

Costs of broad-based stock option plans

Paul Oyer^{a,*}, Scott Schaefer^b

^a Graduate School of Business, Stanford University, 518 Memorial Way, Stanford, CA 94305, USA

^b David Eccles School of Business, University of Utah, 1645 East Campus Center Drive, Salt Lake City, UT 84112, USA

Received 17 June 2004

Available online 4 November 2005

Abstract

We generate estimates of the costs of broad-based stock option programs under varying assumptions about why firms use these pay schemes. We show that, if accounting considerations alone drive option grants, a typical firm in our sample incurs between 50 cents and one dollar of real costs in order to increase reported pre-tax net income by one dollar. This cost is reduced, but is still quite substantial, if accounting leads firms to grant options rather than restricted stock. We also show that, if option grants are efficient, the patterns in our data are consistent with firms using these grants to attract and retain employees.

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JEL classification: G30; J33; J41

Keywords: Employee compensation; Stock options

1. Introduction

Employee stock options have generated substantial interest recently among academics, business practitioners, and policy-makers.¹ For economists interested in firms' relationships with employees, option debates have centered on two key issues. First, to what extent are firms' option-granting choices distorted by the favorable accounting treatment accorded to stock options? Second, if observed option grants are driven by factors other than accounting, then what

* Corresponding author.

E-mail addresses: pauloyer@stanford.edu (P. Oyer), scott.schaefer@business.utah.edu (S. Schaefer).

¹ See Crimmel and Schildkraut (2001) and Oyer and Schaefer (2005) for detail on the incidence of broad-based option grants.

benefits are firms able to capture in order to offset the considerable risk-related costs of such plans?

Hall and Murphy (2003), for example, argue that the use of option-based pay arises primarily from the favorable accounting treatment of option grants. Under accounting rules in place to date, firms have significant latitude in making accounting choices regarding options, and at most firms the costs of employee stock options never appear on an income statement. Shifting pay toward options and away from other forms of compensation allows firms to reduce reported compensation expense, and thereby boost earnings. Other authors, including Core and Guay (2001), Kedia and Mozumdar (2002), Hand (2004), and Oyer and Schaefer (2005), have argued that there may be substantial economic benefits to firms from granting stock options broadly to employees. Options may help firms attract and retain employees, provide incentives, or finance investment by reducing cash wage payments. If options are selected for these reasons, however, it must be the case that options perform better on these dimensions than would comparable cash or restricted stock compensation packages.

In this paper, we pose two main questions relating to the widespread use of stock options as compensation instruments for lower-level employees. First, what are the costs of observed stock-option grants if accounting considerations play an important role in firms' decisions to grant options to employees? Second, if accounting considerations do not play an important role in firms' option-granting decisions, then what can we learn about the potential reasons for such option grants from the fact that firms chose to grant options rather than restricted stock?

We rely on data from the 2000 Survey on Current Practices in Broad-Based Stock Option Plan Design conducted by the National Center for Employee Ownership (NCEO). The NCEO Survey is unique in that it provides very detailed information regarding specific compensation plans offered to individual employees. We observe, for example, the number of options typically granted to new employees at various levels of the organization. Much prior research on firms' decisions to grant options broadly relies on data that is more highly aggregated, such as that found in firms' annual reports. These disclosures do not permit detailed analysis of compensation contracts offered to individual employees other than top executives. The detailed information in the NCEO data comes with the drawback that the sample is not a random group of firms or even of firms with broad-based stock option plans. Even compared to the high volatility typical of firms that grant options to middle managers (see Oyer and Schaefer, 2005), NCEO sample firms have high stock volatility. Therefore, the exact estimates we present apply only to the NCEO sample.

To address our first question, we examine the link between accounting and options put forward by Hall and Murphy (2003). They suggest that managers seek to maximize accounting earnings and perceive options as "nearly free." Therefore, managers' option-granting decisions reflect the *accounting cost* of such actions rather than the *economic cost*. If this is true, then broad-based option grants are socially inefficient. This inefficiency may arise either from problems with corporate governance, or from informational asymmetries in capital markets.

We proceed under two sets of assumptions. First, to bound the potential accounting-related costs of stock-option grants, we assume that the favorable accounting treatment accorded to stock options is the sole reason for firms' decisions to grant equity broadly.² Next, we assume that

² To be clear on this point, to our knowledge no scholars have argued that the favorable accounting treatment is the *sole* reason that firms grant equity to employees. Some have argued that accounting is the *primary* reason, or that accounting explains why firms elect to grant options rather than stock. We examine this case because doing so puts an upper bound on potential accounting-related costs.

options and stock offer equivalent advantages as compensation instruments (for any of a number of possible reasons, as listed above), but that firms choose options rather than restricted stock because of the accounting treatment. Note that under either set of assumptions, stock options may be a relatively expensive form of compensation for the firm. If employees are risk averse and unable to diversify the risk inherent in option holdings, then employees will not value option-based compensation as highly as alternative forms of less risky compensation. Under the first assumption, the best alternative to any observed cash-plus-options pay plan is a cash-only plan that the employee values equivalently. Under the second assumption, the best alternative to an observed option-based plan is a cash-plus-restricted-stock plan the employee values equivalently.

Given various assumptions regarding employee risk aversion, we can compute the cost to the firm of offering the best alternative plan, and compare this to the cost of offering the observed cash-plus-option-based plan. For each firm in our data set, we compare the risk premium associated with observed option grants to the resulting per-manager increase in the firm's reported pre-tax income. If, for example, the median firm in our sample were to grant an all-cash compensation package were it not for the favorable accounting treatment of options, then observed option grants impose \$3000 in additional compensation cost per manager annually (relative to cash compensation), but allow the firm to increase reported earnings by \$9000 per manager. The *implied marginal willingness-to-pay for a dollar of earnings* for the median firm is \$0.64—that is, the decision maker at the median firm is willing to (or, more precisely perhaps, is allowed to) incur sixty-four cents in *real costs* (at the margin) in order to increase reported income by \$1. Note that this specific estimate is for a single firm and relies on a number of assumptions. A broader set of firms and assumptions yield estimates of the implied willingness-to-pay in the range of 50 cents to \$1.

If the median firm's preferred alternative to an observed option grant is an equivalently valued restricted stock grant, then the real costs of option-based pay remain surprisingly high. For the median firm, option grants impose \$1400 in additional compensation cost per manager annually (relative to restricted stock), but allow the firm to increase reported income by \$10,600. In this case, the implied marginal value of a dollar of earnings for the median firm is 18 cents (with most firms, under varying reasonable assumptions, falling between 10 and 40 cents). This implied marginal willingness-to-pay for earnings is instructive because it quantifies the marginal cost of counteracting the options-related inefficiency. If managers are allowed to destroy fifty cents to a dollar at the margin (or ten to forty cents, under our second assumption) in shareholder value in order to boost earnings by a dollar, then it must be the case that the marginal cost to shareholders of preventing this value-destroying practice (through improvements in governance practices) is at least this large.

Second, we find that if option-granting behavior is not driven by accounting considerations, then the choice of options over cash and restricted stock is best explained by theories involving the attraction and retention of employees. If employees are reasonably risk tolerant and somewhat optimistic about their employers' prospects, they may prefer stock option grants to equally costly (to the firm) stock grants. We also find that the value of options varies more significantly with labor market conditions than the value of stock grants, and that options give employees stronger incentives to stay at a firm when labor market conditions create attractive outside options.

As we noted above, a number of potential justifications for stock option use have been proposed in the literature, and our main aim in this paper is not to distinguish among them. Instead, we structure our analysis around various hypothetical statements, and derive implications of each. As a result, readers with strongly held prior beliefs about any of these possibilities can better understand firms' motivations in offering option plans and the resulting costs to shareholders.

Our first main conclusion is that if accounting rules lead managers and directors to issue options (either in lieu of cash or stock) broadly, then the costs to shareholders of this practice are large. Our second conclusion is that there is some reason to believe that observed option grants may be part of economic-profit-maximizing employment contracts. We show that such grants do perform better than comparably valued stock- and cash-based plans at attracting and retaining employees in some cases. Our analysis here, like prior studies, leads us to conclude that more than a single factor leads firms to adopt broad-based option plans. While one of these factors may well be the favorable accounting treatment of option grants, we believe our analysis suggests that this is not the sole (or even the main) motivation for broad option plans.

Ours is not the first study to highlight the difference between the cost of option grants to firms and their value to employees. In fact, our analytical approach is very similar to that used recently by Hall and Murphy (2002). We think our analysis takes three important steps beyond existing research. First, Hall and Murphy (2002) focus on top executives (mainly Chief Executive Officers), while we study middle managers. The majority of options granted to employees are granted to middle managers (see Oyer and Schaefer, 2005), so we believe it is worth separately considering the determinants of firms' option-granting choices to this group. Second, because top executives have considerable decision-making power, Hall and Murphy (2002) start from the presumption that the key benefit offsetting the costs of option grants is the provision of incentives. This is likely not true for middle managers because they typically have considerably less influence on firm value than do top executives. Third, our detailed data on middle-level manager grants allows us to compute the implied average and marginal economic cost of a dollar of accounting earnings under various assumptions.

The remainder of the paper is structured as follows: In Section 2, we provide background on accounting for stock option grants and discuss recent developments in the literature on broad-based stock option plans. In Section 3, we discuss our data source. We present our main analyses in Section 4, and conclude in Section 5.

2. Background on broad-based stock option plans

Under Generally Accepted Accounting Principles (GAAP), the 1973 Accounting Principles Board Opinion (APB) number 25 and the 1995 Statement of Financial Accounting Standards (FAS) number 123 require firms to expense the value of stock or stock option grants. Though they must measure and report the value of employee stock options using an option-pricing model such as the Black–Scholes formula, they can apply the “intrinsic value” of an option (that is, the difference between the strike price and the firm's stock price on the grant date) on their income statements.³ Though changes in these rules are imminent, currently most option grants to employees never affect the firm's income statement.⁴

One might expect this difference in accounting treatment to have no effect on firm decisions. Option grants are disclosed in financial statements and market analysts should be able to in-

³ See Murphy (1999) for institutional background on employee stock options, including vesting and valuation issues.

⁴ A number of firms have recently chosen to include the value of option grants as an operating expense. For example, in 2002, Coca-Cola began expensing option grants with no apparent change in their grant policy. PepsiCo began expensing option grants in 2003, but also announced they were scaling back their broad-based plan. Amazon.com (in 2002) and Microsoft (in 2003) also started to expense stock options at the same time as they switched most of their equity grants to restricted stock. We discuss this further in Section 4.3.

corporate the cost to shareholders of such grants into stock prices.⁵ Several factors could lead this accounting treatment to have effects on decision making, however. Often, managerial bonus contracts are tied specifically to net income, providing an incentive for managers to shift compensation expense to option grants. Further, even if markets do correctly discount share prices due to option grants, managers may naïvely believe the reverse and grant options in an attempt to inflate market valuations. Some senior managers' arguments against proposals to require expensing of stock options would indicate that these managers expect markets to penalize firms that expense options.⁶

Academics differ over the importance of this accounting treatment in firms' choices to issue stock options broadly. Hall and Murphy (2003), for example, conclude that accounting rules play a central role. They argue that because options lead to no cash or accounting charges, managers and directors perceive the costs of option grants to be much lower than the actual costs. Given, however, the large fraction of top managerial compensation that comes in the form of stock options (see Murphy, 1999), it is hard to imagine that CEOs and directors would somehow fail to see that option grants lead to a (potentially large) wealth transfer from shareholders to employees. An alternative view of the Hall and Murphy argument is that managers understand these costs, but are not motivated to act in shareholders' interests. Oyer and Schaefer (2005) reason that if option grants are a manifestation of such an agency problem, then one might expect cross-sectional variation in option-granting behavior to be driven in part by weak corporate governance. To our knowledge, this pattern has not been discovered in the data.

A number of authors have considered efficiency-based (as opposed to accounting-based) justifications for broad option grants. Core and Guay (2001) and Kedia and Mozumdar (2002), using data from SEC disclosures, argue that incentives are an important consideration in firms' stock option grants. However, Oyer and Schaefer (2005), using the NCEO data set studied here conclude that observed option grants are too small to provide meaningful incentives for middle-level managers.

Core and Guay (2001) and Kedia and Mozumdar (2002) also find evidence that options are granted as a means of conserving cash at financially constrained firms. Oyer and Schaefer (2005) suggest that this "options-as-finance" explanation makes sense only if employees are the lowest cost source of funds. Given the risk aversion of individuals and the comparative advantage of specialist financial intermediaries at assessing ventures, financing constraints could be an important consideration in option grants if employees "sort" to firms about which they are optimistic. In this paper, we further probe the sorting explanation by determining the conditions under which firms may prefer to grant options rather than restricted stock.

While the sorting explanation considers options as a means of attracting employees, Oyer (2004) develops a model where firms grant options so as to efficiently retain employees. He suggests that, if changing the structure of wage contracts is costly and a firm's value is correlated with its workers' market wages, the risk costs of stock option grants can be outweighed by savings in turnover and renegotiation costs. Kedia and Mozumdar (2002) and Oyer and Schaefer (2005) report empirical results that are consistent with retention being an important consideration in option grants. As with sorting, we determine when a firm that wants to decrease retention costs would use options rather than stock grants.

⁵ Aboody et al. (2004) provide evidence that markets incorporate employee option grants into stock prices. Garvey and Milbourn (2004) argue that markets do not perfectly incorporate this information, however.

⁶ Some managers have provided arguments against expensing that do not rely on market misperceptions, including the difficulty of valuing option grants properly. Guay et al. (2003) discuss and critique some of these arguments.

3. Data

We use data compiled from the 2000 Survey on Current Practices in Broad-Based Stock Option Plan Design conducted by the National Center for Employee Ownership (NCEO). The NCEO is a private, non-profit organization that provides members with information about employee ownership programs. In early 2000, the NCEO mailed a survey to compensation administrators at public and private companies of all sizes and in a wide variety of industries. The survey was sent only to companies that the NCEO believed had a “broad-based stock option plan” in place or expected to implement such a plan within two years of the survey. “Broad-based” plans were defined as stock option plans where 50% or more of the firm’s employees receive or hold stock options. Survey respondents provided financial information such as average salary and number of options granted at various levels of the firm, as well as details on other compensation plans and reasons for granting options. The 247 firms that returned questionnaires to the NCEO do not constitute a random sample of firms or even of firms with broad-based stock option plans. However, it does provide an extremely rich set of details about stock option contracts at a large set of companies that, as of 2000, chose to distribute stock options broadly within their organizations.

Table 1 provides summary statistics from the NCEO sample. Not all data items are available for all firms, because some firms left blanks in the survey and market value information is not available for privately held firms. The typical firm in this sample has a few hundred employees and sales under \$30 million annually. There are, however, some very large firms that bring sample averages up considerably. We concentrate on the group of workers defined by the survey respondent as “middle managers.” These employees generally earn between \$75,000 and \$100,000 in cash salary per year.

The firms in the NCEO sample have high stock volatility, largely due to the fact that “new economy” firms are both highly volatile and prone to use broad-based option plans. As will become clear below, our estimates of the risk costs of employee option grants are very high. While the exact estimates we present apply only to the NCEO sample, it is clear from more random samples that firms that make options grants to middle managers are, on average, high volatility firms (see Oyer and Schaefer, 2005).

Table 1
Summary statistics

	Median (1)	Mean (2)	Std. Dev. (3)	Sample size (4)
Employees	172	4,059	14,919	244
Sales	\$25.7	\$774	\$2,994	215
Firm value as of April 2000	\$525	\$8,201	\$44,650	126
Stock volatility	0.712	0.772	0.372	126
Middle manager compensation:				
Cash salary (\$000s)	\$90	\$82.5	\$15.2	216
% of firm “owned”	0.039%	0.16%	0.29%	216
Black–Scholes value (\$000s)	\$88.0	\$134.5	\$139.0	216
Modified BSV (\$000s)	\$57.9	\$95.2	\$100.0	216

Notes. Risk-free rate is assumed to be 5%. Options assumed to expire in ten years and fully vest in four years. All dollar values are in millions unless noted. Volatility used for Black–Scholes calculations is the minimum of 0.75 and 0.75 times historical volatility. Historical volatility is estimated based on firm size for private companies.

To estimate option values, we use the number of options a firm reports granting to new middle-manager hires. If the firm does not make grants to new hires, we use the number of options granted in the firm's "ongoing/periodic" plan. If the firm does not make new hire or ongoing grants, we use the number granted in the firm's "single grant" (that is, one-time) plan. In most firms, middle managers' option holdings confer the right to purchase a very small fraction of the firm's equity. On average, middle managers at our sample firms "own," via the options, rights to 0.16% of the firm's equity. There are, however, a number of very small firms where each middle manager owns in the neighborhood of 1% of the firm. The median value is 0.039%, which is approximately 1/25th of 1%.⁷

We compute two measures of the value of options held. The first is the Black–Scholes value (BSV), for which we assume a ten-year expiration period. Because many firms in the sample are growing and are therefore likely to become less volatile, we estimate future volatility as the minimum of 0.75 and 75% of historical volatility. For the private firms in the sample, we estimate volatility based on the volatility/number of employees relationship we observe for public firms in our sample. We also compute a "modified Black–Scholes value" which is the same as the standard Black–Scholes calculation, but assumes the options expire after four years. Prior research shows that the vast majority of employee options are exercised soon after they vest; hence, this modified calculation likely offers a better estimate of the cost to the firm of issuing these options (see, for example, [Aboody, 1996](#), and [Huddart and Lang, 1996](#)).

The value of options granted varies substantially across firms. Middle managers at the median firm in the NCEO sample hold options with BSV of \$88,000, or the approximate equivalent of one year's salary. Given that options typically vest over four years, the BSV implies about one fifth of a typical middle manager's pay comes in the form of options. Middle managers hold more than \$200,000 of option value at 49 of the 216 firms for which we can value option grants, while middle managers hold less than \$10,000 at 24 sample firms. The modified Black–Scholes values are, naturally, considerably lower. A middle manager at the median firm holds \$58,000 of option value if he expects to exercise the options after four years. Both the standard and modified BSVs are considerable overstatements of their actual value to the managers, however, because of the risk inherent in holding options. This difference between the cost to shareholders of granting options and the perceived value to managers is the focus of the next section.

4. Analysis

We begin our analysis by focusing on a decision maker within the firm who specifically chooses option-based pay over alternative cash- or restricted-stock based packages. From this starting point, we make a variety of assumptions about the underlying sources of benefits associated with stock-option use, and then use the observed option grants in our NCEO sample to make inferences regarding the decision maker's incentives and economic environment.

4.1. Comparing options to cash

We start with the assumption that the only benefit to firms from using any form of equity-based compensation is the increase in income arising from stock option grants. We make this

⁷ These values are upper bounds on the potential ownership claims from option grants because we calculate ownership as the number of options granted divided by the number of shares outstanding at the time of the survey. The denominator of this ratio increases as options are exercised at firms that do not buy back shares.

assumption in order to derive an implied marginal willingness-to-pay for earnings, which we then compare to figures derived from other work, and to our expectations. If firms benefit in other ways from granting options to employees (as we believe to be the case), then our calculations of the implied marginal willingness-to-pay for earnings will be overstated.

Risk-averse employees discount the value of equity-based pay, which implies the firm must increase its overall expected wage bill in order to meet the employee's participation constraint.⁸ Under our maintained assumption, restricted stock offers no offsetting benefit, meaning restricted stock is strictly dominated by cash as a compensation instrument for employees. The favorable accounting treatment of options, however, may create perceived benefits that outweigh the required risk premium. We therefore proceed by comparing observed (in our NCEO data) cash-plus-option packages to hypothetical cash-only pay plans offering identical value to the employee.

Calculating the value to the employee of observed stock-option packages is a non-trivial exercise. Vesting requirements mean employees are restricted from selling their option holdings, which implies that the market valuation of an option package (such as that implied by the Black–Scholes formula) likely overstates the value to an employee. Following Lambert et al. (1991) and Hall and Murphy (2002), we make a variety of assumptions regarding employee risk preferences and exercise behavior, and use these to compute the value of a given stock option package to an employee (that is, the employee's certainty equivalent).

Consider a representative middle manager at a firm in the NCEO sample. We assume that the manager takes a job at time $t = 0$, that his options vest fully over four years, and that he exercises them at the end of that four year period. If the firm's stock price is below the options' strike price at the end of four years, the manager leaves the firm and forfeits the options. This somewhat understates the actual value a manager is likely to gain from an option grant, but reflects the fact that options are generally exercised near the time of vesting. Given this assumption, the cost to the firm of an option grant is simply the BSV of the option grant with an expiration date of four years after the grant. We denote this cost by M , and observe that it is the modified BSV we defined in the previous section.

We assume the manager has constant relative risk aversion. Specifically, his utility from wealth level w is given by

$$u(w) = \frac{w^{1-\rho}}{1-\rho}, \quad (1)$$

where ρ is his coefficient of relative risk aversion.⁹ In accepting a job, the employee considers the effect of the firm's pay plan on his wealth over a four-year period. Hence, the employee's expected utility from taking a job offering a cash-plus-options pay plan is given by

$$\int u(4S + \theta + W_0) dF(\theta), \quad (2)$$

⁸ Here, we follow most of the literature on equity-based compensation by ignoring portfolio considerations. That is, we assume employees cannot hedge their options grants. If, for example, an employee takes an offsetting short position in his firm's options upon receiving an option grant, then the value to the employee of the grant is simply the market value, and the costs associated with risk aversion are zero. Simpler hedging schemes, such as holding a portfolio that is relatively under-invested in the shares of similar firms, could reduce the employee's risk-premium below the values we calculate here. There is little evidence (either anecdotal or systematic) to suggest that employees make a practice of hedging their option grants in this way.

⁹ For the special case where $\rho = 1$, constant relative risk aversion implies log utility.

where S is the annual cash salary, θ is the realized value of the options upon exercise, W_0 is the manager's outside wealth, and F is the cumulative distribution function of the realized option value.¹⁰ We derive F by assuming firm value at time $t = 4$ is log-normally distributed with mean $V_0(1 + r)^4$ (where V_0 is the firm's value at $t = 0$ and r is the annual stock return anticipated by the employee) and variance σ^2 . The volatility σ is calculated as described in the previous section.

Making assumptions about ρ , r and W_0 , we can calculate the certainty equivalent of each middle manager's compensation. That is, we calculate an annual salary, S^* , such that the manager is indifferent between the observed salary and option package and cash-only pay of S^* . This certainty-equivalent salary is the solution to the following equation:

$$\int u(4S + \theta + W_0) dF(\theta) = u(4S^* + W_0). \quad (3)$$

Under the assumption that the employee is left on his participation constraint by the observed cash-plus-option plan, S^* is the smallest salary the firm could offer in a cash-only plan and still induce the employee to take the job.

We can use these calculations to assess firms' benefit/cost tradeoffs regarding option grants. Specifically, it is straightforward to compute the cost to the firm of both the observed cash-plus-option package and the certainty-equivalent cash-only plan. Under our maintained assumption that equity-based pay confers no benefit other than the favorable accounting treatment, the difference $4S + M - 4S^*$ is the cost to the firm (and the deadweight loss to society) associated with stock option use over the four-year period. We can also compute the increase in the firm's reported pre-tax income associated with the use of stock-option-based pay. Because the cost to the firm of granting options (M) never appears on the firm's income statement, the increase in pre-tax income (again over the four-year period) is $4S^* - 4S$.

We can further assess the firm's implied *marginal* willingness-to-pay for a dollar of earnings. This firm could increase its income by an additional dollar per year by offering salary of $S - 1$ and increasing the size of its option grant by an amount large enough to compensate the employee for this reduction in salary. Because this further shift away from fixed pay makes the employee's compensation riskier, the firm's expected wage bill would have to go up by the resulting increase in the employee's risk premium. This increase in risk premium is the (real) cost to the firm of increasing income by \$1. By revealed preference, the firm is unwilling to incur this cost to increase its income (because it elects to pay a salary of S rather than $S - 1$). Hence, the marginal value to the firm of increasing earnings by \$1 is just slightly less than the increase in risk premium associated with reducing salary by \$1.

To illustrate our calculations, we construct an example using a specific technology firm (which we refer to as Firm X) from our data set. At the time of the NCEO survey, Firm X had between 1000 and 3000 employees, annual sales between \$500 million and \$2 billion, market value between \$2 billion and \$4 billion, and volatility near the sample average.¹¹ New middle managers at this firm received option grants with a BSV of about \$132,000 and a modified BSV (M) of \$89,079. The manager's annual salary (S) was \$90,000, so the cost to the firm of employing this manager for four years ($4S + M$) is \$449,079. Assuming an outside wealth (W_0) of one year's

¹⁰ We assume that salary and wealth growth offset the effects of discounting. In this section, we discount option value by the expected stock return, suggesting the employee expects the same return from the firm's stock as from an alternative investment.

¹¹ We use these ranges of values to preserve the confidentiality of the firm.

salary, $\rho = 1$, and $r = 10\%$, this manager is indifferent between the observed cash-plus-options package and an all-cash package paying \$433,027 over four years. In this case, we would conclude that if Firm X was granting options strictly to increase accounting earnings, it would do so at a cost of \$4013 per middle manager per year (that is, one fourth of \$449,079–\$433,027.) It incurs this cost in order to increase reported pre-tax income by \$18,257 per manager per year because, over the four-year period, the firm would report only \$360,000 of compensation expense compared to \$433,027 if it paid the manager entirely in cash. We compute the implied marginal value to this firm of increasing income by \$1 by asking how much the firm's total expected wage bill would go up if it reduced its salary offer by one dollar. (Note the average cost of a dollar of earnings is $\$4013/\$18,257 = \$0.21$.) Under the assumption that accounting is the only benefit associated with equity-based pay, this firm appears willing to incur \$0.50 in real costs to increase reported pre-tax income by \$1.

Though we ignored them in our example, there are tax implications of stock option grants to employees, because all taxes on gains from options are deferred until exercise.¹² For that reason, and to make our utility calculations more realistic, we assign a tax rate of 40%. For ease of presentation, we convert all figures back to pre-tax dollars in the tables and discussion that follow.

Table 2 shows the results of our comparison of observed cash-plus-options packages to hypothetical cash-only packages at each of our NCEO sample firms. For each firm in the sample, we compute the annualized compensation cost to the firm (that is, $(4S + M)/4$), and the annual salary that would be required if no options were granted (S^*). This allows us to compute the per-manager annual cost the firm incurs due to the employee's risk premium, and the per-manager increase in the firm's income. We also compute the implied marginal value of a dollar of reported income. To give some sense for the range of values in the data, we rank the firms according to the per-manager annual risk premium due to option use, and present values for the 20th, 50th and 80th percentile firms.

We assume that the employee's expected return on the stock roughly reflects historical average equity returns by setting $r = 10\%$. In our basic case, we let the manager's coefficient of relative risk aversion be 2.5, which has been suggested as a lower bound for the risk aversion of an average individual (see Hall and Murphy, 2002). We further assume the manager's outside wealth is equal to one year's salary. In panel A column (1), we see that for the sample median firm, the annualized compensation cost is \$64,900, but the middle manager views this outlay as equivalent to a cash-only job paying \$57,600. As a result, the firm is spending over \$7000 more annually per middle manager than it needs to in order to retain that person's services assuming option grants are having no benefit other than the favorable accounting treatment. This firm pays a cash salary of \$52,000, so the option package allows the firm to reduce the compensation expense appearing on the income statement by \$5500 per manager. The implied marginal value of \$1 of reported income for this firm is \$3.13. The remainder of Table 2 makes clear that there is considerable variation in the cost of options across firms in the NCEO sample. Column (5) shows that the standard deviation of annual risk premium is more than \$20,000. Many firms incur very low risk costs from their option programs, while 20% of firms incur risk costs of \$27,000 or more annually per manager.

¹² The vast majority of options granted to managers in the NCEO sample are non-qualified stock options (NQSOs), so the tax rates are the same as those for regular income. In the case of incentive stock options, the tax issues are more complicated and potentially more advantageous for employees. There are tax implications for the firm as well, but the net effect of these appears to be of second-order importance. See McDonald (2004).

Table 2

Stock options compared to cash compensation (\$)

	Median (1)	20th percentile (2)	80th percentile (3)	Mean (4)	Std. Dev. (5)
A. $r = 10\%$, $\rho = 2.5$, $W = S$					
Annual salary (S)	52.0	70.0	90.0	82.5	15.2
Annualized cost to firm of cash-plus-options ($\frac{4S+M}{4}$)	64.9	71.8	133.5	106.3	30.1
Equivalent cash-only salary (S^*)	57.6	71.8	106.3	91.0	17.4
Annual risk premium	7.4	0.0	27.2	15.2	20.2
Annual increase in pre-tax income	5.5	1.8	16.3	8.5	5.9
Implied marginal value of 1 in pre-tax income	3.13	0.11	4.34	3.23	3.90
B. $r = 10\%$, $\rho = 1$, $W = S$					
Annual salary (S)	90.0	70.0	70.0	82.5	15.2
Annualized cost to firm of cash-plus-options ($\frac{4S+M}{4}$)	102.0	70.2	106.2	106.3	30.1
Equivalent cash-only salary	99.1	70.2	89.5	96.5	20.3
Annual risk premium	2.9	0.0	16.7	9.8	14.4
Annual increase in pre-tax income	9.1	0.2	19.5	14.0	11.5
Implied marginal value of 1 in pre-tax income	0.64	−0.26	1.67	0.79	0.87
C. $r = 10\%$, $\rho = 2.5$, $W = 10S$					
Annual salary (S)	90.0	90.0	70.0	82.5	15.2
Annualized cost to firm of cash-plus-options ($\frac{4S+M}{x}$)	102.0	103.9	106.2	106.3	30.1
Equivalent cash-only salary	99.4	104.0	89.4	96.4	20.2
Annual risk premium	2.6	−0.1	16.8	9.9	15.0
Annual increase in pre-tax income	9.4	14.0	19.4	13.9	11.2
Implied marginal value of 1 in pre-tax income	0.60	0.13	1.91	0.92	1.12

Notes. For the first three columns, percentiles are based on ranking of annual risk premium. Dollar values are in thousands, except for implied marginal value of \$1 of pre-tax income. Column (4) is the mean and column (5) the standard deviation of each variable across the NCEO sample. Sample consists of 216 NCEO firms for which we have all necessary information for making these calculations.

The calculations in panel A suggest that the costs to firms of broad-based option grants are very high if managers have roughly average risk aversion. However, because only a subset of firms grant options, employees are likely to sort themselves among firms according to risk tolerance. We therefore generate two more sets of calculations assuming recipients of option grants are more risk tolerant than average.

Panel B examines an employee who is much more risk tolerant (at least over the option vesting period). There, we assume $\rho = 1$. In panel C, we consider option value risk in the context of the employee's entire future income flow by assuming his outside wealth is ten times his annual salary. We assume that $\rho = 2.5$ which, as noted above, is considered a conservative estimate for typical lifetime risk aversion. Between our wealth assumption and the salary during the vesting period, the employee has fourteen years of certain salary. This seems like a reasonable approximation of the discounted value of future earnings. Naturally, these assumptions reduce the magnitudes of risk premiums relative to the figures in panel A. The sample median risk premium per middle manager per year drops from \$7400 (in panel A) to \$2900 (panel B) and \$2600 (panel C). A considerable number of NCEO firms (more than 20%) still suffer costs of \$15,000 or more each year for each manager. We note that on average, firms remain willing to incur almost a dollar (\$0.79 and \$0.92 in panels B and C, respectively) in real costs in order

to inflate reported earnings by \$1.¹³ These second and third sets of calculations demonstrates that selection of risk-tolerant employees does benefit firms that wish to present high earnings by substituting option-based pay. The real costs of this decision to shareholders remain substantial, however.¹⁴

The top part of column (1) suggests that risk considerations lead employees at the median firm to discount the annualized \$12,900 of BSV by \$7400, or more than 50%.¹⁵ The discount is roughly 24% for the median firm when we assume less risk aversion. This is as great or greater of a discount as Hall and Murphy (2002) calculate for the executives in their sample, even though they assume those executives to be less diversified than our middle managers. This difference is due to the fact that firms that make broad option grants have relatively high volatility; Hall and Murphy (2002) assume a volatility of 30%, which is far below the actual volatilities of our sample firms. When we recompute our Table 2 assuming a volatility of 30% for all firms, our calculations of the implied marginal willingness-to-pay for earnings drop markedly.

To give some sense of the magnitudes of our option cost estimates, consider the implied willingness-to-pay for earnings calculated by Erickson et al. (2004). They estimate the amount firms are willing to pay to increase earnings by analyzing how much tax is refunded to firms when they are found to have fraudulently inflated earnings. They find that these firms are willing to incur between 11 and 19 cents of real cost per marginal dollar of additional income. Even our most conservative estimates of the real costs of option grants are several times this amount for the vast majority of firms in our sample.

Another way to think about the magnitude of our option cost estimates is to consider the total value destroyed if options are granted solely for accounting purposes. This is important because, if the total value destroyed is not sufficiently large relative to the transaction costs of taking over a firm, then the market for corporate control cannot fix the underlying governance problem. Given our focus on one set of employees (middle managers) and the many assumptions in our analysis, our estimates of the effect of inefficient option grants on total firm value is imprecise. But we can create a back-of-the-envelope estimate of the range of these costs to give some sense of their magnitude. The analyses in Table 2 suggest that a typical firm in the sample wastes \$2000 to \$10,000 per middle manager per year. Presumably senior executives get more while entry level employees get less, so we assume that the middle manager is roughly representative for the firm. Consider a public firm of 172 people (the sample median.) Under the varying assumptions we use, this firm would be wasting between about half a million and \$2 million per year. If we assume the problem continues for several years and discount the waste over that time, this firm's option plan destroys something on the order of \$2.5 million to \$20 million (depending on the

¹³ The mean willingness-to-pay for earnings remains substantial—\$0.49—even for the case where $\rho = 1$ and $W = 10S$. Also, the implied marginal value of \$1 of earnings can be negative in cases where the employee prefers the observed option package to an alternative package costing the firm the same amount. This arises in cases where risk costs are outweighed by option value, and occurs only when the firm's option grants are small and its stock has relatively low volatility.

¹⁴ We also experimented with varying the rate of return on the firms' shares expected by the employee. The implied marginal willingness-to-pay for earnings is, not surprisingly, strictly decreasing in the employee's expectation of returns. For the case where $\rho = 1$ and $W = S$, if the employee expects a 5% return, then the mean implied marginal willingness-to-pay for earnings is \$1.32, while this figure falls to \$0.43 when the employee expects 15%. The observation that high employee expectations of stock returns make equity grants less costly (and, perhaps, even profitable) for the firm underlies our discussion of sorting below.

¹⁵ While this discount sounds quite large, we show below that there is a substantial probability that the employee gets nothing from the typical grant.

discount rate, expected growth in number of employees, and the number of years the plan is expected to continue.) So, even at this small firm, there is quite a bit of value to be unleashed by taking over the firm and restructuring its pay practice. The argument is far more compelling at a firm with the sample mean of 4000 employees. At such a firm, a similar calculation suggests the option plan lowers the market value of the firm by \$50 million to \$400 million.

Our analysis suggests one of three possibilities must be correct:

- (1) the typical firm with a broad option plan incurs very large costs in order to increase accounting earnings,
- (2) some of the assumptions of our analysis are invalid, or
- (3) there must be at least some reasonably significant real economic benefits associated with these option grants to middle managers.

While our belief, based on the analysis here and elsewhere, is that the option plans we have studied create economic value (at least *ex ante*), readers with strong beliefs to the contrary may conclude otherwise. However, we believe it is difficult to reconcile our analysis with the idea that accounting treatment is the main driver of the option plans we have studied. In Section 4.3, we consider what some of the economic benefits of these plans might be.

4.2. Comparing options to restricted stock

To compute the figures in Table 2, we assumed the only benefit associated with equity-based compensation is the favorable accounting treatment accorded to stock options. This is a strong assumption, as there may be other benefits to tying employee compensation to the value of the firm. Here, we suppress the potential source of these benefits, and simply assume that cash-plus-equity-based compensation plans dominate cash-only plans. As we will show, this implies that in the absence of the favorable accounting treatment of employee stock options, firms would elect to make restricted stock grants that the employee values equivalently to observed stock option grants. We therefore proceed by comparing the costs to the firm of observed option-plus-cash plans to hypothetical restricted-stock-plus-cash plans. This allows us to form another set of estimates of the costs to shareholders of stock option use.

We again consider a representative middle manager at a firm in the NCEO sample and assume the manager takes a job at time $t = 0$. Using the same assumptions regarding preferences and firm value as above, we calculate how much stock the firm would have to grant to create the same certainty equivalent for the manager. As above, we let θ be the value of the observed option grant upon exercise, and derive the cumulative distribution function (F) for this random variable by assuming firm value at time $t = 4$ is log-normally distributed with mean $V_0(1 + r)^4$ and variance σ^2 . We further let ϕ be the value of a hypothetical restricted stock grant after four years, and derive the cumulative distribution function for this random variable (G) making identical assumptions regarding firm value. We then calculate the size of the restricted stock grant that satisfies the following equation:

$$\int u(4S + \theta + W_0) dF(\theta) = \int u(4S + \phi + W_0) dG(\phi). \quad (4)$$

The difference between the modified BSV and the value of the stock grant is the additional risk premium the firm pays as a result of granting options rather than restricted stock. Under the

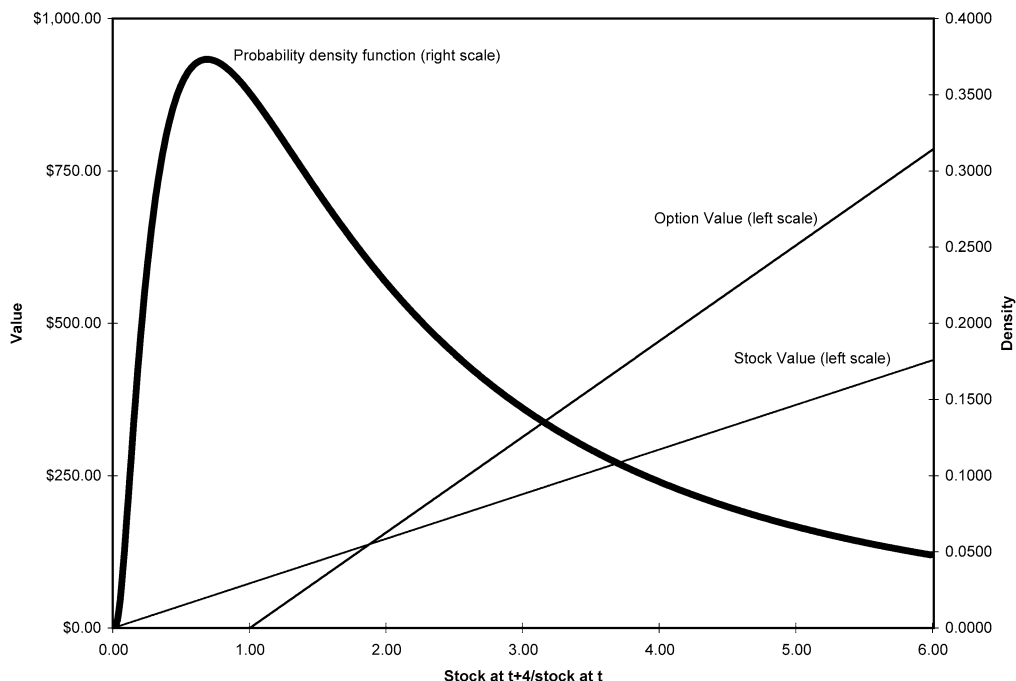


Fig. 1. Stock and option value.

assumption that the benefits to the firm are the same from these stock and option grants, this amount represents the cost to the firm (and the deadweight loss to society) of granting options.

For a large range of values of ρ and r , Eq. (4) will require a more costly (to the firm) grant of options than of restricted stock. This can be seen graphically in Fig. 1. There, we plot option and stock grant values for Firm X, the technology firm we used as an example above. One thin solid line shows the value at date $t = 4$ of a middle manager's options as a function of firm value if exercised on that date. Another shows the value at date $t = 4$ of a restricted stock grant with equivalent cost to the firm (as of the grant date) as the observed option grant. The thick solid line is the probability density function associated with firm value at date $t = 4$.

As the graph makes clear, for a substantial portion of the probability distribution, the value of the stock grant is higher than that of the option grant. In fact, the stock value is higher than the option value at date $t = 4$ with 83% probability. Note that the option grant is valued more highly than the stock grant at very high levels of firm value; this is, however, precisely when the marginal value of wealth (for the risk-averse employee) is lowest. The extreme outcomes associated with the stock-option grant mean the employee discounts the value of this form of compensation more highly than stock-based compensation.¹⁶

We now use Firm X to illustrate the methodology used in the rest of this section. Applying the assumptions made above ($\rho = 2.5$, $r = 10\%$, and wealth equal to one year's salary), we compute that a restricted stock grant with a market value of \$80,632 would have the same value to the manager as the option package we observe. The observed option package has a modified

¹⁶ See Jenter (2002) for a more complete elaboration of the implications of the inverse correlation between the marginal utility of wealth and the pay-for-performance sensitivity of stock options.

Table 3
Stock options compared to restricted stock (\$)

	Median (1)	20th percentile (2)	80th percentile (3)	Mean (4)	Std. Dev. (5)
A. $r = 10\%$, $\rho = 2.5$, $W = S$					
Annualized cost to firm of cash-plus-options plan	114.2	71.0	106.2	106.3	30.1
Annualized cost to firm of cash-plus-restricted-stock plan	110.0	71.0	86.9	94.4	19.0
Annual increase in risk premium	4.2	0.0	19.3	11.9	16.6
Annual increase in pre-tax income	10.0	1.0	16.9	11.8	9.2
Implied marginal value of 1 in pre-tax income	0.58	−0.21	1.88	0.98	1.20
B. $r = 10\%$, $\rho = 1$, $W = S$					
Annualized cost to firm of cash-plus-options plan	102.0	100.4	106.2	106.3	30.1
Annualized cost to firm of cash-plus-restricted-stock plan	100.6	100.4	96.0	100.1	3.2
Annual increase in risk premium	1.4	0.0	10.1	6.2	9.5
Annual increase in pre-tax income	10.6	3.4	26.1	17.6	16.0
Implied marginal value of 1 in pre-tax income	0.18	−0.25	0.52	0.22	0.32
C. $r = 10\%$, $\rho = 2.5$, $W = 10S$					
Annualized cost to firm of cash-plus-options plan	102.0	100.4	106.2	106.3	30.1
Annualized cost to firm of cash-plus-restricted-stock plan	100.7	100.4	95.6	99.7	22.8
Annual increase in risk premium	1.3	0.0	10.7	6.5	10.5
Annual increase in pre-tax income	10.7	0.4	25.6	17.2	15.3
Implied marginal value of 1 in pre-tax income	0.16	−0.25	0.58	0.24	0.38

Notes. For the first three columns, percentiles are based on ranking of annual increase in risk premium associated with use of stock options. Dollar values are in thousands, except for implied marginal value of \$1 of pre-tax income. Column (4) is the mean and column (5) the standard deviation of each variable across the NCEO sample. Sample consists of 216 NCEO firms for which we have all necessary information for making these calculations.

BSV (M) of \$89,079. Hence, we conclude that options impose additional risk costs of \$2112 per manager per year (that is, one fourth of \$89,079–\$80,632). As a result of having made the option grant rather than the stock grant, however, Firm X is able to report \$20,158 additional pre-tax income per manager per year because the firm would have to report the \$80,632 of stock grant value as an expense over four years. The implied marginal value of a dollar of accounting earnings to Firm X is \$0.17.

The results for the NCEO sample as a whole are presented in Table 3. The first set of calculations (in panel A) assumes $\rho = 2.5$ and $r = 10\%$. We present the cost to the firm of both the observed cash-plus-option package and the hypothetical cash-plus-restricted-stock package. Given the high volatility of many firms in the NCEO sample, options are very costly under this set of assumptions. On average, our NCEO sample firms pay a risk premium that is \$11,900 more annually per manager than would be required if the firm used stock instead of options. Reported pre-tax income is higher by \$11,800 per manager per year, on average, as a result. The average implied marginal value of one dollar of pre-tax income is \$0.98. As the standard deviations in column (5) and the values for the firms in columns (2) and (3) suggest, there is considerable variation in these values across the sample. A substantial number of firms pay risk premiums that are higher by more than \$20,000 per manager per year, while others pay no risk premium.

The estimates in panels B and C of Table 3 allow for more risk-tolerant managers by assuming $\rho = 1$ and $W = 10S$, respectively. Under these assumptions, the costs of options relative to stock grants declines sharply. On average, option grants result in a risk premium that is higher by \$6200 (\$6500 in panel C) per manager per year than would result from restricted stock grants. However, the median additional risk premium is only \$1400 (\$1300). Firms report pre-tax income that is higher by \$17,600 (\$17,200) per manager per year as a result of the option grants. The average implied marginal value of \$1 in income is \$0.22 (\$0.24).¹⁷

Even assuming that the best alternative to stock options is equivalently valued (by the employee) equity, firms incur large costs associated with observed option grants. The implied marginal willingness-to-pay for a dollar of income is considerable—still higher, in most cases, than the Erickson et al. (2004) estimates for firms that were allegedly committing fraud.

4.3. *Benefits of option grants relative to stock grants*

To this point, we have assumed the only differences between stock and options are (1) the favorable accounting treatment accorded to option grants, and (2) the lower risk costs associated with stock grants. As we showed above, if these are the only differences between stock and options, then option grants impose higher real costs on firms than would comparably valued (by the employee) stock grants. It may, however, be the case that option grants provide some benefit relative to stock grants *other* than the favorable accounting treatment, and that it is this benefit rather than (or in addition to) accounting considerations that causes firms to choose to grant options.

In this section, we exploit additional differences between stock and options to consider various efficiency-based justifications for option use. Our main argument is this: If the accounting treatment is not the sole reason firms choose to grant options rather than stock, then it must be the case that option grants offer some benefit to firms that cannot be attained via stock grants. We use this assertion to assess the plausibility of three explanations of stock option use. First, we ask whether firms' option-granting decisions might arise from financially constrained firms' attempts to conserve cash. Second, we ask whether option grants might allow firms to attract employees who are optimistic regarding the firms' prospects. Third, we ask whether option grants might serve as a low cost way for firms to retain employees.

Note that we do not perform formal analysis of the possibility that option grants create incentives. In Oyer and Schaefer (2005), we presented evidence that the incentive effects of NCEO sample firms' option grants are trivial. As we discuss there, broad option grants at these firms can only be justified on incentive grounds under very limited circumstances. If one were to believe these circumstances hold at some of the NCEO firms, prior work can shed light on the trade-offs between options and restricted stock grants in such situations. As the discussion in Hall and Murphy (2003) and the models in Feltham and Wu (2001), Barron and Waddell (2004), and Lambert and Larcker (2003) show, options provide more incentives per dollar of economic cost to the firm. Whether these additional benefits relative to restricted stock grants are cost effective depends on the individual firm and employee.

¹⁷ Combining the assumptions in panels B and C reduces these estimates further. A manager with wealth equal to $10S$ and a coefficient of relative risk aversion equal to one is extremely risk tolerant, and we find in this case that the median implied marginal willingness-to-pay for earnings drops to \$0.02.

4.3.1. *Cash constraints*

Core and Guay (2001) argue that firms grant stock options to middle managers as a means of conserving cash. Note that an optimizing firm would only conserve cash through substituting equity grants for cash if its employees were the cheapest source of capital available. This is unlikely to be the case no matter what form of equity the firm offers. However, as we showed in Section 4.2, risk-averse employees discount option grants more than they discount stock grants. Therefore, if a firm were to try to raise money from its employees by substituting equity grants for cash compensation, it would find it more cost effective to grant stock than options. As we will show below, employees may be a good source of funds if they are optimistic about the firm's prospects, but a firm would want to issue equity to such employees even if it were not cash constrained. We conclude, if the firms in our sample are granting options efficiently, the fact that they grant options rather than restricted stock suggests option grants are not made due to financing constraints.

4.3.2. *Sorting*

Making options part of compensation may enable firms to select employees who are optimistic about the firm's prospects, or risk tolerant. The firm may benefit in a number of ways from attracting such employees. First, the firm may be able to save on compensation costs if optimistic employees value the options at more than they cost the firm. Second, optimism may be correlated with productivity, especially in situations where the firm asks the employee to invest in firm-specific skills. Third, it is possible that risk tolerance is positively correlated with productivity. Oyer and Schaefer (2005) discuss employee sorting in detail, while Zhang (2003) and Bergman and Jenter (2004) present specific models of the form of employee optimism and conclude that empirical evidence is consistent with firms using options to save on compensation costs when employees value options highly.

The sorting hypothesis is not without problems, however. First, it is unclear why optimistic employees would not prefer being paid in cash and then simply trading in their own accounts. One possible explanation is the tax benefits from employee stock option grants. However, the vast majority of options below the senior executive level come in the form of "non-qualified stock options," for which the tax advantages are limited to a tax deferral on accrued income. Alternatively, employees may face transaction costs in trading on their own accounts. This seems plausible, as Madrian and Shea (2001), Benartzi and Thaler (2001), and many anecdotal accounts suggest that employees seem to trust their employers to make their investments for them. Note that these concerns do not apply if productivity is correlated with optimism, because then there is a clear reason why the firm would make equity ownership a precondition for employment. Also, it is inconsistent with a rational-expectations equilibrium for employees to systematically overvalue a firm's shares. However, if employees are naïve momentum investors, then one can imagine firms attempting to benefit from the possibility of lower wages as a result. Note the sorting/momentum hypothesis suggests that options should become less attractive as compensation instruments during bear markets.

Here, we further assess the sorting hypothesis by comparing the efficacy of stock and option grants at achieving the objective of attracting optimistic employees. Our approach is similar to that performed above. We analyze NCEO sample middle managers, and compare observed stock option grants to hypothetical restricted stock grants that the employee values equivalently. The key difference between our analysis here and that contained in Section 4.2 is that here we allow the employee to have an optimistic assessment of the firm's prospects. As we showed above, the cost to the firm of granting the observed option package is always higher than the cost of a

hypothetical restricted stock package if the firm and the employee agree on the firm's expected return over the coming four years. However, if the employee is optimistic regarding the firm's prospects, then the cost to the firm of granting the equivalently valued (from the employee's perspective) hypothetical restricted stock package may be higher than that of the observed option package. Options offer higher payoffs to the employee (see Fig. 1) in the event that firm value increases by a large amount; hence, a sufficiently optimistic employee prefers an option package that costs the firm the same amount.

We again illustrate our approach to the data by analyzing Firm X. The modified BSV of option grants by this firm to middle managers is \$89,079, so we compare the employee's valuation of that grant to a grant of \$89,079 in stock. Given outside wealth of one year's salary, $S = \$90,000$, $\rho = 2.5$, and $r = 10\%$, risk considerations would cause the employee to discount the option grant by over \$16,000. However, he would discount the stock grant by only around \$6000. This middle manager strictly prefers a stock grant costing the firm \$89,079 to an option grant costing the firm this amount, and prefers an all-cash package worth \$89,079 to either equity position.

This preference ordering changes, however, as we let the employee become more optimistic. Specifically, if the employee expects the annual return on the firm's stock will be greater than 18%, then the employee values the stock grant package at more than the \$89,079 it costs the firm. If the employee expects the firm's annual return will be 22% or greater, then the employee prefers the option grant to the all-cash package. Finally, if the employee expects an annual return of 32% or better, then the employee prefers the option grant to the stock grant. Therefore, under this set of assumptions, it takes a truly extremely optimistic employee to prefer options to grants that cost Firm X the same amount.

A more risk-tolerant employee ($\rho = 1$) prefers the stock grant to all-cash pay for any r of 13.2% or higher, prefers the option grant to cash for $r > 13.9\%$, and prefers the option grant to the stock grant if $r > 15.1\%$. While 15.1% seems like a somewhat high expected level of stock return, many option-granting firms had been experiencing returns of this level and much higher at the time of the NCEO survey. As Benartzi (2001) showed, employees tend to be "momentum" traders in their personal accounts, expecting rising stocks to continue to rise. If employees of Firm X were somewhat risk tolerant and had momentum-based expectations, then they may have preferred the observed option-based pay packages to hypothetical cash- or restricted-stock-based plans that had the same expected cost to the firm.

Figure 2 plots the relationship at Firm X between risk tolerances, expected return, and employee preferences across the three possible forms of pay in more detail. For each pair of risk aversion coefficients and expected annual stock return, we plot which compensation package the employee values the highest. As the graph shows, the set of return expectations for which option grants are cost effective becomes quite extreme as the employee grows more risk averse. However, if this firm can select on fairly risk-tolerant employees, it can profitably pay them with stock options.

Firm X and Fig. 2 are quite representative of our findings for other NCEO firms. However, the analysis does change somewhat when we look at firms that are more extreme in terms of size, volatility, or amount of options granted. Figure 3 shows the risk tolerance, expected return, and employee preference relationship at a start-up firm in our sample with fewer than 100 employees and very high volatility (which, in calculating option values, we cap at 75%.) This firm makes grants to middle managers with BSV of approximately \$150,000 and modified BSV of \$109,000. As the figure shows, a manager with even a very modest level of risk aversion would have to be extremely optimistic before he would prefer option grants to stock grants. However, at the time of the survey, many start-ups had experienced returns in the high double digits for some years. If

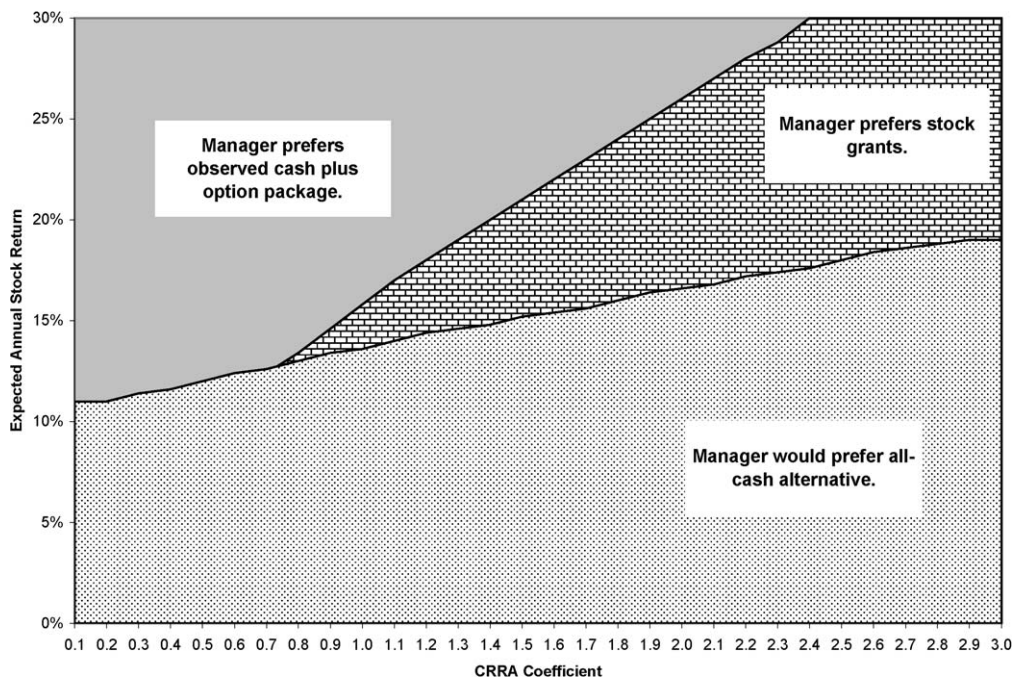


Fig. 2. Risk tolerance, expected return, and employee preferences—"Firm X".

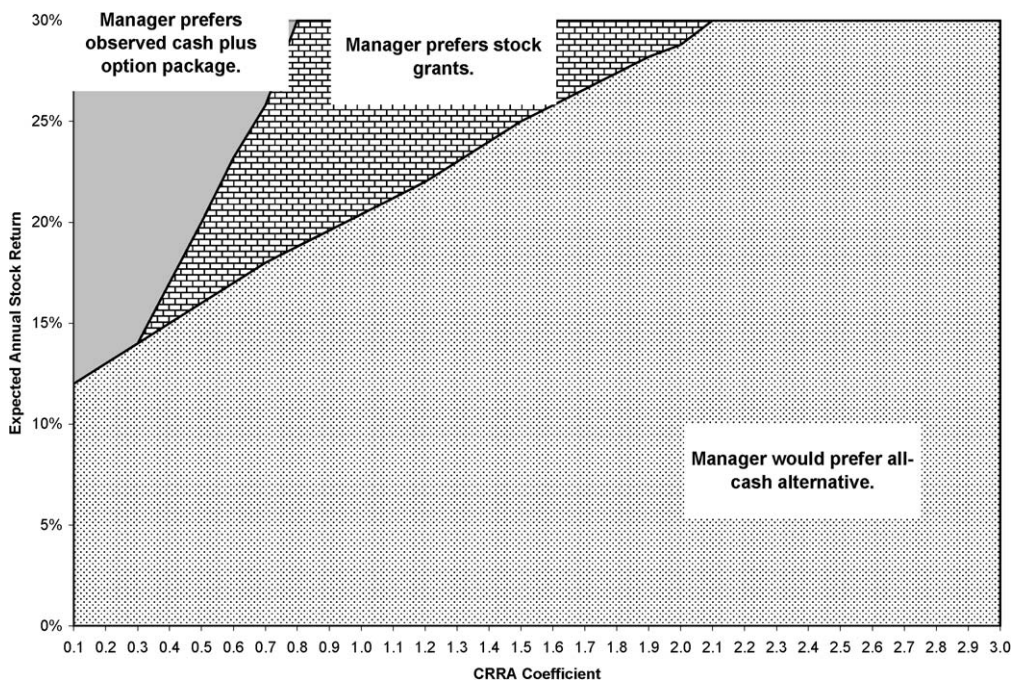


Fig. 3. Risk tolerance, expected return, and employee preferences—start-up firm.

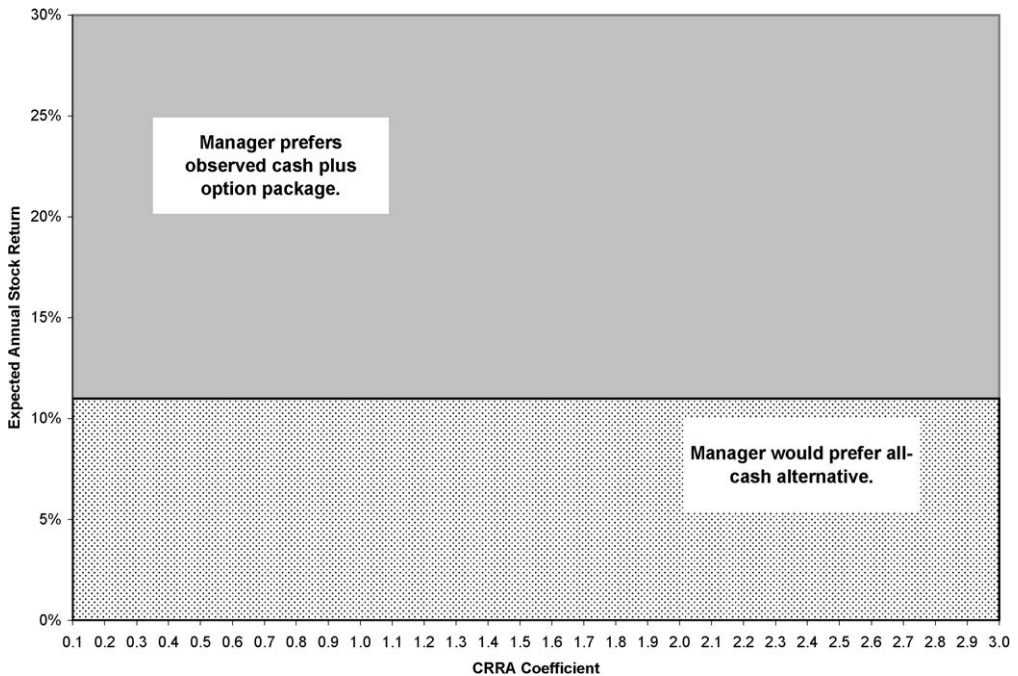


Fig. 4. Risk tolerance, expected return, and employee preferences—large, stable firm.

managers expected these returns to continue, they may have been willing to accept their pay in highly volatile stock options.

Figure 4 considers a very different type of firm in the NCEO sample. This is a large firm (tens of thousands of employees) with volatility well below the NCEO sample average. Middle managers receive options with a BSV of \$12,200 and a modified BSV of \$7400. The low level of options as a fraction of manager wealth and low volatility make the risk premium of the option package at this firm quite small. As a result, employees do not have to be very optimistic to be willing to accept options and even to strictly prefer them to equally costly stock grants.

Our findings suggest that, under the sorting hypothesis, there are reasons other than the differential accounting treatment that firms may select to issue options to employees rather than stock. Specifically, if employees' expectations regarding the firm's future returns are very optimistic, then the firm can more effectively induce selection by offering stock options rather than restricted stock. While, for much of the NCEO sample, employees have to be optimistic about their firms' prospects for the observed option packages to have increased shareholder value, it seems only natural to think that there is a fair amount of variation in employee beliefs. Given existing evidence suggesting that employees are momentum stock traders, it seems quite reasonable to think that many employees had optimistic beliefs at the time of the NCEO sample.

This analysis may help explain Amazon.com and Microsoft's recent decisions to change from employee option grants to stock grants. Both firms went through a long period of consistently high stock returns. As a result, employees may well have formulated high expectations for future returns. As the stocks have performed less well recently, however, employees may have updated their expectations downward. This shift may have moved many Amazon.com and Microsoft

employees from the upper left dark zone on the risk tolerance/expected return grid into the middle area where stock grants are more cost-effective.

4.3.3. Retention

One reason often cited by firms for granting stock options is to retain employees. Options typically vest over a period of a few years and so employees who leave a firm may forfeit potential income from their options. Vesting is not enough to explain the use of options, however, as employers could easily set aside cash in the same manner, which would economize on employees' risk premiums. Oyer (2004) suggests a potential advantage associated with using equity as a deferred compensation instrument. Consider a setting where a firm's stock price is positively correlated with the market wages of its employees. When the firm's share price is high, employees' outside job opportunities are attractive. However, this is precisely when the value of employees' unvested option-based compensation is high, so the firm can economize on the costs of renegotiating wage contracts by granting options. Similarly, when the firm's share price is low, employees have few attractive outside options.¹⁸ The value of employees' unvested compensation is also low, allowing the firm to reduce employees' total compensation without cutting nominal wages.¹⁹

We assess the retention hypothesis by comparing the efficacy of stock and option grants at achieving the objective of indexing deferred compensation to employees' outside options. The key tradeoff between stock and options is this: A stock grant imposes smaller risk costs on an employee, but the value of an option grant is more responsive to changes in share prices. When share prices are high (low), the option grant therefore leads to a higher (lower) value of unvested compensation as compared to restricted stock grants. Our exercise here is to examine these differences in risk costs and value of unvested compensation, making the same general assumptions as above regarding the distribution of stock returns, valuation and life of options, and managers' utility function.

To capture the key feature of the Oyer (2004) model, we assume variability in share prices stems from both industry- and firm-specific shocks. Industry shocks affect all firms that compete in the same labor market as our sample firms. These shocks also affect the outside labor market opportunities available to the sample firm's employees. Firm-specific shocks are unrelated to employees' labor market prospects. For simplicity, we assume the realization of the industry shock is equally likely to be "good," "neutral," or "bad," with a neutral shock implying a 10% return on the firm's shares and the good and bad shocks equidistant from the neutral shock. We further assume that industry shocks account for 40% of each sample firm's share price volatility. The remaining 60% of the volatility stems from a mean-zero idiosyncratic shock.²⁰ Given these assumptions about share prices, we can ask how the value of unvested compensation is affected by the firm's choice of stock vs. options. Suppose a manager accepts a position at time $t = 0$. One year later, at time $t = 1$, the firm and all the other potential employers receive either a good, neutral, or bad common shock plus a mean-zero idiosyncratic shock.

¹⁸ Oyer and Schaefer (2005) calibrate the retention model using the NCEO firms and conclude that the grants observed are consistent with retention being an important consideration in option grants.

¹⁹ A related justification for options is analyzed by Inderst and Mueller (2004). They argue that options minimize wage costs in exactly the states of the world where high fixed wages may lead a firm's owners to decide (inefficiently) to shut the firm down. By indexing wages to firm value, this inefficiency is mitigated.

²⁰ The choice of 60% idiosyncratic risk is based on the R^2 from several regressions we ran of individual firm returns on the NASDAQ composite index or the Dow Jones Internet Commerce and Internet Service indexes.

We again present an example using Firm X. Given our assumptions, the good, neutral, and bad shocks at Firm X would be +51, +10, and –31%, respectively. The additional cost (from employee risk premium) to the firm of options compared to stock grants is about \$1000.²¹ If the industry shock is positive, then a firm that grants restricted stock can expect the employee's unvested compensation to be worth \$92,000 at time $t = 1$. However, if the firm makes the observed option grant, the modified BSV of his unvested options at $t = 1$ would be \$102,000. In the event of a positive industry shock, this employee will be tempted to leave the firm only if outside employers are willing to compensate the employee for the lost value of unvested pay. By paying the extra \$1000 in risk premium, this firm expands the set of labor market conditions in which it faces no labor market competition.

This trade-off between risk and value of unvested compensation is more dramatic in the case of the start-up company we analyzed in the last section. At that firm, the added risk of options leads the firm to have to pay an additional two to three thousand dollars per year compared to the case where it grants stock. However, the options produce \$131,000 in expected unvested compensation in the event of a good shock compared to just \$110,000 for restricted stock. As discussed in the previous section, options do not create much additional risk cost relative to stock grants at the large, stable firm profiled in Fig. 4. Because of the relatively small grants, neither form of compensation generates much unvested pay. To the extent that either generates any retention value, options have a small advantage. If the common shock is good, we estimate options lead to expected unvested pay value of \$8200 versus \$6700 for stock grants. In the 216 firms in the NCEO sample as a whole, the average additional expected unvested pay value created by options, relative to stock grants, when the common shock is good is \$11,300 and the median is \$9800.²² It appears plausible that options may help firms reduce transaction costs by limiting the states of the world in which firms must respond to employees' outside wage offers. However, without some information on the magnitude of these costs, we cannot determine for sure if this value is enough to overcome the additional risk costs of options. On balance, the evidence is consistent with retention being an important consideration in firms' decisions to grant stock options.

5. Conclusion

We examined the cost to shareholders of employee stock option grants. We measured these costs under three distinct underlying assumptions. First, we assumed that firms grant stock options solely due to the favorable accounting treatment of option grants and that, if the accounting treatment of options were changed, pay would switch to cash only. Under this assumption, we concluded that option grants cost many firms at least several thousand dollars per middle manager per year. In return, the typical firm in our sample was able to report additional pre-tax income of \$10,000 or more per middle manager than it would have reported had it paid the manager in cash.

²¹ Note that this amount is lower than in our previous calculations because we are now assuming that some of the firm's volatility is driven by an industry shock that also affects market wages. The risk from options is still always greater than that from stock.

²² We experimented with different assumptions regarding the fraction of stock volatility that is common across firms in an industry. The figures computed here assume that industry shocks account for 40% of each sample firm's share price volatility, but our calculations are not dramatically affected even if we assume only 10% of each firm's volatility is common to firms in an industry. Specifically, we find that under the 10% assumption, the mean (median) difference in retention value between option and stock grants is \$8700 (\$7900).

Further, by looking at the *marginal* cost of the last share granted, we estimate that, if options are granted strictly to increase reported earnings, a typical firm in our sample is willing to incur real costs of fifty cents to a dollar to increase pre-tax income by one dollar.

Second, we assumed that equity grants create some actual economic benefit to firms, but that these benefits can be just as easily captured by restricted stock grants as by option grants as long as the employee values the two types of grants equally. We further assumed that firms grant options instead of stock due to the favorable accounting treatment. Option grants are considerably less costly under these assumptions, though the costs are not trivial. We estimated the implied marginal willingness-to-pay for a dollar of pre-tax income to be on the order of twenty cents.

Finally, we assumed that firms made option grants as part of economic-profit-maximizing employment contracts. That is, we assume that the option grants create enough additional benefits relative to stock grants to justify the additional risk costs they impose. We then analyzed several possible motivations for option grants to determine under what conditions the option grants we observe are more efficient than hypothetical stock grants that would cost the firm the same amount. We concluded that option grants can create more value than stock grants if employees are very optimistic about the prospects of their firm or if turnover probability is quite sensitive to unvested option value when labor market conditions are favorable for employees.

The primary caveat that must be applied to our analysis relates to the selection of our sample from the NCEO. As we have noted, the sample is not randomly drawn, and contains a high proportion of “new economy” firms. Share price volatilities of our sample firms are quite high, and so some care must be taken in extending our findings to firms with lower volatilities.

We draw two main conclusions from our analysis. First, if the accounting treatment of stock options underlies firms’ decisions to grant them broadly, then the costs to shareholders of this practice are very large. The willingness-to-pay for earnings implied by our sample firms’ option grants is several times higher than that found by Erickson et al. (2004) in their study of firms that fraudulently attempted to boost earnings. Given this, we believe there is reason to question the assertion that option-granting behavior is driven entirely (or even largely) by the accounting treatment of stock options. Large shareholders or corporate raiders would reap millions of dollars of benefits (possibly hundreds of millions at some of the larger firms in our sample) from using their control rights to stop this practice if there were no economic benefits associated with it.

Our second conclusion is that, under reasonable assumptions regarding employee optimism and labor market conditions, observed option grants may be part of economic-profit-maximizing employment contracts. That is, it is possible that our sample firms’ economic profits are higher given their observed option grants than profits would have been under equivalently costly (to the firm) cash- or restricted-stock-based plans. While we believe that our analysis helps to understand the underlying costs of option grants, we leave a definitive answer to the questions of just how much accounting treatment drives option grants to future research.

Acknowledgments

We thank Corey Rosen and Ryan Weeden for providing the NCEO data. For discussions and comments, we thank Jeremy Bulow, Rachel Hayes, Charles Hadlock, Kevin J. Murphy, Madhav Rajan, Stefan Reichelstein, Jeff Zwiebel, George Pennacchi (the Editor), two referees, and seminar participants at the 2004 JFI/Olin School Corporate Governance Conference.

References

- Aboody, D., 1996. Market valuation of employee stock options. *J. Acc. Econ.* 22, 357–391.
- Aboody, D., Barth, M.E., Kasznik, R., 2004. SFAS 123 stock-based compensation expense and equity market values. *Acc. Rev.* 79, 251–275.
- Barron, J.M., Waddell, G.R., 2004. Work hard, not smart: Stock options in executive compensation. Mimeo. Purdue University and University of Oregon.
- Benartzi, S., 2001. Excessive extrapolation and the allocation of 401(k) accounts to company stock. *J. Finance* 56, 1747–1764.
- Benartzi, S., Thaler, R.H., 2001. Naive diversification strategies in defined contribution savings plans. *Amer. Econ. Rev.* 91, 79–98.
- Bergman, N., Jenter, D., 2004. Employee sentiment and stock option compensation. Mimeo. MIT Sloan School of Management.
- Core, J.E., Guay, W.R., 2001. Stock option plans for non-executive employees. *J. Finan. Econ.* 60, 253–267.
- Crimmel, B.L., Schildkraut, J.L., 2001. Stock option plans surveyed by NCS. Compensation and working conditions. Spring, 3–21.
- Erickson, M., Hanlon, M., Maydew, E., 2004. How much will firms pay for earnings that do not exist? Evidence of taxes paid on allegedly fraudulent earnings. *Acc. Rev.* 79, 387–408.
- Feltham, G.A., Wu, M.G.H., 2001. Incentive efficiency of stock versus options. *Rev. Acc. Stud.* 6, 7–28.
- Garvey, G.T., Milbourn, T.T., 2004. Do stock prices incorporate the potential dilution of employee stock options? Mimeo. Claremont Graduate School and Washington University.
- Guay, W., Kothari, S.P., Sloan, R., 2003. Accounting for employee stock options. *Amer. Econ. Rev.* 93, 405–409.
- Hall, B.J., Murphy, K.J., 2002. Stock options for undiversified executives. *J. Acc. Econ.* 33, 3–42.
- Hall, B.J., Murphy, K.J., 2003. The trouble with stock options. *J. Econ. Perspect.* 17, 49–70.
- Hand, J.R.M., (2004). Give everyone a prize? Employee stock options in venture-backed firms. Mimeo. University of North Carolina.
- Huddart, S., Lang, M., 1996. Employee stock option exercises: An empirical analysis. *J. Acc. Econ.* 21, 5–43.
- Inderst, R., Mueller, H., 2004. Benefits of broad-based option pay. Mimeo. London School of Economics and New York University.
- Jenter, D., 2002. Executive compensation, incentives, and risk. Mimeo. MIT Sloan School of Management.
- Kedia, S., Mozumdar, A., 2002. Performance impact of employee stock options. Mimeo. Rutgers University and Virginia Polytechnic.
- Lambert, R.A., Larcker, D.F., 2003. Stock options, restricted stock, and incentives. Mimeo. The Wharton School, University of Pennsylvania.
- Lambert, R.A., Larcker, D.F., Verrecchia, R.E., 1991. Portfolio considerations in valuing executive compensation. *J. Acc. Res.* 29, 129–149.
- Madrian, B.C., Shea, D.F., 2001. The power of suggestion: Inertia in 401(k) participation and savings behavior. *Quart. J. Econ.* 116, 1149–1187.
- McDonald, R.L., 2004. The tax (dis)advantage of a firm issuing options on its own stock. *J. Public Econ.* 88, 925–955.
- Murphy, K.J., 1999. Executive compensation. In: Ashenfelter, O., Card, D. (Eds.), *Handbook of Labor Economics*, vol. 3. North-Holland, Amsterdam.
- Oyer, P., 2004. Why do firms use incentives that have no incentive effects? *J. Finance* 59, 1619–1640.
- Oyer, P., Schaefer, S., 2005. Why do some firms give stock options to all employees? An empirical examination of alternative theories. *J. Finan. Econ.* 76, 99–133.
- Zhang, G., 2003. Market valuation and employee stock options. Mimeo. Duke University, Fuqua School of Business.