ARE CEOS REALLY PAID LIKE BUREAUCRATS?

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ABSTRACT

A common view of CEO compensation is that there is essentially no correlation between firm performance and CEO pay. This calls into question an important component of effective corporate governance. This "zero correlation" belief is based on the widely cited result that CEO wealth rises by only $3.25 for every $1,000 increase in firm value (Jensen and Murphy, 1990b) and findings that the elasticity of CEO salary and bonus with respect to firm market value is only 0.1.

We use a new 15-year panel data set of CEOs in the largest U.S. firms and focus on a broad measure of "compensation" that includes changes in the value of CEO holdings of stock and stock options. We find very large pay to performance sensitivity. For example, for a moderate change in firm performance (moving from a median stock price performance to a 70th percentile performance), the compensation of the median CEO in our sample increases by more than 50 percent, which represents an increase in CEO wealth of $1.8 million. We estimate a median elasticity of CEO compensation with respect to firm value of 3.9 for 1994. This value is about 30 times larger than previous elasticity estimates that ignore the effects of changes in the value of stock and stock option holdings.

We also document that both the level of CEO compensation and the sensitivity of CEO compensation to firm performance have grown dramatically over the past 15 years. In our sample, the direct compensation (salary and bonus plus stock option grants) of the mean (median) CEO increased by 209 percent (136 percent) from 1980 to 1994. Because of the large increase in stock option awards and in the value of stock holdings in the past 15 years, measures of CEO pay-to-performance sensitivity increased during the period by factors of 2 to nearly 7.

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1. Introduction

A common view of CEO compensation is that CEOs are paid like bureaucrats. There is said to be a weak link between the performance of large public companies and the compensation of their CEOs. For example, Jensen and Murphy (1990a) argue that in "most publicly held companies, the compensation of top executives is virtually independent of performance. . . .on average, corporate America pays its most important leaders like bureaucrats." Jensen and Murphy's (1990b) argument is based on their widely cited finding that, on average, CEOs receive only $3.25 for every $1,000 increase in shareholder wealth. Rosen (1992) surveys the large empirical literature on CEO compensation and concludes that "evidence from several independent studies and samples leaves us fairly secure that the effect of stock returns on log compensation is in the 0.10-0.15 range." An elasticity of 0.10 implies that a CEO whose work produced annual rates of return of 20 percent would be paid only 1 percent more than a CEO whose work produced annual rates of return of 10 percent.[1]

The design of performance incentives for managers in large companies is an enormously important issue. Linking pay with performance is the most direct way to mitigate the agency problem, which arises because of conflicts of interest between the managers and the owners of corporations. If there is no meaningful connection between CEO pay and company performance, it is doubtful that the trillions of dollars of assets in public corporations are being

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[1] The view that there is little correlation between firm performance and CEO pay is often echoed in the popular press. Recent examples include articles by Roger Lowenstein (Wall Street Journal, April 4, 1996) who writes that in company proxy statements, "glorious tributes are rendered to 'pay for performance,' but 'pay regardless of performance' is closer to fact, " and Judith Dobrzynski (New York Times, February 22, 1996) who states that the connection between CEO "pay and performance remains weak throughout corporate America, despite vociferous complaints from shareholders and pointed attacks from politicians and social critics...."

managed efficiently. As Jensen and Murphy argue, if CEOs are paid like bureaucrats, "is it any wonder then that so many CEOs act like bureaucrats rather than the value-maximizing entrepreneurs companies need to enhance their standing in world markets?"[2]

In this paper we argue that CEOs are not paid like bureaucrats. We use a new 15-year panel data set of large publicly traded U.S. firms that contains detailed information on CEO holdings of stock and stock options. This data enables us to produce precise measures of pay-to-performance responsiveness and to document the large increase in CEO holdings of stock and stock options between 1980 and 1994. We focus on a broad measure of compensation, which includes changes in the value of stock and stock options, to measure the sensitivity of pay to performance.[3] We report a variety of measures of pay-to-performance sensitivity and find a very strong link between the fortunes of CEOs and the fortunes of the companies they manage. We find that virtually all of the pay-to-performance sensitivity is driven by changes in the value of CEO stock and stock option holdings.

Our main empirical finding is that CEO wealth changes by millions of dollars for typical changes in firm value. For example, the median total compensation for CEOs is about $1 million if their firm's stock has a 30th percentile annual return (-7.0 percent) and is $5 million if the firm's stock has a 70th percentile annual return (20.5 percent). Thus, there is a difference of about $4 million dollars in compensation for achieving a moderately above average performance relative to a moderately below average performance. The difference in

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[2] Jensen and Murphy (1990a, p. 138)

[3] Jensen and Murphy (1990b) also use a broad measure of CEO compensation. We discuss why our conclusions differ from theirs shortly.

compensation between a 10th percentile firm performance and a 90th percentile performance is more than $9 million.[4]

In addition, we show that both the level of CEO compensation and the sensitivity of CEO compensation to firm performance have risen dramatically over the past 15 years. Between 1980 and 1994, the direct compensation (salary, bonus, and the value of annual stock option grants) of CEOs increased by 136 percent at the median and 209 percent at the mean in real terms. Moreover, because most of this increase in pay was in the form of stock options and because of the strong performance of the US stock market increased CEO holdings of stock, the pay-to-performance sensitivity of CEOs has increased substantially. As one example, the median elasticity of CEO compensation with respect to firm market value more than tripled from 1.2 to 3.9 between 1980 and 1994. This total compensation elasticity for 1994 is about 30 times larger than previously reported elasticities that focus narrowly on direct pay (salary and bonus) and ignore holdings of stock and stock options. That is, pay-to-performance sensitivities from changes in salary and bonus are swamped by sensitivity generated by changes in the value of stock and stock options.

It is worth stating from the outset why our results differ from previous findings. With regard to the large literature that indicates that salary and bonus elasticities are small, our findings differ simply because previous sensitivity measures ignored changes in the value of stock and stock options, which account for virtually all of the sensitivity. Indeed, we corroborate the finding that salary and bonus is quite insensitive to changes in firm

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[4] Sensitivity estimates using mean changes in compensation are many times larger. But, as we will argue later, these are misleading since they are driven by large outliers. Thus, we focus on medians throughout this paper.

performance.[5]

Our conclusion differs from that of Jensen and Murphy's for two reasons. First, Jensen and Murphy's total wealth sensitivities rely on data from a period (1969-83) that predates the explosion in stock option issuance during the 1980s and 1990s. Indeed, the resulting increase in sensitivity during the last 15 years seems to be exactly in line with the prescription called for by Jensen and Murphy.

Second, Jensen and Murphy focus on only one measure of sensitivity -- the total change in CEO wealth relative to changes in firm value. Although this is an important measure of sensitivity, when taken in isolation it can be misleading because the denominator -- changes in firm value -- is so large. A several million dollar change in CEO wealth appears very small when divided by the very large annual changes in the market value of Fortune 500 companies. Even the small sensitivity estimate of Jensen and Murphy of $3.25 for every $1,000 change in firm value[6] can represent a large change in CEO wealth: if a $5 billion dollar company increases in value by 10 percent, then CEO wealth increases by $1.6 million. Thus, for billion dollar companies, the Jensen and Murphy sensitivity estimate may seem small only because it is implicitly measured against a one-to-one benchmark. As a result, we report a variety of sensitivity measures that show dollar and percent changes in CEO wealth for various changes

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[5] However, even with regard to salary and bonus elasticities, we find that sensitivity has roughly doubled over the past 15 years.

[6] For changes in the value of stock and stock options, Jensen and Murphy (1990b) use a smaller (73 firm) sample from 1969-83, which contains many fewer details about stock options than our data set. Nevertheless, our 1980 estimate of the total change in CEO wealth for a $1,000 change in value is $3.11 (after we adjust our number in a few minor ways to make it comparable to theirs), which is very close to their estimate of $3.25.

in firm performance.

It is important to note that we do not argue that current CEO contracts are efficient. Nor do we argue that current pay-to-performance sensitivity is sufficiently high. Such statements would require us to make strong assumptions about many parameter values that are not easily measured. Indeed, our findings suggest that there are some potentially serious flaws in current CEO contracts, which we discuss in section 8. We do, however, believe that our results contradict the claim that CEO pay-to-performance is essentially non-existent. By extension, our findings also contradict the claim that current contracts are necessarily inefficient simply because pay-to-performance sensitivities are too low.

2. Motivating CEOs

It is now well understood that one of the key challenges of effective corporate governance is solving the agency problem (Jensen and Meckling, 1976). CEOs have goals that are not always aligned with those of the shareholders. CEOs may purchase expensive and unnecessary corporate jets, undertake large acquisitions that expand their "empire", and take actions to entrench themselves in their current position. This pursuit of private benefits by the CEO is often at odds with the value maximizing objectives of shareholders. Moreover, shareholders in large publicly traded corporations have limited ability to observe the actions of top executives or to judge whether the actions of CEOs are appropriate. How then can shareholders induce CEOs to maximize firm value?

The most direct way to mitigate the agency problem is to align the incentives of the CEO with those of the shareholders. The issuance of stock and stock option plans has the

potential to create the type of high powered incentive systems that move toward such an alignment. Indeed, an extreme version of high powered incentives would imply paying the CEO 100 percent of the marginal returns of the firm. In effect, this approach sells the firm to the CEO.

High-powered incentives have obvious benefits. However, in the very large corporations we are studying, there are limits to the "high poweredness" of the incentives. The first limit is the obvious point that the typical CEO does not have enough money to buy a substantial fraction of the very large public companies. It is instructive to do some back-of-the-envelope calculations to determine how much "financing constraints" limit the amount of stock that a CEO could purchase. Given personal bankruptcy laws, it is unlikely that a rational lender would loan a CEO substantially more than the CEO's wealth to make such a purchase. How much wealth does the typical pool of potential CEOs have? While we have not been able to obtain data on total CEO wealth, we can make a rough guess of typical CEO wealth using our data. The median CEO in our data has about $7.5 million in wealth (the sum of the value of stock and stock options) invested in the firm. If we assume that median CEO wealth is triple this figure, it would amount to almost $23 million. Alternatively, if we assume that CEO wealth is equal to ten times annual compensation, we obtain a median estimate of about $15 million. Taken together, $20 million might be a reasonable estimate of median CEO wealth for the companies in our sample. Given that the median market value of these companies is about $2.34 billion, a CEO with $20 million dollars in assets could purchase a about 0.85 percent of the firm. Thus, for the largest public corporations, a reasonable upper-bound for the amount of stock that typical CEOs could purchase is one percent, which is two orders of magnitude lower

than the one-to-one relationship that is sometimes used as a benchmark.[7]

A second potential problem with high-powered incentives is CEO risk aversion. If a risk-averse CEO were forced to accept a very high-powered incentive contract, the utility of the CEO would fall. Equilibrium in the CEO labor market would then require that a CEO would have to be paid at a higher average level. So, high powered incentives are more costly to firms than lower powered incentives, which, of course, is not to say that the benefits these incentives do not outweigh their costs.

A second issue related to risk-aversion is the possibility that high-powered contracts may induce risk-averse CEOs to avoid high-risk, high-return projects that are optimal from the perspective of well-diversified shareholders.[8] Thus, while high-powered pay contracts are likely to improve incentives on many margins, they may harm incentives on the risk margin.[9]

It is difficult to know how serious this issue is. Our interviews with CEO pay consultants indicated that CEOs are concerned with risk. Many CEOs expressed concern that their company stock and stock option holdings left their personal portfolios undiversified. One CEO of a large financial company complained, "Why should I be so undiversified? We would never advise one of our clients to have such concentrated holdings."

To further explore this issue, we conducted some simulations using a power utility

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[7] This financing constraint implies an upper bound on the Jensen and Murphy statistic of a $10 increase in CEO wealth per $1000 increase in firm value.

[8] If CEOs extract rents from their job, then they are likely to act in ways that reduce their chance of being fired. This will discourage them from undertaking high-risk, high-return projects.

[9] See Fama and Jensen (1985), who discuss this issue in the context of different organizational forms (e.g. proprietorships, open corporations).

function and various estimates of risk aversion. The analysis and results are presented in Appendix A. The key conclusion from this analysis is that under reasonable assumptions of risk aversion, putting nearly all of the CEOs wealth in company stock substantially reduces the CEOs utility. For example, if a CEOs coefficient of relative risk aversion is assumed to be 3, forcing the CEO to put all $20 million of his or her wealth into company stock results in a "certainty equivalent" of only $2.8 million. Thus, while only suggestive, both simulations and evidence from our interviews indicate that risk-aversion may be a serious issue for CEOs with large holdings of company stock and stock options. [10]

Financing constraints and risk-aversion limit significantly the amount of pay-to-performance that is feasible, at least relative to the Jensen and Murphy one-to-one benchmark. This raises the issue of how much sensitivity is needed for CEOs to make correct decisions. The answer to this question depends importantly on which kinds of CEO activities are being studied.

One CEO activity concerns the CEO's supply of effort. Consider a model in which CEOs supply a single continuous quantity of effort. Then, anything less than one-to-one correspondence between CEO pay and firm value leads to an insufficient supply of effort. Assuming that the marginal disutility of effort is increasing in effort and that the marginal product of the CEO's effort is falling as effort increases, then efficiency is achieved if the CEO supplies effort so as to equalize the marginal product and marginal disutility of the CEO's effort. However, if the CEO receives only a small fraction of the marginal product, then the

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[10] Indeed, Haubrich (1994) has argued that because of risk-aversion, the calibration of standard agency models indicate that low sensitivity CEO contracts may be efficient.

CEO will supply substantially less effort than is optimal (of course the shape of the marginal product and marginal utility curves determine how much less effort the CEO supplies than is optimal). For this scenario, Jensen and Murphy's benchmark of receiving the full marginal product is appropriate. However, given that CEOs are a self-selected group of high-effort, overachieving individuals, it may be that lack of effort is not a first-order agency issue in this population.

A second CEO activity involves (legal) stealing -- CEO consumption of items that confer high private benefits to the CEO (e.g. the purchase of corporate jets, nice offices etc). Unless the CEO essentially owns the firm, the CEO will over-consume perquisites paid for by the company and will have a bias toward activities that confer high private benefits. However, it should be noted that this argument applies to every worker in the firm. To completely eliminate the agency problem, a firm must design compensation packages so that the compensation of every worker with decision-making power varies dollar-for-dollar with changes in firm value.

However, many important decisions a CEO makes involve choosing among a limited number of large, discrete projects, some of which have higher expected returns than others. As long as the CEO receives higher utility by choosing higher return projects, then the CEO will make the efficient choice. In this case, it is not necessary to pay the CEO the full difference in firm value in order to induce the CEO to make the correct decision. The CEO only needs to be compensated for any differential in private benefits between the two projects (plus any additional effort and risk related to the high return project) in order to have the correct incentives. For example, suppose that project A has expected returns that are $200 million

more than the expected returns of project B but that project B yields private benefits that the CEO values to be $1 million, then the CEO needs to be paid only $1 million more (plus a dollar) for choosing project A. One-to-one correspondence is not necessary. Changes of thousands of dollars in compensation may be sufficient to induce CEOs to choose correctly among projects that have expected returns that differ by millions of dollars.

Thus, given that financing constraints and risk-aversion make it impossible to sell the firm to the CEO, it will be optimal to use a combination of monitoring and incentive based contracts. Incentive contracts can be made high-powered enough to induce CEOs to make correct choices when making big strategic decisions. Then, (imperfect and costly) monitoring can be used to minimize the agency problems that have smaller costs to the firm.[11]

3.   Data Description and Means

Our data set covers the years from 1980 to 1994 and combines CEO compensation information from corporate proxies and 10-K filings with stock price and stock return information from CRSP and accounting data from Compustat. In addition, some compensation data from the 1970s were collected in order to construct measures of the value of stock options held by CEOs in the first years of the sample. The data for the 1984 to 1991 period were provided to us by David Yermack and this data is described in Yermack (1995). We then randomly selected half of Yermack's 792 companies and extended his sample up to 1994 and

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[11] In addition, CEOs are likely to be motivated by factors other than the ability to consume wealth and their desire to keep their jobs. Good performance may earn them the respect of their peers. Increases in wealth that produce little marginal utility through direct consumption can increase their rankings on lists of the wealthiest citizens and bestow upon them status and attention. Many of these factors reinforce the impact of incentive-based compensation on CEO performance.

back to 1980. Our data set consists of information on 478 companies for the period 1980 to 1994.[12]

The Yermack firms are essentially the largest publicly traded companies in the U.S. Each year, *Forbes* creates four lists of the largest U.S. companies, ranked on the basis of sales, profits, assets, and market value. In order to be in the sample, a firm must be included in one of the four *Forbes* 500 lists at least four times between 1984 and 1991. In order to have a sample of firms that is representative of large firms at the end as well as the middle of our sample, we added 50 percent of the firms (40 firms) that have met the large firm requirement since 1991. If a firm qualifies, the firm is in the sample in all years during which it was publicly traded, even if the firm did not make any of the lists for that year. In some cases, when the data from the proxy statements and 10-K forms were vague or incomplete, data was collected from firms' Annual Reports, *Forbes* magazine's annual CEO surveys, press reports, and direct correspondence with the companies.

Most of the CEO literature uses the compensation data provided by the *Forbes* survey. The main problem with the *Forbes* data is that it has limited information on stock and stock option awards. The information reported on stock options includes only the value of stock options exercised during the year, which reflects past, not current, compensation. The proxy data by contrast includes detailed information on the amount of stock options granted during the year, including details about the exercise prices and the duration. Although there are a few exceptions, we find that the vast majority of options are issued at the money with a 10 year

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[12] Not all firms are present in every year and some firms split into more than one firm, in which case we treat the new firms as two additional firms in the data set.

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duration. The options then become vested over time. For example, a typical options grant becomes vested 25 percent per year over four years.

We use the details about option grants and the Black-Scholes formula for pricing options in order to value stock option grants. The distinguishing feature of our data set is that with our panel of yearly proxy data on options grants, option gains, and total options held, we are able to calculate the value of all stock options held by the CEO at a given point of time and the change in that value for a given change in firm value. The methodology for making these calculations is described in Appendix B.

Some summary statistics for our data for fiscal year 1994 are presented in Table I. The median CEO in our sample is 58 years old, has held the job of CEO for 6 years, and has been employed by the company for 22 years. Nine percent of the CEOs in our sample founded their companies. The mean (median) CEO owned 2.1 percent (0.14 percent) of the firm's stock. The mean (median) CEO received $1.3 million ($1.1 million) in salary and bonus, stock options worth $1.2 million ($325,000), restricted stock worth $201,000 ($0), and other compensation totaling $319,000 ($69,000).

4. Trends in CEO Compensation

In this section, we document how CEO compensation has increased over time and relative to the compensation of other workers. Tables IIa and IIb report the means and medians of CEO compensation from 1980 to 1994 in real 1994 dollars. Column 1 of the tables shows that mean salary and bonus has risen by 97 percent over the past 15 years, from $655 thousand to $1.3 million, and median salary and bonus has risen by 85 percent. The rise in the value of

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stock option grants has been even more dramatic. Between 1980 and 1994 the mean value of

stock options grants rose by 683 percent from $155 thousand to $1.2 million. The median

value of stock option grants rose from $0 to $325 thousand. The sum of all direct

compensation rose by 209 percent at the mean and 136 percent at the median.[13]

The fourth column of each table shows the broader measure of CEO compensation —

the total increase in wealth, which includes all direct compensation plus changes in the value of

stock and stock option holdings. Total wealth changes are quite volatile, reflecting the large

variation in year-to-year changes in the stock market. Nevertheless, the same basic pattern

emerges. Total wealth changes in the early 1980s are generally much smaller than total wealth

changes in the late 1980s and 1990s.

The remarkable growth in stock option awards can be seen in Figure I. The percentage

of CEOs receiving stock option awards during the year increased from only 30 percent in 1980

to nearly 70 percent in 1994. Likewise, the percentage of CEOs holding any stock options

(including past grants) increased from 57 percent to about 87 percent over the period. The

increase in stock option awards explains much of the increase in CEO pay over the past 15

years and will be shown later to be one of two reasons for the large increase in pay-to-

performance sensitivities that we find.

Table III documents the real growth of CEO compensation over time relative to the

growth of pay of other workers. Between 1982 and 1994, mean CEO pay increased by 175

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[13] Note that the direct compensation measure used in this table excludes other components of compensation such as restricted stock grants and other compensation for which it is impossible to construct consistent time series. As Table I shows, these other components are small relative to the included ones.

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percent or about 8.8 percent per year. The median growth rates are 120 percent and 6.8 percent respectively. The third row shows the growth rate of total compensation for all wage and salary workers, based on the Employment Cost Index. As is well known, average compensation for all workers was almost flat during this period, rising by 0.6 percent a year from $30,400 to $32,600. Our proxy for bureaucrats is state and local government workers, excluding teachers. Their total compensation has grown slowly as well, at a rate of 0.9 percent a year. Professors have also seen little growth in their real compensation during this period.

The sixth row of Table IV contains a measure of the increase in incomes of the very rich.[14] The incomes of individuals at the top one-half of one percent of the income distribution increased by about 55 percent during the period, far more than the growth rate of average workers but only one-third as high as the mean CEO compensation growth rate. The next two columns include compensation data on two groups of superstars, Major League Baseball (MLB) players and National Basketball Association (NBA) players, which have had remarkable compensation growth of 207 percent and 379 percent respectively. However, these very high growth rates in sports leagues are distorted by complicated changes in rules governing free agency and salary caps.

In the last two rows, we show how the total wealth increase of CEOs (including increases in the value of stock and stock option holdings) has increased during this period. Because the endpoint values of this time series are driven by the overall market return during the particular years, we have normalized the endpoint values by assuming that all firms (in both

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[14] Specifically, this is the income level that excludes the top 0.5 percent of adjusted gross income earners, as reported on tax returns. See Feenberg and Poterba (1993) who report this "high income threshold" up to 1990. We thank Dan Feenberg for updating these numbers for us.

years) had an increase in firm value of 5.9 percent (the median of the annual rates of return of all S&P500 firms between 1970 and 1995). Using this normalization, the broad measure of CEO compensation increased by 270 percent at the mean and 140 percent at the median.

In sum, our data confirm the general impression that CEOs have enjoyed large gains in compensation, both in absolute terms and relative to other highly paid groups, with the exception of professional athletes. It is interesting to note that Jensen and Murphy (1990b) reported that the level of CEO pay actually *decreased* in real terms between the 1934-38 and the 1974-86 periods. For example, if we put their numbers into 1994 dollars, the median salary and bonus of CEOs in the largest fourth of New York Stock Exchange firms was $863 per year in the 1930s and dropped to $819 in the 1970/80s. Our numbers indicate that median salary and bonus is now more than $1 million and is nearly $1.5 million when stock and stock option grants are included. This suggests that the decline in the level of CEO pay reported by Jensen and Murphy has been more than reversed during the last 10 years.[15]

5.   Measures of the Sensitivity of CEO Pay to Firm Performance

In this section, we use a variety of measures to show how sensitive CEO pay is to firm performance. Our emphasis is on how the stock and stock option holdings of CEOs affect the sensitivity of CEO pay since, as we will show, changes in the value of stock and stock option

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[15] We are aware of only one other period in history during which increases in stock options grants brought about a large increase in CEO wealth. Lewellen (1968) shows that between 1945 and 1955 CEO wealth increased by 133 percent, largely due to the introduction of stock option plans. (Lewellen's wealth measure smooths *ex post* gains from stock option holdings). During these ten years, average earnings of production workers rose by only 7 percent. However, Lewellen shows that over the longer 1940 to 1963 period, CEO compensation actually fell by 25 percent while real earnings of production workers increased by 62 percent.

holdings are much larger than changes in other components of compensation. In fact, in order

to highlight the important role of stock and stock options in affecting sensitivity, for many of

our calculations we hold all other components constant. We begin by showing the small

sensitivity of salary and bonus and of stock option grants. Although our sensitivity estimates

are slightly higher than previous estimates, we basically corroborate earlier findings that salary

and bonus elasticities are small.[16]

5.1   *Salary and Bonus Sensitivity*

A large number of studies suggest that the elasticity of CEO compensation with respect

to changes in firm value is quite small, in the range of 0.10 to 0.15.[17] In what follows, we use

our data to estimate the salary and bonus elasticity. Our results confirm the finding that this

elasticity is small.

In order to calculate salary and bonus elasticities, the log difference of salary and bonus

is regressed on the percentage change in firm value (e.g. the firm's return, r). Although the

bonus part of pay is affected by current year performance, we also include the previous year's

return of the firm, since the (less variable) salary component of compensation typically depends

on last year's performance. In addition, in order to investigate whether there is a relative

component of CEO's pay, we add current and lagged values of the *S&P500* as right-hand side

variables. Thus, we regress:

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[16] In addition, we ignore the fact that poor performance can lead to the firing of a CEO. Studies have shown that CEOs are more likely to be replaced when performance is poor, suggesting that our estimated sensitivity is biased downward, particularly in the lower tail of performance.

[17] A sampling of examples include Murphy (1985), Coughlin and Schmidt (1985), Gibbons and Murphy (1990), Barro and Barro (1990), and Kaplan (1994).

$$ln(SB_{t,i}/SB_{t-1,i}) = \beta + \gamma^1 r_{t,i} + \gamma^2 r_{t-1,i} + \theta^1 r_{t,i}^{SP500} + \theta^2 r_{t-1,i}^{SP500} + \varepsilon_{t,i}$$

The results are shown in the first two columns of table IV. The first column shows that the

elasticity of salary and bonus with respect to changes in firm value is about 0.19, which is close

to previous estimates of between 0.10 and 0.15. The lagged value is smaller at about 0.05,

suggesting that the bonus component of compensation has a tighter link to performance than

the salary component. The second column shows that there is an operational relative pay

component. Salary and bonus responds negatively to changes in the market as a whole, as

indicated by the negative 0.21 coefficient on the contemporaneous market return. This

coefficient is consistent with earlier studies that find weak evidence that CEOs are judged at

least partially on relative performance.[18]

We also tested to see if sensitivity has risen over time by interacting each of these

variables with time dummies for the early 1980s (1980-85) and the more recent period (1986-

94). The coefficients are larger (in absolute value) for the later period, suggesting that

sensitivity has increased since the early 1980s. For example, the salary and bonus elasticity

with respect to contemporaneous returns have approximately doubled from 0.13 to 0.24.

This analysis is repeated in the next three columns, with direct compensation (salary

and bonus plus stock option grants, but not the change in the value of stock or stock options)[19]

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[18] See Gibbons and Murphy (1990) and the survey by Rosen (1992).

[19] Stock options grants are the dollar value of stock options given during the year, valued with
the Black-Scholes formula. This should not be confused with the change in the value of the CEO's
existing stock option holdings, which (along with changes in the value of stock holdings) is the main
source of the large elasticities estimated in this paper.

substituted for salary and bonus. The estimates, although a bit larger, tell a similar story. The sensitivity comes mostly from contemporaneous performance, suggesting that bonuses and end-of-year stock option grants are the driving forces behind the sensitivity in direct compensation. There is some evidence of relative pay, and again sensitivity seems to have risen since the early 1980s. We will come back to the interpretation of these results in section 8.

What is important to recognize now is that these numbers represent small sensitivity relative to the sensitivity generated by stock and stock option holdings. For example, the 0.24 elasticity of salary and bonus (adding the coefficients on contemporaneous and lagged performance) implies that a 10 percent increase in firm performance will increase salary and bonus by 2.4 percent or about $25,000 (evaluated at the median CEO salary and bonus in 1994). As we will show, this amount of sensitivity is smaller than the sensitivity generated by holdings of stock and stock options by a factor of almost 50.

5.2   Sensitivity Measures Using Changes in the Value of Stock and Stock Option Holdings

We now turn to estimating the sensitivity of total CEO compensation to changes in firm value. Our focus is on changes in compensation generated by changes in the value of stock and of stock options. We ignore sensitivity based on changes in salary and bonus since such changes are essentially in the rounding error of changes in the value of stock and stock options. While including changes in the value of stock and stock options represents a broad measure of compensation, it is the right measure in terms of monetary incentives. CEOs presumably care about changes in their wealth emanating from all sources, not just salary and bonus. Indeed,

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increasing the responsiveness of pay-to-performance is perhaps the main reason why boards give CEOs stock and stock options, both of which typically have restrictions that force CEOs to hold the stock and stock options.[20] Thus, our measure of total compensation includes salary and bonus, restricted stock grants, other compensation, stock option grants, changes in the value of stock holdings, and changes in the value of stock option holdings. In order to highlight the importance of stock and stock option holdings, all of the sensitivity in the simulations that follow are the result of changes in the value of stock and stock options holdings.

The advantage of knowing the details of CEO stock and stock option holdings is that this enables us to calculate precisely how their wealth changes in response to various changes in firm rates of return. We begin by creating a distribution of annual stock returns for large firms by pooling the annual returns for the period 1970 to 1994 of the 500 firms in each year that had the largest market values at the end of the previous year.[21] The nine decile cutoffs of firm returns are shown at the top of table V. For example, the return at the 10th percentile is negative 27.6 percent, the median return is 5.9 percent, and the 90th percent decile return is 47.9 percent.

From the proxy data, we construct entire compensation packages for each CEO in our

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[20] CEOs often continue to hold stock and stock options even after the restrictions have lapsed because of both explicit and implicit restrictions on the selling of stock. In our interviews with CEO pay consultants, we found that many companies have explicit guidelines that indicate how much stock CEOs must hold. In many other companies, implicit guidelines are in place since boards and stockholders do not like CEOs to unload their stockholdings, in part because selling sends a bad signal to the market. In our analysis, we do not distinguish between stock options that do and do not have restrictions.

[21] These returns exclude dividends. But we do include the value of dividends received by the CEO in the component of compensation that reflects the increase in the value of stock holdings.

sample for 1994 using the panel to build up the stock of stock options that the CEO holds at each point of time. Then, we simulate nine levels of total compensation for each CEO, which correspond to the nine decile cutoffs of the distribution of stock returns. Thus, the first column shows the mean and median compensation of *all CEOs* under the assumption that each firm performed at the 10th percentile rate of return. The first four rows show the mean compensation of salary and bonus, option grants, other compensation and restricted stock grants. Note that these components of compensation are assumed to be invariant to firm performance, and therefore have identical values across columns.

The next two rows display the change in the value of stock options and stock holdings at the various firm performance levels. These columns show dramatic changes in the level of compensation. For example, assuming a 10th percentile performance, the average CEO in our sample loses $2.4 million in the value of stock option holdings and nearly $15 million in the value of their stock holdings. These losses swamp the amount of direct compensation gains to the CEO, so that on net CEOs lose an average of about $14 million when their firm performs this badly (a 10th percentile performance). This contrasts with net gains of $7.6 million for a median performance and an astounding $35 million for a 90th percentile performance.

This extreme variation of pay, however, is misleading because the large swings in the value of stock are driven by a few outliers such as Bill Gates, who owns about one-quarter of Microsoft, one of America's largest companies. Thus, in the rest of the paper, we focus on medians rather than means.

In the bottom half of the table, the analysis is repeated for median rather than mean compensation. While slightly less dramatic, the results still indicate very large sensitivity. For

example, for a 10th percentile performance, our median CEO loses about $435,000. Losses in the value of stock and stock option holdings more than offset the amount of direct pay. This contrasts with total compensation of about $3 million for the typical CEO with a median stock performance, and $8.6 million for 90th percentile performance. For the median CEO in our sample, there is a $9 million difference in CEO wealth in moving from a 10th percentile company performance to a 90th percentile performance.[22] It is hard to reconcile these results with the view that CEO compensation has no correlation with firm performance. Holdings of stock and stock options create a strong link between firm performance and changes in CEO wealth.

5.3 Distributions of Four Sensitivity Measures

The separate roles of holdings of stock and stock options in creating sensitivity can be seen in Table VI, where we show distributions of four sensitivity measures.

5.3.1 Dollar Changes

The entries in the first row of this table indicate the dollar amount (in millions) by which CEO total compensation changes if the firm's stock price increases from a median performance to a 70th percentile performance. The mean change is shown in the first column and the next nine rows indicate the decile cutoffs of percent changes, ranked from the smallest to the largest. The first row indicates these changes under the (counterfactual) assumption that

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[22] When we repeated this analysis for a five year period, the results are even more dramatic. We again assumed salary and bonus to be invariant to firm performance and then used overlapping five-year periods from 1965 to 1994 to calculate and rank firm returns. A 10th percentile five-year performance was consistent with a negative 45.5 percent return. A 90th percentile performance is consistent with a 160.7 percent return. Under these assumptions, the median CEO receives about $4.6 million over 5 years for a 10th percentile performance but nearly $34 million for a 90th percentile performance, a difference of about $29 million.

CEOs have no stock holdings. This highlights the sensitivity created by holdings of stock options.

The table shows that moving firm performance from the a median performance to a 70th percentile performance increases CEO wealth by a substantial by $1.5 million at the mean and $0.85 million at the median, assuming no stock holdings. The zero change at the 10th percentile reflects that fact that slightly more that 10 percent of the CEOs hold no stock options at all. At the 90th percentile, CEO wealth increases by about $3 million.[23]

The next two rows report the same calculations, including CEO holdings of stock in their firms. The sensitivities are larger at the mean and the median. The mean change from moving from the 50th percentile performance to the 70th percentile performance is an increase in CEO pay of $9.6 million. The median increase is about $1.8 million.

5.3.2 Percent Changes

The second panel of the table repeats the analysis with percent changes in compensation replacing dollar changes. For example, the table indicates that the median increase in CEO compensation in moving from a median to a 70th percentile performance is 58 percent. This number ranges from only 15 percent at the 10th percentile to 150 percent at the 90th percentile. Taken together, the findings again indicate that even modest changes in firm performance, changing firm performance from a 50th to the 70th percentile performance, increases CEO compensation by a substantial amount -- more than 50 percent, which represents $1.8 million. Moreover, both the holdings of stock and stock options contribute to this sensitivity.

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[23] The sensitivity downward is basically symmetric, so we have not reported the downward sensitivities.

5.3.3 Elasticities

In order to calculate the elasticities of total compensation (where compensation is defined to include all stock and stock option based changes in wealth), we again assume that all direct compensation (including salary, bonus, stock option grants and other compensation), is invariant to firm performance, which is approximately correct given the earlier analysis. We then evaluate elasticities of total compensation at the median firm performance. That is, we calculate total compensation for each CEO at the 50th percentile and at the 70th percentile. The elasticity is the percentage change in this total compensation divided by percentage change in firm value (which is 14.6 percent). The mean and distribution of elasticities, from smallest to largest, are shown in the third panel of the table and plotted in Figure 2.

In order to highlight the separate roles that stock and stock options play, the first two rows show the elasticities under the assumption that CEOs hold no stock. The mean elasticity is 2.6 and the median elasticity is 2.3. Relaxing the assumption that CEOs hold no stock raises the elasticities substantially. The distribution of elasticities has a mean of about 4.9 and a median of 3.9. Moreover, the 10th percentile of firm elasticities is about one and the 90th percentile of elasticity is a strikingly large ten. Note that the median elasticity of 3.9 is about 30 times larger than estimates in the literature of the elasticity of salary and bonus with respect to firm returns.

5.3.4 CEO Dollar Wealth changes Relative to Firm Dollar Changes

Finally, we show how much CEO wealth changes relative to dollar changes in firm value. This number is the same as the Jensen and Murphy (1990b) statistic, except that our numbers do not include two additions to sensitivity calculated by Jensen and Murphy --

sensitivity generated by the probability of being fired and sensitivity generated from future changes in salary and bonus. Thus, if we want to make our number directly comparable to theirs, we need to add about 60 cents per thousand dollar. Not including the 60 cent addition, the table indicates that a $1,000 increase in firm value increased CEO wealth by about $25 at the mean and $5.29 at the median. The means and medians are quite different because stock ownership percentages and firm market values have highly skewed distributions.

5.4 Regression Estimates of Pay to Performance Sensitivity

Most of our calculations so far are based on simulations. We have chosen this method because we have the exact holdings of CEO stock and stock options and simulations enable us to ask well-defined questions such as how much the median CEO gains if performance changes by a certain amount. Nevertheless, as a robustness check, it is useful to estimate sensitivity with regression analysis.

We run the simplest possible specification (given the constraint that we cannot log total wealth changes since this number is sometimes negative). We regress total compensation, defined as all direct compensation plus all indirect compensation (changes in the value of stock and stock option holdings), on the firms contemporaneous return for that year. Because the resulting estimates are influenced by outliers, we run robust regressions.[24]

The result is shown in Table VII. The coefficient is 0.043 and is highly significant. This coefficient implies that a 1 percentage point increase in the firm's return increases the CEOs wealth by $43,000. The results of Table VI, which show sensitivity for 1994, indicate

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[24] We use the STATA version 5 rreg command which uses Huber weight iterations followed by biweight interations.

that this measure of sensitivity is less than half of the median sensitivity reported there, which is about $125,000 for every one percent increase in firm value ($1.82 million divided by 14.6 percent).

Note, however, that this is the average sensitivity over the entire 15 year period, which is much less than the sensitivity for the last year in our sample, 1994. Therefore, in column 2, we interact returns with each year to see how sensitivity has changed over time. As expected, sensitivity rises steadily over time. The sensitivity in 1994 is almost nine times larger than that of 1980. The coefficient for 1994 is 0.124, which implies that a one percentage point increase in firm value leads to a $124,000 increase in CEO wealth. This estimate is almost identical to the $125,000 estimate based on our simulations, giving us confidence that our earlier sensitivity calculations are correct. We now turn to describing more precisely how sensitivity has changed over time.

6.   How Has Sensitivity Changed Over Time?

The dramatic rise in CEO compensation has been driven to a large extent by an increase in annual stock option grants, which has produced a large buildup in total CEO holdings of stock options. Moreover, although the holding of direct stock relative to total firm value has remained constant or fallen a bit since the early 1980s, the dollar value of stock held by CEOs has risen sharply since the early 1980s due to the stellar performance of the stock market. The median value of stock holdings of CEOs rose from $1.2 million in 1980 to $4.4 million in 1994 (in 1994 dollars). Taken together, these factors have dramatically increased the pay-to-

performance sensitivities in the last 15 years.[25]

In order to measure how much sensitivity increased between 1980 and 1994, we start by repeating the analysis presented in Table V for the earliest year in our sample, 1980. The results are shown in Table VIII. The difference in sensitivity between the two tables is striking. For example, in terms of mean compensation, a 10th percentile performance leads to a loss of "only" $2.4 million (1994 dollars) in 1980, which is much smaller than the $14 million loss for 1994. Likewise, a 90th percentile performance leads to only an average gain of $7 million in 1980, compared to the remarkable $35 million average gain in 1994.

The results for medians are qualitatively the same but, as before, less dramatic. While the median CEO lost $435 thousand for a 10th percentile performance in 1994, the median CEO actually has positive compensation of $242 thousand in 1980. Likewise, the gain for a 90th percentile performance for the median CEO is only $1.8 million in 1980, compared to an $8.6 million gain in 1994. Thus, the $9 million change in CEO compensation from moving the firm's performance from the 10th to the 90th percentile in 1994 was less than one-fifth as large in 1980.

In Table IX, we show how four measures of sensitivity change over time. The measures are 1) the median elasticity 2) the median change in CEO wealth for a $1,000 change in firm value 3) the dollar difference in CEO wealth from a dramatic improvement -- moving from a 10th percentile performance to a 90th percentile performance, and 4) the dollar difference in CEO wealth from a modest improvement -- moving from a 50th percentile performance to a

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[25] Since CEO holdings of firm stock are often the result of exercising stock options, some of the increased sensitivity that shows up as due to stock holdings actually originated in stock option grants.

70th percentile performance.

The increase in sensitivity is evident in all of the measures. For example, between 1980 and 1994, the median elasticity more than triples from 1.2 to 3.9. The median wealth change per thousand dollar firm value change more than doubles from $2.5 to $5.3. And the CEO wealth change for a dramatic firm performance change increases by a factor of almost 7, from $1.4 million to more than $9 million. The same wealth change for a modest improvement in firm performance increases from $281,000 to $1.8 million. Note that the increase in sensitivity would be even larger, although only modestly so, if we considered the slight increase in direct pay sensitivity, which was documented in table IV. The key point is that, regardless of which sensitivity measure is used, there has been a dramatic increase in CEO pay-to-performance sensitivity during the last 15 years.[26]

7. Do CEOs Ever Lose Money?

An important issue in the sensitivity debate is whether CEOs are punished sufficiently for poor performance. Our sensitivity analysis suggests that CEOs can actually lose money — since the losses in stock and stock option holdings can more than offset gains from direct compensation. However, it is an empirical question as to whether this actually does happen,

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[26] To decompose the increase in sensitivity into the share due to the increase in stock options grants and the share due to the rise in the stock market, we reestimated our median elasticity under two counterfactual assumptions. The first assumption is that the stock market was at the same level in 1994 that it was in 1980. This calculations isolates the increase in sensitivity due solely to the increase in stock options grants. We find that under this assumption, the elasticity would have risen from 1.2 in 1980 to 2.6 in 1994. Next we estimate the elasticity under the assumption that the stock market increased at a 5.9 percent rate per year. Under this assumption, the elasticity in 1994 would have been 3.0. The elasticity actually rose to 3.9. Therefore, roughly half of the increase in sensitivity came from the increase in stock options, 15 percent came from ordinary increase in the stock market, and 35 percent came from the extraordinary stock market performance of the past 15 years.

and if so, to what degree.

In order to investigate this issue, we calculated the percentage of CEOs that actually suffered a loss in wealth during the last year (1994) of our sample, the last two years (1993 to 1994) and so on up to the last five years (1990 to 1994). For these calculations we used the 200 CEOs in our sample who were CEO for all 5 years from 1990 to 1994. The results are shown in Table X. The first column shows the S&P500 stock return for each of the periods. The next column shows the percent of CEOs in our sample who suffered an actual decline in wealth during the period. The third column shows the median stock return for the "loser's" firms during that year. The fourth and fifth columns show the mean and median wealth losses for those CEOs who experience wealth declines.

The numbers indicate that CEOs do in fact experience wealth declines and that the amounts are both frequent and non-trivial. For example, in 1994, which was almost a flat year for the stock market, about 24 percent of the CEOs in our sample actually lost money during the year. Moreover, the mean and median losses for the losers was $13 million and $3 million respectively. When a longer period is examined, the same pattern emerges, but is less dramatic. However, even over a three year period, 10 percent of CEOs lost an average (median) of $74 million ($15 million). For the five year period, five percent of the CEOs lost an average (median) of $64 million ($30 million).

Although this analysis in no way proves that the degree of downward sensitivity is sufficient or optimal, it does suggest that at least some CEOs are severely punished for poor firm performance. More importantly, these results are consistent with the general theme of this paper, which is that the sensitivity of CEO wealth is much larger than has previously been

recognized, and that this includes both gains and losses in CEO wealth.[27]

Note also that all of our sensitivity measures ignore the possibility that CEOs may get fired if their firm performs poorly. Gilson and Vetsuypens (1993), for example, find that almost one third of all CEOs are replaced when firms enter financial distress (i.e. enter bankruptcy or privately restructure their debt) whereas CEOs in solvent firms have annual turnover rates of less than 10 percent (Warner et. al., 1988 and Weisbach, 1988). The prospect of being fired clearly raises the sensitivity of CEO pay-to-performance, especially since CEO stock and stock option grants sometimes contain provisions that nullify the awards if a CEO is fired before the restrictions elapse. However, given the existence of generous CEO buyouts, sometimes called golden parachutes, it is not clear how much CEOs lose, on net, when they are fired.

8. Implications

The results of this study have a number of important implications that make us think differently about the incentives facing CEOs and the direction of future research in this area.

8.1 *The Lack of Salary and Bonus Sensitivity and the Importance of Holdings of Stock and Stock Options*

One important implication follows from the fact that changes in the value of stock and stock options completely swamp changes in salary and bonus. The large literature that measures pay-to-performance sensitivity with salary and bonus elasticities should be

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[27] In an extension of this paper, the downside risk to CEOs from their stock option holdings is analyzed and documented in greater detail. See Hall (1997).

interpreted with the important caveat that salary and bonus sensitivity is only the tip of the iceberg.

Our interviews with CEO compensation consultants helped to explain why CEO salary and bonus is so insensitive to firm performance. CEO pay levels are typically set by boards who hire CEO pay consultants to advise them. The methods used to set overall pay levels rely heavily on subjective judgements: What is the appropriate CEO comparison group? What are the best performance measures? Are there any unusual circumstances that explain good or bad performance? Indeed, even formula based bonus programs have wiggle room since most plans include some subjective objectives. For example, did the CEO put in place a solid succession plan? Given the discretion built in to the system, it is especially hard for boards to lower the pay of a CEO for bad performance. As one consultant put it, "The CEO is often very powerful. Everyone in the company works for the CEO and the board often serves at the CEO's pleasure. It would take a lot to get in front of that very large train. Nobody has the incentive to make the case that the CEOs pay should be lowered." Many of the compensation consultants we met talked with reported at least one instance in which they were fired by a company for suggesting a pay cut for the CEO.

The fact that it is hard in practice to use salary and bonus to penalize CEOs for bad performance has the important implication that equity-based pay may be the only feasible way to align CEO incentives with shareholder objectives. That is, given current institutional norms in board rooms, CEO stock and stock option holdings are the key to creating and maintaining strong incentive-based pay that both penalizes CEOs for poor performance and rewards CEOs for good performance.

8.2   The Lack of Relative Pay

A related and disturbing implication of our results is that "relative pay" is not a significant component of CEO compensation packages. Our results indicate that relative pay sensitivity via salary and bonus and grants of stock options is trivial relative to the sensitivity generated from movements in the value of stock and stock option holdings, which do not have a relative component. One principle of efficient compensation is that managers should be rewarded for outcomes over which they have control, while being insulated by economy-wide or industry-wide shocks.[28] This implies that CEOs should be paid relative to some market or industry index. Consistent with this, Gibbons and Murphy (1990) show that CEO salary and bonus changes are positively related to own firm returns and negatively related to market/industry returns. Likewise, we also find a relative pay component with regard to direct pay. However, our findings suggest that changes in direct pay, which do have a relative pay component, are trivial compared to changes in the value of stock and stock option holdings, which do not have a relative pay component.

One way to introduce relative pay is to issue options with an exercise price that moves with a market or industry index.[29] Such an option contract would introduce relative pay, which is lacking in current contracts. While more research is needed, we suspect that this would

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[28] See Holmstrom (1979). There is an important caveat to this argument, however. If managers can take actions to reduce their exposure to industry or economywide shocks, which is typically the case, then completely insulating them from such shocks is not optimal (Baker, Jensen and Murphy, 1988). Nevertheless, the near complete absence of relative pay seems to be a puzzle.

[29] According to the CEO pay consultants we interviewed, one of the main reasons why such contracts are rarely used is that stock options with moving exercise prices have "bad accounting." That is, unlike at the money options with a fixed exercise price, which do not reduce current earnings, options with an unknown exercise price must be expensed against current earnings under existing accounting rules.

represent a substantial improvement over current contracts.

8.3   Career Concerns

Our results also have implications for "career concerns." Gibbons and Murphy (1992) have shown that pay-to-performance sensitivity needs to be higher for older workers closer to retirement since younger workers have an alternative incentive mechanism -- the prospect of being promoted and improving future pay. Consistent with this theory, they find that CEO salary and bonus elasticities are slightly higher for workers near retirement. Again, however, these elasticities are small relative to total compensation elasticities. Given that CEOs typically receive more stock options each year, it seems likely that total compensation sensitivity naturally rises over time for the typical CEO, unless CEOs unload stock and stock options faster than they receive such options as they near retirement.[30]

8.4   Do Current Contracts Lead to Risk-Avoidance?

Our findings also suggest that risk-avoidance behavior is potentially a first-order agency issue. We have shown that typical swings in CEO wealth amount to millions of dollars, and we that there is substantial downside as well as upside risk. Does this cause CEOs to avoid high-risk, high-return projects that, from the perspective of well-diversified shareholders, ought to be undertaken? That is, while it may still be the case that there is too little sensitivity in typical CEO contracts, our results suggest the possibility that current contracts lead CEOs to avoid risk-taking.

8.5   Why the Increasing Use of Stock Options?

Lastly, it is important to understand why the use of stock options and therefore the

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[30] One of us (Hall) is currently testing this hypothesis in a separate paper.

sensitivity of pay-to-performance has increased so dramatically over the past 15 years. We have two theories, which are not mutually exclusive. First, the increase in the use of stock options may reflect a desire by boards to increase the relationship between pay and performance. Boards may have been influenced by the critique of Jensen and Murphy and others that pay-to-performance is central to inducing CEOs to make profit maximizing decisions. Boards of directors (as well as increasingly powerful institutional investors) may not want their CEOs to be paid like bureaucrats and have therefore responded with high-powered incentive contracts.

Our results are at least suggestive that this is the case. For example, our finding that salary and bonus sensitivity has increased over time is consistent with the story that boards are attempting to increase pay-to-performance. While salary and bonus sensitivities are only the tip of the iceberg in terms of overall levels of sensitivity, they may reveal important information about the iceberg.

A second possible explanation for the increased use of stock options is that boards want to pay CEOs more (either to compete for executive talent or because the boards are beholden to their CEOs) and option grants are a less visible vehicle for paying CEOs than salary and bonus is. Finding a less visible way to pay CEOs is important because public opposition to high pay levels appears to have increased as levels of pay have risen. As one compensation consultant stated, "One of our CEOs made nearly $10 million dollars last year in stock option appreciation. It would be inconceivable that we could have paid him that much in salary. With

stock options, the CEO makes money only if the stockholders make money."[31] CEO

consultants also say that stock options are attractive because they are "free." Since there is no

current accounting charge from granting stock options, consultants and boards view options as

costless.

Even if CEOs are receiving stock options in order to mask the rise in the level of CEO

pay, the options still generate the benefits of high-powered pay-to-performance contracts. In

this case, boards may have improved the incentive structures of CEO contracts for the wrong

reason. Nevertheless, a high-priority for future research is understanding why CEO stock

options grants have grown so dramatically over the past 15 years.

It is also worth noting that the dramatic increases in CEO pay over the past 15 years are

not very large relative to the market value of firms in our sample or to their number of

employees.[32] If annual CEO direct compensation were reduced to 42 percent of its current

level (essentially back to 1980 levels) and the annual savings were returned to shareholders,

shareholders in the median firm in our sample would receive an extra .04 percentage points of

return on their shares. If the savings were spread equally among the firm's workers, the median

annual per worker gain in our sample of firms would be $63. [33]

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[31] Dial and Murphy (1995) report an interesting example of this involving executives at General Dynamics. There was a huge public outcry when they were given large bonuses for raising the company's stock price. This outcry basically ended when the bonus plan was replaced with a stock option plan "even though the payouts under the two plans were virtually identical." (p. 285)

[32] The median market value for firms in our sample is $2.4 billion. The median number of employees is 14,000.

[33] Since most executive compensation packages cover a range of top managers, it would be interesting to recalculate these per-shareholder and per-worker statistics including all top executives. Unfortunately, our data set includes only CEOs.

9. Summary and Conclusion

Are CEOs paid like bureaucrats? Our evidence suggests that the answer is no. We use a new data set that enables us to carefully measure how the value of CEO stock and stock options change when a firm's stock market value changes. Taking into account CEO holdings of stock and stock options, CEO compensation is highly responsive to firm stock performance. The median CEO in our sample loses $435,000 for a 10th percentile firm performance and increases his wealth by about $8.6 million for a 90th percentile performance. Moreover, when CEO holdings of stock and stock options are considered, the pay-to-performance elasticity is 3.9, which is about 30 times larger than previous estimates that measure the elasticity of only salary and bonus.

We find that both the level of CEO compensation and the sensitivity of CEO compensation to performance has increased sharply over the past 15 years. Mean (median) direct CEO compensation increased by 209 percent (136 percent) in real terms during the past 15 years, and the large increase in stock option awards and in the value of stock holdings during this period has dramatically increased the sensitivity of CEO wealth to firm performance. For example, the elasticity of CEO compensation to firm market value more than tripled from 1.2 to 3.9 between 1980 and 1994. During the same period, the dollar change from moving the firm from a median to a 70th percentile performance increased by a factor of 7, from $280,000 to $1.82 million.

We do not claim that current CEO contracts are efficient. Nor do we claim that current pay-to-performance sensitivity is sufficiently high. Those are stronger statements than are implied by our findings. Indeed, our findings point to some potentially serious deficiencies in

current CEO compensation packages. However, we believe that our findings do contradict the claim that CEO contracts are wildly inefficient because there is no correlation between performance and pay. Our evidence demonstrates that the fortunes of CEOs are strongly related to the fortunes of the companies they manage.

Appendix A

It is difficult to know how risk-averse CEOs are, and therefore how problematic it would be if CEOs used most of their wealth to purchase company stock. Nevertheless, it is possible to say something about this if one is willing to impose some structure on the typical CEO's utility function. A particularly useful utility function in this regard is power utility, which has decreasing absolute risk aversion and constant relative risk aversion:

$$U(W) = \frac{W^{1-\gamma}}{1 - \gamma}$$

where gamma is the coefficient of relative risk-aversion (CRRA):

$$\gamma = - \frac{U''}{U'} W$$

There is no agreed upon estimate of the CRRA. The equity premium puzzle suggests that the CRRA is quite large, in the range of 10 to 30. Most economists, however, believe it to be much smaller (in the range of 2 to 4) based on introspection about the types of bets that individuals with CRRAs would be willing to accept.[34]

The difficulty with forcing a CEO to take on the risk of purchasing even 0.85 percent of the median firm is shown in Appendix table I. The first row reports the certainty equivalent of selling 0.85 percent of the firm ($20 million) to a CEO with $20 million in wealth, under a variety of assumptions about the value of the CRRA.[35] That is, the numbers below each CRRA indicate the wealth level that solves:

$$U(W) = E[U(\overline{W} + \pi)]$$

where π is random variable that reflects the volatility of the firm's return. The standard deviations are based on the average standard deviation of the largest 500 firms during the past 25 years. The CRRAs that we analyze range from one to ten, although one is probably too low and ten too high.

Assuming that the CEO purchases 0.85 percent of the firm, the certainty equivalents

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[34] Some economists (Burnside 1994; Campbell and Cochrane 1995; Cecchetti, Lam and Mark 1993; Hansen, Sargent and Tallarini 1994) believe that the CRRA is quite large and that there is no equity premium puzzle. See Kocherlakota (1996) for an interesting survey.

[35] The calculations assume that if the CEO becomes insolvent, bankruptcy proceedings leave the CEO with a wealth of $100,000. The calculations do not change very much when the lower bound is increased to $500,000.

indicate the amounts that the CEO would have to be compensated in order to be willing to take on the risk of the company. For example, if a CEO with $20 million were forced to purchase 0.85 percent of the company (which would cost the CEO $20 million), then the value the CEO places on the $20 million dollars (its certainty equivalent) ranges from $14 million when the CRRA is assumed to be two to only $550 thousand if the CRRA is assumed to be five. The certainty equivalent of this deal (having to buy $20 million in stock) is often a small fraction of initial wealth (see panel B of Appendix Table I). As the next row in the table indicates, this situation is greatly worsened if the CEO is forced to purchase $40 million worth of the firm (assuming that the CEO can get financing). However, if the CEO is forced to purchase only half as much (0.425 percent, costing $10 million), risk aversion does not reduce the CEO's utility dramatically, suggesting that CEO purchases of 0.5 percent are possible. This analysis suggests that risk-aversion may be a first-order issue in the design of CEO contracts.[36]

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[36] Haubrich (1994) argues that because of risk-aversion, it is possible to calibrate standard agency models in such a way that current compensation packages may be efficient.

Appendix B: Constructing a Measure of Total Stock Option Holdings

To construct a measure of the total stock option holdings of each CEO at a given point in time, we use proxy data on stock option grants, gains from exercising stock options, and the total number of stock options held by the CEO.

Annual proxies contain information on options granted during the preceding fiscal year, including the number, duration, and exercise price of the options. In order to construct a CEO's total holdings of stock options, we go back to the first year in which the CEO was the CEO and use the annual data on option grants to build up the stock of stock options held by the CEO, including the exercise price and remaining duration of each option.[37] Each year, we reduce the remaining duration of options granted in the previous year, add the options granted in that year, and subtract options sold.

There are three characteristics of the data that complicate this procedure. First, CEOs often hold options that they received before they became CEO. Second, the exercise price is sometimes missing. Third, the proxies report option gains as a dollar value, so it is impossible to determine exactly which options were sold in a given year. We are helped, however, by the fact that proxies sometimes contain information on the total number of options held by the CEO (or alternatively the total number of vested options held by the CEO). This information on total options allows us to test the accuracy of our algorithm for building up the stock of stock options holdings and to adjust for cases in which our algorithm produces an inaccurate count of stock options.

Initial Conditions

CEOs often hold options that they were granted before they became CEO. In many cases, we can obtain a measure of the total number of these previous options from the proxy for the year before the CEO became CEO (proxies contain information on option holdings of other top executives). When this measure is not available, we use the maximum of the total number of vested options held by the CEO before becoming CEO and a variable that we call *backcount*. *Backcount* is a measure of the total options held by the CEO that is constructed by taking the earliest year of data for which total options held by the CEO is available in the proxy and then going backwards in time, subtracting the number of options granted and adding the number of options sold. We assume that these initial options have a remaining duration of 7 and that the exercise price is the median price from three years before. None of our results are sensitive to reasonable changes in these values.

Missing Exercise Prices

The exercise price is missing for 3.7 percent of options grants in our 1980-1994 sample. It is missing in 20.6 percent of the cases in the 1970 data used to construct the 1980 stock of

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[37] In constructing the stock of stock options for 1980, the first year in our data set, we go back only to 1971. Since most stock options have a duration of 10 years, and since only 32 CEOs in our sample both were CEOs in 1970 and held stock options in 1971, we are losing little information by not going back further. Moreover, in those few cases, we use our regular procedure for handling initial conditions (see below) in order to calculate the number of stock options held at the end of 1970.

stock options. Since nearly all options are granted at the money, we assume that the exercise price is the end of year stock price for the fiscal year in cases in which it is missing.[38]

Accounting for Gains from Selling Stock Options

Annual proxy statements report the dollar value of gains from options sold during the fiscal year. This is not sufficient information to tell how many options were sold or exactly which options were sold. In order to subtract options sold we make two assumptions. First, we assume that the options were sold at the median stock price during the year. Second, we assume that CEOs sell their oldest options first. This is a reasonable assumption since basic option theory tells us that CEOs should not exercise options early (ignoring dividend issues) and because some firms have rules that require CEOs to exercise the earliest options first. Most importantly, in a rising stock market the earliest options will be the most in the money. Therefore, our assumption that CEOs sold these options is a conservative one in that it minimizes our estimates of the pay-to-performance sensitivity. In a very small number of cases, the median price during the year in which the options were sold is less than the exercise price of the option. In this case, we assume that the exercise price was incorrect, and arbitrarily reduce it by 50 percent.

Adjusting the Option Stock to be Consistent with the Total Number of Options Held by the CEO

In years in which the proxies contain a measure of the total number of options held by the CEO, we can compare the option holdings produced by our algorithm with the proxy total. The simple correlation between the two measures is .79. A regression of our total option measure on the proxy measure has a coefficient of 1.003, suggesting that our measure is unbiased. The ratio of the error variance to the true variance is .64. It is important to note that since we rely mostly on medians in our estimation, our results are not very sensitive to this (apparently white noise) measurement error.

For observations for which the proxy measure of total options is available, we rescale our options holdings to coincide with the proxy measure. When the proxy measure of options is below our measure, we subtract the oldest options from our stock of stock options until the two measures coincide. When the proxy measure of total options (or vested options) is above our measure, we first assume that we sold too many options in accounting for the previous year's gains, and add back in the options until we reach the correct number of total options. If this number is still too low, we rescale option holdings to coincide with the proxy total.

Data on total stock options held are available for most firms from 1980-1983 and from 1993-1995, so our measures of stock options holdings are likely to be more accurate in those

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[38] Repricing of existing options appears to be a minor problem. Yermack (1995) found that only 1.5 percent of firm changed the terms of previously awarded stock options in a given year. This is consistent with an SEC report (1993) that also found a very low incidence of repricings in a survey of 1,000 companies. In addition, Chance, Kumar and Todd (1997) look at a sample of about 4,000 publicly traded firms over 10 years and found 73 repricing events from 40 firms. Moreover, we randomly checked 50 of our proxy statements and found no instances in which past options were repriced.

years. Fortunately, this period contains the beginning and end of our sample period and is therefore the focus of our attention.

Adjusting for Stock Splits

Finally, in building up the stock of stock options held by a CEO, it is necessary to adjust the number and exercise price of stock options to account for stock splits. We obtain information on stock splits from CRSP. First, we take all stock splits identified in the CRSP event file. We identify additional stock splits by comparing daily stock returns with daily price changes.[39] To adjust the stock options, we needed to determine whether option grants in a given year occurred before or after the stock split. In cases in which the exercise price was known, it was usually obvious whether the options were granted before or after the split. In cases in which the exercise price was not given, we assumed that they were granted after the split because in 96 percent of the cases in which the exercise price was known, the options were granted after the split.

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[39] If the stock price changed by more than 20 percent and the daily return was substantially smaller, we assumed that a split had occurred.

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Table I

Data Summary Statistics (1994)

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
Age of CEO	57.6	58.0	6.6	36.0	82.0
Years As CEO	8.4	6.0	7.3	1.0	38.0
Years Employed by Company	22.0	22.0	13.3	1.0	59.0
Founder of Company (Dummy)	0.09	0	0.29	0	1
Percent of Firm Stock Owned by CEO	2.15%	0.14%	6.65%	0%	53%
Salary and Bonus	$1,292,290	$1,050,000	$1,163,920	$52,000	$16,000,000
Value of Option Grants	$1,213,180	$324,989	$2,874,280	$0	$28,849,350
Value of Restricted Stock Grants	$201,736	$0	$757,127	$0	$9,737,770
Other Compensation	$319,014	$69,000	$961,007	$0	$11,154,000

n=368

Table IIa

Mean CEO Compensation (1994 Dollars)

Year	Mean Salary & Bonus	Mean Value of Stock Option Grants	Mean Direct Compensation[1]	Mean Total Wealth Increase[2]
1980	654,935	155,037	809,973	5,493,312
1981	676,912	211,014	887,926	2,032,343
1982	675,441	235,571	911,011	4,481,189
1983	732,029	266,388	998,417	10,383,767
1984	770,878	258,402	1,029,280	1,852,328
1985	830,365	431,333	1,261,698	8,122,815
1986	931,056	375,738	1,306,793	10,439,932
1987	960,839	543,886	1,504,725	3,964,999
1988	1,057,791	530,653	1,588,444	3,782,151
1989	1,062,148	574,162	1,636,309	13,357,133
1990	1,005,860	751,477	1,757,336	907,567
1991	994,470	780,604	1,775,074	17,546,181
1992	1,061,370	959,791	2,021,161	14,852,845
1993	1,175,870	891,843	2,067,715	12,774,561
1994	1,292,290	1,213,180	2,505,469	9,168,990
% Change 1980-1994	97.3	682.5	209.3	—

Notes: 1) Direct compensation is salary and bonus plus value of stock option grants.
2) Total wealth increase is the increase in the value of the CEO's holdings of firm stock and stock options plus direct compensation.
3) Annual sample sizes vary from 365 to 432.

Table IIb

Median CEO Compensation (1994 Dollars)

Year	Median Salary & Bonus	Median Value of Stock Option Grants	Median Direct Compensation[1]	Median Total Wealth Increase[2]
1980	566,541	0	622,777	1,025,342
1981	604,050	0	650,515	818,455
1982	572,067	0	669,588	1,119,251
1983	641,307	0	760,926	1,842,217
1984	677,527	0	784,504	915,421
1985	705,190	6,257	853,985	2,044,776
1986	809,962	64,274	964,111	1,586,680
1987	846,671	89,190	1,083,832	964,806
1988	929,539	44,651	1,120,047	1,569,690
1989	938,202	42,410	1,152,117	2,358,251
1990	857,791	71,646	1,098,947	483,799
1991	857,427	141,852	1,179,344	3,033,961
1992	860,891	236,296	1,250,785	2,318,349
1993	945,608	271,091	1,309,698	2,002,501
1994	1,050,000	324,989	1,472,202	1,046,897
% Change 1980-1994	85.3	NA	136.4	—

Notes: 1) Direct compensation is salary and bonus plus value of stock option grants.
2) Total wealth increase is the increase in the value of the CEO's holdings of firm stock and stock options plus direct compensation.
3) Annual sample sizes vary from 365 to 432.

Table III

Compensation Growth: CEOs Relative to Other Workers (1994 Dollars)

Group	1982	1994	% Change 1982-1994	Annualized % Change 1982-1994
CEO Direct Compensation (Mean Values)[1]	$911,011	$2,505,469	175.0	8.8
CEO Direct Compensation (Median Values)[1]	$669,588	$1,472,202	119.9	6.8
All Workers[2]	$30,400	$32,600	7.2	0.6
State & Local Government (excluding education)[2]	---	---	11.9	0.9
Professors[3]	$40,700	$47,900	17.7	1.4
Top 0.5% of AGI[4]	$180,900	$281,100	55.4	3.7
MLB Players[5]	$376,300	$1,154,500	206.8	9.8
NBA Players[5]	$325,600	$1,558,000	378.5	13.9
CEO Total Wealth Increase assuming median performance (Mean Values)[6]	$1,904,056	$7,039,669	269.7	11.5
CEO Total Wealth Increase assuming median performance(Median Values)[6]	$1,030,428	$2,476,637	140.4	7.6

Notes:
1) CEO Direct Compensation is salary and bonus plus the value of stock option grants.
2) All Workers and State & Local Government are total compensation from the employment cost index (Bureau of Labor Statistics). Compensation levels for all workers are calculated by dividing NIPA total compensation of all employees by the total number of employees in the economy.
3) Professors is total salary (Source: ACADEME, March-April 1996).
4) Top 0.5% of AGI is the cutoff point for being in the top 0.5% of AGI (an updated version of the series in Feenberg and Poterba, 1993)
5) MLB and NBA Players are salaries (Source: Commissioner's Office).
6) CEO Total Wealth Increase assuming median performance is the increase in wealth from holdings of firm stock plus increase in wealth from holdings of stock options plus direct compensation assuming that every firm in the sample had a 5.9 percent increase in market value.

Table IV

Sensitivity of Salary and Bonus and Option Grants to Firm Performance

Independent Variable	Dependent Variable					
	Salary and Bonus			Combined Compensation		
	1	2	3	4	5	6
Firm Return in Current Year	0.1899 (0.0130)	0.1997 (0.0135)		0.3191 (0.0257)	0.3336 (0.0265)	
Firm Return in Previous Year	0.0463 (0.0109)	0.0430 (0.0111)		-0.0378 (0.0259)	-0.0457 (0.0263)	
S&P 500 Return in Current Year		-0.2098 (0.0552)			-0.2538 (0.1415)	
S&P 500 Return in Previous Year		-0.0257 (0.0574)			0.0477 (0.1496)	
Firm Return in Current Year * $(80 \leq year \leq 85)$			0.1262 (0.0226)			0.2174 (0.0345)
Firm Return in Current Year * $(86 \leq year \leq 94)$			0.2404 (0.0165)			0.4026 (0.0373)
Firm Return in Previous Year * $(80 \leq year \leq 85)$			0.0528 (0.0173)			0.0351 (0.0273)
Firm Return in Previous Year * $(86 \leq year \leq 94)$			0.0349 (0.0144)			-0.0947 (0.0386)
S&P 500 Return in Current Year * $(80 \leq year \leq 85)$			-0.2197 (0.0911)			-0.1320 (0.2165)
S&P 500 Return in Current Year * $(86 \leq year \leq 94)$			-0.2219 (0.0700)			-0.3548 (0.1874)
S&P 500 Return in Previous Year * $(80 \leq year \leq 85)$			-0.1740 (0.1008)			-0.1862 (0.2681)
S&P 500 Return in Previous Year * $(86 \leq year \leq 94)$			0.0180 (0.0719)			0.1359 (0.1824)
Number of Observations	5773	5773	5773	5680	5680	5680
R^2	0.09	0.09	0.10	0.05	0.05	0.06

Notes: All regressions include a full set of year dummies. Huber standard errors in parentheses.

Table V

Composition of CEO compensation ($1,000s), assuming stock price performance at each decile[1] (1994): 1 year

deciles	10	20	30	40	50	60	70	80	90
A: % Change in Stock Price	-27.6	-15.3	-7.0	-.01	5.9	12.8	20.5	30.5	47.9
B: Mean Compensation									
salary and bonus	1,292	1,292	1,292	1,292	1,292	1,292	1,292	1,292	1,292
option grants	1,213	1,213	1,213	1,213	1,213	1,213	1,213	1,213	1,213
other comp.	325	325	325	325	325	325	325	325	325
restricted stock grant	204	204	204	204	204	204	204	204	204
Increase in value of:									
options	(2,448)	(1,414)	(662)	(1)	569	1,251	2,028	3,054	4,886
stock	(14,659)	(7,812)	(3,183)	727	4,009	7,858	12,147	17,707	27,422
Total Compensation	(14,073)	(6,193)	(811)	3,760	7,611	12,143	17,209	23,794	35,342
C: Median Compensation									
salary and bonus	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050
option grants	325	325	325	325	325	325	325	325	325
other comp.	70	70	70	70	70	70	70	70	70
restricted stock grant	0	0	0	0	0	0	0	0	0
Increase in value of:									
options	(1,283)	(772)	(367)	(0.5)	329	729	1,191	1,779	2,854
stocks	(1,037)	(512)	(155)	96	358	691	1,023	1,460	2,233
Total Compensation[2]	(435)	441	1,014	2,196	3,026	4,042	5,111	6,385	8,598

Notes: 1) Salary, bonus, option grants, other compensation and restricted stock grants are all assumed to be invariant to firm performance.
2) This is the median of the sum which does not equal the sum of the medians.
3) The stock price distribution comes from the annual returns (excluding dividends) for each firm in the S&P 500 for each year between 1970 and 1995.

Table VI

Four Measures of Pay to Performance Sensitivity (1994)
If firm moves from 50th percentile to 70th percentile performance
(from a 5.9% return to a 20.5% return)

deciles	Mean Change	Smallest Change 10	20	30	40	50	60	70	Largest Change 80	90
One-year dollar change in compensation					*Dollar Change (Millions)*					
--50th to 70th, no stock[1]	1.46	0.00	0.05	0.30	0.54	0.85	1.09	1.43	1.95	3.06
--50th to 70th, with stock[2]	9.58	0.15	0.65	0.96	1.34	1.82	2.42	3.42	6.08	13.24
One-year percent change in compensation					*Percent Change*					
--50th to 70th, no stock[1]	37.8	0.0	4.6	13.6	24.6	33.2	40.2	50.0	60.1	81.6
--50th to 70th, with stock[2]	70.8	15.0	25.9	38.2	48.9	57.6	68.0	81.2	111.3	149.5
Percent change in compensation divided by percent change in market value					*Elasticity*					
--50th to 70th, no stock[1]	2.59	0.00	0.32	0.93	1.68	2.27	2.75	3.42	4.11	5.59
--50th to 70th, with stock[2]	4.85	1.03	1.77	2.61	3.35	3.94	4.66	5.56	7.62	10.23
Dollar change in compensation for $1000 change in market value					*Jensen and Murphy Statistic*					
--50th to 70th, no stock[1]	3.66	0.00	0.21	0.70	1.27	2.15	3.07	4.39	5.65	9.30
--50th to 70th, with stock[2]	25.11	0.54	1.30	2.50	3.58	5.29	6.78	10.31	16.43	44.82

Notes: 1) Assumes CEOs hold no stock (but that they do hold stock options).
2) Allows for changes in the value of both stock and stock options.

Table VII

Sensitivity Regressions

Independent Variable	Dependent Variable Total Wealth Change (Millions)	
	(1)	(2)
Annual Return (percent)	0.043 (0.001)	
Annual Return * 1980		0.014 (0.007)
Annual Return * 1981		0.026 (0.002)
Annual Return * 1982		0.031 (0.002)
Annual Return * 1983		0.025 (0.002)
Annual Return * 1984		0.037 (0.003)
Annual Return * 1985		0.026 (0.003)
Annual Return * 1986		0.036 (0.003)
Annual Return * 1987		0.049 (0.003)
Annual Return * 1988		0.038 (0.003)
Annual Return * 1989		0.052 (0.003)
Annual Return * 1990		0.046 (0.003)
Annual Return * 1991		0.033 (0.002)
Annual Return * 1992		0.066 (0.002)
Annual Return * 1993		0.085 (0.003)
Annual Return * 1994		0.124 (0.003)

Notes: Regressions are robust regressions and include a full set of year dummies.

Table VIII

Composition of CEO compensation ($1,000s), assuming stock price performance at each decile[1] (1980): 1 year

deciles	10	20	30	40	50	60	70	80	90
A: % Change in Stock Price	-27.6	-15.3	-7.0	-.01	5.9	12.8	20.5	30.5	47.9
B: Mean Compensation									
salary and bonus	655	655	655	655	655	655	655	655	655
option grants	155	155	155	155	155	155	155	155	155
other comp.	61	61	61	61	61	61	61	61	61
restricted stock grant	0	0	0	0	0	0	0	0	0
Increase in value of:									
options	(240)	(140)	(66)	(0.1)	57	126	204	308	495
stock	(3,025)	(1,604)	(643)	169	850	1,649	2,540	3,694	5,711
Total Compensation	(2,394)	(873)	163	1,040	1,779	2,647	3,616	4,874	7,077
C: Median Compensation									
salary and bonus	567	567	567	567	567	567	567	567	567
option grants	0	0	0	0	0	0	0	0	0
other comp.	13	13	13	13	13	13	13	13	13
restricted stock grant	0	0	0	0	0	0	0	0	0
Increase in value of:									
options	0	0	0	0	0	0	0	0	0
stocks	(247)	(123)	(37)	16	86	161	238	339	515
Total Compensation[2]	242	327	470	727	969	1,112	1,290	1,477	1,836

Notes: 1) Salary, bonus, option grants, other compensation and restricted stock grants are all assumed to be invariant to firm performance.
2) This is the median of the sum which does not equal the sum of the medians.
3) Numbers are in 1994 dollars.

Table IX

Change in Four Sensitivity Measures Over Time
Sensitivity measures are based on changes in the value of holdings of stock and stock options only

Year	Median Elasticity (1)	Median Change in CEO Wealth per $1000 Change in Firm Value (2)	Median 10th to 90th Dollar Change (Millions of Dollars) (3)	Median 50th to 70th Dollar Change (Millions of Dollars) (4)
1980	1.17	2.51	1.396	0.281
1981	1.40	2.70	1.631	0.323
1982	1.50	2.86	1.676	0.334
1983	1.71	3.35	2.097	0.415
1984	2.02	3.21	2.671	0.523
1985	1.91	3.46	2.881	0.569
1986	2.26	3.84	3.318	0.654
1987	2.42	3.97	3.885	0.761
1988	2.33	3.63	3.931	0.770
1989	2.81	4.11	4.517	0.887
1990	3.10	3.64	5.297	1.034
1991	2.68	4.22	4.424	0.873
1992	3.61	4.63	6.773	1.333
1993	3.99	5.30	7.929	1.560
1994	3.94	5.29	9.237	1.823

Notes: Columns (3) and (4) are in 1994 dollars.

Table X

Do CEOs Ever Lose Money?

Years	S&P 500 Stock Return	Percent of CEO Sample with Decline in Wealth	Median Stock Return for Firms with Decline in Wealth	Mean Wealth Loss of CEOs with a Decline in Wealth (Millions of Dollars)	Median Wealth Loss of CEOs with a Decline in Wealth (Millions of Dollars)
1994	0.020	24.0	-0.181	12.82	3.10
1993 through 1994	0.126	15.0	-0.192	47.75	4.96
1992 through 1994	0.226	10.0	-0.326	74.30	14.63
1991 through 1994	0.564	3.5	-0.347	23.83	27.41
1990 through 1994	0.551	5.0	-0.273	64.27	29.89

Notes: Sample consists of the 200 CEOs in our data set who were CEO for all 5 years from 1990 to 1994.

Appendix Table I

Risk Aversion and CEO Stock Holdings

CEO Wealth = $20 Million

A. Certainty equivalent of initial wealth, assuming CEO takes on risk of buying a percentage of the firm

CEO buys:	Standard Deviation (σ)	Coefficient of Relative Risk Averson (γ)					
		1	2	3	4	5	10
.85%	$6.5 million	$18.7 m	$14.1 m	$2.79 m	$0.92 m	$0.55 m	$0.21 m
1.7%	$13 million	$12.7 m	$1.38 m	$0.40 m	$0.25 m	$0.20 m	$0.14 m
.425%	$3.25 million	$19.7 m	$19.4 m	$19.1m	$18.8 m	$18.4 m	$15.8 m

B. Certainty equivalent as a percentage of wealth

.85%	$6.5 million	93.5%	70.5%	14.0%	4.6%	2.8%	1.1%
1.7%	$13 million	63.5%	6.9%	2.0%	1.3%	1.0%	0.7%
.425%	$3.25 million	98.5%	97.0%	95.5%	94.0%	92.0%	79.0%

Notes: Certainty equivalents based on 50,000 draws. Assumes that CEO wealth never falls below $100,000.

Figure I

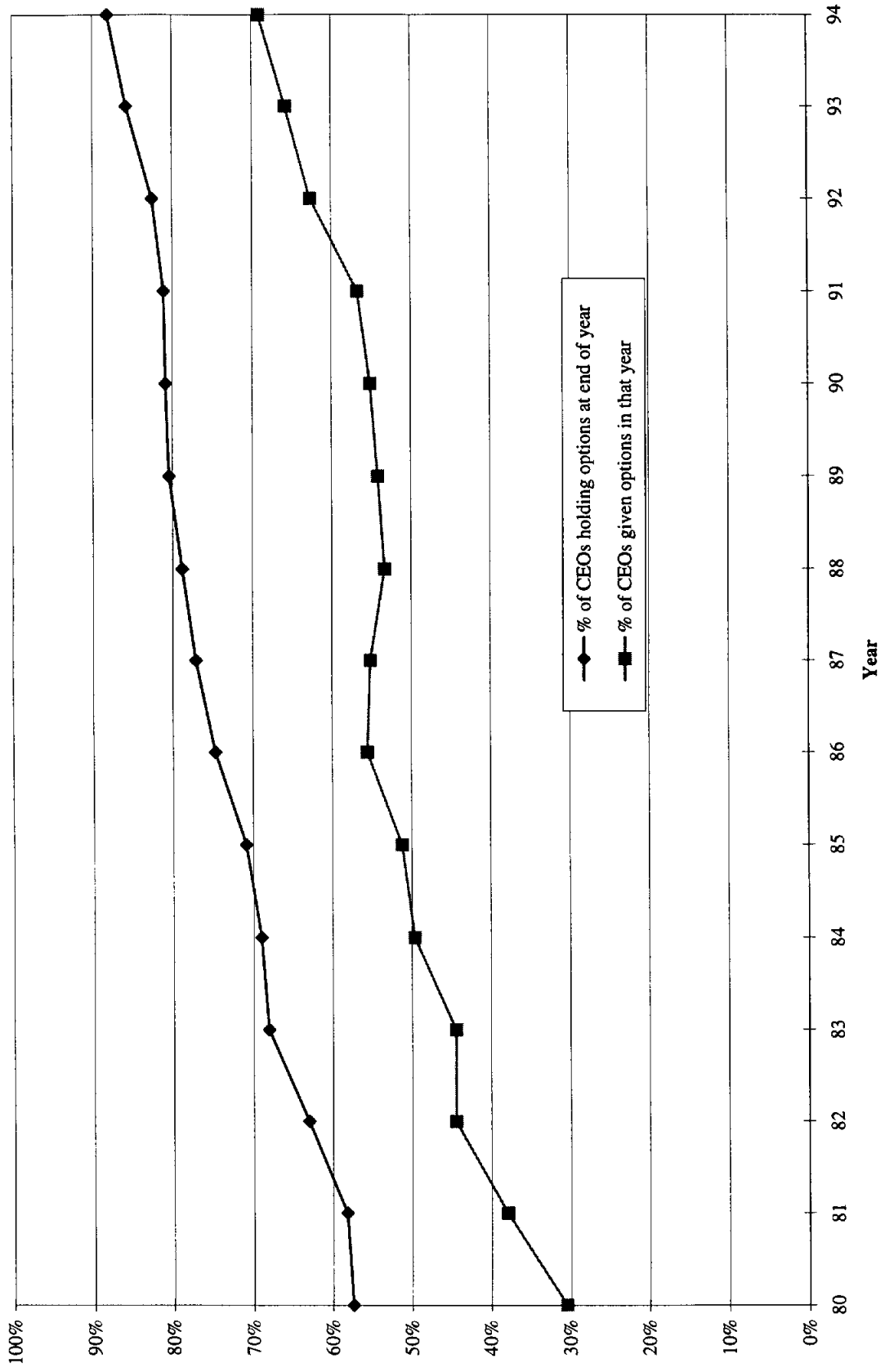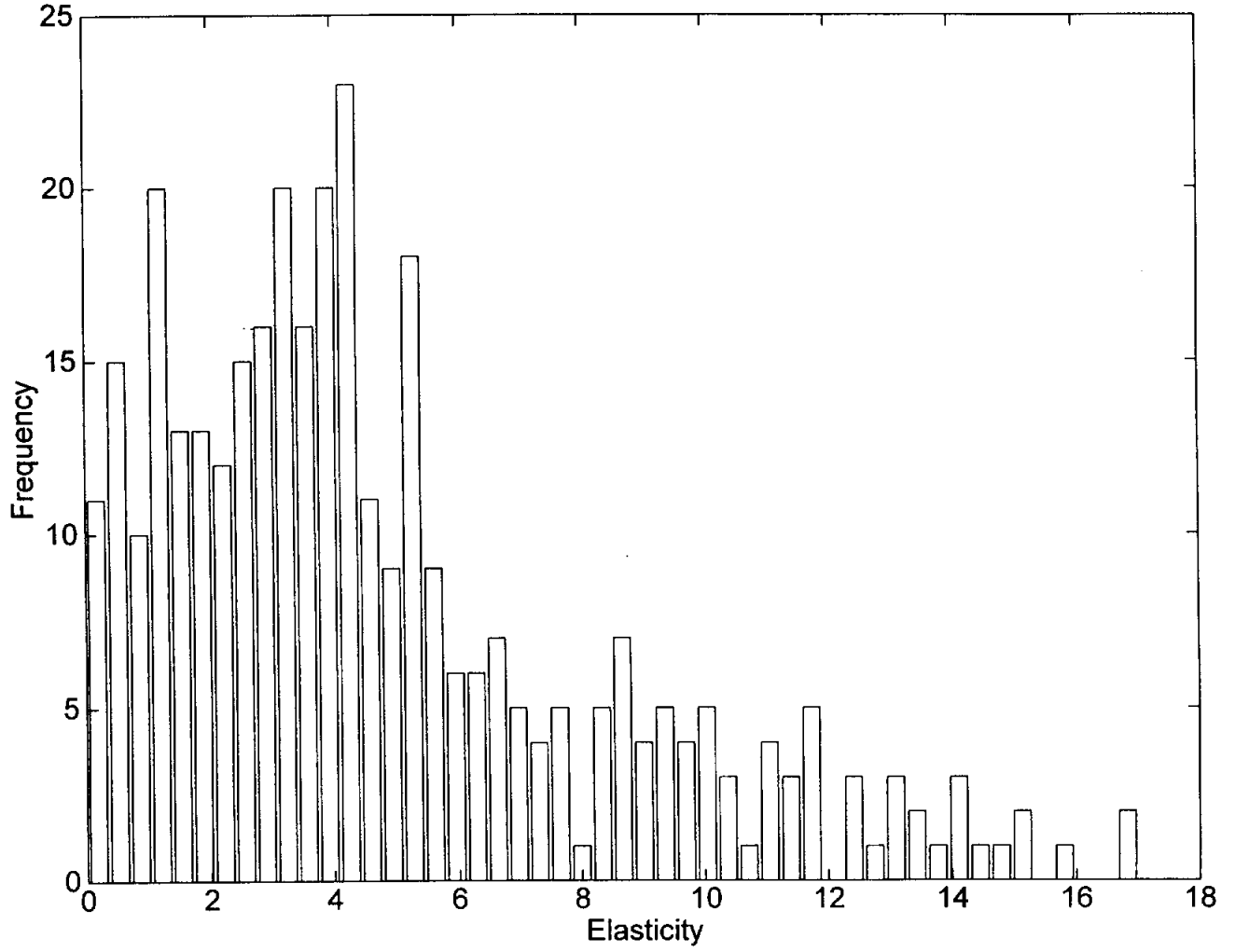## CEO Compensation with Stock Options (1980-1994)

Legend:
- —◆— % of CEOs holding options at end of year
- —■— % of CEOs given options in that year

Year

Figure II

Distribution of Elasticities (1994)

(Percent change in CEO compensation / percent chance in firm market value)