CEO Compensation: Trends, Market Changes, and Regulation

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C ompensation figures for the top managers of large firms are on the news frequently. Newspapers report the salaries, the bonuses, and the profits from selling stock options of the highest paid executives, often under headlines suggesting excessive levels of pay or a very weak relation of pay to the performance of the firms.[1] Especially after the fraud scandals at Enron and other important corporations around the world, executive performance and pay have been carefully scrutinized by the public.

Academic economists, however, have long ago recognized the importance of understanding the issues involved in determining executive pay and have been studying them for decades. In short, the main economic problem behind executive compensation design is that firm owners need to align the incentives of the executives to their own interests—typically to maximize firm value. To achieve this alignment, the compensation of the manager is usually made contingent on the performance of the firm. While in the largest firms executive compensation typically represents a small fraction of the total firm value, the decisions that a top executive makes can be potentially important for firm performance. Therefore, the way in which the dependence of compensation on firm performance is structured can have a significant impact on the added value that the executive brings to the firm. There is by now a large body of academic studies that document practices in executive pay and study the

[1] Some recent examples, following the release of an Associated Press study for 2007, include Beck and Fordahl (2008a, 2008b) and Associated Press (2008).

optimal design of compensation contracts. Some of the most important and recent findings in the literature are summarized in this article.

In Section 1, I present the various instruments commonly used to compensate executives and the main empirical regularities about executive pay. Over the last two decades, the average pay of a chief executive officer (CEO) working in one of the 500 largest firms in the United States has increased six-fold. This increase has occurred simultaneously with a change in the composition of pay of these CEOs, moving away from salary and increasingly toward performance-based compensation in the form of stock grants and stock option grants. This shift has resulted in a clear increase in the sensitivity of the total pay of CEOs to the performance of their firms. Although the increase in the level and the sensitivity are most likely related, I separate the discussion into two sections for a more detailed exposition of the evidence and a discussion of possible explanations.

In Section 2, I summarize how the level of pay has evolved since 1936. Then I briefly review some of the explanations in the academic literature for the sharp increase in the last two decades. I focus on a recent strand of the literature that has built on ideas from the classic papers of Lucas (1978) and Rosen (1981, 1982) that model firms' competition for the scarce talent of managers. These studies argue that the sharp increase in firm size and value of the last decades could be important to explain the six-fold increase in the level of CEO pay over the same period.

In Section 3, I focus on how the pay of CEOs depends on their performance. I introduce several measures of sensitivity of the CEO's pay to the results of the firm that are widely used in the literature. The empirical studies provide a wide range of estimates for sensitivity, but there is consensus about two facts: an increase in sensitivity over the last two decades and a negative relation of sensitivity with firm size (as measured by market capitalization value). I discuss some of the recent explanations for these regularities. Many of the explanations are based on studying the interaction between the manager and the owners of the firm as a moral hazard problem. In the model, shareholders minimize the cost of bringing the (risk averse) CEO to exert an unobservable effort that improves the results of the firm. This analysis is typically performed in partial equilibrium and aims to describe the form of optimal compensation contracts, i.e., the optimal sensitivity of pay to firm performance. Some recent studies suggest that a seemingly low sensitivity of pay to performance, as well as the negative relation between sensitivity of pay and firm size, could be features of dynamic optimal contracts that are used to solve the moral hazard problem. Also in this moral hazard framework, several recent articles demonstrate the efficiency of some seemingly unintuitive pay practices that are often discussed by the media, such as bonuses in bad earning years or repricing of out-of-the-money options. The level of market competition across firms, as well as the relative demand of general

versus firm-specific skills, has also been shown to be empirically significant in explaining pay trends.

In Section 4, I describe the main regulatory changes affecting executive compensation in the last 15 years: changes in personal, corporate, and capital gains taxes; new limits on the deductibility of CEO pay expenses that favor performance-based compensation; an increase in the disclosure requirements about CEO pay; a standardization of the expensing of option grants; and several initiatives fostering shareholders' activism and independence of the board of directors. Amidst the headlines on excessive pay, the popular press has been debating these changes in regulation, their potential role in the recent rise in pay, and the need for new government intervention.[2]

To shed some light on the role of regulation, I review the findings of academic studies that have rigorously tried to quantify the effect of several specific measures on the level and sensitivity of compensation. As it turns out, these studies find little evidence of a sizable effect on pay practices coming from tax advantages or salary caps. Following the main regulatory changes, some studies find evidence of a small shift of compensation from salaries and bonuses toward performance-based compensation (stocks and options), which translates into a slight increase in the sensitivity of pay to performance. Better corporate governance and the increase in the proportion of institutional shareholders appear to be associated with higher company returns and higher incentives for CEOs. This suggests that regulation efforts to improve corporate governance and transparency have been moving in the right direction, although it is difficult to evaluate the relative importance of regulation versus the market-induced changes in governance practices.

Designing executive compensation packages is, no doubt, complicated. Judging the appropriateness of those packages is, consequently, a very difficult task in which models and sophisticated econometric tools are a necessity. I now proceed to review the most recent attempts at this task and their conclusions.

1. UNDERSTANDING AND MEASURING CEO COMPENSATION

Today companies pay their top executives through some or all of the following instruments: a salary, a bonus program, stock grants (usually with restrictions

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[2] On one hand, in the most recent special report on CEO compensation published by the *Wall Street Journal* (2008), one of the articles is dedicated to the unintended consequences of regulation changes. On the other hand, the "say on pay" proposals, which seek to force boards of directors to have a (nonbinding) vote on the compensation plan that they design for a CEO, have been receiving particular attention in the press—see *The Economist* (2008b, "Pay Attention") on the recent trend of pay in Europe and the regulation responses of some European governments, and *The Economist* (2008a, "Fair or Foul") on the "say on pay" proposals both in Europe and the United States, which cites both U.S. presidential candidates as being in favor of forcing the shareholders' vote.

on the ability to sell them), grants of options on the stock of the firm, and long-term incentive plans that specify retirement and severance payments, as well as pension plans and deferred benefits. The most accepted explanation for these variable compensation instruments is the existence of a moral hazard problem: The separation of ownership and control of the firm implies the need to provide incentives to the CEO that align his interests with those of the firm owners. In the presence of moral hazard, the optimal contract prescribes that the pay of the executive should vary with the results of the firm. However, in spite of the need for incentives, limited funds on the part of CEOs or risk aversion considerations imply that exposing the CEO to the same risk as shareholders is typically either an unfeasible or inefficient arrangement. The optimal contract should balance incentives and insurance. Therefore, part of the compensation should be variable and could be provided through stock or stock options, while part of the compensation, such as the annual salary, should not be subject to risk, providing some insurance to the CEO against bad firm performance due to factors that he cannot control.

Data on the level of annual compensation of workers classified as CEOs are available from the Bureau of Labor Statistics (BLS). These are wages representative of the whole economy. However, details are not available on the specific forms of the contract (i.e., the compensation instruments that were used in providing that compensation). Data from the BLS show that the average CEO earns an annual wage of \$151,370 (May 2007)—less than the average doctor (internist) and about \$25,000 more per year than a lawyer. The annual wage of the average CEO today is about 3.5 times that of the average worker in the economy, and the evolution of this comparison over the last seven years has followed a similar pattern as that of other white-collar professions. However, the distribution of wages of CEOs is extremely skewed. Figure 1 shows the evolution of the total level of pay for the CEOs of the 500 largest firms in the economy, according to the figures in *Forbes*, a magazine that publishes surveys of top CEO pay annually. The average annual wage of this sample of executives in 2007 was about \$15 million, approximately 300 times that of the average worker in the U.S. economy.

For the top 500 firms, information about CEO pay is readily available. Since these companies are public, they file their proxy statements with the Securities and Exchange Commission (SEC), making their reports on their top executives' compensation public. Most academic studies restrict themselves to studying the compensation of the CEOs in this subsample of firms. Therefore, I too concentrate on this subsample in the rest of the article. From this point on, the acronym "CEO" refers to the chief executive officer of one of the top 500 firms in the United States.

Figure 1 also shows the evolution of the three main components of CEO pay from 1989 to 2007. Stock gains refers to the value realized during the given fiscal year by exercising vested options granted in previous years. The

Figure 1 Compensation Data Based on *Forbes* Magazine's Annual Survey (2007 Constant Dollars)
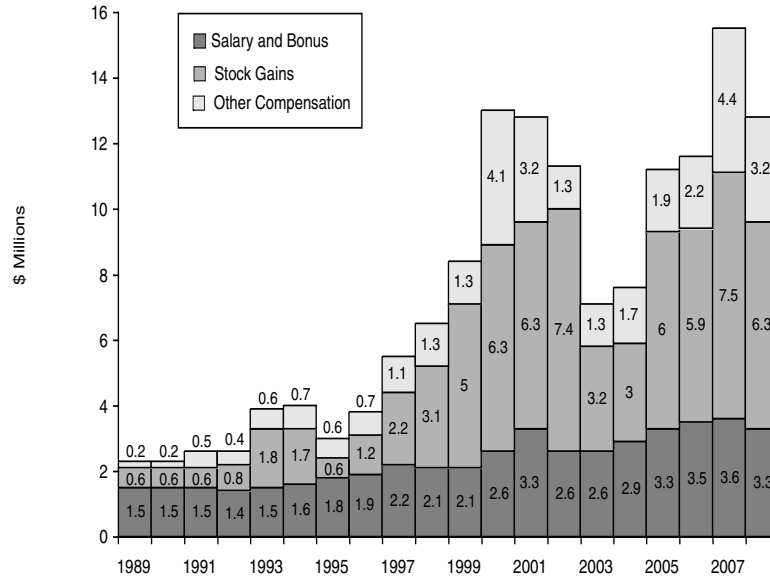

gain is the difference between the stock price on the date of exercise and the exercise price of the option. Other compensation includes long-term incentive payouts and the value realized from vesting of restricted stock and performance shares, and other perks such as premiums for supplemental life insurance, annual medical examinations, tax preparation and financial counseling fees, club memberships, security services, and the use of corporate aircraft. The main trend that we observe in this figure is that, although annual salaries have been increasing, the proportion of total pay that they represent has decreased in the last 20 years, while compensation through options has become the most important component, increasing from a low of 35 percent to 77 percent. The total levels of pay have risen six-fold.[3]

The shift of compensation practices toward options and restricted stocks has one immediate implication: the total compensation of the CEO is now

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[3] The data is from *Forbes* magazine's annual survey. Prior to 1992, the data on options is a record of the gains from exercise. After 1992, *Forbes* records the value of the option grants at the date of granting, using the valuation method that the firm uses in its proxy statement. This method is mostly the Black and Scholes formula, for which the company reports the parameters as established in the SEC disclosure rules of 1993. See Section 4 of this article on regulation.

Also, note that good data on pensions is not available and most studies leave it out of their analysis.

Figure 2 Annual Compensation (*Forbes* Magazine) and Dow Jones Industrial Average During the Previous Year
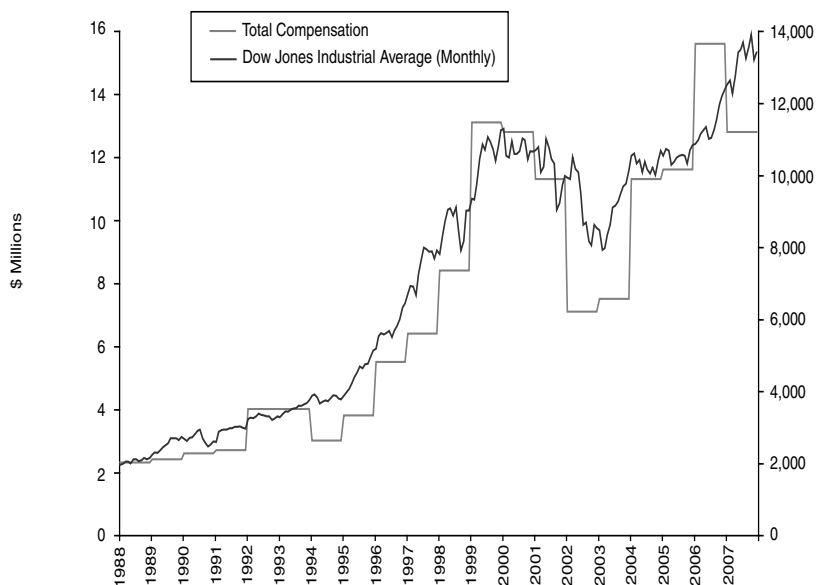
more closely tied to the performance of the firm than it was in the 1980s. In Figure 2, I plot the *Forbes* measure of total compensation from Figure 1, together with the Dow Jones Industrial Average during the previous year, as an approximation for the average performance of the firms managed by the CEOs included in the compensation surveys. Apparently, on average, the compensation of top CEOs is closely correlated with the performance of the top firms that they manage. A more detailed analysis is needed to determine this relation at the individual firm level. In the next two sections, I review the empirical literature that has performed a detailed analysis, documenting the trends in the level and sensitivity of pay. In a widely cited paper, Jensen and Murphy (1990a) studied changes in compensation facts from 1974 to 1986. Following this paper, many studies on pay have been published. Rosen (1992) provided a first survey of the empirical findings on CEO compensation and Murphy (1999) is a very complete survey of the literature in the 1990s. The general picture, according to the most recent studies, is that the rates of growth in the level of CEO pay have increased dramatically since the 1980s, but pay has become, over the same period, more closely linked to firm performance. I present the evidence in two separate sections, one focusing on the level of pay and one on the sensitivity of pay—although, as will become clear

Table 1 Median CEO Pay

Period	Median CEO Pay (Million $)	Avg. Annual Growth Rate
1936–1939	1.11	
1940–1945	1.07	−0.01
1946–1949	0.90	−0.04
1950–1959	0.97	0.01
1960–1969	0.99	0.00
1970–1979	1.17	0.02
1980–1989	1.81	0.04
1990–1999	4.09	0.08
2000–2005	9.20	0.14

Source: Frydman and Saks (2007). CEO pay is in constant year 2000 dollars.

from the discussion, the two features are related through risk and incentive considerations.

2. THE LEVEL OF PAY

The bulk of the literature on CEO compensation (see Jensen, Murphy, and Wruck 2004; Frydman and Saks 2007; Gabaix and Landier 2008) has documented that, after moderate rates of growth in the 1970s, CEO pay rose much faster in the most recent decades. Total compensation reached a median value of $9.20 million (in 2000 constant dollars) in 2005. Frydman and Saks (2007) present previously unavailable historical evidence starting in the 1930s. They find that compensation decreased sharply after World War II and it had a modest rate of growth of about 0.8 percent for the following 30 years. Hence, the recent growth in pay (see Table 1 and Figure 1), with annual growth rates above 10 percent in the period 1998–2007, represents a remarkable change from previous trends.

In the first subsection, I review some estimations of the relevance and appropriateness of the levels of CEO pay that we observe today. I follow with a subsection on the proposed explanations for the time trends of the level of pay in the last century, which are divided into two groups: theories based on competitive markets and optimal contracts and theories based on inefficient practices.

Are Today's Levels of Pay Justified?

According to some recent studies, the cost of CEO compensation for firms may not be so economically significant. However, the economic consequences of not providing the right incentives appear to be potentially large. Gabaix and

Landier (2008), for example, report an average value of CEO pay over firm earnings of 0.5 percent during the period 1992–2003. Margiotta and Miller (2000), relying on a moral hazard model and historical data on compensation contracts of 34 firms from 1948 to 1977, find that companies benefit highly from providing the right level of incentives (ranging from $83 million to $263 million in 1977 dollars, depending on the industry). The observed contracts in their sample, however, imply a modest cost of providing incentives to induce high effort (about $0.5 million in 1967 dollars).[4] More recently, Bennedsen, Pérez-González, and Wolfenzon (2007) use data from Danish firms from 1992 to 2003 to estimate the effect of the CEO's death on firm performance. They find that the industry-adjusted operating returns on assets decrease by 1.7 percent following the absence of the CEO. They also report a decrease of 0.7 percent after a close family member of the CEO passes away. Both measures indicate the importance of CEO input into the performance of the firm, either through effort, talent, or both. Using a competitive model, Terviö (2008) estimates the talent distribution for CEOs and finds that if the managers of the 1,000 largest U.S. companies in 2004 had been substituted by a CEO of the same talent as that of the 1,000th company, the combined value of those companies would have been between $21.3 billion and $25 billion lower. His calculations imply that the contribution of the talented CEOs (net of pay) was between $16.9 billion and $20.6 billion (approximately 15 percent of the total market capitalization of the largest 1,000 firms), while the combined payments to the 1,000 CEOs that year were $7.1 billion.

Explanations for the Increase in the Level of Pay

The widely documented increase in the level and sensitivity of pay in the past two decades has motivated research efforts to construct robust explanations for these trends. Gabaix and Landier (2008) argue in a recent influential article that the six-fold increase in pay since the 1980s can be explained by the six-fold increase in the market value of U.S. firms in the same period. Building on work by Lucas (1978) and Rosen (1981, 1982), Gabaix and Landier's model presents a competitive economy in which firms compete for a manager's talent.[5] In their characterization of the equilibrium, they show that the wage of the CEO increases both with the size of the firm and the average size of the firm in the economy. Using extreme value theory, they calibrate the distribution for a manager's talent and combine this with a calibration of the size distribution of firms. Their results are consistent with the findings of Terviö (2008), who

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[4] Margiotta and Miller (2000) use exponential utility specifications in their empirical estimations, for which incentive considerations are independent of the level of wealth.

[5] See Prescott (2003) for a related model.

independently used a competitive model to estimate the distribution of CEO talent that does not rely on extreme value theory.

Although the model in Gabaix and Landier (2008) can explain trends in CEO compensation since the 1980s, recent evidence in Frydman and Saks (2007) challenges their hypothesis for earlier periods. Frydman and Saks provide a comprehensive empirical account of the evolution of CEO pay in the last century. Their database includes previously unavailable data for the period 1936–1992, hand-collected from the 10-K filings of firms with the SEC. They study an unbalanced panel of 101 firms, selected for being the largest according to market value at three different dates. They find, consistent with previous work, that the increase in CEO pay was moderate in the 1970s and picked up in the last three decades. However, their new historical evidence starting in the 1930s shows that prior to the mid-1970s, while the level of pay was positively correlated with the relative size ranking of the firm in the economy, the correlation between changes in the market value of firms and the changes in the level of compensation was very weak. In particular, their data shows that CEO pay was stagnant from the 1940s until the 1970s, a period during which there was considerable growth of firms—particularly during the 1950s and 1960s.

Some authors in the literature have departed from the usual modeling approach by proposing that the observed contracts are in fact suboptimal. The following are three representative proposals of this sort.

Misperception of the Cost of Options

Murphy (1999) and Jensen, Murphy, and Wruck (2004) have argued that the significant increase in the use of option grants in recent years can be explained in part by the fact that compensation boards do not correctly valuate the cost of granting options. They argue that the tax and accounting advantages of options make it an attractive method of compensation.[6] They claim that, in fact, options are an expensive way of compensating the CEO: risk aversion, combined with the impossibility of hedging, as well as the high percentages of human and monetary wealth that CEOs invest in their own firm, and the positive probability of being unable to exercise the options if they are fired before the options become vested, all imply that managers ought to demand a high risk premium for the options. Thus, while firms are experiencing a cost that is well approximated by the Black-Scholes value of the grants disclosed in the proxy statements and listed in the executive compensation databases, CEOs highly discount their value. Hall and Murphy (2002) explicitly model these issues and provide calculations on how the CEO's risk aversion influences the

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[6] Recent changes in regulation extend the expensing requirements to grants that have an exercise price equal to or above the market price at the time of granting.

valuation of the stock grants. They find that the increase of "risk-adjusted" pay from 1992 to 1999 has not been nearly as dramatic as that of total pay figures taken at face value.

Ratchet Effect

Murphy (1999) provides a description of how firms decide on the annual option grant to be awarded to executives. He points to the fact that firms typically use a measure of the average compensation given to executives in a peer group for reference. His data also indicates that 40 percent of firms have compensation plans that specify the number of options to be granted, fixed for several years, as opposed to the value of the options. In times of a growing stock market, such as the late 1990s, these two compensation practices together would result in a "rachet effect"—an escalation in total pay based on mutual benchmarking, as opposed to rewarding exceptional performance of the individual CEOs.

Entrenchment

Bebchuck and several coauthors (see, for example, Bebchuck and Fried [2003, 2004] and references therein) have argued that there is ample evidence suggesting that executives control the boards of directors and effectively determine their own pay. Kuhnen and Zwiebel (2008) provide a formal model of this hypothesis, which presents the problem of the manager maximizing his own pay subject to an "acceptable" outrage level of the shareholders. The mainstream literature accepts that some incentive problems remain unsolved given the current compensation and corporate practices in effect (see Holmström and Kaplan 2003 or Jensen, Murphy, and Wruck 2004). Yet, there is no consensus on whether the entrenchment model is a better description of real life than the classic moral hazard model, which has shareholders maximizing their value subject to the incentive constraints of CEOs (see Grossman and Hart 1983). It is also worth noticing that the entrenchment explanation per se does not help in understanding the upward trend in the level of pay observed in the last 15 years, since corporate governance practices have been improving during this period (see Holmström and Kaplan 2003).

3.   THE SENSITIVITY OF PAY TO PERFORMANCE

The literature on CEO compensation uses the term "sensitivity of pay to performance" to refer to the changes in the total pay of a CEO that are implied by a given measure of the performance of the firm. The most common measure of firm performance used in the empirical estimations of the sensitivity of pay is the change in the value to shareholders, i.e., stock price change. Theoretical studies based on moral hazard models have shown that the design of the optimal compensation scheme is a complicated task. The way in which the level

of risk aversion of undiversified CEOs decreases with their wealth (which may originate both from their firm pay and from outside sources), for example, has not been well established empirically (Haubrich 1994). Also, finding empirical evidence on the parameters of the model is difficult: How does the hidden action of the CEO affect the results of the firm and how costly is this action to the CEO? These considerations make it difficult to assess quantitatively the optimal sensitivity of direct pay. Moreover, the sensitivity itself is difficult to estimate empirically, since the pay of the CEO changes with firm performance both through direct and indirect channels: The competition for talented CEOs in the market, for example, implies that career concerns and the risk of being fired impose some incentives on the executives that are not captured by their compensation contracts.

In the first subsection, I review the academic work that attempts to quantify the incentives provided through direct pay. In the second subsection, I review the work that quantifies incentives through indirect pay, consisting mainly of studies that document historical trends of the probability of employment termination for CEOs. Although there is no agreement in the literature about the right measure of sensitivity, two stylized facts are widely accepted: total (direct plus indirect) sensitivity of pay has been increasing in the last two decades and sensitivity is negatively correlated with firm size. In the third subsection, I review some of the proposed explanations for these stylized facts, as well as several models that justify the diversity of instruments in real life compensation packages.

Sensitivity of Direct Pay

In an influential paper, Jensen and Murphy (1990a) point out the seemingly low sensitivity of executive pay to performance: an increase in total wealth of $3.25 for each $1,000 of increase in the firm value. This measure of sensitivity is, in the data, highly negatively correlated with the size of the firm. As an alternative that allows for variation of the Jensen and Murphy (1990a) measure across firm size, other studies have estimated the elasticity of pay to firm performance. For both measures, a sharp increase in the sensitivity of pay over the last two decades has been widely documented: estimations suggest an increase in sensitivity of more than five times over that period.

I now describe in detail each of the two measures and the main findings, including a discussion of the regularities with respect to firm size.

The Jensen-Murphy Statistic

Jensen and Murphy (1990a) use data on compensation of approximately 2,000 CEOs of large corporations collected by *Forbes* magazine from 1974 to 1986. In their paper, they focus on a particular measure of pay sensitivity to

performance: They estimate how a $1,000 change in the value of a firm translates into dollar changes in the wealth of its CEO. This measure of sensitivity is often reported in the literature as the Jensen-Murphy statistic.

In their paper, they run regressions of the form

$$\Delta w = \alpha + \beta \left(\Delta V \right) + \theta \left(CONTROLS \right), \tag{1}$$

where ΔV includes lagged as well as contemporaneous measures of changes in the dollar value of the firm. They report that the median CEO in their sample experiences an increase in his total wealth of $3.25 for each $1,000 of increase in the value of the firm he manages. Of this change in wealth, 2 cents correspond to year-to-year changes in salary and bonus, while the rest is because of changes in the value of the stock and option holdings of the CEO, the effect of performance on future wages and bonus payments, and the wealth losses associated with variations in the probability of dismissal. The authors qualify this sensitivity of pay as "low" and inconsistent with the predictions of any agency model. Murphy (1999) updates these estimates using Execucomp data up to 1996 and reports an increase in the sensitivity of pay to $6 per $1,000 by that year.

Garen (1994) and Haubrich (1994) point out that the seemingly low estimates of Jensen and Murphy are consistent with optimal incentives in the presence of moral hazard if the right parameters of risk aversion are chosen for the specific functional forms. Garen (1994) presents a static moral hazard model with closed forms solutions and, as an alternative test for the theory, derives comparative static predictions, which do not rely on the particular values of parameters and are more robust to functional form specifications. He concludes that most implications of moral hazard are consistent with the data. In the same spirit, Wang (1997) provides a computed solution to a dynamic agency (repeated moral hazard) model that, under a reasonable range of parameters, is able to replicate the low sensitivity of pay results in Jensen and Murphy (1990a). The model shows that deferred compensation is sometimes a more efficient way of providing incentives than current pay because of incentive-smoothing over time.

Changes in Sensitivities with Firm Size

The Jensen-Murphy statistic has been documented to be very different across different firm size subsamples: Jensen and Murphy (1990a) divide their sample according to market value and find a total pay sensitivity value of $1.85 for the subsample of larger firms versus $8.05 for that of smaller firms.[7] Updates of this measure provided in Murphy (1999) suggest that the increase in median pay sensitivity from 1992 to 1996 was a lot higher for large firms than

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[7] See, also, Jensen and Murphy (1990b).

for smaller ones (64 percent [from \$2.65 to \$4.36] for the largest half of the S&P 500, 5 percent [from \$7.33 to \$7.69] for the smallest half of the S&P 500, 28 percent [from \$12.04 to \$15.38] for the S&P Mid-Cap corporations, and 24 percent [from \$22.84 to \$28.23] for the S&P Small-Cap corporations). Garen (1994) also finds a negative relationship between sensitivity of pay and firm size. Schaefer (1998) finds that the Jensen and Murphy (1990a) measure is approximately inversely proportional to the square root of firm size. Recent estimations of this measure use quantile regressions to prevent estimations from being driven by big firms in the samples.[8]

The literature agrees that the Jensen-Murphy measure is adequate for firms in which the marginal effect of effort is independent of firm size. However, it has been repeatedly pointed out that it does not correctly capture incentives when the marginal product increases with firm size. Baker and Hall (2004) propose a model that relates compensation to the marginal product of the CEO. They confirm the previous estimates of decreasing sensitivity of pay to firm size and they identify higher marginal products of CEOs working in bigger firms as the main cause.[9] Their model implies that, although the Jensen and Murphy (1990a) measure of sensitivity falls sharply with firm size, the total incentives of CEOs remain constant or fall only slightly since the effect of CEOs' actions increases with firm size. A similar assumption is used in the competitive market model of Edmans, Gabaix, and Landier (forthcoming), in which the effort cost for the CEO is bounded above, but his marginal impact depends on the size of the firm he manages.

Elasticity of Pay to Firm Value

An alternative measure of sensitivity of pay is the elasticity of compensation to performance: the percent increase in executive wealth for a 1 percent improvement in the performance of the firm. Note that assuming a constant elasticity across firms implies variation in the Jensen-Murphy statistic across firm sizes.

A convenient way of estimating the elasticity of pay to firm performance is to regress the logarithm of earnings on the return of the firm's stock:

$$\ln w_t = a + \widetilde{b} \times r_t. \tag{2}$$

Then $\widetilde{b} = d(\ln w)/dr$ measures the semi-elasticity of earnings to firm value and the elasticity is recovered for each particular return value as approximately $b = r\widetilde{b}$. Initial estimates of the semi-elasticity of cash compensation (salary and bonus) to stock returns, surveyed in Rosen (1992), had reported

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[8] See, for example, Murphy (1999) and Frydman and Saks (2007).

[9] This is consistent with the hypothesis that more talented CEOs work for bigger firms, as mentioned in Rosen (1992). See, also, the competitive market for talent models of Gabaix and Landier (2008) and Terviö (2008) reviewed later in this article.

a median value for b of about 0.10—an increase in a firm's return of 10 percent ($\Delta r = 0.1$) implies a 1 percent increase in pay.[10] Using average values for w and r, Rosen (1992) reports that these semi-elasticity values imply a Jensen-Murphy statistic for cash compensation (salary plus bonus) of 10 cents, compared with their finding of 2 cents.[11] He concludes that lower sensitivities of pay at bigger firms probably influence the Jensen-Murphy estimation, especially since they do not log the compensation figures.

Hall and Liebman (1998) provide estimates of the elasticity of compensation using detailed data on CEO pay from 1980 to 1994. To correctly estimate the elasticity and several other measures of sensitivity of pay (including the Jensen-Murphy statistic), they collect data on stock and options grants from the proxy statements of firms. They construct the portfolio of stock and options for each CEO in their databases in 1994: This way they can include in their measure of total pay the variation in the wealth of the CEO because of the changes in the price of the firm's stock.[12] Also, they can evaluate the potential changes in wealth for different realizations of the stock price (the ex ante sensitivity of pay). Since changes in the wealth of the CEO are sometimes negative because of the decrease in the value of their stock holdings, Hall and Liebman cannot directly run the regression in (2) to calculate the semi-elasticity. Instead, with information both on current total compensation as a function of the firm's return in 1994, $w(r_t)$, and on the distribution of annual stock returns, they predict changes in compensation for a given change in firm return, a hypothetical $\widetilde{w}(r_{t+1})$. With this predicted total compensation measure, they calculate the semi-elasticity directly from the formula

$$\frac{\widetilde{w}(r_{t+1}) - w(r_t)}{w(r_t)} = \widetilde{b} \times (r_{t+1} - r_t).$$

In their data for 1994, Hall and Liebman evaluate the effects of a typical change in firm return: from a median performance ($r = 5.9$ percent) to a 70th percentile performance ($r = 20.5$ percent), which implies a 14.6 increase in r.[13] For this typical change, they calculate the semi-elasticity for each CEO

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[10] Rosen (1992) points out the discrepancy of the findings in the literature with those of Jensen and Murphy. The sensitivity of salary and bonus in Jensen and Murphy (1990a) is 1.35 cents for $1,000. This number implies an elasticity at the mean firm size of 0.0325; equivalently, an elasticity of 0.1 translates into a change of 10 cents per $1,000 increase in firm value. Rosen attributes these differences to functional forms and to the sensitivity measure, which is dominated by the large firms' observations, with significantly lower sensitivities.

[11] Rosen (1992) uses an average value for w/V of 10^{-3}. Following his calculations, the Jensen-Murphy statistic from equation (1) is $\beta \approx b\frac{w}{V}$.

[12] Jensen and Murphy (1990a) also include in their total compensation measures the changes in the wealth of the CEO attributable to his holdings of stocks and options. Their sample, however, ends in 1983, before the significant increase in option grants that is captured in the Hall and Liebman (1998) sample up to 1994. Moreover, the sample in Jensen and Murphy (1990a) is from *Forbes* 800 and includes the value of exercised options as opposed to the value of options at the time of granting. After 1992, Execucomp started collecting this information.

[13] The median standard deviation of r is about 32 percent in their data.

in their data set:

$$\widetilde{b} = \frac{\frac{\widetilde{w}(0.205) - w(0.059)}{w(0.059)}}{0.146}.$$

The implied mean elasticity is 4.9 and the median is 3.9. Hall and Liebman also compute the Jensen-Murphy median sensitivity based on variation in stock and options only: they find a value of $6, compared to $3.25 reported in Jensen and Murphy (1990a) for the period 1974–1986.[14] They confirm the finding in Jensen and Murphy (1990a) that incentives are provided mainly through the granting of stocks and stock options. The sensitivity of salary and bonuses to firm performance is very low, while the changes in the wealth of the CEO that originate from his stock and option holdings are very big. They find a large increase in the use of option grants in the period covered by their sample, which translates into a significant increase in the sensitivity of various pay to performance measures: Between 1980 and 1994, the median elasticity went from 1.2 to 3.9, while the median wealth change per $1,000 (the Jensen-Murphy statistic) went from $2.5 to $5.3.

Indirect Sensitivity: Provision of Incentives through Career Concerns or Threat of Dismissal

Even if the total pay of a CEO was independent from the performance of his firm, the manager still would have some incentives to exert effort if the threat of dismissal was high enough or career concerns were present. Career concerns is the term used to summarize the fact that workers expect to receive offers for better paying jobs after an above-average performance. Several studies have tried to quantify the importance of these two implicit incentive channels.

Jensen and Murphy (1990a) recognize the existence of indirect provision of incentives that is implicit in the threat of dismissal of the CEO following poor performance. To account for those indirect incentives in their sensitivity measure, Jensen and Murphy provide an approximation of the wealth variations for the CEO that would follow if he were fired from his job. To estimate this wealth loss, they first estimate the probability of CEO turnover as a function of firm performance (net-of-market return in the current and previous year). They find that a CEO in a firm with average market returns in the past two years has a .111 dismissal probability, while a performance 50 percent below market returns for two years increases the dismissal probability to .175. Since they do not have information on whether the separation was voluntary

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[14] Hall and Liebman also report the mean sensitivity of pay in their sample, equal to $25 without evaluating potential changes in wealth due to the threat of dismissal. They claim that the large differences between the mean and the median values are due to the high skewness of stock and option holdings in the sample of CEOs. Jensen and Murphy (1990a) do not report mean values.

or because of retirement, these estimated values represent a rough measure of the real probability of dismissal. They also find evidence of greater effects of performance on turnover for younger CEOs and for smaller firms. They use these estimated probabilities and a simplifying assumption that a fired executive will earn a salary of $1 million elsewhere until retirement to calculate the dismissal-related wealth loss of CEOs of various ages and as a function of their net-of-market return. For example, a 62-year-old CEO would suffer a loss of 26.4 cents for every $1,000 lost by shareholders if his firm performed 75 percent below the market, as opposed to performing the same as the market.[15] The highest sensitivity they find is for younger CEOs, who would experience a loss of 89 cents per $1,000.

Subsequent studies have found an increase in job turnover probabilities in recent years, as well as evidence of the importance of relative performance as a determinant of firing decisions. Kaplan and Minton (2006) extend the analysis for the period 1992–2005, and they find an increase in the probability of turnover with respect to previous periods. They report a decrease of the average tenure of a CEO from over ten years, as reported in Jensen and Murphy (1990a), to less than seven years for the period 1992–2003 (which corresponds to a probability of turnover of 0.149). The average for 1998–2003 is significantly lower, at just over six years (a probability of 0.165), and this subperiod shows higher sensitivity to current measures of performance than in previous periods. Kaplan and Minton include in their analysis three measures of performance: firm performance relative to industry, industry performance relative to the overall market, and the performance of the overall stock market. They find that turnover initiated by boards is sensitive not only to firm performance measures but also to bad industry or economy-wide performance. They interpret this fact as indicative of a change in corporate governance since the 1970s and 1980s, when bad industry or economy-wide performance influenced CEO turnover in the form of hostile takeovers.

In a related study, Jenter and Kanaan (2006), using a new sample including both voluntary and involuntary turnovers during 1993 to 2001, confirm the results in Kaplan and Minton (2006). They find that both poor industry-wide performance and poor market-wide performance significantly increase the probability of a CEO being fired. A decline in the industry performance from the 75th to the 25th percentile, for example, increases the probability of a forced CEO turnover by approximately 50 percent, controlling for firm-specific performance. The firm-specific performance measures are also weighted by boards more heavily when the overall market and industry performance is worse.

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[15] 1986 constant dollars.

Gibbons and Murphy (1992) derive a model with explicit contracts and career concerns that builds on Holmström (1999). Career concerns represent the expectation over future wages based on the market beliefs about the quality of the CEO. They present empirical evidence that explicit incentives increase as the CEO gets closer to retirement age: for one, two, or three years left in office, respectively, they find elasticities of pay to performance of .178, .203, and .183, compared with elasticities of .119 and .116 when they have five or six years left. They interpret this evidence as support for their theoretical findings that career concerns complement the explicit incentives provided by the ties of current wealth to performance in their current employment.

Overall, the available measures of indirect sensitivity of pay to performance appear to have been increasing in the last three decades, in accord with the increase in the direct sensitivity of pay.

Explanations of Sensitivity Facts

Two main empirical regularities emerge from the studies reviewed previously. First, the sensitivity of pay is smaller for CEOs of larger firms. Second, the sensitivity of pay across all firm sizes has increased in the last two decades. In the following subsections, I review the main theoretical explanations proposed for these two facts. Finally, I include a subsection that presents justifications for a set of characteristics of real life compensation contracts. These characteristics may, to the uninformed eye, seem unappealing for the provision of incentives. The theoretical models show, however, that they may just be the optimal instruments to implement sensitivity of pay to performance.

Fact 1: The Sensitivity of Pay Decreases with Firm Size

Baker and Hall (2004) show that, in the presence of moral hazard, the sensitivity of pay optimally decreases with the size of the firm. They rely on a partial equilibrium model with multitasking and heterogeneity in the marginal productivity of the CEO as a function of the firm size. In recent work, Edmans, Gabaix, and Landier (forthcoming) extend Gabaix and Landier (2008) and present an agency model embedded in a competitive market model for talent. They propose a measure of sensitivity of pay that their theory predicts as independent of firm size: the dollar change in wealth for a percentage change in firm value, scaled by annual pay.

Fact 2: There has been an Increase in Sensitivity of Pay in the Last Two Decades

The explanations for the increase in sensitivity of pay to performance fall mostly into two categories: those that maintain that the increase has been driven by changes in firm characteristics and increased market competition

and those that maintain that the increase has been driven by an improvement in corporate governance practices.

A good example of the first category of explanations is the work of Cuñat and Guadalupe who, in a series of three papers (2004, 2005, 2006), evaluate the changes in CEO compensation following several changes in market conditions:[16] Cuñat and Guadalupe (2004) study two episodes of deregulation of the U.S. banking system and find that the increase in competition is correlated with an increase in sensitivity of pay; Cuñat and Guadalupe (2005) find that in the period following the sudden appreciation of the pound in 1996, which implied different levels of competition for tradables and nontradables, we observe an increase in sensitivity of pay for executives in the tradables sector; Cuñat and Guadalupe (2006) find, for a sample of U.S. executives, that industries more exposed to globalization (higher foreign competition as instrumented by tariffs and exchange rates) exhibit higher sensitivity of pay, higher dispersion of wages across different levels of executives, and higher demand for talent at the top, which drives up the salary of the CEO. This evidence supports the conclusions of some theoretical papers that analyze the effects of increased competition for talented CEOs. Frydman (2005), for example, presents a dynamic model of executive compensation and promotions in which the superior information of firms about their incumbent workers implies that an increase in the relative importance of general skills versus firm-specific skills triggers an increase in manager turnover, increased differences in pay among executives of different ranks of the same firm, and higher levels of pay. Frydman contrasts these implications with historical data on compensation, careers, and education of top U.S. executives from 1936 to 2003. She concludes that facts are consistent with the predictions of her model under the hypothesis of an increase in the relative demand of general skills after the 1970s.

The work of Holmström and Kaplan (2003) falls under the second (possibly complementary) category of explanations. They argue that the changes in corporate governance of U.S. firms in the last two decades have had a net positive impact, translating into higher sensitivity of pay to performance. Although they recognize that the increase in options compensation has probably led to new incentive problems that may be behind the corporate scandals of recent years, they argue that the evidence is still in favor of an improvement in the management of firms. They identify three main positive signs: the good comparative performance of the U.S. stock market with respect to the rest of the world, the undisputable increase in the link between CEO compensation and firm performance, and the use of compensation schemes by buyout investors and venture capital investors that resemble those of the average public firm. They review the trends in corporate governance since the

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[16] See, also, references in Gabaix and Landier (2008).

1980s and they identify, as a sign of success, the increasing convergence of international governance practices to those of the United States, which were drastically different from those of, for example, Germany and Japan during the 1980s. They also point to an increase in shareholder activism, which may be due to an increased institutional shareholders' stake in public companies: their overall share in the total stock market went from 30 percent in 1980 to more than 50 percent in 1994. Gompers and Metrick (2001) report evidence supporting the hypothesis in Holmström and Kaplan (2003) that institutional investors improve corporate governance. They find that over the period 1980–1996, firms with higher shares of institutional shareholders had significantly higher stock returns. Gompers, Ishii, and Metrick (2003) construct an index to proxy for the level of good governance of firms based on data on completion of a number of governance provisions aimed at protecting shareholder's rights. They collect data on four dates between 1990 and 1998 and include a very high proportion of the largest U.S. firms according to market capitalization. They find strong correlation between good governance and good firm performance in terms of Tobin's Q (market value over book value), profits, and sales growth. Holmström and Kaplan (2003) also identify signs of improved board of directors' independence: an increase in CEO turnover, a decrease in the size of boards, and an increase in the proportion of the compensation of board members that is in the form of stock and options of the firm.[17] An earlier theoretical paper, Hermalin and Weisback (1998), provides support for the importance of board independence on sensitivity of pay and, in general, CEO performance. This paper models explicitly the determination of independence levels of the board of directors. The CEO uses his perceived higher ability with respect to any alternative hire to bargain with the board and influence its composition. Their model has implications consistent with empirical facts for the 1980s and 1990s, such as CEO turnover being negatively related to prior performance, with greater effect for firms with more independent boards and with accounting measures being better predictors of turnover than stock price performance. Also, the independence of the board is likely to increase after poor firm performance and decrease over a CEO's career.

Diversity of Compensation Practices

In spite of the existence of some stylized facts on sensitivity of pay, real life compensation packages are highly complex and diverse. It is easy to find examples of features of compensation instruments and practices that may seem counterintuitive to the uneducated eye, such as the lack of relative

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[17] Compensation boards are independent committees that design the compensation of the top managers of the firm. See Section 4 on regulation for details on the legal requirements for defining this board and the board of directors as "independent."

performance evaluation, or the repricing of options gone out-of-the-money. However, changing environments and dynamic considerations sometimes imply that such features are part of an efficient provision of incentives. What follows is a brief (nonexhaustive) list of recent theoretical articles that provide justification for some controversial compensation practices.

Commitment. Clementi, Cooley, and Wang (2006) show in a dynamic model of CEO compensation that implementing optimal incentives for executives in the presence of moral hazard and limited commitment through the issue of securities dominates deferred cash compensation arrangements; granting securities improves commitment and helps retain CEOs.

Dynamic Incentives. Wang (1997), as discussed previously, provides a model of repeated moral hazard that can explain very small (or even negative) sensitivities of CEO pay based on the optimal smoothing of incentives over time.

Learning. Celentani and Loveira (2006) show how learning about common shocks in the economy can explain the apparent absence of relative performance evaluation documented in the literature.[18] In the presence of moral hazard, if the productivity of the CEO's effort depends on aggregate conditions, the optimal compensation contract is not necessarily decreasing in poor relative performance.

Short-term Stock Price Performance. Current compensation plans are often criticized for providing incentives for CEOs to engage in actions that increase stock prices in the short term as opposed to creating long-term value for the shareholders.[19] Bolton, Scheinkman, and Xiong (2006) present a model that explicitly accounts for liquidity needs as a reason to participate in the stock market. They show that shareholders may in some circumstances benefit from artificial increases in today's stock prices, which influence the belief of speculators and allow the firm to sell its stock at higher prices in the future. This implies that compensation packages are sometimes optimally designed to make CEOs take actions that make short-term profits higher.

Targeting Efforts of the CEO. Kadan and Swinkels (2008) present a model in which the choice between restricted stock grants or option grants is linked to the potential effect of a manager's actions on firm survival. In financially distressed firms or startups where this effect is higher, stock is more efficient than options. The choice of compensation instruments helps the firm tailor the sensitivity of pay to the firm's idiosyncratic position. They find empirical evidence of stock being more widely used than options in firms with a higher probability of bankruptcy.

Repricing. The public perception of the practice of decreasing the exercise price of options that are out-of-the-money is that it "undoes" incentives

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[18] See, for example, Gibbons and Murphy (1990).

[19] See, for example, Jensen, Murphy, and Wruck (2004).

and is thus interpreted as a sign of management entrenchment. This practice of repricing is fairly uncommon: Brenner, Sundaram, and Yermack (2000) report that 1.3 percent of the executives in their sample (top five officers in a sample of 1,500 firms between 1992 and 1995) had options repriced in a given year. However, it has received academic attention, perhaps motivated by its reputation as a bad compensation practice. Chance, Kumar, and Todd (2000) identify size as the main predictor for firm reprices, with smaller firms repricing more often. Brenner, Sundaram, and Yermack (2000) find that higher volatility also significantly raises the probability of repricing. Carter and Lynch (2001) find that young high technology firms and those whose outstanding options are more out-of-the-money are more likely to reprice. Chen (2004) finds that firms that restrict repricing have a higher probability of losing their CEO after a decline in their stock price and that they typically grant new options in those circumstances, possibly in an effort to retain the CEO. Acharya, John, and Sundaram (2000) present a theoretical model that implies that the practice of repricing can be optimal in a wide range of circumstances. The intuition is that there are benefits to adjusting incentives to information that becomes available after the initial granting and before the expiration of the options; in many cases, these benefits offset any loss in ex ante incentive provisions because of the lack of credibility from possible repricings.

4. REGULATION

The current levels of CEO compensation are viewed by many as excessive and unjustified. It is not uncommon to see demands in the popular press for government regulation of CEO pay.[20] However, the effects of regulation in a complicated matter such as the design of compensation packages for top executives are not always clear. An example of this is the change in regulation that was introduced in 1993 that limits tax deductions for any compensation above $1 million. This limit was introduced partly as a response to the popular rejection of the big increases in CEO pay that took place in the early 1990s. The law, however, established an exception to the limit: "performance-based" compensation (such as, for example, bonuses and options granted at the money).[21] Empirical studies cited below have found that firms have shifted compensation away from salary and toward stocks and options in response to the limit. A popular view today is that the inclusion

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[20] As a recent example, the Emergency Economic Stabilization Act of 2008 passed by Congress on October 3, 2008, explicitly includes some limits on CEO compensation for firms in which the Treasury acquires assets or is given a meaningful equity or debt position. The compensation practices of such firms "must observe standards limiting incentives, allowing clawback and prohibiting golden parachutes." Restrictions also apply to firms that sell more than $300 million in assets to the Treasury through auction.

[21] For references, see United States Senate (2006).

of stocks and options in the compensation packages, together with the stock market boom, is partly responsible for the recent increase in CEO pay. Did the $1 million limit contribute sizably to the increase in pay by encouraging the use of performance-based compensation? In this section, I review the academic studies that have studied this question, as well as the effect of other changes in the tax treatment of CEO compensation.

Regulation has also been introduced in recent years to improve corporate governance in the United States.[22] Mainly, the measures have targeted improved coordination and power of shareholders, as well as the transparency of compensation practices. As a recent example, in the aftermath of corporate accounting scandals at Enron, WorldCom, and other important U.S. firms, the Sarbanes-Oxley Act of 2002 (SOX) increased the legal responsibilities of CEOs and of compensation committees. There are academic studies on the effect of regulation on corporate governance and I summarize their main conclusions in the second part of this section.

Tax Advantages

Tax exemptions for deferred compensation have been in place since the early 1980s. These tax exemptions apply to the capital gains tax owed by a CEO, which is levied for capital gains that are part of his compensation. We may wonder whether the savings on capital gains tax for stock option grants could have played a role in explaining the spectacular increase in the use of options in compensation packages. Also, some of the regulatory efforts that have stated specific limits for tax deductions have triggered criticisms since firms that were paying less to their executives may now raise their salaries to the limit, which is rendered by the regulation as acceptable. For example, with the passing of the Deficit Reduction Act of 1984, the U.S. government imposed a tax on excessive (three times the executive's recent average remuneration) "golden parachutes," i.e., payments to incumbent managers who were being fired in relation to a change in control. Jensen, Murphy, and Wruck (2004) argue that these types of agreements were fairly uncommon before the law was passed and that the regulation had the effect of endorsing the practice, which became a standard in the following years. A similar argument has been made for the Omnibus Budget Reconciliation Act resolution 162(m) of 1992, which imposed a $1 million cap on the amount of the CEO's nonperformance-based compensation that qualifies for a tax deduction.

In this section, I review a few of the academic studies that have tried to quantify the effect of tax advantages on CEO compensation. The main conclusion is that there exists a tax advantage of deferred compensation, although

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[22] See Weinberg (2003) for a discussion of the financial reporting issues in corporate governance and of the Sarbanes-Oxley Act of 2002.

a modest one. Also, studies of the effect of resolution 162(m) have found evidence of a certain increase in salaries of companies that were paying less than $1 million before the new law was enacted, as well as some shifting of compensation toward performance-based instruments and away from salaries. There is evidence that this shift translated into a slight increase in total compensation. The studies, however, do not find evidence that the majority of the spectacular rises in the level of compensation and the increases in the use of options can be attributed to tax reasons.

Quantifying the Effect of the Special Tax Treatment for Compensation in the Form of Options

Currently, pay in the form of options has a tax advantage for CEOs when compared to payments in salary: There are no capital gains tax charges on the increase in value of a stock from the grant date to the exercise date. If, after exercise, the executive holds the stock and there is further increase in its value, capital gains tax is owed only on the appreciation from the date of exercise to the date of sale.

Motivated by different tax treatments of various instruments of compensation, Miller and Scholes (2002) explicitly compare the after-tax value (together for the firm and the CEO) of compensation in wages and several deferred compensation instruments (deferred salary schemes, stock purchase plans, deferred stock plans, nonqualified option plans, and insurance plans). Miller and Scholes document that by 1980 there had been already a rapid increase in the usage of deferred compensation versus bonus and salary. The use of these instruments is usually interpreted as a sign of incentive provision: With the granting of stock options, the compensation board attempts to align the incentives of the CEO with those of the shareholders, which helps increase the long-term value of the company. However, they find that none of the instruments they analyze have clear tax disadvantages with respect to wage payments: they are all either beneficial or tax-neutral. They argue that the tax savings makes it difficult to identify incentive provision as the only reason for deferred compensation.

The advantage of options versus pay is also analyzed in Hall and Liebman (2000) with data for 1980–1994.[23] A simplified version of their analysis is presented here. We must compare two alternative ways of compensating the CEO, both with net present value of P for the firm. On one hand, the firm could grant options to the CEO for a present value of P, which would vest in N years. The return of this compensation to the CEO, assuming an annual return of r for his firm, is

$$P \left[1 + r \left(1 - T_c \right) \right]^N \left(1 - T_p \right),$$

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[23] For details on current tax treatment of CEO compensation, see United States Senate (2006).

Figure 3 Evolution of Tax Advantage Compared with the Proportion of Pay Given in the Form of Stock and Options
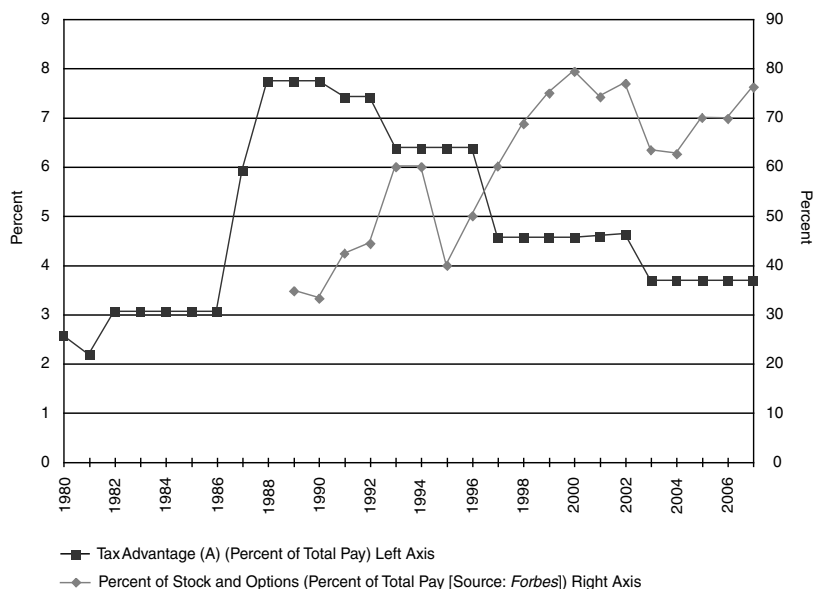
Source: IRS and *Forbes* magazine.

where T_p, T_c, and T_{cg} are, respectively, the personal, corporate, and capital gains tax rates. On the other hand, the firm could schedule a cash payment of P today. Assuming the CEO invests the whole after-income tax amount in a nondividend-paying security with the same return, r, for the same number of years, N, the return of the cash payment to the CEO is

$$P\left(1 - T_p\right)\left[1 + r\left(1 - T_c\right)\right]^N - T_{cg} P\left(1 - T_p\right)\left\{\left[(1 + r\left(1 - T_c\right))^N - 1\right]\right\}.$$

Therefore, the options advantage, A, depends on the three tax rates:

$$A\left(T_p, T_c, T_{cg}\right) = T_{cg} P\left(1 - T_p\right)\left\{\left[(1 + r\left(1 - T_c\right))^N - 1\right]\right\}.$$

Hall and Liebman (2000) report the value of A for the period 1980–1998 by substituting the corresponding rates, keeping everything else equal. They find that the advantage of options versus cash compensation reached a maximum of \$7 per \$100 of compensation P in 1988–1990 and was down to \$4 per \$100 in 1998. Figure 3 plots the value of the advantage reported in the paper, plus the value for the period 1980–2007 using recent tax rates. The Bush tax breaks have decreased the advantage of options in recent years;

after they expire, and with no further changes, the advantage should go back to the $4 calculated for 1998. In the same figure, on the right axis, I have plotted the ratio of option grants over total compensation from 1992 to 2007 from the *Forbes* data previously shown. Comparing the two series, we can see that, although tax advantages were decreasing in the later period, options were being used relatively more intensively than salaries. Hall and Liebman (2000) complement their analysis with regressions of the use of options on the several tax rates and their calculation of the tax advantage and find no evidence of a sizable effect.

Quantifying the Effect of Caps on Deductibility of CEO Salaries

When firms calculate their corporate tax liability, under the Internal Revenue Code, they are allowed to subtract from their revenues the compensation of their workers. Prior to 1993, this deduction included all compensation given to the top executives of the firm.[24] In 1993, new regulation took effect that limited the deductions of the compensation of each of the five highest ranked executives of a firm to $1 million (section 162(m) of the Internal Revenue Code). The regulation specifies an exception to the $1 million limit: Compensation that is performance-based can be deducted regardless of being worth more than $1 million.

The requirements to qualify as performance-based for each form of compensation can be summarized as follows:

- Salaries are, by nature, nonperformance-based. Any company paying its CEO a salary higher than $1 million would face higher tax costs after the change in regulation.

- A bonus program qualifies if it specifies payments contingent on objective performance measures and is approved in advance by the vote of the shareholders.[25]

- Stock options are considered entirely performance-based compensation. In order to qualify for tax deduction, firms have to detail in an option grant plan the maximum number of options that can be awarded

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[24] The accounting of compensation expenses is briefly discussed later in relation to regulation of disclosure of information to shareholders and the valuation of options.

[25] Murphy (1999) documents that companies do include subjective measures of the performance of the CEO in their bonus plans, usually labeled "individual performance." In the typical bonus plan in his data source, this subjective component rarely exceeds 25 percent of the executive's bonus.

to a given executive in the specified time frame. The plan needs to be approved by the shareholders.[26]

- Stock grants and other types of deferred compensation (pensions, severance payments, etc.) are only considered performance-based if they are granted or their selling restrictions vest based on performance targets.

I now review the three main academic studies of the effect of this change in regulation.

A simple strategy of testing for the effect of section 162(m) on pay practices is to regress changes in compensation on changes in firm value:

$$\Delta \ln (w_{it}) = \beta_0 \Delta r_{it} + \delta_t + \varepsilon_{it},$$

where δ_t captures the annual growth rates.[27] Lower values of δ after the reform would imply the regulation succeeded in slowing the growth of executive compensation. However, the trends in CEO compensation may be responding to changes in the environment other than regulation. To identify the effect of the reform, the empirical studies have exploited the cross-sectional variation in the population of firms. By separating the firms in which compensation practices were not affected by the cap on deductions, they can use those as a control group and isolate the effect of the regulation:

$$\Delta \ln (w_{it}) = \beta_0 \Delta r_{it} + \alpha_t AFFECTED + \delta_t + \varepsilon_{it},$$

where the difference in α_t before and after the change in regulation captures the effect of deduction limits on the growth of pay in the affected firms.[28] Deciding which firms should be classified as affected is not such a simple task, however. Hall and Liebman (2000), for this purpose, use data on the compensation in 1992, the only observation available in the Execucomp data set before the change in the law. They construct a variable equal to 1 if the salary observation in 1992 is above $1 million, and equal to $1 million divided by the salary for firms below that level. They find that a CEO with a $1 million salary in 1992 saw, after the new regulation, his salary grow at an annual rate of approximately 0.6 percent less than an executive earning $500,000.

Perry and Zenner (2001) propose three alternatives for identifying the set of firms affected by the regulation. One is the same indicator constructed in

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[26] These plans are usually specified for several years. If, after approval, the compensation board finds it necessary to exceed the total number of options specified in the plan for a given CEO, the excess amount of options does not qualify for a deduction.

[27] In the empirical studies, several measures of performance (sometimes logged, sometimes in differences) and lagged performance are included as explanatory variables, as well as other controls like CEO tenure and other relevant available information. In this section, I use a simplified statement of the regression equations meant only for illustration.

[28] It has also been argued that setting the deduction cap at $1 million encouraged firms that were far below this level of compensation to increase their manager's pay, since $1 million became "acceptable" (see *Wall Street Journal* 2008). If this effect really existed, it would bias the estimates in the above regression.

Hall and Liebman (2000), a second one is an indicator that takes a value of 1 if the salary in 1992 is above $900,000, and a third is an indicator that takes a value of 1 if the executive had a combined salary and bonus payment above $1 million in any year before the change in regulation. They find similar results in the three specifications. Consistent with Hall and Liebman (2000), Perry and Zenner estimate lower growth of salaries for affected firms and evidence of an increase in the sensitivity of bonus and total compensation to stock performance after 1993.

Rose and Wolfram (2002) point out that using 1992 levels of pay to classify firms creates statistical correlation between compensation and the variable that indicates whether firms are affected by the regulation that does not correspond to an effect of the change in the law: Firms that had higher compensation levels in 1992 had different characteristics than low compensation firms and these characteristics likely influence their pay growth rate. They propose an alternative estimation using differences in differences that circumvents this problem.[29] To correct for potential bias, Rose and Wolfram construct their indicator for affected firms using predicted instead of observed compensation for years after 1993: They use data in 1992 to construct what the level of compensation of each firm in the sample would have been had there not been a change in regulation. They construct the indicator based on combined salary and bonus payments, since they find that using only salary or broader measures of compensation constitutes a less precise predictor. Based on their classification methodology, the sample mean growth rates of compensation after 1993 were higher for affected firms than for those that were unaffected. An important feature in Rose and Wolfram's analysis is that they include data on the decisions of qualification of salary, bonus, and stock plans (although this is limited to a small sample of firms, based on a consultant firm survey). Stock option plan qualification is the most common choice; in their sample, this implies a tax savings of about 25 percent of ex ante total compensation. About two-thirds of the sample of firms had qualified their stock plans by 1997. Rose and Wolfram find that affected firms were more likely than unaffected firms to qualify their long-term incentive plans (more than twice as likely) and bonus plans (three times more likely), but both groups qualify their option plans in the same proportion. They find evidence of salary compression at the $1 million level after 1993 and a flattening of the distribution of cash payments (salary plus bonus) for firms that choose to qualify bonus plans. However, they do not find strong statistical evidence for an overall compression effect for all firms. Hence, they find no evidence of a perverse consequence of the law suggested in the financial press, whereby the argument was that nonaffected firms raised their salaries to $1 million because the limit was in fact made into

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[29] See, also, Rose and Wolfram (2000) for a detailed explanation.

an "acceptable" standard by the new law. Interestingly, Rose and Wolfram find that firms that choose to qualify their option plan have higher growth of salary, bonus, and total compensation after 1993 than both unaffected firms and affected firms that do not qualify. Their estimates are, in general, very noisy, but their evidence is consistent with the hypothesis that qualification and limiting the compensation growth are alternative means of responding to political pressures on executive compensation.

Regulating Corporate Governance

Several regulations passed in the last 15 years have focused on improving corporate governance in U.S. firms. I now summarize the most important initiatives.

In 1992 the SEC increased the disclosure requirements in proxy statements, asking firms to include detailed information about the compensation of the CEO, chief financial officer, and the three other highest-paid executives. Along with those details, the statements had to include an explanation of the compensation policies of the firm, as well as performance measures of the firm in the past five years. In particular, firms were required to report the value of option grants given to the executives. Options could be valued at the time of grant using several alternatives. If Black-Scholes valuation was used, companies were not required to specify the value of the parameters used in the formula, such as the risk-free interest rate, expected volatility, and dividend yield, or any adjustment to the valuation made to take into account the nontransferability of the options and the risk of forfeiture. Alternatively, firms could choose any other accepted pricing methodology, even simply the value of the options under the assumption that stock prices would grow at 5 percent or 10 percent annually during the term of the option (the "potential" or "intrinsic" value of options). In November 1993, the SEC amended its rules and required the disclosure of the parameters used for the valuation and details of any discount.[30] The reforms of 1992 also expanded the set of allowable topics for shareholder proposals to include executive compensation and decreased the minimum share or capital stake necessary to initiate a proxy vote.

Following the accounting fraud scandals at Enron, Tyco, WorldCom, and a number of other firms, the government passed the Sarbanes-Oxley Act in July 2002.[31] The Act had several consequences for corporate governance practices, mainly the requirement of independent accounting auditing, mandatory executive certification of financial reports (accompanied by an increase in penalties for corporate fraud), forfeiture of certain bonuses to executives

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[30] Murphy (1996) finds evidence that, in the year in which they had a choice, managers chose the valuation method that minimized the value of their pay.

[31] In November 2001, after weeks of SEC investigations, Enron filed a restatement of its financial results that revealed that the company had underreported its debt exposure.

after a financial restatement resulting from malpractice, or the prohibition of personal loans extended by the firm to the executives. In November 2003, the SEC approved proposals by the NYSE and NASDAQ to guarantee the independence of directors, compensation committees, and auditors.

In 2004, the Financial Accounting Standards Board (FASB) modified their recommendations for the valuation of stock grants: Reporting the fair value of options became the norm, eliminating the previous alternative of reporting their intrinsic value, and expensing requirements were extended to options granted with an exercise price equal to or higher than the market price at the time of granting (FAS 123[R]). In 2006, the SEC made these recommendations compulsory. At the same time, it increased the disclosure requirements of compensation of the executives (salary and bonus payments for the past three years, a detailed separate account of stock and option grants, as well as holdings that originated in previous year's grants, including their vesting status, and retirement and post-employment compensation details). The SEC also demanded an explanation of compensation objectives and implementation in "plain English." It required a classification of the members of the board of directors and of the compensation committees as independent or not independent, with an explicit statement of the arguments used for this classification. Finally, it asked for the disclosure of compensation of directors following rules similar to those for the top executives.

Recently, the proposal of making mandatory a "say on pay" nonbinding vote of shareholders on the compensation of the CEO has received attention both from the media and politicians, and has been voluntarily adopted by a few U.S. corporations.[32] This proposal is in line with the above described efforts of making compensation practices as transparent as possible to shareholders.

Quantifying Effects of Regulation on Corporate Governance

Most of the above described changes in regulation could directly or indirectly influence compensation contracts, as well as firm performance. A few studies have tried to quantify these potential effects.

Johnson, Nelson, and Shackell (2001) document that the 1992 SEC reforms related to shareholder participation translated into an increase in the number of shareholder-initiated proposals on CEO pay. However, they do not conclude that the probability of a proposal is higher for firms with poor incentive alignment.[33] Instead, this probability of proposal is higher for firms with higher levels (or lower sensitivity) of CEO compensation. They attribute this correlation to the higher "exposure" of the compensation practices of firms

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[32] The "say on pay" practice is already in place in the United Kingdom, the Netherlands, and Australia. See, for example, the article "Fair or Foul" (*The Economist* 2008a).

[33] Poor incentive alignment is approximated by the proportion of compensation that is not predictable by observable variables, following Core, Holthausen, and Larcker (1999).

with higher salaries. They find, however, a positive effect on corporate governance when they look at the probability of acceptance of the proposals: it is higher in firms with poor incentive alignment and higher for institutional investor proposals.

Chhaochharia and Grinstein (2007) provide some evidence on the effects of SOX and of the changes in the stock exchange independence requirements, as evaluated by investors in the stock market. They analyze the effects of the announcements of those regulatory changes on the stock prices of firms with different compliance levels. They construct portfolios of firms based on their degrees of compliance and find that less compliant firms (for example, firms that restated their financial statements or that do not have independent boards) earn abnormal returns of about 6 to 20 percent around the announcement of the new rules. They also report evidence that the market believes that small firms find it more difficult to comply with requirements for internal control and independence of directors: Their portfolios have small negative abnormal returns after the announcements, in contrast with positive abnormal returns of larger noncompliant firms.

The imposition of the $1 million limit with the passing of section 162(m) discussed earlier arguably could have consequences for corporate governance—on top of any direct effect on executive compensation. The evidence discussed in the previous subsection points to an increase in sensitivity of pay, which may have translated to better alignment of the incentives of the CEO with those of shareholders. This hypothesis is consistent with the evidence in Maisondieu-Laforge, Kim, and Kim (2007): They find that stock returns and operating returns improve for firms affected by the cap. However, one may argue that compensation committees may have been compelled to forego some of the subjective components in the granting of bonuses and options in order to qualify compensation plans for tax exemptions. These committees may have been compelled to qualify their compensation plans solely for tax savings purposes, or to comply with what may have been viewed as the "correct" practice after section 162(m) was approved. Hayes and Schaefer (2000) find that the part of CEO compensation that is unexplained by observable performance measures is a good predictor for future performance. This suggests that discretion of the compensation board may in fact be rewarding good executive performance, and the requirements for qualification of bonus schemes may be distorting good compensation practices.

5. CONCLUSION

Real life compensation contracts are complicated. Even in the absence of illegal actions on the part of CEOs, it is easy to find examples in which the incentives of managers are not perfectly aligned with those of the shareholders. The recent cases of fraudulent behavior, such as the accounting scandals

at Enron, the backdating of options, or insider trading, obviously demand government intervention, as does any other breach of the law. However, a close look at the problem of CEO pay design demonstrates that providing incentives is a complicated matter and that many seemingly unintuitive features of compensation packages may, in fact, be helpful in solving incentive problems. There is ample evidence that, despite rising levels of CEO pay in the last two decades, improved corporate governance practices have translated into stronger ties between pay and performance over the same period. Recent regulation of corporate governance seems to have been aiding market-driven changes in internal control. However, it is also easy to find indications that some of the compensation regulation may impose unnecessary burdens and distortions on firms.

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