year). The figure includes any incentive awards based on one period's performance regardless of whether the cash was paid in full or deferred (completely or partially). Excluded from the figure are cash bonuses that are dependent on fulfillment of some future or longer-term organizational performance objectives; cash payments paid during the previous year for performance during an earlier period; and sales commissions. (This definition is a paraphrase of the survey instructions.)

Job Level: The position reporting level. The Chief Executive Officer is reporting level 1. Reporting level 2 reports directly to the CEO. For managers in divisions or subsidiaries, the divisional president or general manager cannot have a reporting level higher than 2. This definition is supposed to guarantee that only the corporate-level CEO has reporting level 1.

Years of Education, Birthday, and *Date of Hire* are defined in the conventional manner.

Variables from the Corporate-Level Compensation Data

Company Name: The name of the business participating in the survey. This variable was used to build the link to COMPUSTAT data.

Assets: Corporate total assets as reported by the respondent to the survey (usually a member of the corporate-level human resource management staff). This variable was used to verify that the company was participating in the survey at the corporate level. Respondent companies from subsidiaries, divisions, and separate business units of a corporation could elect to participate as if they were stand-alone companies. In this case, the variable Assets would contain total assets for the relevant business unit, an amount less than corporate total assets. Such companies were excluded from the present study. The Assets variable was also used to verify that the relevant fiscal year closed prior to March 1 of the survey year. Only companies with an exact match between the Assets variable in the compensation file and the Total Assets variable from COMPUSTAT were included in the study. This procedure ensured that the COMPUSTAT fiscal year information dated 1980 was available to make the compensation decisions reported in the 1981 compensation data, and so forth for the succeeding years.

Shareholders' Equity: Corporate common equity as reported by the survey respondent. This variable was used to check the match to COMPUSTAT based on the company name and assets. (Definitions of shareholders' equity are complicated by the treatment of preferred stock, so an exact match was not required.)

COMPUSTAT Variables

The descriptions below are based on COMPUSTAT (Standard and Poor's 1988) documentation of standard financial accounting concepts. The item numbers refer to the variable locations on the annual industrial files.

Net Sales: Sales revenue net of discounts and returns (COMPUSTAT Item 012).

COGS: Cost of goods sold (COMPUSTAT Item 041).

Selling and Administrative Expenses: Selling, overhead, and general administrative expenses (COMPUSTAT Item 012 less Item 041 less Item 013).

Operating Income: Net Sales − COGS − Selling and Administrative Expenses.

Interest Expense: Gross interest expense (COMPUSTAT Item 015).

Income Taxes: Total income taxes (COMPUSTAT Item 016).

Net Income: Income before extraordinary items (COMPUSTAT Item 018) plus gain (or loss) on extraordinary items (COMPUSTAT Item 048).

Minority Interest Income: The part of net income due to unconsolidated minority interests in the company (COMPUSTAT Item 049).

Preferred Stock Dividends: Dividends paid to holders of preferred stock (COMPUSTAT Item 019).

Total Assets: End of fiscal year book value of all assets on the balance sheet. This value must equal the sum of all liabilities and shareholders' equity (COMPUSTAT Item 006).

Inventory: Asset consisting of the value of raw, intermediate, and finished goods inventory (COMPUSTAT Item 003). The method of book valuation is discussed below.

Inventory Valuation Method: Last-in-first-out (LIFO) is distinguished from all other methods; other methods are treated as first-in-first-out (FIFO). The inventory adjustment method is based on COMPUSTAT Item 059.

Current Assets: Cash and short-term investments, accounts receivable, inventory, and other short-term assets (COMPUSTAT Item 004).

Gross Property, Plant, and Equipment: Asset consisting of undepreciated historical cost of property, plant, and equipment (COMPUSTAT 007).

Net Property, Plant, and Equipment: Asset consisting of depreciated historical cost of property, plant, and equipment (COMPUSTAT 008).

Other Long-Term Assets: Total Assets less current assets less net property, plant, and equipment (COMPUSTAT Item 006 less Item 004 less Item 008).

Current Liabilities: Short-term debt, accounts payable, and other short-term liabilities (COMPUSTAT Item 005).

Current Debt: Short-term debt component of current liabilities (COMPUSTAT Item 034).

Common Equity: End of fiscal year book value of common stock equity (COMPUSTAT Item 060).

Gross Investment: Gross spending on new property, plant, and equipment (COMPUSTAT Item 030).

Dispositions: Proceeds from the sale of property, plant, and equipment (COMPUSTAT Item 107).

Cumulative Adjustment Factor: Restates common stock data so that all previous fiscal years are on the same basis as the most recent fiscal year in the file, usually 1987 (COMPUSTAT Item 027).

Bureau of Economic Analysis Variables

The variables described below are based on the National Income and Product Accounts (NIPA, *Survey of Current Business,* monthly). NIPA variables are referenced by their standard table numbers. NIPA variables extracted from CITIBASE (Citicorp Database Services 1978) are referenced by the CITIBASE name as well. The Bureau of Economic Analysis (BEA) in the Department of Commerce maintains estimates of fixed reproducible tangible wealth. Variables from this BEA data base are referenced by their table numbers in *Fixed Reproducible Tangible Wealth in the United States, 1925–85* (called *FRTW* below). (See also Musgrave 1986.)

Equipment Proportion of Industry Fixed Nonresidential Investment: Derived from the ratio of Fixed Nonresidential Private Capital, Equipment Investment, in millions of current dollars, to Fixed Nonresidential Private Capital, Total Investment, in millions of current dollars; *FRTW* Table B1, by two-digit Standard Industrial Classification. This variable was supplied by Shapiro (See Brainard et al. 1988) as extracted from the BEA *Wealth* tape, which contains the *FRTW* data.

Structure Proportion of Industry Fixed Nonresidential Investment: Derived from the ratio of Fixed Nonresidential Private Capital, Structure Investment, in millions of current dollars, to Fixed Nonresidential Private Capital, Total Investment, in millions of current dollars; *FRTW* Table B1, by two-digit Standard Industrial Classification. This variable was also supplied by Shapiro. Equipment and structure proportions of industry fixed nonresidential investment sum to one.

Industry Implicit Price Deflator for Plant Investment: Derived as the ratio of Fixed Nonresidential Private Capital, Plant Investment (millions of current dollars) to Fixed Nonresidential Private Capital, Plant Investment (millions of 1982 dollars); *FRTW* Table B1, by two-digit Standard Industrial Classification. This variable was also supplied by Shapiro.

Industry Implicit Price Deflator for Equipment Investment: Derived as the ratio of Fixed Nonresidential Private Capital, Equipment Investment (millions of current dollars) to Fixed Nonresidential Private Capital, Equipment Investment (millions of 1982 dollars); *FRTW* Table B1, by two-digit Standard Industrial Classification. This variable was also supplied by Shapiro.

Industry Implicit Price Deflator: Derived as the ratio of GNP by Industry, billions of current dollars (NIPA Table 6.1) to GNP by Industry, billions of 1982 dollars (NIPA Table 6.2), by two-digit SIC. This variable was supplied by Shapiro as extracted from the BEA NIPA tape.

Implicit Price Deflator for Fixed Nonresidential Investments in Structure: Derived as the ratio of Fixed Investment by Type, Structures, billions of current dollars (NIPA Table 5.12) to Fixed Investment by Type, Structures, billions of 1982 dollars (NIPA Table 5.13); extracted from CITIBASE as GDIS and converted to annual average.

Miscellaneous Variables

Tax Rate: U.S. Federal marginal corporate tax rate (.46 for 1980 to 1986, .40 for 1987, and .34 thereafter).

Derived Variables Used in the Compensation and Performance Analysis

The estimate of the replacement cost of total assets was developed using the methods of Brainard et al. (1988) and Hall et al. (1988). The flow of the calculation is described here. Programming is available from the author. Abowd and Tracy (1989) contains a detailed discussion of the methodology. The result of the calculation is an estimate of the cost of reproducing a company's current total assets (primarily property, plant, equipment, and inventory) without purchasing the company outright (by purchasing all of its outstanding stocks and bonds).

For each company, a complete history was assembled from annual industrial data, research data, back data, and research back data files supplied by COMPUSTAT. Some company histories begin in 1950, others in 1960, and still others in 1968 (the start date of the September 1988 annual industrial file for most companies). The company histories were used to impute a series of structure, equipment, inventory, and other investments that were converted from historical cost to current replacement cost, depreciated according to economic life, and summed over the economic life of each asset to produce an estimate of the replacement cost of the asset.

Plant investments were assumed to have an economic life of 26 years; equipment investments were assumed to have an economic life of 14 years. The first five years of data for each company were used to estimate the growth rate of the asset Gross

Property, Plant and Equipment (subject to a minimum of zero and a maximum of 10% per annum). This growth rate was used to impute a history of gross structure and equipment investments prior to the initial data year the sum of which was exactly equal to the earliest value of Gross Property, Plant and Equipment. For each subsequent year, gross investment in property, plant, and equipment was set equal to Gross Investment less Dispositions. Current and (imputed) historical cost gross investments were then adjusted (by imputing a writeoff or addition, as appropriate) so that the historical cost investment series always summed to the current Gross Property, Plant and Equipment asset.

The vintage history of gross investments was divided into structure and equipment using the Structure as a Proportion of Industry Investment and Equipment as a Proportion of Industry Investment series for the appropriate years. The historical cost plant investments were then converted to current replacement cost by multiplying by the ratio of the current value of the Industry Implicit Price Deflator for Structure Investments to the appropriate historical value of the same series. Historical cost equipment investments were similarly converted to current replacement cost using the Industry Implicit Price Deflator for Equipment Investment. Current replacement cost investments were depreciated using straight line depreciation over the economic lives assumed for plant and equipment, respectively. The sum of the current replacement cost structure investments for the current and 25 preceding years plus the sum of current replacement cost equipment investments for the current and 13 preceding years is *Gross Property, Plant, and Equipment, Replacement Cost.*

Net Property, Plant, and Equipment, Replacement Cost was calculated according to the same formula as Gross Property, Plant, and Equipment, Replacement Cost using the depreciated replacement cost estimates for structure and equipment investments.

Inventory was only adjusted to the extent that LIFO accounting was used. Up to three different inventory valuation methods were allowed. The proportion of Inventory valued using LIFO was estimated from the COMPUSTAT Inventory Method variable. For Non-LIFO Inventory the replacement cost and historical cost are equal. LIFO Inventory was converted to replacement cost by multiplying the LIFO proportion of last year's Inventory, valued at replacement cost, by the ratio of the current value of the Industry Implicit Price Deflator to last year's Industry Implicit Price Deflator and adding the change in historical cost LIFO Inventory between the current and previous fiscal years. The sum of LIFO and non-LIFO Inventory, valued at replacement cost, is the series *Inventory, Replacement Cost.* The value of replacement cost and historical cost Inventory are equal for the first year a company appears in the COMPUSTAT data regardless of Inventory Method.

Other Assets were converted to replacement cost by multiplying last year's Other Assets, valued at replacement cost, by the ratio of the current value of the Implicit Price Deflator for Fixed Nonresidential Investments in Structure to last year's Implicit Price Deflator for Fixed Nonresidential Investments in Structure and adding the change in historical cost Other Assets between the current and previous fiscal years. The resulting series is *Other Assets, Replacement Cost.* The value of replacement cost and historical cost Other Assets are equal for the first year a company appears in the COMPUSTAT data.

Replacement Cost of Total Assets: Net Property, Plant, and Equipment, Replacement Cost + Inventory, Replacement Cost + Other Assets, Replacement Cost + (Current Assets − Inventory) − (Current Liabilities − Current Debt).

After-Tax Return on Assets: Ratio defined as 100 · (Net Income + Interest Expense (1 − Tax Rate))/((Total Assets + Total Assets previous fiscal year end)/2).

After-Tax Return on Equity: Ratio defined as 100 · (Net Income − Minority Interest Income − Preferred Dividends Paid)/((Common Equity + Common Equity previous fiscal year end)/2).

After-Tax Gross Economic Return: Ratio defined as 100 · (Operating Income − Income Taxes)/Replacement Cost of Total Assets previous fiscal year end.

Total Shareholder Return: Ratio defined as 100 · ((Dividends per Common Share/Cumulative Adjustment Factor) + (Common Stock Price/ Cumulative Adjustment Factor) − (Common Stock Price previous calendar year end/Cumulative Adjustment Factor previous calendar year end))/((Common Stock Price previous calendar year end/Cumulative Adjustment Factor previous calendar year end)).

A thorough discussion of accounting measures of profitability can be found in Bernstein (1983, Chapter 19). Some of the pitfalls are discussed in Foster (1986, Chapter 3). The definitions of after-tax return on assets and after-tax return on equity are from Bernstein and appear to conform to current accounting practice.

REFERENCES

Abowd, John M., George T. Milkovich, and John M. Hannon. 1990. "The Effects of Human Resource Management Decisions on Shareholder Value." *Industrial and Labor Relations Review,* this issue.

Abowd, John M., and Joseph S. Tracy. 1989. "Unions and Market Power." Unpublished working paper, Cornell University.

Antle, Rick, and Abbie Smith. 1986. "An Empirical Investigation of the Relative Performance Evaluation of Corporate Executives." *Journal of Accounting Research,* Vol. 24, No. 1 (Spring), pp. 1–39.

Baker, George P., Michael C. Jensen, and Kevin J. Murphy. 1988. "Compensation and Incentives: Practice vs. Theory." *Journal of Finance,* Vol. 43, No. 3 (July), pp. 593–616.

Becker, Gary S., and George J. Stigler. 1974. "Law

Enforcement, Malfeasance, and Compensation of Enforcers." *Journal of Legal Studies,* Vol. 3 (January), pp. 1–18.

Bernstein, Leopold A. 1983. *Financial Statement Analysis: Theory, Application, and Interpretation.* Homewood, Ill.: Richard D. Irwin.

Bhagat, Sanjai, James Brickley, and Ronald C. Lease. 1985. "Incentive Effects of Stock Purchase Plans." *Journal of Financial Economics,* Vol. 14, No. 2 (June), pp. 195–215.

Brainard, William C., Matthew D. Shapiro, and John B. Shoven. 1988. "Fundamental Value and Market Value." Yale University working paper, May.

Brickley, James, Sanjai Bhagat, and Ronald C. Lease. 1985. "The Impact of Long-Range Managerial Compensation Plans on Shareholder Wealth." *Journal of Accounting and Economics,* Vol. 7, No. 1–3 (April), pp. 115–29.

Citicorp Database Services. 1987. *CITIBASE: Citibank Economic Database (Machine-Readable Magnetic Data File, 1946–Present).* New York: Citibank.

Coughlan, Anne T., and Ronald M. Schmidt. 1985. "Executive Compensation, Management Turnover, and Firm Performance: An Empirical Analysis." *Journal of Accounting and Economics,* Vol. 7, No. 1–3 (April), pp. 43–66.

Ehrenberg, Ronald G., and George T. Milkovich. 1987. "Compensation and Firm Performance." In Morris Kleiner et al., eds., *Human Resources and the Performance of the Firm.* Madison, Wis.: Industrial Relations Research Association, pp. 87–122.

Fama, Eugene F., and Michael C. Jensen. 1983a. "Separation of Ownership and Control." *Journal of Law and Economics,* Vol. 26 (June), pp. 301–25.

Fama, Eugene F., and Michael C. Jensen. 1983b. "Agency Problems and Residual Claims." *Journal of Law and Economics,* Vol. 26 (June), pp. 327–49.

Foster, George. 1986. *Financial Statement Analysis,* 2d Edition. Englewood Cliffs, N.J.: Prentice-Hall.

Gibbons, Robert, and Kevin J. Murphy. 1990. "Relative Performance Evaluation for Chief Executive Officers." *Industrial and Labor Relations Review,* this issue.

Gomez-Mejia, Luis R., Henry Tosi, and Timothy Hinkin. 1987. "Managerial Control, Performance, and Executive Compensation." *Academy of Management Journal,* Vol. 30, No. 1, pp. 51–70.

Grossman, Sanford J., and Oliver D. Hart. 1983. "An Analysis of the Principal-Agent Problem." *Econometrica,* Vol. 51, No. 1 (January), pp. 7–46.

Hall, Bronwyn H., Clint Cummins, Elizabeth S. Laderman, and Joy Mundy. 1988. "The R&D Master File Documentation." NBER Technical Working Paper No. 72, December.

Hart, Oliver, and Bengt Holström. 1987. "The Theory of Contracts." In Truman F. Bewley, ed., *Advances in Economic Theory, Fifth World Congress.* Cambridge, England: Cambridge University Press.

Healy, Paul M. 1985. "The Effect of Bonus Schemes on Accounting Decisions." *Journal of Accounting and Economics,* Vol. 7, No. 1–3 (April), pp. 85–107.

Holmström, Bengt, "Moral Hazard and Observability." *Bell Journal of Economics,* Vol. 10, No. 1 (Spring), pp. 74–91.

Jensen, Michael C., and William H. Meckling. 1976. "Theory of the Firm: Managerial Behavior, Agency Costs, and Ownership Structure." *Journal of Financial Economics,* Vol. 3 (October), pp. 305–60.

Jensen, Michael C., and Kevin J. Murphy. 1987. "Are Executive Compensation Contracts Structured Properly?" University of Rochester unpublished working paper.

Jensen, Michael C., and Kevin J. Murphy. 1988. "Performance Pay and Top Management Incentives." University of Rochester unpublished working paper.

Lambert, Richard A., and David F. Larker. 1985. "Golden Parachutes, Executive Decision-Making, and Shareholder Wealth." *Journal of Accounting and Economics,* Vol. 7, No. 1–3 (April), pp. 179–203.

Lambert, Richard A., and David F. Larker. 1987. "An Analysis of the Use of Accounting and Market Measures of Performance in Executive Compensation Contracts." *Journal of Accounting Research,* Vol. 25 (Supplement), pp. 85–125.

Larker, David F. 1983. "The Association Between Performance Plan Adoption and Corporate Capital Investment." *Journal of Accounting and Economics,* Vol. 5 (April), pp. 3–30.

Larker, David F. 1986. "Choosing a Performance Measure: An Analysis of the Alternatives." *Topics in Total Compensation,* Vol. 1, No. 1 (Fall), pp. 57–71.

Lazear, Edward P. 1979. "Why Is There Mandatory Retirement?" *Journal of Political Economy,* Vol. 87, No. 6 (December), pp. 1261–84.

Lazear, Edward P. 1986. "Salaries and Piece Rates." *Journal of Business,* Vol. 59, No. 3 (July), pp. 405–31.

Leonard, Jonathan S. 1990. "Executive Pay and Corporate Performance." *Industrial and Labor Relations Review,* this issue.

Lewellen, Wilbur G. 1968. *Executive Compensation in Large Industrial Corporations.* New York: National Bureau of Economic Research.

Lewellen, Wilbur G., and Blaine Huntsman. 1970. "Managerial Pay and Corporate Performance." *American Economic Review,* Vol. 60, No. 4 (September), pp. 710–20.

Lewellen, Wilbur G., Claudio Loderer, and Kenneth Martin. 1987. "Executive Compensation and Executive Incentive Problems: An Empirical Analysis." *Journal of Accounting and Economics,* Vol. 9, No. 3 (December), pp. 287–310.

Masson, Robert T. 1971. "Executive Motivations, Earnings, and Consequent Equity Performance." *Journal of Political Economy,* Vol. 79, No. 6 (November), pp. 1278–92.

Miller, Merton H., and Myron S. Scholes. 1982. "Executive Compensation, Taxes and Incentives." In William F. Sharpe and Cathryn M. Cootner, eds., *Financial Economics: Essays in Honor of Paul Cootner.* Englewood Cliffs, N.J.: Prentice-Hall, pp. 179–201.

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

Murphy, Kevin J. 1985. "Top Executives Are Worth Every Nickel They Get." *Harvard Business Review,* Vol. 64 (March–April), pp. 125–32.

Musgrave, John C. 1986. "Fixed Reproducible Tangible Wealth in the United States, 1982–85." *Survey of Current Business,* Vol. 66, No. 8 (August), pp. 36–39.

Rabin, Bonnie R. 1986. "Executive Compensation and Firm Performance: The Case of Employment Agreements." M.S. thesis, School of Industrial and Labor Relations, Cornell University.

Rabin, Bonnie R. 1987. "Executive Compensation and Firm Performance: An Empirical Analysis." Ph.D. thesis, School of Industrial and Labor Relations, Cornell University.

Ross, Stephen A. 1973. "The Economic Theory of Agency: The Principal's Problem." *American Economic Review* (Papers and Proceedings), Vol. 63, No. 2 (May), pp. 135–39.

Standard and Poor. 1988. *COMPUSTAT.* New York: Standard and Poor Corporation.

Tehranian, Hassan, and James F. Waegelein. 1985. "Market Reaction to Short Term Executive Compensation Plan Adoption." *Journal of Accounting and Economics,* Vol. 7, No. 1–3 (April), pp. 131–44.

U.S. Department of Commerce. Bureau of Economic Analysis. *Survey of Current Business,* monthly.

U.S. Department of Commerce. Bureau of Economic Analysis. 1987. *Fixed Reproducible Tangible Wealth in the United States, 1925–85.* Washington, D.C.: GPO.