

EXECUTIVE EQUITY COMPENSATION AND INCENTIVES: A SURVEY

1. INTRODUCTION

Corporate governance is generally considered to be the set of complementary mechanisms that help align the actions and choices of managers with the interests of shareholders. Monitoring actions by the board of directors, debtholders, or institutional blockholders can have an important impact on the economic performance of an organization (for example, Jensen [1989], Mehran [1995], Core, Holthausen, and Larcker [1999], and Holderness [2003]). Another important and often debated component of the governance structure is the compensation contract selected for providing remuneration to managers (for example, the level of remuneration or choice of performance measures).

Executive compensation has been the subject of extensive prior research, and excellent general reviews already exist for the interested reader (for example, Murphy [1999]). For our purposes here, we will not reproduce this discussion but rather focus on the more narrow, but crucial, topic of stock-based compensation and incentives.

Stock and option compensation and the level of managerial equity incentives are aspects of corporate governance that are especially controversial to shareholders, institutional activists, and governmental regulators. Similar to much of the corporate finance and corporate governance literature, research on stock-based compensation and incentives has generated not only useful insights, but also has produced many contradictory findings. Not surprisingly, many fundamental questions

remain unanswered, and one of our goals is to highlight topics that seem especially appropriate for future research.

Within the corporate governance literature, and more specifically within the executive compensation literature, there are alternative views on the efficiency of observed contracting arrangements between firms and their executives. For the purposes of this survey and as an organizing principle of our literature review, we follow a traditional agency-theory framework and define an efficient contract as one that maximizes the net expected economic value to shareholders after transaction costs (such as contracting costs) and payments to employees. An equivalent way of saying this is that we assume that contracts minimize agency costs. Clearly, the types of contracts that are efficient at any particular time or in a particular sector of the economy are a function of various transaction costs. For instance, a contract that was efficient in the United States fifty years ago may not be efficient today because information costs have fallen greatly and the optimal organizational form has changed as a result. Over time, optimal contracting arrangements evolve with changes in contracting technology. As part of this evolutionary process, firms are experimenting with new contracting technologies. Some experiments succeed and others fail as firms update their beliefs and learn about the efficiency of their governance structures. Throughout this process, firms may be uncertain about the optimal contracting technology. As a result of this uncertainty and because of differences in beliefs about optimal incentive levels, one would expect variation in the observed contracts

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across firms. However, unless beliefs are systematically biased, we expect that compensation contracts are efficient, on average, and that average equity incentive levels across firms are neither “too high” nor “too low.” (For an example and discussion of how an evolutionary process converges to an efficient outcome, see Lazear [1995, pp. 8-10].)

In contrast to this economic perspective, a number of scholars and practitioners either implicitly or explicitly take the view that contracting arrangements are largely inefficient and do not minimize agency costs (for example, Morck, Shleifer, and Vishny [1988], Crystal [1991], and Jensen [1993]). A view that sees most firms behaving inefficiently is hard to support. At the opposite extreme is the view that transaction costs in the labor market, the stock market, and the market for corporate control are so small that all agency costs are eliminated. Fama (1980), for instance, argues that labor market discipline eliminates agency problems with CEOs, who know that any opportunistic behavior will be punished by a complete downward revision of the value of their human capital. However, this view abstracts away from information costs, contracting costs, and frictions in the market for corporate control.

Later research (for example, Shleifer and Vishny [1997] and Zingales [1998]) develops theories that incorporate the attractive features of both of these polar extremes. This approach assumes that firms contract optimally, but that transaction costs prohibit continuous recontracting. Since contracting is not continuous, firms’ contracts gradually deviate from the optimal level. This view allows some managers to exploit shareholders because the managers have temporarily gained power, but this process is mean-reverting so that shareholders, over time, regain authority (Zingales 1998). Thus, at any point in time, the existence of recontracting costs allows some managers and firms to extract rents, but on average the system is efficient within transaction costs. Notice that this perspective does not imply that it is impossible to find examples of gross agency problems; it only suggests that these observations are “unusual” in cross section and are likely to be reduced over time. This definition of efficiency is used in our discussion.

We also concentrate our survey on literature that tests economic hypotheses within samples of U.S. firms. However, we believe that much of our discussion can be generalized to firms throughout the world. Bushman and Smith (2003) present a broad overview of how differences in country-specific factors lead to different governance and compensation structures that arise endogenously within those environments. In many other countries, investors are not as well-protected and widely dispersed ownership is not optimal. In these settings, managers and their families retain much ownership and explicit equity-based compensation may be unnecessary

(La Porta, Lopez-De-Silanes, and Shleifer 1999). Important features of the U.S. environment include a regulatory system that emphasizes the protection of shareholders and requires that each firm transparently disclose material information about its finances and its contracts, and a government that grants individuals and firms much freedom to seek their own good. These features contribute to widely dispersed ownership in many U.S. firms, in which managers own a small fraction of the equity, and where the relatively low managerial ownership levels make it potentially important to write contracts that emphasize equity ownership. As a working theoretical representation, we assume that the use of equity compensation in the United States is endogenously determined within the broad legal, regulatory, and governance environment faced by U.S. firms.

Our objective is to synthesize the broad literature on equity compensation and executive incentives. Moreover, we hope to reduce some of the unsupported rhetoric or folklore in the academic literature and practitioner discussions on equity-based compensation. There remain many unanswered questions and considerable controversy within some areas of the research with respect to theoretical assumptions and empirical approaches to testing these theories. We do not attempt to resolve all of these controversies, but instead we try to highlight areas in which research could shed light on these issues. Finally, we do not claim to provide an exhaustive review of this literature, and we admit that our views and interests influence our emphasis and inference.¹

In the next section, we provide some basic institutional detail on the use of stock compensation and incentives. Section 3 summarizes research on the determinants of equity incentives and the economic effects of these choices. Section 4 details unresolved issues, controversies, and topics for future research. Section 5 provides a brief summary of our review.

2. INSTITUTIONAL BACKGROUND

Equity incentives and stock-based compensation are important features of the contracting environment between shareholders (as represented by the board of directors) and executives. Hall and Liebman (1998) and Hall and Murphy (forthcoming) provide evidence from samples of large U.S. firms that the overall sensitivity of CEO stock-based wealth to changes in stock price and the vast majority of this sensitivity come from CEO stock and option ownership. Hall and Murphy (forthcoming) report that in 1998, the median values of stock and options held by Standard & Poor’s industrial CEOs and Standard and Poor’s financial CEOs were

\$30 million and \$55 million, respectively. These values and sensitivities are large relative to annual flow pay. For example, Core, Guay, and Verrecchia (2000) report that the ratio of equity portfolio value to annual total pay was 30.3 on average for CEOs during the 1993-98 period.

There has been a large increase in the use of stock options to provide CEO compensation and incentives. In 1980, CEO annual flow compensation was mainly in the form of cash salary and bonus (Hall and Liebman 1998), with only 30 percent of CEOs receiving new option grants. Mean salary and bonus was \$655,000, compared with \$155,000 from new option grants. By 1994, options had become a major component of CEO flow compensation, with 70 percent of CEOs receiving new option grants, and mean option grants amounting to \$1.2 million (valued by the Black and Scholes [1973] model), compared with \$1.3 million in cash pay. In addition to being an important component of chief executive compensation, stock options are an important component of CEO equity incentives. Hall and Liebman (1998) report that in 1980, 57 percent of CEOs held some amount of options, and by 1994, this figure had reached nearly 90 percent. In Core and Guay's (1999) sample of CEOs from the 1992-96 period, options contributed approximately one-third to the value of the median CEO's equity portfolio and contributed roughly one-half of the median CEO's total equity incentives (that is, the sensitivity of portfolio value to stock price).

The use of options is pervasive but does vary across industries. Core and Guay (2001a) document cross-sectional variation in the magnitude of corporate option plans. They find that the median large firm has options outstanding that amount to 5.5 percent of common shares outstanding. This percentage is relatively larger, 10 percent to 14 percent, for growth industries such as computer, software, and pharmaceutical firms, and relatively smaller, 2 percent to 3 percent, for low-growth industries such as utilities and petroleum firms. The fraction of total outstanding employee options held by top executives also varies by industry. Murphy (1999) shows that the importance of options in CEO annual pay is pervasive across several industry groups, but is substantially less important for utility firms. Consistent with these findings, Ittner, Lambert, and Larcker (2001) find that the use of stock options and restricted stock in high-technology, "new-economy" firms substantially exceeds the equity compensation in large, "old-economy" manufacturing firms.

Another way to examine the importance of equity incentives is to examine stock option "overhang," a measure commonly used by institutional investors. Option overhang is calculated as the ratio of stock options granted, plus options that have been approved for future grants, divided by the total shares

outstanding. In our opinion, this measure is somewhat naive because it counts an unissued option the same as an issued option. Nevertheless, analysts and other institutional investors seem to use stock option overhang when analyzing firms' investment potential. Using Investor Responsibility Research Center data on stock option overhang, we see that the mean (median) overhang was approximately 13.0 percent (11.2 percent) in 1999. Boards of directors have substantially increased overhang during the 1990s, and at the end of 2000 they had approved options that amount to approximately 10 percent of shares outstanding.

3. EQUITY COMPENSATION AND INCENTIVES

3.1 Compensation and Incentives

As noted in Antle and Smith (1986) and Jensen and Murphy (1990), executives are given variable compensation and incentives through three primary mechanisms: 1) flow compensation, which is the total of the CEO's annual salary, bonus, new equity grants, and other compensation; 2) changes in the value of the CEO's portfolio of stock and options; and 3) the possibility that the market's assessment of the CEO's human capital will decrease following termination because of poor performance or a change in control. For executives below the CEO, the potential for promotion is an additional source of incentives.

In this paper, we define incentives as variation in executive wealth related to the stock price, and we focus on the incentives to increase the stock price provided by the manager's ownership of equity (such as stock and stock options). Consistent with the majority of research that examines the incentives provided by equity holdings, we use the term "equity incentives" to denote the incentives created by equity securities that motivate a manager to increase stock price.

We acknowledge that managerial equity holdings provide other incentives, but we do not devote much attention to these incentives, which we consider second-order effects and/or effects offset by other contracting mechanisms. (For example, although options provide incentives to cut dividends, it is easy for the board to require the CEO to maintain a certain dividend.) These other incentives arise because the value of stock and options is also sensitive to other moments of the stock price, such as variance (Jensen and Meckling 1976; Haugen and Senbet 1981; Smith and Stulz 1985; Lambert,

Larcker, and Verrecchia 1991). For example, the value of common stock in a leveraged firm increases with the volatility of firm value, and the value of a stock option held by a diversified investor increases with the variance of stock price. Guay (1999) shows that the sensitivity of option portfolio value to stock return volatility can be economically significant for some CEOs, but the sensitivity of common stock value to volatility is economically unimportant for all but the most financially distressed firms (in Section 3.5, we discuss research that suggests that firms use options to provide risk-taking incentives to managers). Finally, the fact that the value of stock options decreases with the level of dividend payments suggests that option holders can have incentives to reduce dividend payments. A body of evidence documents lower dividend payments following the initiation of option plans (Lambert, Lanen, and Larcker 1989; Bartov, Krinsky, and Lee 1998) and suggests that managerial option holdings are associated with a substitution of repurchases for dividends (Fenn and Liang 2001).

Although we concentrate on the role of stock and stock options in providing incentives to increase stock price, stock options and restricted stock are also used as a means of attracting certain types of employees and increasing retention (or reducing voluntary turnover), and we discuss such use in Section 3.6. These uses of options are likely to be more important for lower level employees (Core and Guay 2001a; Oyer and Schaefer 2001). Survey data reported in Ittner et al. (2001) indicate that employee retention is a primary reason why firms use options. A useful area for future research is to examine the extent to which stock option programs actually affect voluntary turnover. Furthermore, as we discuss in Section 4.5, it is unclear if stock option plans are the most effective means of reducing turnover. Oyer and Schaefer provide evidence consistent with the hypothesis that firms use option programs to attract employees who are less risk-averse and who have optimistic beliefs about the firm's prospects.

In defining incentives as the sensitivity of the manager's wealth to stock price changes, we ignore as well the incentives provided by the termination threat and from variation in the flow of annual compensation. We ignore as well variation in incentives from performance measures other than the stock price. For most CEOs, the assumption that the majority of incentives are driven by variation in the value of equity holdings is realistic.² Murphy (1985), Jensen and Murphy (1990), and Hall and Liebman (1998) show that the vast majority of a typical CEO's incentives to increase stock price are driven by variation in the value of his stock and option portfolio, that is, not by flow compensation. Core, Guay, and Verrecchia (2000) show that for the typical CEO, nonprice incentives provided by flow compensation are not

economically large in comparison with the price-based incentives provided by the CEO's equity portfolio.³

As one moves deeper into the organization to employees below the CEO and below top management, equity-based incentives take on a relatively less important role. For example, Core and Larcker (2001) find that non-CEO executives typically hold much less equity as a multiple of their base salary than does the CEO. For lower level managers, the stock price is less informative about actions, and local measures of performance (such as division profits) are more relevant and useful for providing incentives (Bushman, Indjejikian, and Smith 1995; Ittner, Larcker, and Rajan 1997). In addition, the incentives related to potential promotion become more important. However, in cross section, firms vary substantially in their use of equity incentives for lower level employees. For example, lower level employees in high-technology firms tend to receive larger equity grants (Ittner et al. 2001) and hold greater levels of stock options (Core and Guay 2001a).

A substantial body of theoretical and empirical work supports stock price as a relevant performance measure for assessing executive choices. However, like any performance measure, stock price is a noisy measure of the executive's performance because it is influenced by factors beyond the executive's control. As a result, equity incentives impose risk on the executive and the executive must be paid a premium over an acceptable level of fixed cash pay to compensate for this risk. Clearly, there are costs to the firm for providing "too many" or "too few" equity incentives. For example, the executive may not take actions that maximize shareholder wealth—a possible outcome when "too many" or "too few" incentives are provided—or will require a large risk premium—a possible outcome when "too many" incentives are provided. We return to this topic later when we discuss relative performance evaluation and option valuation.

3.2 Measurement of Equity Incentives

A fundamental question for the compensation literature is the measurement of incentives in general, and equity incentives in particular. A key point in analyzing executive incentives is that an executive's incentives from stock and options are properly measured by *portfolio* incentives (for example, Jensen and Murphy [1990] and Lambert, Larcker, and Verrecchia [1991]). As emphasized by Yermack (1995), one cannot determine whether an executive has an appropriate level of incentives by examining newly granted restricted stock and options compensation in a given year. Evidence in Core and Guay (forthcoming a)

indicates that the correlation between newly granted incentives and previously held portfolio incentives is low.

Techniques for creating empirical proxies for equity incentives were originated by Jensen and Murphy (1990). These techniques are expensive, however, because complete data on the characteristics of an executive's option holdings are not publicly available. Core and Guay (forthcoming a) develop and validate an inexpensive and accurate method of estimating option portfolio value and the sensitivities of option portfolio value to stock price and stock-return volatility that is easily implemented using data from only the current year's proxy statement or annual report. This method can be applied to either executive stock-option portfolios or to firmwide option plans. In broad samples of actual and simulated CEO option portfolios, Core and Guay show that these proxies capture more than 99 percent of the variation in option portfolio value and sensitivities. A potential limitation of their analysis is that they assume, consistent with most prior literature beginning with Jensen and Murphy (1990), that changes in the Black-Scholes value of an option portfolio is an appropriate measure of an employee's incentives to increase the stock price. We discuss the appropriateness of the Black-Scholes model in detail in Section 4.2.

Although estimating these proxies is straightforward, in recent years a debate has ensued over how to transform the proxy into a measure of equity incentives. Most researchers, beginning with Jensen and Murphy (1990), use the Black and Scholes (1973) method to value an executive's option portfolio, and measure the executive's incentives to increase the stock price by how much the total value of the executive's stock and option portfolio changes with a small change in the stock price. Studies such as Demsetz and Lehn (1985), Jensen and Murphy (1990), and Yermack (1995) measure incentives from equity holdings as fractional ownership, which is the dollar change in the value of the executive's stock and option portfolio wealth for a *dollar change* in firm value. This approach is motivated by Jensen and Meckling's (1976) model of the firm with a risk-neutral agent. Under the assumption that monitoring is costly and imperfect, the agent has an incentive to consume perquisites, such as luxurious office space and jet aircraft, so long as the agent owns less than 100 percent of the firm. This is because he or she gets all or most of the benefits from the perquisite but bears only a fraction of the costs through ownership claims. Under this theory, agency costs are mitigated when the risk-neutral manager owns a large percentage of the firm so that the manager internalizes the cost of the perquisites consumed. Data showing small fractional ownership lead Jensen and Murphy (1990) to conclude that CEO equity incentives are too weak to provide economically meaningful

incentives and lead Morck, Shleifer, and Vishny (1988) to conclude that CEO ownership is generally "too low."⁴

One problem with this theory is that all CEO actions are assumed to be equally difficult to monitor. For example, there is an implicit, but untenable, assumption that it is equally difficult for the shareholders to observe that the CEO has bought a jet aircraft for personal consumption as it is for them to observe whether the CEO spent enough time evaluating a new project before he adopted it. Second, when CEOs are wealth-constrained, a small fraction of firm value translates into a large fraction of CEO wealth. Hall and Liebman (1998) argue that managerial risk-aversion and wealth constraints imply that managers with large dollar holdings of equity can have powerful incentives even when their fractional share holdings are small. (We discuss the implications of wealth-based contracting in greater detail below.) This theoretical notion can be approximated for equity incentives by computing the dollar change in the value of the executive's stock and option portfolio for a *percentage change* in firm value. For example, an executive with \$10 million in stock holdings would experience a \$1 million change in wealth for a 10 percent change in stock price.

It is important to keep in mind that the two measures are transformations of one another. When computed for stock holdings only, the *dollar change* in executive wealth for a *dollar change* in firm value is proportional to the fraction of shares outstanding owned by the executive. The dollar change measure can be converted to a percentage change measure by multiplying it by the market value of the firm. For example, Jensen and Murphy (1990) and Yermack (1995) estimate the sensitivity of a CEO's holdings of stock and options to stock price with respect to a \$1,000 change in the value of common stock. As such, the percentage change measure is equal to the Jensen and Murphy measure multiplied by the market value of the firm and divided by \$100,000.

Baker and Hall (1998) shed much light on this debate by showing that the appropriateness of the two approaches to measuring incentives is determined by how CEO actions are assumed to affect firm value. For example, when a CEO's actions primarily affect firm *dollar returns* (such as perquisite consumption through the purchase of a corporate jet), the appropriate measure of the CEO's incentives is his percentage holding in the firm. In contrast, when CEO actions primarily affect firm *percentage returns* (such as the implementation of firm strategy), the appropriate measure of CEO incentives is her dollar holdings in the firm (Baker and Hall 1998, pp. 8-9). While there are likely to be situations in which the measures complement each other (for example, fractional share holdings may be more important when a CEO is tempted to engage in a

value-destroying action), dollar holdings are likely to be the more important incentive measure in a wide variety of situations.

3.3 Determinants of Equity-Based Incentives

A fundamental reason for the use of equity incentives is the desire by firms to link changes in executive wealth directly to changes in stock price, thereby providing executives with incentives to maximize shareholder wealth. Obviously, if shareholders (or the board of directors) could directly observe the firm's opportunities and the executives' actions and know beforehand which actions would maximize shareholder wealth, no incentives (including equity incentives) would be necessary. However, because shareholders do not know and cannot specify every action an executive should take in every scenario (that is, the first-best contract cannot be implemented), the firm must instead delegate many of these choices to the executive, who presumably has superior information about many of these decisions. To motivate the executive to take actions that are in the best interests of the shareholders, compensation risk is imposed on the executive by linking the executive's wealth to firm performance (that is, the second-best contract is used).

The use of second-best contracts immediately leads to the key question of how firms determine the appropriate level of equity incentives to give an executive. Demsetz and Lehn (1985) hypothesize that required levels of managerial equity ownership are related to firm size and monitoring difficulty. They argue that there is an optimal firm size and optimal level of managerial ownership given the firm's factor inputs and product markets. If the optimal firm size is large, the dollar cost of a fixed proportionate equity ownership is also correspondingly large (that is, it is more costly for large firms to require that managers own a given percentage than it is for small firms).

In addition, larger firms require more talented managers who are more highly compensated (Smith and Watts 1992) and consequently are expected to be *wealthier* (Baker and Hall 1998). Under the typical assumption that individuals' utility functions exhibit declining absolute risk-aversion (such as constant relative risk-aversion), CEOs of larger firms are expected to have higher dollar incentives from equity (Baker and Hall 1998; Himmelberg, Hubbard, and Palia 1999). Both studies find that CEO portfolio incentives, measured as dollar equity ownership, increase at a decreasing rate with firm size.

Demsetz and Lehn (1985) also hypothesize that firms operating in less predictable or noisier environments have higher monitoring costs. Because of these higher monitoring

costs, Demsetz and Lehn argue that firms in noisier environments will exhibit a higher concentration of ownership, but managerial risk-aversion implies that ownership levels will increase at a decreasing rate with noise.⁵ A related argument is Smith and Watts' (1992) hypothesis that the prevalence of growth opportunities within firms makes it more difficult for shareholders or outside board members to determine the appropriateness of managers' actions. Requiring managers to hold stock and options lowers monitoring costs by giving managers incentives to maximize shareholder value. Smith and Watts hypothesize and find a positive relation between firms' growth opportunities and the degree to which firms use equity incentives to tie a manager's wealth to firm value. Gaver and Gaver (1993), Mehran (1995), Himmelberg, Hubbard, and Palia (1999), and Palia (2001) provide additional support for this hypothesis by documenting a positive association between proxies for growth opportunities and CEOs' equity incentives.

Thus, in contrast to the allegations of many media pundits (and some academics) who assert that incentive levels are random, arbitrary, or out of equilibrium, empirical evidence suggests that, on average, firms base their equity incentives on systematic and theoretically sensible economic factors. Any research that assumes that incentives are systematically "too high" or "too low" is effectively assuming that incentives are not in equilibrium. (This idea is covered in detail in Section 4.) Furthermore, the empirical findings suggest that it is inappropriate to use a single firm characteristic, such as firm size, to benchmark executive equity holdings against mean or median equity holdings. Instead, the regression models reveal that multiple firm characteristics, such as size and proxies for investment opportunities, must be weighted to construct a prediction of the expected level of equity incentives.

3.4 Equity Grants and Incentives to Increase Stock Price

The above discussion suggests at least one motivation for why firms make new grants of stock-based compensation, such as stock options and restricted stock. Specifically, over time, managers' equity incentives can become misaligned with the level of incentives desired by shareholders. This misalignment occurs because firm and/or manager characteristics that drive target incentive levels change (for example, the firm grows over time or the firm's investment opportunity set may exogenously shift). In addition, managers periodically sell and buy stock, and exercise options to satisfy personal consumption. Finally, the incentives provided by a given portfolio of stock and options change over time. For example, the incentives provided by an option portfolio vary with stock price, stock-return

volatility, and the time remaining until the options expire. If firms and executives agree on a target level of equity incentives, one might expect that firms use grants of stock and options to adjust portfolio incentives to the target level. Core and Guay (1999) find that new grants of equity incentives are negatively associated with the degree to which the CEO's portfolio incentives exceed an empirical estimate of the CEO's target incentive levels.

3.5 The Use of Stock Options to Add Convexity to Compensation Contracts

Smith and Stulz (1985) and many others have recognized that a potential cost of management stock holdings is that the linear payoff structure creates a potential incentive for a risk-averse manager to take actions that reduce firm risk or to reject risky, positive net present value (NPV) projects. Amihud and Lev (1981) hypothesize and May (1995) presents empirical evidence consistent with the hypothesis that managers with very large stock holdings undertake risk-reducing acquisitions. Tufano (1996) finds that hedging activities in the gold industry are more extensive when CEOs have larger stock holdings. Thus, it seems optimal to add convexity to managers' contracts when there is a link between a manager's effort choice and variance (for example, Hemmer, Kim, and Verrecchia [1999], Feltham and Wu [2001], and Lambert and Larcker [2001a]). Similarly, convex compensation contracts are also likely when the manager can make project selection choices to affect firm risk (for example, Lambert [1986], Hirshleifer and Suh [1992], and Core and Qian [2001]).

These theories also suggest that the optimal amount of convexity in a compensation contract depends on a variety of firm and CEO characteristics. Innes (1990) shows that even if an agent is risk-neutral, a limited liability restriction can introduce convexity into an optimal contract. In the traditional moral hazard agency model with a risk-neutral principal and a risk-averse and effort-averse agent (for example, Holmstrom [1979]), the form of the optimal contract is determined by the distribution function that maps managerial actions into the stock price and the manager's risk-aversion. The contract is more convex when the distribution function is more skewed and when the manager is less risk-averse (Holmstrom 1979; Hemmer et al. 1999). For contracts that consist of a combination of stock and options, Lambert and Larcker (2001a) show that the "optimal" exercise price for a single large option grant is generally higher than the stock price at the date of the grant (that is, the options are "out of the money"). Core and Qian (2001) show that when there are no growth opportunities, the CEO's contract contains little convexity per

unit of slope, but when there are large growth options that are difficult to evaluate, the CEO's contract is both more convex and more steeply sloped. Consistent with the general predictions of these theories, Guay (1999) shows that firms with greater growth opportunities provide more risk-taking incentives and that firm risk is indeed greater when managers hold more risk-taking incentives.

3.6 Other Reasons for Equity Compensation

Since options and restricted stock are valuable, they can also be used to provide executives with compensation. Even when an executive already has the appropriate level of incentives, the firm may choose to compensate her with equity as a substitute for cash. One would expect that it is more costly to use risky claims, such as stock options or restricted stock, instead of cash to compensate a risk-averse agent for past performance. (We discuss below that there is much debate over the magnitude of this cost differential.) However, because stock options and restricted stock require no contemporaneous cash payout, firms with cash constraints are expected to use these forms of compensation as a substitute for cash pay (for example, Dechow, Hutton, and Sloan [1996] and Core and Guay [1999, 2001a]). Implicit in these arguments is the assumption that the firm's cost of capital is lower when it "sells" a small amount of stock to an employee in lieu of cash compensation than if it were to sell a similar amount of stock to the market. Many high-growth firms argue that stock-based compensation allows them to supplement cash compensation and compete for high-quality employees.

Stock and option grants can also be driven by tax motivations. For example, grants of options (and grants of restricted stock that are tied to performance-contingent plans) are not subject to the U.S. Internal Revenue Code Section 162(m) \$1 million limit on the tax deductibility of fixed compensation. Further, when future corporate tax rates are expected to be higher, the future tax deduction from deferred compensation can be favorable relative to the immediate tax deduction received from cash compensation.⁶ Therefore, the use of stock-based compensation is expected to be less costly for firms with low marginal tax rates. Yermack (1995), Matsunaga (1995), Dechow, Hutton, and Sloan (1996), and Bryan, Hwang, and Lilien (2000) find that the use of stock options is greater for firms with lower marginal tax rates.

Finally, firms may substitute stock option compensation for other forms of compensation because of the financial accounting treatment of stock options. Specifically, unlike other types of compensation—such as cash pay and restricted stock, which are an expense on the income statement—the

value of stock option grants is generally not expensed, but is instead disclosed in the footnotes to the financial statements. Dechow, Hutton, and Sloan (1996) and Core and Guay (1999, 2001a) provide some evidence that option grants are larger when it is more costly for firms to have low earnings (because of dividend constraints or debt covenants). Further, for reasons that are not well understood, some firms appear to believe that the distinction between recognition and disclosure of option expense is economically important. Carter and Lynch (2001b) provide direct evidence that firms are willing to incur economic costs to obtain favorable accounting treatment for stock options when they show that firms accelerate option repricings to obtain such treatment.

4. CONTROVERSIES, UNRESOLVED ISSUES, AND TOPICS FOR FUTURE RESEARCH

4.1 Equity Incentives and Firm Performance

There is presently no theoretical or empirical consensus on how stock options and managerial equity ownership affect firm performance. Studies of this issue generally take one of two perspectives. Studies such as Morck, Shleifer, and Vishny (1988) argue that, on average, observed CEO equity ownership and incentives are “too low.” If this were true, most firms would increase firm value by increasing CEO equity incentives. In this setting, CEO equity ownership and firm performance should exhibit a positive association because high- (low-) ownership CEOs are closer (further away) from optimal incentive levels.

Morck et al. (1988) find some evidence consistent with this hypothesis, except among CEOs with very large fractional equity ownership. McConnell and Servaes (1990) find evidence of a positive relationship between increases in ownership and firm performance as long as managerial ownership is less than 50 percent. Frye (2001) finds evidence that firms that provide more equity-based compensation to employees perform better. Sesil, Kroumova, Kruse, and Blasi (2000) find mixed evidence that firms using options extensively perform better, and Ittner et al. (2001) find that the relationship between option grants and firm performance varies across organizational levels within a sample of new-economy firms. A limitation of this research is that the causal direction of the relation between equity incentives and performance is unclear (Kole 1996). Rather than higher equity incentives producing better future firm performance, it may be the case that firms expecting better

future performance grant more equity (for example, Yermack [1997]). It would be worthwhile for researchers to analyze this important question using a simultaneous equation or transfer function approach (incorporating leads and lags) to provide evidence on the directionality of the function linking equity ownership with firm performance. Obviously, one problem with this econometric approach is that it is necessary to specify both the structural and reduced-form equations, along with the selection of appropriate instrumental variables (Himmelberg et al. 1999).

Also consistent with this hypothesis is evidence of a positive association between management stock and option holdings, and firm leverage (for example, Mehran [1992] and Berger, Ofek, and Yermack [1997]). Berger et al. (p. 1437) conjecture that firms generally have too little leverage and that shareholders value increases in leverage associated with increases in ownership. The authors provide evidence that increases in option holdings, but not increases in stock ownership, are associated with increases in leverage.

Related literature in corporate finance examines the performance of companies completing a leveraged buyout (for example, Kaplan [1989] and Smith [1990]) and reverse-leveraged buyouts (for example, Holthausen and Larcker [1996]). These changes in organizational structure are generally associated with large shifts in the level of equity owned by executives (in both dollar terms and as a percentage of firm value). The results of these studies reveal large increases (decreases) in performance for firms completing a leveraged buyout (reverse-leveraged buyout). Moreover, the performance consequences are associated with changes in managerial equity ownership.

In contrast to studies that view equity incentives as being too low, Demsetz and Lehn (1985), Core and Guay (1999), and Himmelberg, Hubbard, and Palia (1999) consider an alternative prediction about the relationship between equity incentives and performance. These authors conjecture that firms and managers contract optimally, and that managerial-ownership levels are set, on average, at the value-maximizing level.⁷ In these studies, equity-incentive levels are determined by firm and manager characteristics. For example, as noted above, higher (lower) ownership is predicted and observed in firms where more (less) monitoring is required. From this perspective, no simple ex-ante relationship between ownership and firm performance is expected. That is, low-ownership firms are not necessarily expected to perform poorly because these firms do not require high-powered equity incentives to ensure that managers take appropriate actions. Similarly, high-ownership firms use high-powered equity incentives to resolve serious monitoring problems not because they expect that high

incentive levels will allow them to achieve positive abnormal performance. Himmelberg, Hubbard, and Palia (1999) present evidence to support the view that one would not expect to see an association between performance and the level of incentives in equilibrium. However, as discussed by Zhou (2001), future research is necessary to examine the appropriateness (goodness of fit) for the structure imposed by Himmelberg et al. (1999).

It can be argued that a problem with cross-sectional studies of the determinants of equity incentives is that they provide little evidence of whether firms systematically require incentive levels that are “too high” or “too low.” That is, incentive levels could vary across firms in ways that are consistent with economic theory and yet still be on average too high or low. However, if this were the case, one would expect it to be readily documented by studies that examine the relationship between equity incentive levels and firm performance. For example, if all firms imposed excessively large equity incentives on executives, firms with the lowest incentive levels should be closest to optimal and have the better performance, whereas firms with the highest incentive levels should be furthest from optimal and have the worst performance. The fact that empirical researchers have had difficulty documenting a robust relationship between incentives and performance suggests that the data are not well described by a simple story about incentives being “too high” or “too low” for most firms.

The two schools of thought about the expected relationship between performance and incentives make very different assumptions about the nature of the adjustment costs of correcting suboptimal contracts. For example, Morck et al. (1988) implicitly assume that adjustment costs are so great that firms cannot recontract when incentives are not properly aligned. Therefore, these firms deliver lower cash flows to their shareholders, and their market values are lower.⁸ Conversely, by concentrating on the equilibrium behavior of optimizing firms, Demsetz and Lehn (1985) assume that firms can continuously recontract because there are no adjustment costs. The choice of one of these two extremes drives the design and interpretation of the results of any study that examines the relationship between ownership and performance. It is perhaps not surprising that there is no consensus on the performance consequences of managerial equity ownership.

As an alternative approach, we suggest that firms choose optimal managerial equity incentives when they contract (consistent with the literature that predicts no link between ownership and performance), but that transaction costs prohibit continuous recontracting (consistent with the literature that documents a strong relation between ownership and performance). Because ownership is periodically reoptimized, we expect no association between ownership and

firm performance in a cross-sectional regression that controls for the endogenous determinants of firms’ optimal ownership levels. However, because contracting is not continuous, firms’ ownership levels gradually deviate from the optimal level. This means that a subset of firms always has misaligned incentives but recognizes that the costs associated with recontracting sometimes exceed the benefits. Given these assumptions, an effective sample for testing for a link between ownership and firm value is a set of firms for which managerial equity ownership levels are too low (high), but then recontract to increase (decrease) ownership. For this sample of firms, required adjustments in managers’ ownership should increase cash flows to shareholders and increase firm value because firms should rationally recontract only when the benefits associated with better aligned incentives are greater than the costs of recontracting.

Core and Larcker (forthcoming) explore this approach in the context of target ownership plans. They argue that if target ownership plans improve managerial incentives, adoption should have favorable operating performance consequences for the firm. They assume that when a firm with low managerial ownership requires that managers increase their ownership, this increase mitigates agency problems and motivates managers to select actions that are more consistent with shareholder objectives. Their evidence is consistent with this hypothesis.

Overall, despite considerable prior research, the performance consequences of equity ownership remain open to question. Clearly, the need for high-powered incentives varies across firms and thus greater equity ownership by a particular executive does not necessarily imply that agency costs are lower or that performance will be stronger. However, empirical evidence that equity incentives vary across firms in ways consistent with economic theory does not preclude the possibility that costly contracting allows incentives periodically to become misaligned or that some firms contract sub-optimally with their executives. Exploring the extent of these latter possibilities is an area for future research.

4.2 Executive versus Market Valuation of Equity and the Efficiency of Equity Compensation

Lambert, Larcker, and Verrecchia (1991) point out that the manager’s entire portfolio of stochastic and nonstochastic wealth is important for contracting purposes. The study models a firm that gives a risky contract to a manager who has initial wealth correlated with the stock price. Lambert et al.

show that the risk-averse and undiversified manager has a certainty-equivalent value for the contract that is less than the risk-neutral firm's value of the contract (or, equivalently, the cost to the firm of providing the contract). These results are consistent with the standard agency result that a contract that imposes risk on an agent is more costly than a contract that imposes no risk.

In contrast to Lambert et al., most agency models do not explicitly consider outside wealth: the contract has to meet the agent's reservation utility in expectation (for example, Holmstrom [1979]). Because all executives have outside wealth, this simplification can lead to some confusion in empirical tests of these models. However, these models can be expanded to incorporate outside wealth by assuming that the agent's reservation utility is greater when the agent has more outside wealth (for example, Lambert and Larcker [2001a]). The optimal contract in this setting unwinds some of the agent's initial wealth and replaces it with a precise exposure to firm risk. For example, the contract might require the agent to sell her investment in the market portfolio and purchase a position in the firm's stock.

A central insight of Lambert et al. is that in a contracting setting, it is costly for the principal to ignore the structure of the manager's wealth. For typical power utility functions, Lambert et al. show that the manager's valuation of an option can be less than 50 percent of the Black-Scholes value when the manager is constrained to hold 50 percent of his wealth in firm stock. The valuation is lower for managers who are more risk-averse and less diversified. Finally, Lambert et al. provide evidence that giving an undiversified agent a stock option can lead to incentives to actually *reduce* variance, as opposed to the more typical assumption that an agent with a stock option has an incentive to increase variance. This last finding partly results from the authors' assumption that the agent can reduce firm variance without changing its expected return. In the Black-Scholes model, an option is made more valuable when variance increases because of the assumption that there is a risk-return tradeoff in which expected returns increase when variance increases. Lambert et al. de-link this risk-return tradeoff, and show that an agent prefers a decrease in variance when there is no decrease in expected returns. This result does not depend on risk-aversion, as even a risk-neutral agent would prefer a variance decrease for an in-the-money option, provided that the variance decrease did not reduce the expected stock return. The analysis of Lambert et al. and subsequent work by Hall and Murphy (forthcoming), Hall and Murphy (2000), Carpenter (2000), and others illustrate the importance of considering the manager's total portfolio of wealth when valuing a stock option portfolio from the perspective of the manager.

Hall and Murphy (forthcoming) replicate the analysis in Lambert et al. (1991) and use it to make some normative prescriptions about the structure of current compensation arrangements. Hall and Murphy claim that stock options are a wasteful and inefficient means of conveying *compensation*. The intuition is that paying *compensation* in stock or options to a risk-averse executive can be more costly to the firm than delivering to the executive the same value in cash. This is unquestionably true if the effect of the compensation is solely to increase the amount of risk imposed on the executive and the incentive effects of the stock options are ignored. However, some firms may deliver compensation in the form of equity rather than cash (for example, to conserve cash). In these cases, because the intended purpose of the equity *compensation* is not to increase risk imposed on the executive, the firm likely would allow the recipient to rebalance her portfolio so that the firm-specific risk that the recipient was exposed to after the grant was the same as it was before the grant (Core and Guay 2001b). As described below, executive valuation of equity compensation in this latter scenario is likely to be substantially different than valuation in the former setting.

Similar to the Lambert et al. (1991) study, Hall and Murphy (forthcoming) assume that an executive has wealth of \$20 million and that the only two investment choices available to him are firm stock and the risk-free asset. Although the executive would prefer to hold less, he is exogenously specified to hold \$10 million of wealth in assets that are perfectly correlated with the firm's stock price (that is, stock holdings and the present value of compensation from the firm). Further, Hall and Murphy assume that the executive is exogenously constrained from selling any existing holdings and cannot rebalance portfolio holdings when he receives a \$1 million compensation payment in the form of options. In other words, the firm gives the executive compensation, but simultaneously increases the risk imposed on him by not allowing portfolio rebalancing.

Now consider how the executive values the \$1 million option grant in this setting. After the grant, he has \$11 million in equity, which is further away from his preferred level of stock holdings. Because the executive cannot implement any portfolio rebalancing and is not provided with a compensating risk premium, he values this option grant at less than its Black-Scholes value of \$1 million. Since the value received by the executive can be substantially below the cost to the firm, Hall and Murphy conclude that equity grants are an expensive form of *compensation*. However, as noted above, this grant increases incentives and is not pure compensation. Further, because stock option grants impose more risk on executives per dollar of compensation compared with the risk per dollar

imposed by stock grants, Hall and Murphy conclude that stock option compensation is an inefficient form of equity compensation. In addition, they conclude that the use of Black-Scholes deltas overstates the incentives provided by an executive's option portfolio, and suggest that researchers must risk-adjust compensation payments. This conclusion again follows from the assumption that the risk-averse executive cannot rebalance his portfolio following an increase in its value, and therefore will discount this value increase.

It is important to note that Hall and Murphy implicitly assume that the option grant improves incentives: "If the grant provides incentives that shift the distribution, and if the shift is not already incorporated into stock prices as of the grant date, we will *underestimate* [emphasis added] both the cost and value of the option" (forthcoming, section 2, footnote 13). As discussed above, this assumption that all firms have too few incentives is equivalent to an assumption that firm incentives are out of equilibrium. If one believed that incentives were in equilibrium, one would not ex ante expect that an equity grant would improve incentives. Further, if one believed that incentives were in equilibrium, one would not expect the firm to restrict the executive from selling stock to rebalance incentives following price increases.

Core and Guay (2001b) relax the exogenous assumptions of Lambert et al. (1991) and Hall and Murphy (2001), and instead assume that the equity grant is made as *compensation* under a contract between the firm and the executive. Specifically, Core and Guay assume that the executive's holdings of \$10 million in firm equity are not exogenously specified, but are instead part of a second-best optimal employment contract, which requires her to hold exactly \$10 million of equity incentives. Finally, they assume that the executive is allowed/required to rebalance portfolio holdings over time to maintain the agreed level of incentives. Now consider how this executive values a \$1 million grant of equity. Because she is allowed to implement portfolio rebalancing and sell \$1 million of existing stock holdings at their market value and still maintain the contracted level of firm equity, the executive will value the equity grant at its market value. Using similar logic and assumptions, Core and Guay show that the executive values a change in the value of her stock and option portfolio at its market value. This conclusion again follows from the assumption that the risk-averse executive can rebalance her portfolio following an increase in its value back to the contractual, second-best, optimal level of incentives. Thus, under these assumptions, the Black-Scholes sensitivity of stock and option portfolio value to stock price—as typically used by researchers—is a reasonable approximation for executives' incentives to increase the stock price.

A key assumption in the Core and Guay (2001b) analysis is that because the executive is allowed to rebalance to the target incentive level, there are no incentive effects induced by the \$1 million grant that increase or decrease the principal's expected payout. If this assumption does not hold (for example, as in Hall and Murphy [2001]), the stock option grant changes incentives and affects the principal's payout, and the analysis becomes considerably more complicated.

These two arguments represent polar cases, and the relative applicability of the two approaches depends on one's assumptions and the specifics of the situation under study. The Hall and Murphy (2001) analysis most directly applies to the cost of imposing additional *incentives* on an executive (assuming that this increase is optimal from the perspective of shareholders). However, this approach is not directly related to the use of equity as *compensation* because compensation relates to the payment made to executives, not the risk imposed. The opposite is true for the Core and Guay (2001b) approach. Their analysis addresses the use of equity grants to provide compensation, and assumes that there is an equilibrium level of incentives and that the executive has an ex-ante contract that requires him or her to hold this level of equity incentives. Grants of incentives following the contract do not change the level of incentives required, and accordingly these grants are valued at market value because they impose no extra risk. Further, the Core and Guay argument assumes that the costs of selling stock to rebalance the level of risk imposed on the executive are small (so that the executive can rebalance frequently and completely), and the executive's value of the grant is reduced as these costs increase. Rebalancing costs include trading commissions and Securities and Exchange Commission (SEC) and other (implicit or explicit) restrictions on when stock can be sold. Core and Guay (forthcoming b) also show that, provided the executive can rebalance once shortly following the equity grant, the executive is expected to value a typical newly granted option at 95 percent of its market value.

The Hall and Murphy (2001) analysis may be applicable to very large option grants ("mega-grants") that impose excess incentives beyond the optimal level that the executive cannot shed. However, mega-grants may be a case where the executive has control of the board and uses this grant to extract wealth from shareholders. (It is frequently hypothesized that options are a means of rent extraction—for example, Core, Holthausen, and Larcker [1999]—but as we discuss in Section 4.6, this hypothesis lacks an explanation of why risky option grants are a preferred means of rent extraction.) In either case, when the effect of a compensation payment is to impose extra risk on the executive, there is no doubt that the executive values this compensation payment at less than its market value. When

this extra risk is inefficient, the compensation payment is inefficient.

A key issue in the debate over the valuation and efficiency of equity compensation is the extent to which executives actually rebalance their stock and option portfolios in response to equity grants. Although empirical evidence suggests that executives do rebalance their portfolios in response to stock and option grants (for example, Janakiraman [1998], Heath, Huddart, and Lang [1999], Ofek and Yermack [2000], and Core and Guay [2001a]), the extent of this activity and how it varies cross-sectionally remain open questions.

Finally, a problem with both the Core and Guay, and Hall and Murphy approaches is that they do not provide explicit models that explain why stock options arise in an optimal contracting setting. Both approaches impose some exogenous structure and assume that the principal-agent problem is solved by a contract that is linear in the stock price. This assumption focuses on the fact that option grants and restricted stock grants provide incentives to increase the stock price, but ignores the convexity and risk-taking incentives created by the options (as noted above). The continued development of optimal contracting models for stock options and equity grants, and careful testing of their empirical implications, would be very helpful for understanding the valuation and efficiency of equity compensation.

4.3 The Debate over Relative Performance Evaluation

A widespread concern among both practitioners and academics is that executive portfolios lack relative performance evaluation (RPE) or, equivalently, that stock and stock options gain value not only because the firm performs well, but also because the market rises. For example, Abowd and Kaplan (1999) remark:

Stock options reward stock price appreciation regardless of the performance of the economy or sector. Why should CEOs be rewarded for doing nothing more than riding the wave of a strong bull market? If the exercise price could be linked to measures like the S&P 500, or an index of close product-market competitors, then executives would be rewarded for gains in stock price in excess of those explainable by market factors outside their control. If market-wide stock movements could be netted out of executive incentive schemes, then equivalent incentives could be provided while reducing the volatility of the executives' portfolios (p. 162).

Murphy (1999) and Gillan (2001) echo a similar perspective. Abowd and Kaplan suggest that current practices are wasteful and that research could “lend insight into the value of resources *squandered* [emphasis added] by a failure to implement relative performance evaluation plans” (p. 163).

A central tenet of agency theory is Holmstrom's (1982) prediction that compensation contracts are expected to filter out systematic noise through relative performance evaluation. Janakiraman, Lambert, and Larcker (1992), Antle and Smith (1986), Gibbons and Murphy (1992), and others have found relatively little evidence that the annual bonus portion of executive compensation exhibits RPE. However, given our observation above that most of a CEO's incentives come from his or her equity portfolio, the lack of *explicit* RPE in a bonus payment does not imply the lack of implicit RPE in the overall contract. Casual empiricism, such as in Abowd and Kaplan's study, observes large stock and option portfolios, and assumes there is no RPE. That is, if firms use RPE, one might expect to see explicitly indexed CEO contracts, where the CEO holds securities that only expose him to idiosyncratic firm performance and effectively remove systematic risk from the CEO's performance evaluation. We argue below that while there is no *explicit* RPE in CEOs' stock and option portfolios, there is considerable *implicit* RPE in these portfolios.

A potential explanation for the apparent rarity of RPE equity incentives follows from the observation that CEOs are expected to hold equity portfolios that reflect the terms of their employment contracts, not the portfolios they would choose in the absence of constraints. Portfolio theory predicts that a rational, risk-averse CEO would hold *no* stock in her firm (in the absence of private information), and instead would have *all* of her wealth invested in a diversified portfolio.⁹ That is, a CEO will generally hold a substantial quantity of stock in her firm only if required to do so as part of the compensation contract (for example, for incentive reasons).¹⁰ Under certain assumptions, this form of employment contract is reasonably consistent with an RPE prediction that the optimal contract requires the CEO to hold more than her preferred exposure to the firm's idiosyncratic (nonmarket) return.

To see this, imagine that a firm hires a new CEO with \$100 in outside wealth that the executive prefers to hold in the market index (with return R_m). (For simplicity of exposition, we assume that the CEO prefers to hold 100 percent of his outside wealth in the market index, but the same argument applies if the CEO prefers to hold a combination of the risk-free asset and the market index.) Suppose that the employment contract with this new CEO requires the purchase of \$50 of the firm's stock, which the executive finances by selling \$50 of his market holdings.¹¹ Under the simplifying assumption that the

firm has a beta equal to 1, the stock return is $R_m + R_i$. Accordingly, after fulfilling the contract, the executive owns \$50 in the market portfolio with return R_m and \$50 in firm stock with return $R_m + R_i$. This new portfolio is equivalent to the \$100 market portfolio that was originally held, plus a new \$50 exposure to the idiosyncratic component of the firm's return R_i . The executive's wealth is no more correlated with market movements after the contract than that preferred in the absence of the contract. The only aspect that has changed is that the executive now holds a \$50 exposure to the firm's idiosyncratic risk, which is exactly the prediction of RPE. The implicit indexing of the executive's holdings of the firm's stock is not observed because the structure of the executive's outside wealth and preferences is not observed (Core, Guay, and Verrecchia 2000; Core and Guay 2001b; Jin 2001). This analysis suggests that executive contracts are likely to be more consistent with RPE than might be observed by casual empiricism or by previous empirical RPE research that has not considered the structure of the executives' other wealth.

The explicit use of RPE in executive compensation contracts (for example, indexed stock options) is quite uncommon. Johnson and Tian (2000) note some possible reasons for this empirical observation. Firms face several potentially costly implementation issues with respect to indexed options. For example, an observable nonmanipulable benchmark index must be specified that captures common uncertainty beyond the executive's control (for example, Dye [1992]). Indexed options can create greater incentives to increase risk than standard options. Furthermore, as discussed below, indexed options require the firm to use variable financial accounting that results in compensation expenses for options. A disadvantage of indexed stock option contracts would be evident if the recognition of accounting expenses is important to the firm. Nevertheless, the extent of RPE in executive compensation contracts is an important issue that deserves further research.

4.4 Do Firms Contract over CEO Wealth?

A key issue in understanding the efficiency of equity-based compensation and incentives is to determine whether firms contract over CEO wealth. We hypothesize that an efficient contract varies the amount of incentives given to a CEO as a function of the CEO's total wealth (as well as a variety of other parameters). To demonstrate the intuition behind this claim, we make the simplifying assumption that the optimal contract is a linear function of the stock price, and consider how a firm

would contract with a CEO who has constant relative risk-aversion. Given that the CEO has constant relative risk-aversion, and conditional on firm characteristics and CEO effort-aversion, the optimal linear contract would expose some fixed proportion of the CEO's wealth to firm risk. This risk exposure would be equivalent to requiring the CEO to own stock with value equal to a fixed proportion (say, 60 percent) of his or her wealth.¹² Now suppose that there are two CEOs who have the same wealth, the same constant relative risk-aversion utility functions, the same marginal product, and the same cost of effort. Each CEO has the same efficient contract. Then one CEO inherits a lot of money, but the second loses all outside wealth in a divorce. Unless they recontract or rebalance, both CEOs have incentives to take actions that do not maximize firm value, the first by working less and the second by taking fewer risks. Only if CEOs have constant absolute risk-aversion (that is, a CEO with \$100 in wealth values a \$10 gamble the same as a CEO with \$1 million in wealth) would there be no benefit to wealth-based contracting.

Given that the merits of wealth-based contracting are compelling, it is interesting to consider what frictions might prevent the firm from engaging in this economic approach. To write such contracts, the firm requires information about the executive's firm-specific wealth as well as total wealth (inside and outside). Contracting over firm-specific wealth would not seem to pose much of a problem because these amounts are readily observable, given U.S. disclosure and insider-trading laws. For example, the SEC legally requires that insiders disclose their own firm stock holdings, option exercises, direct purchases and sales of stock, and any indirect "quasi-sales" of stock through synthetic instruments such as caps or collars (Bettis, Bizjak, and Lemmon 1999). As a result, the majority of costs from implementing wealth-based contracting are likely to stem from the absence of information on the manager's outside wealth, which he or she is under no legal obligation to disclose. However, even if the firm does not know exactly the executive's outside wealth, it can form an unbiased expectation of it. For example, the firm is likely to have substantial knowledge about previous employment history that provides information about outside wealth (such as previous cash compensation, stock holdings of previous employers, and number of years employed).

Empirical evidence documenting whether firms contract over executive wealth would provide important insights into the research questions outlined in Sections 4.1-4.3. However, to our knowledge, there is little direct empirical evidence on this topic. Yet anecdotal evidence from conversations with companies and consultants suggests that firms consider their CEO's total risk exposure. For example, we know of a retailer

that emerged from bankruptcy and gave a new CEO 1,000,000 at-the-money options at a low stock price (\$10). The options produced substantial risk-taking incentives for the CEO and he implemented “risky” strategic and operational initiatives resulting in substantial stock price appreciation (\$100). After this outcome, the CEO became very risk-averse and refused to adopt risky projects. One explanation was that he wanted to “bank” the gain, and any risk or volatility was undesirable to him. The board’s solution was to encourage the CEO to rebalance his wealth by exercising the in-the-money options. The board then replaced the exercised options with new at-the-money options. Obviously, it is difficult (and inappropriate) to generalize from anecdotes such as this one.

Indirect evidence of wealth-based contracting includes Baker and Hall (1998) and Core and Guay (1999), who show that CEO incentives increase with firm size. Firm size can be used as an indirect proxy for CEO wealth as larger firms require more talented CEOs who demand greater compensation (Smith and Watts 1992). The evidence in Core and Guay (1999) that CEO incentives increase with CEO tenure may also indicate a relationship between CEO wealth and CEO incentives (assuming more senior CEOs have greater wealth). The finding that firm-specific indicator variables dramatically increase the explanatory power of regressions that model the level of equity incentives (for example, Core and Guay [1999] and Palia [2001]) is consistent with unobserved heterogeneity in CEO wealth being associated with differences in CEO incentives. However, this heterogeneity can also be interpreted as firm-specific differences in monitoring and contracting technology (Himmelberg et al. 1999). Evidence in Core and Larcker (forthcoming) that CEO ownership targets are typically around five times CEO salary seems to run counter to a prediction of wealth-based contracting because CEO salaries likely exhibit much lower cross-sectional variation than CEO wealth (although firms may use cash pay as a noisy proxy for wealth levels).

Finally, recent research by Bettis et al. (1999) as well as considerable anecdotal evidence indicate that some CEOs use derivative securities such as caps and collars to hedge firm-specific risk. Consistent with the predictions of efficient wealth-based contracting, caps and collars can be an effective way to allow executives to rebalance firm-specific risk in cases where their firm-specific wealth grows beyond the level implied by an efficient contract. However, inconsistent with the predictions of efficient wealth-based contracting, in firms with poor corporate governance (such as a captured board), CEOs may be allowed to engage in these hedging activities even when it is not efficient to do so. Furthermore, some CEOs may undertake these hedging activities secretly without board

approval. However, the fact that secret hedging activities are likely to run afoul of SEC disclosure rules suggests that this behavior is not expected to be widespread. The small sample size in Bettis et al. (1999) is consistent with the hypothesis that this behavior is limited, or that firms and CEOs are engaging in this behavior and not filing required SEC disclosures.

4.5 Repricing Stock Options

Stock option repricing—the practice of resetting the exercise price of previously granted options that are significantly out of the money—has attracted considerable attention in recent years, and is an area of particular concern for institutional investors and the business press:

Heavy criticism has come from the financial press and from large institutional investors such as the State of Wisconsin Investment Board, who argue that resetting is tantamount to rewarding management for poor performance and that, more importantly, it destroys incentives present in the initial contract (Acharya, John, and Sundaram 2000, p. 66).

The typical argument against repricings is that firms provide options to employees as a form of equity incentives, and these incentives are intended to encourage employees to take value-maximizing actions. When the stock price rises, employees are rewarded through the increase in the value of their options. However, if options are repriced after the stock price falls, the repricing effectively removes the risk originally imposed on the executive for incentive purposes, and may be seen as a “reward” for poor performance. Thus, critics argue that repricing is an inappropriate aspect of the compensation contract. A related point consistent with the critics’ perspective is that if the firms had not repriced, over half of their sample would have stock options that were at the money within two years after the repricing event (Chance et al. 2000). This result raises the question of whether the repricing is actually necessary. Of course, two years is a long time if you lose valuable employees to competitors in the interim.

In a counterargument, Saly (1994) and Acharya et al. (2000) point out that it is generally optimal to allow a long-term contract to be renegotiated, and an ex-ante strategy of repricing options following bad outcomes dominates a commitment to not recontract. Intuitively, if the outcome is bad and is known to be the CEO’s fault, the CEO can be terminated. If the firm wishes to keep the CEO following a bad outcome, it will want to provide the CEO with optimal incentives, which involves recontracting.

Arguments against repricing also fail to consider the retention incentives that options are likely to provide. Employee stock options generally have vesting requirements that encourage employees to remain with the firm until the options are exercisable. Further, employee stock options are not tradable or portable. This means that employees must exercise any vested options when they leave the firm, thereby forfeiting the time value of the options (that is, the employees are forced into suboptimal early exercise of the options). As an employee builds up an option portfolio over time, these retention incentives increase, thereby making it more costly for a competitor to hire away the employee. That is, not only would a competitor have to pay the employee the market wage, the firm would also have to compensate the employee for the value forgone from forfeiting unvested options or suboptimally exercising options prior to maturity. When the stock price falls precipitously, these retention incentives are largely eliminated and the probability of employee turnover increases as it becomes less costly for competitors to lure employees away. Repricing options can serve to reinstate the retention incentives. Obviously, repricing is costly from the perspective of the firm, but this cost may be substantially smaller than the cost of employee turnover (Acharya et al. 2000; Carter and Lynch 2001a) and thus repricing can be a value-increasing action by the board of directors.

It is important to note that the preceding argument is limited in that it assumes the existence of options and ignores the fact that restricted stock or other forms of deferred compensation could be equally or more effective as a retention device. For example, tenure-based restricted stock could have the same expected retention value as an equivalent dollar value of options, but with less risk.

Finally, we note that although stock options are commonly thought to provide retention incentives, there is little direct empirical evidence that documents these effects. This is an important question for future research to address.

Empirical research on stock option repricing provides insight into several issues. First, researchers document the frequency of repricing. Using a sample of ExecuComp firms from 1992 to 1995, Brenner, Sundaram, and Yermack (2000) find an incidence of repricing of less than 1.5 percent per firm year. Chance, Kumar, and Todd (2000) find a lower incidence of repricing when they examine 4,000 large firms included in the NAARS database from 1985 to 1994. In a sample of firms with December 1998 fiscal years obtained from a Lexis-Nexis search, Carter and Lynch (2001a) find more than 260 firms that reprice. Interestingly, most of the firms are small, high-technology firms that are not included in the Brenner et al. and Chance et al. studies. Consistent with Carter and Lynch, Ittner

et al. (2001) find that repricing frequency is substantially higher for small, hi-tech “new-economy” firms. For example, Ittner et al. find that 63.8 percent of the firms in their sample of 217 firms allow repricing, with shareholder approval required in 35.4 percent of the cases. Moreover, 59.6 percent of their sample have repriced stock options at least once and 31 percent have repriced stock options more than once following their initial public offering. It is worthwhile to note that a new financial accounting treatment of repricings may continue to affect their frequency. We discuss this development later.

Prior research finds that repricing follows poor firm-specific performance, and some researchers interpret this as evidence that repricings are not being undertaken to protect managers from industry performance. However, Carter and Lynch (2001a) point out that repricings are conditional on bad firm-specific performance *and* on the firm’s (unobserved) decision not to terminate its employees. If bad managers are fired and get no repricing, then for the remaining sample of good managers, an observed negative relation between repricing and performance could arise spuriously because the managers who are punished for poor performance are excluded from the sample.

Brenner et al. (2000) and Chance et al. (2000) provide evidence that repricings reflect governance problems (that is, entrenched managers are more likely to conduct repricings). Brenner et al. present evidence that option grants and compensation are higher for managers whose options are repriced, although this evidence is confounded by the fact that the repricing dummy variable in their regressions is endogenous. However, Carter and Lynch (2001a) match each repricing firm against a control firm with out-of-the-money options and find no evidence of a correlation between repricings and governance problems. A limitation of empirical research on repricings, as noted by Brenner et al., is that it does not examine CEO turnover. Clearly, it would be desirable for future research to examine the motivations to reprice and the performance consequences from this board action.

4.6 Manipulation of Exercise Price and Timing of Stock Option Grants

Yermack (1997) finds positive abnormal stock returns after option grants. The study presents evidence to support the hypothesis that these returns occur because managers time the option grant prior to the release of good news. By making grants before the release of good news, the manager effectively awards himself an in-the-money option, which is more

valuable than the at-the-money option that he appears to grant himself. Yermack also presents evidence that the resulting discount (stock price thirty days following grant minus exercise price) is higher for firms with weaker governance (such as when the CEO is a member of the compensation committee). Complementing Yermack's argument that managers time equity grants around fixed information disclosure dates, Aboody and Kasznik (2000) suggest that managers also time the disclosure of information around fixed equity grant dates. Specifically, they provide evidence that firms delay the disclosure of good news and accelerate the release of bad news prior to stock option award periods.

Although the manipulation effect appears to be statistically significant in earlier research, one can question its economic significance and whether rational CEOs would engage in risky behavior for such a small expected gain. Based on abnormal returns for thirty days after the grant date, Aboody and Kasznik (2000) find that the disclosure strategy increases the CEO's option award value by a mean of \$46,700 (the median is \$18,500). Aboody and Kasznik argue that this practice amounts to compensation that is economically important. The amount estimated by them represents 2.5 percent (5.1 percent) of reported total CEO compensation of \$1,885,600 (CEO option compensation of \$923,400). Given that the average CEO within this sample is likely to have a stock and option portfolio worth more than ten times his annual compensation, the typical CEO's wealth gain from this behavior is much less than 1 percent. No evidence is reported as to whether total CEO compensation for the sample firms engaging in this practice is statistically different than for firms not engaging in the practice. There is also the issue of expected litigation costs in the event of shareholder litigation (discussed below) and the potential decrease in the value of their human capital as it becomes known that they are "manipulating" corporate disclosure.

Yermack argues that this type of granting practice would likely be construed as illegal insider trading. If the CEO engages in this behavior opportunistically to the detriment of shareholders and without board permission, the CEO violates his or her fiduciary responsibility to the shareholders. If shareholders sue the firm over this behavior, the CEO is not covered by the directors' and officers' firm insurance, and thus could lose his entire wealth in litigation. Unless the CEO expects the risk of being caught in this behavior to be extremely low, it seems highly irrational to engage in such risk-seeking behavior.

Both Yermack (1997, pp. 471-2) and Aboody and Kasznik (2000, p. 98) also entertain the possibility that their evidence is consistent with managers acting in shareholders' interests. For example, because the incentives to increase stock-price volatility created by an in-the-money option are lower than

those created by an at-the-money option (Lambert et al. 1991), firms may wish to issue in-the-money options but prefer to avoid the accounting cost of such options. To accomplish this objective, they allow managers to time disclosures. Provided that CEOs' and other employees' compensation are adjusted downward to reflect this extra value, one could argue that this type of behavior is entirely consistent with firms acting in shareholders' interests by writing efficient contracts that minimize a complex array of contracting costs.

Obviously, little is known about the extent to which CEOs "self-deal" with stock options. On the one hand, it has been argued that the timing of stock option grants is consistent with a form of opportunistic insider trading. However, the economic importance of this behavior for the executive and the firm is very unclear. On the other hand, arguments can be made that observed granting behavior simply reflects efficient contracting between boards and CEOs. This latter argument is bolstered by the seemingly transparent nature of self-dealing with options that should make monitoring this activity relatively easy. In addition, one might question why CEOs use stock options to extract rents given that the payoff from options is risky, depends on stock price increases, and generally has a vesting period over which the CEO must remain employed before he can realize any gains. It would be desirable for future research to provide some resolution to manipulation behavior by managers in response to stock option grants.

4.7 Does the Accounting for Stock Options Cause Inefficient Use of Options?

In a competitive labor market, options are granted to employees as a form of compensation in return for services rendered. Like any other factor in production, corporations use these employee services to earn profits. However, unlike other factors in production, firms generally record no accounting expense for compensation that is paid in options (assuming the grant date stock price is less than or equal to the exercise price).¹³ It is important for the reader to note that the recognition of option compensation as an expense in firms' financial statements is a separate issue from whether option compensation is an economic cost. Institutional accounting rules are influenced by objectives to produce reliable financial statements, as well as by the political process. With respect to option compensation, these forces have resulted in financial accounting rules that allow most firms to avoid recognition of option expense in accounting earnings, and to disclose instead an estimate of the expense in a footnote to the financial statements.

Although firms can choose to expense (that is, reduce reporting earnings) the estimated value of options granted, few firms make this choice. As such, other things being equal (including firms' economic profits), the accounting earnings of firms that grant options extensively are expected to be greater than the earnings of firms that use no options. In contrast, stock appreciation rights, which provide an identical payoff to options but settle in cash rather than in stock, are required to be expensed. However, regardless of whether firms choose to expense options in income, pro-forma income that includes option expense must be disclosed in the footnotes to the financial statements. Furthermore, there is significant disclosure about outstanding employee options in both the firm's proxy statement and annual report. Evidence in Aboody (1996) and Bell et al. (2001) is consistent with an efficient stock market recognizing and pricing these competing claims to the firm's equity.

Nevertheless, firm managers appear to behave as if they believe their stock prices would suffer if earnings included an expense for stock option compensation. For example, Carter and Lynch (2001b) find that firms accelerated repricing activity around the effective date of an accounting rule that required expensing of repriced options. Prior to December 1998, repricings did not trigger an accounting expense. After this date, firms were required to use variable accounting for repriced options, thereby incurring an accounting expense. The authors find that firms accelerated repricing activity around the effective date of this accounting rule. Following this change in accounting treatment, Carter and Lynch (2001b) observe a sharp reduction in the use of repricings to reinstate incentives. A survey by iQuantic (2001) finds that the majority of high-tech "new-economy" firms with underwater options have switched from repricing underwater options to giving a supplemental grant of options at the lower strike price. If canceling and reissuing options was optimal from a contracting standpoint, it seems that firms are incurring real economic costs to avoid the accounting expense associated with repricings.

If managers incorrectly perceive that there are real costs associated with expensing compensation, options may be overused and substituted for other forms of compensation, such as cash or restricted stock. If there is a very large real cost of expensing options, firms might prefer options even if, as argued by Hall and Murphy (forthcoming), their economic cost is greater than that of restricted stock. It is important for future research to examine the role of accounting in motivating firms to either increase or decrease their use of stock options. Specifically, shareholders presumably want the board of directors to select stock option plans that maximize shareholder value, not short-term earnings. Thus, if indexed options or other stock option designs that require variable

accounting provide optimal incentives for executives, why would a board reject such a compensation plan because of "unfavorable" accounting? Clearly, the role of financial accounting for employee stock options is of considerable importance to firms, but is not well understood by economists.

4.8 Do Executives and Lower Level Employees Actually Understand How Stock Options Work and the Implicit Incentives in These Options?

There is an extensive literature in the behavioral sciences regarding biases in individual beliefs, and a growing literature in finance and insurance on heuristic behavior by investors (for example, Odean [1998]). Benartzi (2001) shows that employees invest a large fraction of their 401(k) assets in their own firm's stock, which seems to be a suboptimal portfolio choice given their large human capital investment in the firm. An assumption or implication of these studies is that some individuals do not understand the expected distribution of stock prices. Researchers are beginning to examine how these psychological biases relate to employee stock options (for example, Heath et al. [1999] and Core and Guay [2001a]). Lambert and Larcker (2001b) provide direct evidence on this issue in a recent survey. Specifically, middle-level managers assign a value to their stock options that exceeds the Black-Scholes value by 50 to 200 percent. This result suggests that the holder's beliefs about the stock price distribution are different from those of the market, which is consistent with either systematically favorable private information or biased beliefs on the part of the option holder. If a large number of option holders do not understand the underlying price distribution, it is conceivable that they may not understand the incentives provided by an option. Certainly, employees understand that the value of the option increases when the stock price increases, and that increases in stock price are more likely when the employee and all the firm's employees work harder, smarter, and more efficiently. However, as mentioned above, it is reasonable to question how accurately the partial derivatives of the Black-Scholes model measure executive incentives produced by stock options. An interesting question for future research is to examine how executives actually value their stock options. It would be useful to uncover what differences, if any, there are between the perceived and economic value of stock options, whether these differences vary with the employee's level in the organization, in wealth, in education, and other factors, and the implications of these differences for the incentives that stock options give employees.

A related question is whether it is good policy for the firms to recognize these biases and to “take advantage” of the employees by “selling” them “overvalued” equity. An alternative hypothesis is that people will pay for the chance to become very wealthy, and placing a large bet on the success of their firm may be their optimal portfolio choice. It would be possible to model this with a utility “function” or correspondence that is convex between present wealth and wealth that is ten times greater, even though it is locally concave at each wealth level. Of course, employees can satisfy their demand for stock with open market purchases so that any overvaluation that manifested itself would have to occur because employees cannot buy in the market the equivalent of a long-maturity option on their own firm’s stock.

5. CONCLUDING REMARKS

There is a long history of academic research that examines the managerial incentives associated with stock options and equity ownership. The aggressive use of stock options and the large payouts from stock option grants in recent years have produced considerable debate in boardrooms and the financial

press about the desirability of using equity compensation in executive compensation programs. In this survey, we provide a synthesis of the major research findings, as well as the fundamental controversies and unresolved issues about equity incentives. As is commonly the case in academic work, decades of research have perhaps produced more questions than answers.

One of the key results from our survey is that simple normative prescriptions, such as “repricings are an indication of poor governance” or “more equity ownership by executives is always better than less ownership,” are inappropriate. It is almost always necessary to understand the objectives of shareholders, the characteristics of managers, and other elements of the decision-making setting before drawing any conclusions about the desirability of observed equity-based incentive plans or the level of equity ownership by managers. Sweeping statements about governance and compensation, without a detailed contextual analysis, are almost always misleading. Moreover, unsupported conjectures by activist shareholders can impose substantial costs on firms by motivating boards of directors to adopt inappropriate equity compensation plans to placate this same group of shareholders.

ENDNOTES

1. For example, there are many interesting design characteristics associated with stock options that we do not consider in this review. One such characteristic is the reload feature of some stock options. Hemmer et al. (1998) provide a useful analysis of reloads.

2. This assumption likely does not hold for CEOs with large turnover probabilities. For example, a new CEO is more likely to be terminated (and lose the present value of his future compensation) following poor performance than a CEO who has established his or her ability to run the firm.

3. Our assumption that the majority of a CEO's incentives are driven by variation in equity portfolio values does not imply that accounting or nonfinancial performance measures (such as innovation and customer loyalty) are not used in contracting with CEOs. We only assume that for the typical CEO, the use of these measures in his contract does not create large incentives that are distinct from incentives to increase the stock price.

4. Haubrich (1994, p. 258) notes: "Jensen and Murphy use their findings to challenge the principal agent paradigm. The pay-performance sensitivity of .003 is a far cry from the 1.0 predicted by the risk-neutral version of principal agent theory." For a small group of CEOs with extremely high fractional ownership, Morck, Shleifer, and Vishny (1988) conclude that ownership was "too high."

5. While traditional agency theory (for example, Holmstrom and Milgrom [1987] and Aggarwal and Samwick [1999]) predicts a decreasing relation between risk and optimal incentives (that is, less equity for managers of high-tech firms than for managers of utilities), Demsetz and Lehn (1985) and subsequent researchers find greater equity ownership for firms with greater uncertainty. Core and Guay (forthcoming b) reconcile these competing findings and show an increasing relation between risk and incentives, as predicted by Prendergast (2000), Core and Qian (2001), and Raith (2001).

6. From the employee's perspective, deferred compensation, such as restricted stock and options, always provides higher expected after-tax returns (before adjusting for risk) than a cash payment of equal value because taxes on the return are deferred (Smith and Watts 1982).

7. Demsetz and Villalonga (2001) argue that it is important to control for significant outside owners when examining the effect of inside ownership on performance. For a survey of the governance effects of outside blockholders, see Holderness (2003).

8. It is important to note that, under the assumption of market efficiency, this hypothesis does not imply that *stock returns* will be

lower for firms that contract suboptimally. That is, if the market understands that a firm is contracting suboptimally with its executives, the value of the firm will be lower but stock returns will be normal.

9. By "no" stock, we mean no stock other than the small amount of stock the CEO owns by owning the market portfolio. If CEO stock ownership was primarily driven by private information, one would expect to observe that some CEOs hold large quantities of stock (those CEOs with positive information) while other CEOs hold no stock (those CEOs with negative information). Further, one would expect to observe large swings in ownership as private information is generated and disseminated. These features are not commonly observed, and laws against insider trading seem to preclude this behavior.

10. Another exception to this point is the case of a founding CEO. In this case, it may be difficult for the CEO to sell all of her stock immediately without incurring substantial "signaling costs." However, programs such as those employed by Bill Gates, in which the CEO announces regular sales at certain times in the future, allow founding CEOs to reduce their equity holdings gradually without incurring information costs.

11. It is possible that the executive is required to purchase firm stock in excess of his market portfolio holdings. In these cases (and assuming that shorting the market portfolio is costly or not feasible), the role of firm-sponsored RPE is likely to be greater.

12. Although the degree of executive diversification is generally unknown, some survey data are available. Lambert and Larcker (2001a) find that the average survey respondent has approximately 19 percent of her wealth directly tied to her firm. A survey conducted by Oppenheimer Funds Inc. (2000) finds that 32 percent of option holders had 20 percent or more of their financial assets in stock options or stock of their company, 20 percent had 30 percent or more, and 12 percent had 40 percent or more.

13. The fact that options may provide employees with incentives does not provide a justification for excluding an estimate of the economic cost of granting options from the computation of labor expense. To the extent that options create incentives, they are like any other incentive in that they work by imposing risk on the employee, and the firm has to pay the employee extra compensation to accept this risk. Evidence in Bell et al. (2001) is consistent with investors' perception that services rendered by employees in return for newly granted options extend beyond the year in which the options are granted. As such, it may be reasonable to view the services received from option compensation as a temporary economic asset to be amortized (expensed) over a few years following the grant date.

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