Employee Sentiment and Stock Option Compensation

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Abstract

The use of equity-based compensation for employees in the lower ranks of large organizations is a puzzle for standard economic theory: undiversified employees should discount company equity heavily, and any positive incentive effects should be diminished by free rider problems. We analyze whether the popularity of option compensation for rank-and-file employees may be driven by employee optimism. We develop a model of optimal compensation policy for a firm faced with employees with positive or negative sentiment, and show that employee optimism by itself is insufficient to make equity compensation optimal. The crucial insight is that firms compete with financial markets as suppliers of equity to employees and that employees' access to the equity market restricts firms' ability to profit from employee optimism. It follows that any explanation for option compensation based on employee optimism requires two ingredients: first, employees need to be over-optimistic about firm value, and second, firms must be able to extract some of the implied rents even though employees can purchase company equity by themselves. Such rent extraction becomes feasible if employees prefer the stock options offered by firms to the equity offered by the market, or if the traded equity is overvalued. We provide empirical evidence confirming that firms use broad-based option compensation when boundedly rational employees are likely to be excessively optimistic about company stock, and when employees are likely to have a strict preference for options over stock.

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1. Introduction

The use of equity-based compensation for employees below the executive rank has been growing rapidly during the last decade, with broad stock option plans as the most common method. The National Center for Employee Ownership (2001) estimates that between 7 and 10 million US employees held options in 2000. The popularity of option compensation for employees in the lower ranks of large organizations is a puzzle for standard economic theory: any positive incentive effects should be diminished by free rider problems and overshadowed by the cost of imposing risk on employees. Holding options in their employer exposes employees to price risk which is highly correlated with their human capital.[1] Hence employees should be an inefficient source of equity capital, at least compared to well-diversified outside investors.

Several studies show, however, that employees do not value company stock and options as prescribed by extant theory. For example, employees voluntarily purchase large amounts of company stock at market prices for their 401(k) and ESOP plans, and especially so after company stock has performed well. In any portfolio selection framework, this observation shows that employees' valuations of company stock are higher than the prevailing market price. With regard to options, survey evidence suggests that many employees have unrealistic expectations about future stock prices and frequently value their options substantially above Black-Scholes values. Motivated by these observations, we analyze whether the popularity of option compensation for rank-and-file employees of large firms may be driven by employee optimism.

We develop a model of optimal compensation policy for a firm faced with employees who exhibit either positive or negative sentiment towards it. We assess the circumstances under which employee optimism leads to equity-based compensation, and show that employee optimism by itself is insufficient to make option compensation optimal for firms. The crucial insight is that firms compete with financial markets as suppliers of equity to employees; the ability of employees to purchase equity on their own restricts firms' ability to profit from employee optimism, and hence restricts or even eliminates firms' incentive to compensate with equity. The feasibility and magnitude of firms' rent extraction is determined by employees' *willingness to pay* for equity compensation – that is, the cash wages that employees are willing to give up in return for equity compensation – which is determined in part by what employees can purchase in the equity market. If employees can purchase any claim on the firm at fundamental value by themselves, then optimistic employees capture all of the behavioral surplus from their optimism and the firm gains nothing from paying with equity.

Our model identifies two channels which make optimistic employees willing to "overpay" for equity compensation, thereby enabling firms to extract rents from them: Optimistic employees may pay more than fair value for equity compensation because they prefer the compensation instruments offered by firms to the equity claims traded in the market, or they may pay more than fair value because the market overvalues the firms' traded equity. Both mechanisms allow firms to use equity to lower their compensation costs, and hence make equity compensation the optimal choice for firms.

The first channel is operative if firms are able to offer equity claims to employees which (i) employees cannot purchase by themselves, and (ii) which employees prefer to equity claims of similar fundamental value available to them through the market. When these conditions hold, the rents firms extract by paying optimistic employees with equity are restricted to the *additional* utility employees obtain from the compensation instruments relative to the utility they could obtain from traded equity. Crucially, firms' interest in paying with equity in this situation results from firms' ability to offer an equity claim to optimistic employees which these prefer to the best alternative they can find in the market, and not simply from employee optimism.

Any preference employees might have for a firm's compensation instruments (such as employee options) over the same firm's traded equity can be caused either by bounded rationality or by real constraints on employees' equity purchases. Bounded rationality is suggested by survey evidence which indicates that many employees simply do not know how stock options relate to traded stock, and how traded equity can be used to value options.[2] Comparing the values of non-linear compensation instruments such as options to traded equity is difficult and likely beyond the capabilities of most employees. Instead, employees are likely to rely on heuristics and to evaluate options on the basis of their own or their peers' past experience with option payoffs. When these valuation heuristics lead employees to prefer options over traded shares, the first channel is operative and option compensation becomes optimal for firms. Alternatively, employees may prefer their firm's compensation instrument over its traded equity because of constraints on employees' purchases in the equity market. Borrowing constraints are likely to prevent many employees from obtaining large levered positions in the equity market. Since optimistic employees may prefer a levered to a non-levered position in their employer, borrowing constraints can be an alternative reason for employees to value stock options more highly than traded stock.

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[1] In the remainder of the paper we use the term "employees" as equivalent to "non-executive employees".
[2] See Lambert and Larcker (2001) and Hodge, Rajgopal, and Shevlin (2005).

The second channel through which firms can profit from equity compensation operates when the firms' equity is overvalued in the market. We show that optimistic employees' willingness to pay for traded equity is capped by its market price. Overvaluation loosens this constraint and allows firms to profit by effectively selling overpriced equity to their optimistic employees. On the margin, firms become indifferent between paying their employees with equity, and issuing overvalued equity directly into the market.[3] This overvaluation channel makes equity compensation profitable even if employees do not prefer the firms' non-traded compensation instruments to traded equity, i.e., even if the price the firm is able to charge is no higher than the prevailing market price.[4]

Next, the model allows us to analyze the effects of sentiment-induced equity compensation on firm profitability and labor market outcomes. Perhaps somewhat surprisingly, positive employee sentiment is not always beneficial to a firm. Because employees' human capital covaries positively with stock returns, optimistic employees may decide to work at a different firm while still investing in the one they are optimistic about, thereby avoiding the positive correlation between labor income and financial wealth. If firm-specific human capital risk is a serious problem, and if the equity market is sufficiently efficient, this mechanism can make firms without positive sentiment the beneficiaries of positive sentiment towards other firms, both in terms of profitability and in terms of firm size. On the other hand, firms subject to positive sentiment are the net beneficiaries if their employees exhibit a strong preference for non-traded compensation instruments over traded stock and the level of firm-specific human capital risk is moderate, or when equity markets are inefficient. The stock option boom of the late 1990s can thus be interpreted as a situation in which firms subject to both positive employee sentiment and overvalued equity benefited through lower compensation costs, a larger number of employees, and higher profits.

With the theoretical foundation for the use of equity compensation in place, we empirically test whether the observable cross-sectional and time-series patterns of broad-based option grants are

[3] If firms face downward-sloping demand curves for their shares in the market, and employees are subject to an endowment effect (so that they do not sell shares granted to them, even though they would not have purchased any by themselves), then paying optimistic employees with shares may be cheaper than issuing equity into the market (for a related example, see Baker, Coval, and Stein (2004)). Alternatively, transaction costs associated with seasoned equity issues (Smith (1986), Lee, Lochhead, Ritter and Zhao (1996), and Altinkiliç and Hansen (2000)) may make paying optimistic employees with equity cheaper than issuing equity into the market.

[4] While paying optimistic employees with equity lowers current compensation costs, firms may be worried about a subsequent backlash from employees if realized returns do not live up to employees' expectations. To avoid the later backlash, a firm would have to substitute cash compensation for the equity compensation preferred by employees. This substitution increases the firm's short-run compensation costs and disadvantages it relative to other firms in the labor market. The optimal level of equity compensation is then determined by the tradeoff of lower compensation costs today against a more severe backlash if realized stock returns are low tomorrow.

consistent with the hypothesis that option compensation is driven by employee sentiment. Our model predicts that option compensation is used when employees are optimistic about options, and when employees strictly prefer (non-traded) options to the equity instruments available in the market. We use several proxies for employee sentiment to empirically assess this prediction. The proxies are motivated by results in the prior literature showing that employee sentiment towards their employer improves with prior stock price performance. Due to the amplified nature of option payoffs, we expect boundedly rational employees to extrapolate more strongly from past returns when valuing options than when valuing stock. Thus, as past stock price performance increases, both employee sentiment *and* employees' preference for options over traded equity increase. We therefore predict that better stock price performance is associated with greater use of stock option compensation going forward. We make use of the psychology literature on expectation formation and excessive extrapolation to develop both additional proxies for sentiment and additional testable hypotheses relating stock return patterns and firm characteristics to stock option compensation. All hypotheses are developed in detail in Section 4.

Figure 1 gives a first graphical impression of the evolution of employee option grants in our sample of 2,171 publicly traded firms from 1992 to 2003. The graph provides prima facie evidence in support of the sentiment hypothesis: in close parallel with stock market valuations, per employee option grants started to rise rapidly in the mid 1990s, peaked in 2000, and dropped by approximately 60% over the subsequent three years. Using regression analysis, we show that the predictions of the employee sentiment hypothesis are confirmed by both the cross-sectional and the time series evidence: Option compensation for non-executive employees is most common among firms with excellent prior stock price performance. The average prior two-year return for companies with granting activity in the top quintile is 30% per annum, compared to 4% p.a. for firms in the bottom quintile.[5] Sorting firms by prior returns yields average (median) grants of $21,293 ($2,965) among firms in the top return quintile compared to only $7,589 ($1,030) among firms in the bottom return quintile. Consistent with Griffin and Tversky (1992), the effect of past returns on granting activity is non-linear, with granting activity concentrated among the very best prior performers. Consistent with Benartzi (2001), the positive relationship between stock returns and option grants becomes stronger when we enlarge the window over which past returns are measured. In addition, firms in or close to financial distress use fewer options, suggesting that bad sentiment prevents these firms from using option compensation to conserve on cash. Finally, firms which grant more options have faster employment growth than firms which use fewer or no options, consistent with the predictions of our model.

[5] We define non-executive employees as all employees except the five most highly paid executives in the firm. See Section 5 for an extensive discussion.

Next, we test the model prediction that firms are more likely to pay lower-level employees with options when top executives view their own stock as overvalued. We identify situations in which company leaders are likely to view their firm's stock price as too high by looking at firms in which managers have manipulated earnings upwards, and at firms in which top managers sell large amounts of company equity. We measure earnings manipulation using several versions of the modified Jones model and find that firms likely to have overstated earnings grant between 13% and 23% more options than other firms. The insider trading results indicate that firms in which the top five managers cash out grant 11% to 18% more options to their employees than comparable firms, while firms in which top managers purchase equity for their own accounts grant 17% to 19% less. The last result, however, is not robust to the inclusion of firm fixed effects, leaving us with mixed evidence for the relationship between executive trading and employee option compensation.

We examine share repurchase decisions by option granting firms to provide further evidence on executives' beliefs on mispricing.[6] If top executives view their own stock price as too high, they should be reluctant to repurchase shares at market prices, and should instead consider issuing new shares into the market. The results show that a sizeable subset of the heaviest option granters in our sample are also active repurchasers of company equity, rendering it unlikely that market prices are viewed as substantially overvalued by top executives. We conclude that a perception of equity overvaluation by these firms' top executives does not explain their employee option programs. In the framework of our model, and consistent with the empirical evidence above, this leaves employees' preference for options over traded equity as the driving force behind option compensation.

Finally, our empirical results provide evidence against the hypothesis that firms with cash constraints use option compensation in order to minimize cash payouts.[7] Core and Guay (2001) point out that equity compensation can be efficient if firms need to raise cash and if the information asymmetries between firms and employees are smaller than between firms and outside investors. We therefore control for several measures of cash constraints in the empirical analysis. We find that option grants are strongly *positively* associated with corporate cash balances and contemporaneous cash flows, and *negatively* with cash outflows for debt service. These findings cast doubt on the hypothesis that option grants are motivated by cash constraints. Instead, the results add support to the idea that employee sentiment determines the ability of firms to compensate their employees with equity: employees are likely to display

[6] The result that share repurchases are empirically linked to employee option programs has been documented by, among others, Weisbenner (2000), Kahle (2001), and Bens, Nagar, Skinner, and Wong (2003).

more positive sentiment towards firms with higher cash balances, higher levels of investment, and better investment opportunities, and worse sentiment towards firms with higher levels of debt and higher interest payments. This interpretation also helps to explain Fama and French's (2005) observation that many fast-growing and highly profitable firms issue equity to employees every year, in apparent contradiction to the Myers and Majluf (1984) pecking order theory. We propose that equity compensation is not driven by firms' intention to raise funds, but instead by exuberant employees who demand to be paid with options.

Beyond our own empirical results, our model explains several other empirical regularities. Employees who prefer options over traded stock are consistent with the survey evidence of Ittner, Lambert, and Larcker (2003) according to which firms feel the need to compensate employees with options in order to attract and retain them. Moreover, anecdotal evidence from the dot-com era supports the model prediction that an improvement in employee sentiment towards a firm can lead to a reduction in employment and an increase in compensation at other firms: Snider (2000) reports that law firms were forced to massively increase the salaries for associates in 1999 to prevent them from leaving to internet start-ups offering large option packages. Finally, our model helps explain the empirical dominance of options over restricted stock as means of compensation. Without stock price misvaluation, equity compensation is beneficial to firms only if they are able to offer instruments which optimistic employees prefer to the equity claims available in the market. Paying with restricted stock is, therefore, unlikely to bring any benefits to the firm since employees can purchase unrestricted stock in the open market. In contrast, the absence of traded employee stock options makes rent extraction through options easier. [8]

Our paper is not the first to consider employee sentiment as a factor in option compensation. The paper closest to our model is by Oyer and Schaefer (2005) who calibrate the effect of optimism about future returns on employees' relative valuations of stock and options. The main difference to our approach is that their analysis does not consider employees' ability to purchase equity in the market. Calibrating employees' valuations of equity instruments focuses on only one aspect of employees' decision process and ignores the comparison employees make between the instruments offered by firms and the equity offered by the market. As financial markets put an important constraint on firms' ability to extract rents from employees, it is crucial to analyze this second aspect of employees' decision making in order to understand the use of option compensation and the attendant division of rents between firms and employees. Our analysis differs further from Oyer and Schaefer in that we explicitly model the effect of

[7] See, for example, Yermack (1995), Dechow, Hutton, and Sloan (1996), and Core and Guay (2001).

employee sentiment on labor market equilibria, taking into account firm-specific human capital risk and allowing for equity to be mispriced by the market.

Finally, we note that employee optimism is clearly not the only driver behind the use of broad-based option programs. There is significant evidence that changes in accounting rules have affected option granting practices in the past, and considerable anecdotal evidence that the recent shift to option expensing has led many firms to reduce their employee option programs.[9] At the same time, since accounting rules are similar for all firms, they cannot easily explain the large cross-sectional differences in the use of option compensation we find in the data. More specifically, accounting rules cannot explain why broad based option programs are concentrated among highly successful firms, and why firms entering distress are forced to cut back on their use of option grants. We conclude that the accounting hypothesis and the sentiment hypothesis are both likely to be valid, with the accounting hypothesis representing a "level effect" which is uniform across firms, and the sentiment hypothesis representing a "cross-sectional effect" explaining differences between firms.

In the next section we present a simple model of optimal employee compensation when employees display sentiment towards firms. We defer a detailed review of the prior literature until section 3. Section 4 translates the model and the prior literature on employee sentiment into testable predictions. Section 5 describes the data and variable definitions, and Section 6 presents the empirical results. The final section summarizes and concludes.

2. A Simple Model of Optimal Compensation

We develop a simple one-period model in which two firms compete in the labor market and compensate their employees using cash and equity instruments. Both firms are assumed to be large, so that equity compensation has no effect on employees' incentives to exert effort. The two firms, indexed by 1 and 2, have identical production functions using labor l_1 and l_2 as sole input to produce output G_1 and G_2, with $G_i = f(l_i)$, and $f(0) = 0$, $f' > 0$, $f'(0) = \infty$, and $f'' < 0$. The two firms hire employees in a competitive labor market, each offering a compensation contract consisting of W_i in cash wage, N_i units of traded company equity, and M_i units of a non-traded equity compensation instrument.

[8] Exchange-traded short-term options are available for a subset of firms, but most employees are unlikely to be aware of this.

[9] See, for example, Murphy (2002, 2003), Carter and Lynch (2003), Zheng (2003), and Farber, Johnson, and Petroni (2005).

The sole, but crucial, difference between the two equity instruments offered by firms is that one is traded in the equity market and can be purchased by employees, while the other is not traded and is offered by the firms only. We call the former simply "traded equity" and the latter the "non-traded compensation instrument". The assumption that each firm competes with the market in offering traded equity, while being, in essence, a monopoly supplier of its own compensation instrument will drive much of the model results. To emphasize the fundamental equivalence of the two forms of equity in our model, aside from their different tradability, we assume that for each firm, the payoffs of a unit of the traded and of the non-traded equity are *identical* and given by the random variable $\tilde{X}_i$ ($i \in \{1,2\}$), with mean normalized to 1 and variance σ^2. Thus, our results are not driven by different payoff structures of the two instruments. We assume for simplicity that the equity payoffs of the two firms are independent of each other, and that the number of equity instruments issued is small relative to the number of shares outstanding so that the expected payoffs do not change when more instruments are issued. The equity market is risk neutral with a riskless interest rate of zero, which implies that the fair market value of a unit of traded or non-traded equity of either firm is equal to 1.

There is a homogeneous mass of potential employees which we normalize to 1. Employees are risk-averse with mean-variance preferences and have a reservation wage of zero. We assume that potential employees display sentiment towards firm 1 but not towards firm 2. We think of firm 1 as operating in a "new economy" industry subject to sentiment and fads, and of firm 2 as operating in the "old economy" for which sentiment plays no role.[10] Parameterizing employee sentiment by s, employees believe the payoff of a unit of traded firm 1 equity to be $\tilde{X}_1 + s$, and the payoff of a unit of the non-traded compensation instrument to be $\tilde{X}_1 + z(s)$, with $z' > 0$ and $z(0) = 0$. Thus, we assume that employees do not necessarily recognize the fundamental equivalence in payoffs between the non-traded compensation instrument and traded equity, and allow employees to exhibit differing sentiment towards each.[11]

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[10] Modeling two firms with non-zero sentiment does not change the results, but complicates the exposition.

[11] For simplicity, the model focuses on a base case in which there are no objective differences between the equity claims offered by firms and those offered by the market, and hence employees' divergent valuations for the two claims are purely behavioral. At the cost of additional complexity, we could allow for traded equity and the non-traded compensation instrument to have different payoffs, for example by assuming that the compensation instrument is a call option on the firm's stock. With this assumption, the difference in sentiment between the compensation instrument and traded equity measures whether employees prefer the options offered by the firm to the best alternative employees can purchase in the market. Introducing objective differences between the compensation instrument and the best traded alternative simply provides an additional reason for why employees might prefer one type of claim to the other, and does not change the core results of the model.

Whether employees prefer the non-traded compensation instrument to traded equity, and the determinants of any preference for one over the other, are ultimately empirical questions, and we consider both possibilities in the analysis below (i.e., $s \geq z$ and $s < z$). We motivate the assumption that employees may not recognize the equivalence between traded equity and the compensation instrument by the observation that most employees are unfamiliar with even basic asset pricing techniques. Deriving the value of a non-traded compensation instrument from the observed prices and volatilities of traded equity is often difficult and beyond the abilities of most employees. Instead, employees are likely to value the compensation instrument using simple heuristics such as extrapolation from past payoffs. This may lead employees to prefer, for example, non-traded employee options to traded shares after a period with high stock (and even higher option) returns.

The model takes into account that employees bear risk from firm-specific human capital that is correlated with the equity value of their employer. When working for firm i, employees obtain implicit random compensation $\tilde{Y}_i$, with mean 0, variance σ_Y^2, and $Cov(\tilde{Y}_i, \tilde{X}_i) \equiv \phi \geq 0$, so that the level of firm-specific human capital risk is the same in both firms. Finally, we allow for the market price of a unit of traded equity of firm 1 to deviate from fundamental value because of noise trader sentiment and limited arbitrage. For simplicity, employee sentiment and noise trader sentiment are identical, although allowing these to differ does not materially change the results. Formally, a unit of traded firm 1 equity can be purchased in the market for $p(s)$, where $p(0) = 1$, and $0 \leq p'(s) \leq 1$.[12] As there is no sentiment towards firm 2 equity, its market price equals its fundamental value of 1.

Potential employees use their subjective beliefs about firm value to evaluate the compensation contracts (W_i, N_i, M_i) offered by each firm and take into account their ability to purchase traded equity on their own. For empirical realism, we assume that employees cannot immediately sell the equity they receive as compensation, though our results are unchanged without this assumption. We begin solving the model by calculating the equity purchases of employees with a given compensation package. Since employees are risk averse and since they value firm 2 correctly, it is easy to see that employees never purchase firm 2 equity on their own. In contrast, firm 1 equity may appear cheap to optimistic employees of either of the two firms. The optimal purchase of firm 1 equity by an employee of firm 1 with compensation package (W_1, N_1, M_1) is the $\hat{N}_1$ maximizing the following expected, subjective utility:

[12] In this formulation, $p'(s)$ is a measure of the effectiveness of arbitrage. With $p'(s) = 0$ for all s, there are no limits to arbitrage and capital markets are perfectly efficient. When $p'(s) = 1$, arbitrage has no effect and prices move one for one with sentiment. This price structure is the outcome of standard models of financial markets with noise traders and limited arbitrage (see, for example, Shleifer (2000)).

$$\hat{E}\left[U(\hat{N}_1; W_1, N_1, s)\right] = \hat{E}\left[W_1 + (N_1 + \hat{N}_1)\cdot \tilde{X}_1 + M_1 \cdot \tilde{X}_1 + \tilde{Y}_1\right] - \frac{1}{2} Var\left[W_1 + (N_1 + \hat{N}_1)\cdot \tilde{X}_1 + M_1 \cdot \tilde{X}_1 + \tilde{Y}_1\right] - p(s)\hat{N}_1 \qquad (1)$$

Solving this maximization problem of firm 1 employees, and the corresponding problem of firm 2 employees, yields the following result:

Lemma 1 The optimal purchases of firm 1 equity are given by:

(a) for firm 1 employees:

$$\hat{N}_1^1 = Max \ \{0, \frac{1 + s - p(s) - \phi}{\sigma^2} - N_1 - M_1\} \qquad (2)$$

(b) for firm 2 employees:

$$\hat{N}_1^2 = Max \ \{0, \frac{1 + s - p(s)}{\sigma^2}\} \qquad (3)$$

Lemma 1 states that upon receiving (W_1, N_1, M_1) from firm 1, employees of firm 1 purchase traded equity in their employer until they reach their optimal portfolio of $\frac{1 + s - p(s) - \phi}{\sigma^2}$ units of equity, taking into account the traded equity and non-traded compensation instruments received from the firm. An increase in sentiment s increases the demand for equity in firm 1 by both sets of employees, despite the fact that an increase in sentiment also tends to increase the price of traded firm 1 equity. This is because arbitrageurs cause the increase in price to be smaller than the increase in sentiment ($p'(s) \leq 1$). Also, as would be expected, purchases by firm 1 employees are decreasing in firm-specific human capital risk, ϕ. Since employees of firm 2 do not bear firm 1 specific human capital risk, their purchases of firm 1 equity are independent of ϕ.

Firms maximize shareholder value by hiring the optimal number of workers and minimizing compensation costs. In doing so, firms take into account that employees may purchase equity on their own, and that employees will work for the competing firm if its contract is more attractive:

$$\underset{l_i, W_i, N_i, M_i}{Max} E\left[f(l_i) - l_i \cdot \left(W_i + N_i \cdot \tilde{X}_i + M_i \cdot \tilde{X}_i\right)\right] = f(l_i) - l_i \cdot \left(W_i + N_i + M_i\right) \qquad (4)$$

$$s.t.\quad \hat{E}\left[U(W_i, N_i, \hat{N}_1^i, M_i; s, z(s), \phi, p(s))\right] \geq 0$$

$$\hat{E}\left[U(W_i, N_i, \hat{N}_1^i, M_i; s, z(s), \phi, p(s))\right] \geq \hat{E}\left[U(W_j, N_j, \hat{N}_1^j, M_j; s, z(s), \phi, p(s))\right]\ for\ i \neq j.$$

The firms' valuations of the compensation contracts differ from employees' valuations because firms are risk neutral while employees are risk averse, and because employees (may) feel sentiment towards equity compensation. The difference in risk aversion by itself would make equity-based compensation inefficient since risk is transferred to the party less able to bear it.

The equilibrium in this model, described in the following theorem, is given by a pair of compensation contracts (W_1^*, N_1^*, M_1^*) and (W_2^*, N_2^*, M_2^*) offered by the two firms and by the resulting allocation of labor (l_1^*, l_2^*).

Theorem 1 The equilibrium compensation contracts and labor allocations are such that:

(a) The perceived expected utility from working for each firm is equalized, taking into account employees' optimal purchases of traded firm 1 equity given in equations (2) and (3).

(b) The allocation of labor between the two firms is such that marginal products of labor equal actual compensation costs, and the labor market clears.

(c) The optimal compensation contract offered by firm 2 involves only cash: $N_2^* = M_2^* = 0$.

(d) The optimal compensation contract offered by firm 1 is described by:

$$(i)\ N_1^* \in [0, \frac{s-\phi}{\sigma^2}]\ and\ M_1^* = 0\ if\ \ s > \phi\ and\ \ z(s) \leq s\ and\ \ p'(\cdot) = 0$$

$$(ii)\ N_1^* = \frac{s-\phi}{\sigma^2}\ and\ M_1^* = 0\ if\ \ s > \phi\ and\ \ z(s) \leq s\ and\ \ p'(\cdot) > 0$$

$$(iii)\ N_1^* = 0\ and\ M_1^* = \frac{z(s)-\phi}{\sigma^2}\ if\ \ z(s) > \phi\ and\ \ z(s) > s$$

$$(iv)\ N_1^* = 0\ and\ M_1^* = 0\ if\ \ s \leq \phi\ and\ z(s) \leq \phi$$

Proof See Appendix A.

The intuition for the first three parts of Theorem 1 is straightforward: In equilibrium, the compensation packages offered by both firms are perceived to be of equal value by potential employees, which is the only way both firms can simultaneously attract employees (part a).[13] Also, as is standard, the labor market must clear, and firms hire employees up to the point where their marginal product equals the cost of their employment (part b). Because employees are risk averse and do not exhibit sentiment towards firm 2, firm 2 never offers equity in its compensation package (part c).

The crux of Theorem 1 is in part d, which describes the optimal compensation contract offered by firm 1. Parts (d.i) and (d.ii) describe the case in which employees are highly optimistic $(s > \phi)$ and prefer traded equity to the non-traded compensation instrument $(s \geq z(s))$. Employee optimism, by itself, turns out to be insufficient to make equity compensation profitable and to force firms away from cash wages. The essential insight is that the firm directly competes with the stock market when offering equity to its employees. The availability of traded equity through the market limits the amount of cash wages employees are willing to forgo – or, equivalently, to 'pay' the firm – in return for an extra unit of equity offered by the firm. Specifically, employees' willingness to pay for traded equity is capped by the market price of equity, *independently of their degree of optimism*. Thus, with perfectly efficient markets as assumed in case (d.i), the cost of providing a unit of traded equity – its fundamental value – exactly equals the price which optimistic employees are willing to pay. Firm 1 is therefore indifferent between paying with cash and paying with traded equity of the same market value.

Figure 2a illustrates this result. The downward sloping curve represents employees' marginal valuation for traded equity which is decreasing due to employees' risk aversion. Crucially, employees' willingness to pay firm 1 for equity, given by the bolded line in the figure, can be below their marginal valuations. This is because employees refuse to pay more than the market price of 1 for a unit of traded equity. Once employees' valuations fall below the market price, their willingness to pay again equals their valuation. Since the firm's compensation cost is 1 per unit of traded equity, it is indifferent between all contracts at which employees' marginal willingness to pay equals 1, which is any contract offering between zero and $(s-\phi)/\sigma^2$ units of traded equity.[14] The availability of traded equity at fair prices through the market ensures that the firm captures none of the behavioral rents created by employees'

[13] Equilibria in which one firm attracts all the potential employees and the other firm shuts down are ruled out by the assumption that $f'(0) = \infty$.

[14] This upper bound equals the number of units of traded equity that an employee would buy on his own when purchasing equity at its fundamental value of 1.

optimistic valuations. Put differently, the firm is unable to extract any of the "consumer surplus" represented by the area between employees' marginal valuations and the firm's fixed marginal cost. This result has been overlooked by the prior literature, which has focused on optimistic employees' *valuations* of equity claims rather than their *willingness to pay* for equity.

When markets are not perfectly efficient, in the sense that positive sentiment does increase equity prices (case (d.ii), where $p' > 0$), firm 1 is no longer indifferent to the amount of traded equity it grants its employees. Because optimistic employees' willingness to pay for traded equity goes as high as the (now overvalued) market price, compensating employees with traded equity becomes profitable for the firm, as it is, in effect, equivalent to issuing overvalued equity to the market. Figure 2b provides a graphical representation of this case. Employees' willingness to pay for traded equity is equal to the minimum of their valuation and the market price of equity, with the latter exceeding the fundamental value of 1. The firm provides equity to its employees as long as their willingness to pay for equity is greater than its fundamental value. The firm thus compensates each employee with $(s-\phi)/\sigma^2$ units of traded equity, and in doing so extracts a portion of employees' behavioral "consumer surplus" (given by the shaded trapezoid). Viewing cases (d.i) and (d.ii) of Theorem 1 together, we conclude that compensating employees with *traded* equity cannot be motivated by employee sentiment alone. A necessary additional ingredient for compensation with traded equity to be profitable is an overvalued equity price.

Figure 2a

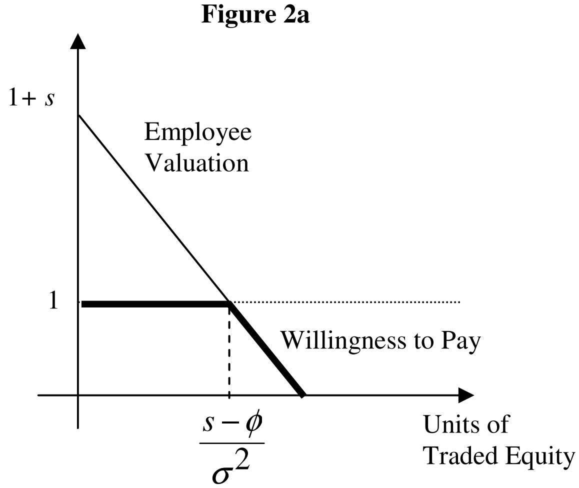
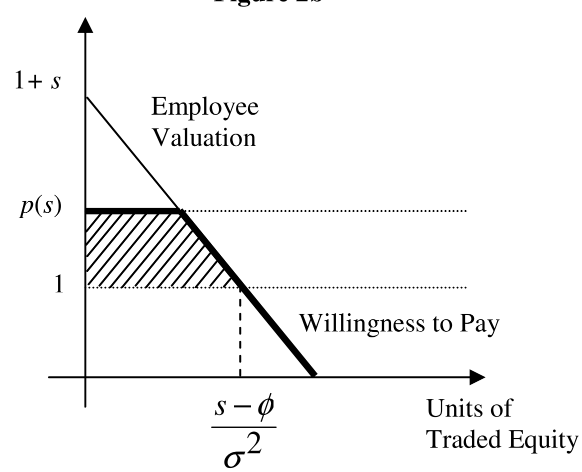
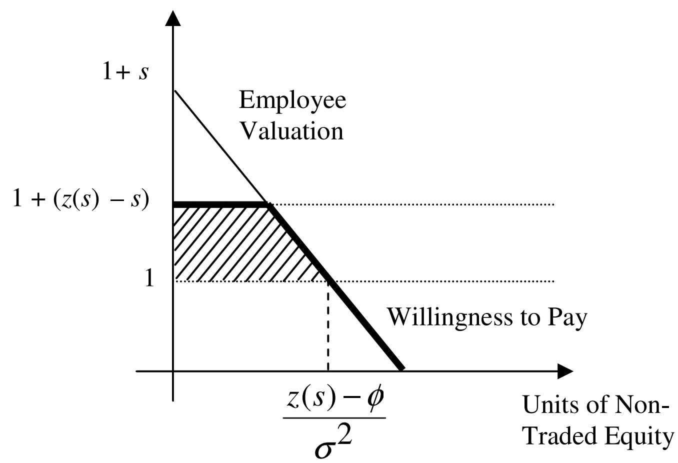


Figure 2b



In contrast, part (d.iii) examines the case in which employees prefer the non-traded equity compensation instrument to traded equity $(z(s) > s)$ and finds that compensating employees with the *non-traded* compensation instrument can be explained by employee sentiment alone. The crucial difference is that employees' willingness to pay for the non-traded instrument may exceed its fair market value. Because firm 1 is a monopoly supplier of its compensation instrument, it is able to extract employees' sentiment premium for the instrument over their sentiment towards traded equity (given by $z(s) - s$). Still, the availability of traded equity continues to limit the rents the firm can extract: the maximum amount optimistic employees are willing to pay for the compensation instrument is the market price of traded equity plus the added value employees' derive from the compensation instrument relative to traded equity. For example, if the market price of traded firm 1 equity is \$5, while optimistic employees value the traded equity at \$10 and the compensation instrument at \$11, then employees are willing to forgo at most \$5 + (\$11 – \$10) = \$6 in wages for the compensation instrument. The sentiment premium for the compensation instrument is equal to \$1 and is successfully extracted by firm 1. Figure 2c illustrates this case (assuming once more that the price of traded equity is 1). Employees' willingness to pay for a unit of non-traded equity goes as high as $1 + (z(s) - s)$, allowing the firm to extract a portion of the employees' behavioral "consumer surplus" (given again by the shaded trapezoid.)

Figure 2c



Finally, part (d.iv) of Theorem 1 simply states that when neither the sentiment for traded nor non-traded equity is sufficiently high to overcome the cost of being exposed to firm-specific human capital risk, then firm 1 resorts to compensating its employees with cash only.

Moving beyond the requirements for equity compensation to be part of an optimal contract, the following theorem demonstrates how employee sentiment affects the profit and employment levels of the two firms in equilibrium.

Theorem 2 Assume that sentiment for traded and non-traded equity of firm 1 is positive: $s > 0$ and hence $z(s) > 0$. We have that:

(a) If $\max(s, z) > \phi$, so that firm 1 pays with equity, firm 1 makes greater profits and hires more employees than firm 2 if and only if:

$$\max(z - s, 0) + (p(s) - 1) > \phi . \quad (5)$$

(b) If $\max(s, z) \leq \phi$, so that firm 1 pays with cash, firm 1 makes smaller profits and hires fewer employees than firm 2.

Proof See Appendix A.

There are two channels through which firm 1 can profit from positive sentiment. First, the $\max(z - s, 0)$ term in (5) represents the sentiment premium for the non-traded compensation instrument which firm 1 extracts whenever that premium is positive. When traded equity is preferred to the compensation instrument ($s > z$), employees can buy their preferred equity instrument in the market with no need for the firm, leading this channel to shut down. The second channel works through sentiment's effect on stock prices and is represented by the $(p(s) - 1)$ term in (5). Positive sentiment combined with imperfect arbitrage lead to overvalued prices, allowing firm 1 to profit by selling overvalued equity to its optimistic employees. When the equity market is perfectly efficient, p is equal to 1, and this second channel closes.

Firm 1 benefits from positive sentiment, and enjoys higher profits and employment than firm 2, if the sum of overvaluation $(p(s) - 1)$ and sentiment premium $(z(s) - s)$ exceeds the level of firm-specific human capital risk, ϕ. Firm-specific human capital enters into the calculation because firm 1 must compensate its employees for the correlation between their human capital and their equity holdings in firm 1. All else equal, this places firm 1 at a disadvantage relative to firm 2; indeed, when employees are optimistic about firm 1, but not sufficiently so to overcome the firm-specific human capital risk ($\max(s, z) \leq \phi$), then firm 1 has lower profits than firm 2 since employees prefer to invest in firm 1 but to work for firm 2.

In summary, the model identifies two reasons why firms pay optimistic employees with equity: the extraction of a sentiment premium for a non-traded compensation instrument, and the issuing of overvalued equity to employees. In both cases, firms compensate with equity because employees are willing to overpay for it. The model also illustrates the effects of sentiment on profitability and labor market outcomes: If firm-specific human capital risk is a serious problem when working for firm 1, and if the equity market is highly efficient, firm 2 can be the beneficiary of positive sentiment towards firm 1. On the other hand, when the non-traded compensation instrument is preferred to traded equity and the level of firm-specific human capital risk in firm 1 is moderate, or when markets are less efficient, it is firm 1 which benefits from positive sentiment towards its equity through lower compensation costs, a larger number of employees, and higher profits. Firm 2 reacts by increasing its wage offer, and still loses employees to firm 1 in equilibrium.[15]

Thus, which firm benefits from employee sentiment in reality depends on the level of the sentiment premium, the extent to which employees care about firm-specific human capital risk, and the level of stock price misvaluation. The prior empirical and experimental evidence (Benartzi (2001), Degeorge et al. (2004), Klos and Weber (2004)) suggests that employees tend to ignore the correlation between human capital and stock returns when evaluating investments. If employees, rightly or wrongly, act as if firm-specific human capital risk ϕ is low, then positive sentiment for firm 1 is more likely to benefit firm 1 than firm 2. Any overvaluation of firm 1 stock prices caused by positive investor sentiment and limits to arbitrage advantages firm 1 further.

3. Literature Review

The question as to why some firms encourage or even mandate holdings of company equity by non-executive employees has attracted considerable attention. Oyer and Schaefer (2005) present an extensive discussion of the potential benefits of stock option usage in firms. They argue that the incentive effects from options for lower-level employees are likely to be insignificant and outweighed by the cost of exposing employees to risk. They further argue that the vesting structure of option grants helps firms retain employees. Lazear (1999) and Murphy (2002) have shown that other forms of deferred compensation that do not expose employees to stock price risk are a more efficient means of providing retention incentives.[16] A large number of papers quantify the deadweight loss from selling company

[15] A natural extension of our model allows for employee sentiment to also affect employees' perception of the value of their human capital. Positive sentiment towards firm 1 then gives employees a direct preference for employment in firm 1 over firm 2, allowing, once again, firm 1 to lower its compensation costs and increase its size and profits relative to firm 2.

[16] Oyer and Schaefer (2005) argue on the basis of Oyer (2004) that unvested options serve to index employees' deferred compensation to their outside opportunities and reduce transaction costs associated with the renegotiation of compensation.

equity and options to employees, with a general consensus that employees' rational valuations of company stock and options are significantly below fair market values.[17]

Murphy (2002, 2003) proposes that firms perceive the cost of option compensation as low and prefer it to cash compensation because options bear no accounting charge and cause no cash outlay. We view this hypothesis as complimentary to the employee sentiment hypothesis, though we note that it does not easily explain the cross-sectional and time series patterns of option compensation presented in Section 6. Inderst and Müller (2004) show that employee option compensation can be beneficial because it lowers a firm's compensation bill in bad states of nature in which owners should have full cash flow rights in order to induce efficient strategic decisions. Finally, Oyer and Schaefer (2005) argue that option compensation allows firms to screen for optimistic employees, but they do not incorporate employees' ability to purchase equity by themselves into their analysis.[18]

Core and Guay (2001) are the first to perform a large-sample analysis of non-executive employee stock option holdings, grants, and exercises. They document the widespread use of stock option grants to non-executive employees in a sample of 756 firms during 1994 to 1997. They present evidence that grants are positively associated with investment opportunities and with the difference between cash flow from investment and cash flow from operations ("cash flow shortfall"). Anderson, Banker and Ravindran (2000) as well as Ittner, Lambert and Larcker (2003) document that stock option compensation is used most extensively in "new economy" firms. Interestingly, and consistent with the evidence we present below, Ittner, Lambert and Larcker (2001) show that new economy companies with greater cash flows use employee options more extensively, contradicting the notion that options are used to alleviate cash constraints. Finally, Desai (2002) and Graham, Lang, and Shackelford (2002) consider the effect of employee stock options on corporate taxes. These studies focus on how option compensation affects corporate taxes and capital structure decisions, and do not attempt to find the determinants of option usage by firms.[19]

[17] See, for example, Lambert, Larcker, and Verecchia (1991), Murphy (1999), Hall and Murphy (2002), Meulbroek (2001 and 2002), Ingersoll (2002), Jenter (2002), and Kahl, Liu, and Longstaff (2003).

[18] Zhang (2002) argues that employee option compensation occurs when both managers and employees view firm equity as overvalued. Through the exercise of granted options and sale of the resultant shares employees and the firm are, in effect, colluding to sell overvalued equity to the market. Employee sentiment does not play a role in the model as employees' opinion about firm value is identical to that of managers.

[19] Graham, Lang, and Shackelford (2002) point out that, despite the massive size of option-related tax deductions, the net effect of option compensation is most likely a revenue gain for the U.S. Treasury because of the income taxes that employees pay at exercise. Therefore, option compensation cannot be explained as a tax-saving strategy.

There is considerable evidence that employees' thinking about company stock and employee stock options is subject to behavioral biases. Benartzi (2001) provides evidence that employees excessively extrapolate past performance when deciding about company stock holdings in their 401(k) plans. Employees of firms with the worst stock performance over the last 10 years allocate 10% of their discretionary contributions to company stock, whereas employees whose firms experienced the best performance allocate 40%. There is no evidence that allocations to company stock predict future performance.[20] Huberman and Sengmüller (2004) analyze 401(k) allocations in a larger sample and confirm that employees choose inflow allocations and transfers to company stock based on past returns over a three-year window. Liang and Weisbenner (2002) find that the average share of discretionary 401(k) allocations to company stock is almost 20% and again increasing in prior stock price performance.

The psychology and behavioral finance literature provides possible explanations for the observed biases in employee thinking about company equity. First, excessive extrapolation can be attributed to the representativeness heuristic described by Tversky and Kahneman (1974). They show that people expect a sequence of events generated by a random process to resemble the essential characteristics of that process even when the sequence is short. In an extension, Griffin and Tversky (1992) document that people tend to focus on the strength or extremeness of evidence provided, while giving insufficient regard to its weight or predictive power. People tend to see trends and patterns even in random sequences, and expect especially extreme sequences to continue. In the context of company equity, the representativeness heuristic may lead employees to expect extreme good and extreme bad price performance to continue into the future.

Finally, there is substantial evidence that employees tend to underestimate, or even ignore, the correlation between their firm-specific human capital and firm stock returns when making investment decisions. Benartzi (2001), Huberman and Sengmüller (2004), and Liang and Weisbenner (2002) document that employees invest significant portions of their retirement funds in 401(k) plans voluntarily into company stock. Degeorge et al. (2004) show that during the partial privatization of France Telecom, employees with higher firm-specific human capital risk invested more in their employer's equity. Consistent with this, Klos and Weber (2004) report experimental evidence that investors fail to take background risk into account when making investment decisions. The empirical evidence, therefore,

[20] Benartzi (2001) also conducts a survey with Morningstar.com visitors asking them to rate the performance of their companies' stock over the last five years and the next five years. Consistent with excessive extrapolation, the respondents' past and future ratings were positively correlated with a ρ of 0.52.

suggests that firm-specific human capital risk is unlikely to play an important role in the design of optimal employee compensation schemes, or, in terms of the notation of our model, ϕ is likely to be low.

4. Empirical Predictions

The model in Section 2 predicts that equity-based compensation is used when employees are optimistic about the non-traded compensation instrument and value it above its fair market value ($z(s) > 0$), and when employees strictly prefer the compensation instrument to the equity available in the market ($z(s) > s$). Greater employee exuberance should therefore make equity compensation more likely and lead to a higher percentage of equity compensation in total pay. Empirically, stock options are the most common form of equity compensation for rank and file employees, and correspond well to the non-traded compensation instrument in our model: employee options are not traded and hence employees are unable to directly observe market prices for them, and their valuation as a function of observable prices and volatilities is sufficiently difficult to exceed the abilities of almost all employees.[21] Most employees are likely to simply compare the options offered by their employer to traded shares, which are the simplest alternative available in the market, and then use valuation heuristics to decide which of the two assets they prefer.

To assess the role of employee sentiment in the use of broad-based option compensation, we need to identify empirical proxies for sentiment. The results in Benartzi (2001) and Huberman and Sengmüller (2002) show that prior stock returns are a major determinant of employees' willingness to invest in company stock, suggesting that employee sentiment improves with prior stock price performance. We further conjecture that other measures of high and increasing firm quality, like investment, cash balances, and R&D, are positively correlated with employee sentiment, while any signs of distress are associated with worsening sentiment.

Learning and extrapolating from past option payoffs is an obvious heuristic for employees with no knowledge of rational option valuation. Due to the amplified nature of option payoffs, employees are likely to extrapolate more strongly from past performance when valuing options than when valuing stock or other simple positions in traded equity. Thus, after periods with high stock returns, employees are likely to view options as more desirable than the traded equity they see in the market. On the other hand, employees are likely to assign low values to options after periods with low stock returns. In terms of the

[21] Single-stock options for some firms are traded. They are usually of much shorter maturity than the options used for compensation, and few employees are likely to be aware of their existence.

notation of our model, we expect employee sentiment for the non-traded compensation instrument (options) to react more strongly to past performance than employee sentiment for traded equity ($z'(s) > 1$), and thus the sentiment premium for options over traded equity to increase in past performance ($z(s) - s$ larger after good performance). Finally, the empirical evidence that employees tend to ignore correlations between human capital and stock returns suggests that firm-specific human capital risk ϕ is unlikely to significantly dampen employees' demand for option compensation after periods of high stock returns ($z(s) - s > \phi$).

Based on the psychology literature reviewed above and the model developed in Section 2, we propose and test six hypotheses. The first three hypotheses use past stock returns to proxy for employee sentiment. The observation that employees' valuations of company equity increase in past performance (and for many rise above the market price), combined with the hypothesized increase of the sentiment premium for options over stock in past performance, leads to our first testable hypothesis:

H1a: Firms should be more likely to grant options and should grant more options to employees after high stock returns.

Griffin and Tversky (1992) document that people tend to give excessive weight to extreme information while giving insufficient regard to its weight or predictive power. We therefore posit that the relationship between past performance and employee sentiment is non-linear, with employee exuberance associated mostly with extraordinarily good returns. In addition, extraordinarily good returns are further amplified in option payoffs, making it likely that option sentiment exceeds sentiment for traded equity. Hence our second prediction:

H1b: Options grants should be non-linearly related to past performance and concentrated among the very best past performers.

Benartzi (2001) documents that the effect of past returns on employees' purchases of company stock increases in the time frame over which past returns are measured. We therefore conjecture that the path of past returns is important in determining employee sentiment towards the firm, and propose that employee sentiment will be especially positive following a series of years with high stock returns. This leads to our third hypothesis:

H1c: Firms should be most likely to grant options and use more options as compensation after the stock price has done well over several years.

While positive sentiment can make option compensation the profit-maximizing choice, negative sentiment makes option compensation clearly inferior to cash compensation. We conjecture that employees in firms in financial or economic distress are unlikely to be exuberant about the prospects for company equity, and may well exhibit negative sentiment towards it. Thus, even though distressed firms are likely to face binding cash constraints and would like to compensate their employees with equity, they will be unable to do so. Using distress as proxy for low employee sentiment, our fourth hypothesis is:

H2: Firms in financial or economic distress should be less likely to pay their employees with options.

Theorem 2 of our model shows that firms which pay with equity are able to lower their labor costs and expand relative to firms which do not benefit from positive sentiment, as long as firm-specific human capital risk is not too much of a concern for employees. The empirical evidence suggests that employees tend to ignore correlations with human capital risk when evaluating investments. Hence our next hypothesis predicts a positive link between option compensation and employment growth:

H3: Firms which pay their employees with options have faster growth in employment compared to firms which do not pay with options.

Finally, our model predicts that firms are more likely to pay their employees with equity when the top managers of the firm view the stock price as too high. Managers are predicted to use actual or perceived inside information about firm value when deciding on the optimal compensation mix. This leads to our final hypothesis:

H4: Firms are more likely to use options and grant more options to employees when managers have reason to view their stock as overpriced.

The next section describes the data sets we use to test these hypotheses.

5. Data Sources and Variable Definitions

5.1 Data Sources

Our main source of data on employee option grants is the Standard & Poors ExecuComp database. The ExecuComp data provides information on option grants to the five highest-paid executives of each firm in the S&P 500, S&P MidCap, and S&P SmallCap stock indexes for the 1992 to 2003 period. Desai (2002) has extrapolated this data to firm-wide option grants by making use of the requirement that firms report the share of total grants given to the top five executives. In particular, the ExecuComp variable "pcttotop" reports what percentage each grant to executives represents of all options granted by a firm. Hence, each reported executive grant provides an estimate of the number of options granted to all employees during a fiscal year. We use the mean of these estimates as proxy for the total number of options granted by a firm in a given firm-year. We drop all firm-years in which the sample standard deviation of these estimates is greater than 10 percent of the mean.

As is standard in the literature, we estimate the number of options granted to *non-executive* employees by subtracting the number of options granted to the top five executives, taken from ExecuComp, from the number of options granted to all employees. We then apply the Black-Scholes (1973) formula to value the options granted to non-executive employees. We do not know the exercise and stock prices at which the non-executive options are granted. To minimize the measurement error from estimating these prices, we assume that 1/12th of the total number of options granted during the year are granted each month, and use the midpoint of the month high and month low stock prices as the exercise and strike price.[22] The estimates of dividend yield and stock price volatility used in the Black-Scholes formula are taken from ExecuComp.[23] The risk-free rate is set to 6 percent, and option maturity is uniformly set to ten years.[24] Finally, we calculate the per-employee value of options by dividing the total value of options granted to non-executive employees by the average number of employees during the year.

[22] Our results do not materially change when the stock price and exercise price are taken to be the midpoint of the year high and year low stock prices, or the midpoint of the year open and close stock prices. The results are similarly unchanged when the Black-Scholes value of the executive options reported in ExecuComp is used to value the employee options.

[23] If dividend yield data is unavailable on ExecuComp, we calculate it as the average dividend yield over the previous two years using Compustat data. If stock price volatility is unavailable on ExecuComp, we calculate it from daily stock return data over the previous two years taken from CRSP. Volatility estimates are censored at 80 percent to eliminate outliers.

[24] Assuming shorter maturities of five or seven years does not change our results.

There are obvious weaknesses to our data on employee stock options. We obtain only an estimate of option grants to non-executive employees, and we do not have information on the number of options outstanding, option exercises, and the number of options expired, forfeited, or cancelled. Furthermore, we have to estimate the strike and grant prices of the option grants, introducing noise into the valuations. Moreover, since we extrapolate from executive grants to employee grants, we miss firm-years in which no executives received options. This also implies that firms which use options for neither top executives nor rank-and-file employees are incorrectly coded as missing rather than zeros, introducing a sample selection bias which we discuss in detail in Section 6.5. An additional weakness of the data is the absence of information on how deep the options are spread into the organization.

To check the robustness of our approach to estimating option grants, and to assess the effect of sample selection bias on our results, we repeat our analyses on a smaller, hand-collected data set. We obtain the data on option grants for a subset of the companies in our full sample collected from annual reports by Core and Guay (2001) for the years 1995 to 1997. We then extend the Core and Guay data through further hand collection to the years 1995 to 2000. As a first robustness check, we calculate the correlation between our measure of option grants with the more precise measure obtained from the hand-collected data. The correlation coefficient is 0.93, providing some assurance that measurement problems are not severe. A more detailed analysis of the hand-collected data is presented in Section 6.5. All the results obtained with the full sample are robust and usually stronger in the hand-collected sub-sample.

5.2 Variable Definitions

Our main measure of past stock price performance (and hence sentiment) in year t is the annualized stock return excluding dividends from CRSP calculated from the beginning of year $t-2$ to the end of year $t-1$. For brevity, we call this return the prior two-year return. We also control for contemporaneous year t stock returns in all our regressions, but note that a positive relation between contemporaneous returns and the value of option grants could be purely mechanical: if the number of at-the-money options to be granted is determined at the beginning of the fiscal year, then high stock returns during the year lead to high grant prices and hence high Black-Scholes values.

In all our regressions we attempt to control for corporate cash constraints. Measuring whether a firm is cash constrained is a difficult task (Kaplan and Zingales, 1997) and we utilize several composite measures of cash constraints developed in other papers as well as their disaggregated components. We use two measures of financial constraints proposed by Core and Guay (2001): cash flow shortfall and interest burden. Cash flow shortfall is the three-year average of common and preferred dividends plus cash flow used in investing activities less cash flow from operations, all divided by total assets. Interest burden is the three-year average of interest expense scaled by operating income before depreciation, with interest burden set to one when interest expense is greater than operating income before depreciation. The third measure of financial constraints we use has been developed by Kaplan and Zingales (1997) and adopted to large-sample empirical work by Lamont, Polk and Saá-Réquejo (2001). We calculate the Kaplan Zingales (KZ) measure of financial constraints as:

$$KZ_{it} = -1.002\frac{CF_{it}}{A_{it-1}} - 39.368\frac{DIV_{it}}{A_{it-1}} - 1.315\frac{C_{it}}{A_{it-1}} + 3.139LEV_{it} + 0.283Q_{it}. \qquad (6)$$

Here CF_{it} is cash flow, A_{it-1} is lagged assets, DIV_{it} is cash dividends, C_{it} is cash balances, LEV_{it} is leverage, and Q_{it} is the market value of equity plus assets minus the book value of equity, all over assets. All ingredients of KZ are winsorized at the 1% level before the measure is constructed. A conceptual difficulty with the KZ measure is that it contains both measures of the availability of funds (CF, DIV, C, LEV) and a measure of investment opportunities in Q. Following Baker, Stein and Wurgler (2003), we construct a cropped KZ measure, called KZ4, which excludes Q. The construction of the financial constraint measures is described in detail in Appendix B. Following Core and Guay (2001), we also control for investment opportunities using Q and the three-year average of R&D scaled by assets as proxies. Finally, we use sales as a control for firm size and a long-term debt indicator as a proxy for access to debt markets.

Our model predicts that managers' perception of stock price misvaluation is a determinant of employee option grants. We use three different proxies for managers' views on misvaluation to measure their effect on compensation policy. First, we examine the relationship between option grants to non-executive employees and earnings manipulation. We use signed discretionary current accruals as calculated in Teoh, Welch and Wong (1998 a,b) from changes on the balance sheet as our first measure of earnings manipulation. Hribar and Collins (2002) propose a more robust calculation of discretionary accruals using information from the cash flow statement, and we use their approach to construct two additional measures of discretionary accruals. The calculations are described in detail in Appendix B. Briefly, both methods predict "normal" accruals using year-by-year industry-level regressions. The regression residual is considered to have been "managed" and is called discretionary current accruals

(DCAs). After calculating DCAs for all firm years, we label firms with signed discretionary accruals in the top 10% of all firm-years as "manipulators".[25]

We use insider trading by managers as the second indicator of managers' opinions about fundamental firm value. Managerial insider trading is calculated as in Jenter (2005) from data on managerial stock ownership reported in the ExecuComp database. The net number of shares bought or sold by each executive in a given year is derived as the change in stock holdings less the number of shares acquired through option exercises and stock grants. Dollar values are calculated by multiplying the number of shares acquired (or sold) by the year-end stock price. We scale each manager's trades by her total exposure to company equity, defined as the sum of her stock and option holdings at the beginning of the year plus stock and option grants during the year. We then average the scaled insider trades for all managers in a firm-year to obtain a firm-wide measure of managers' insider trades.

Finally, we use two measures of open-market share repurchases based on Stephens and Weisbach (1998) and Jagannathan, Stephens, and Weisbach (2000) as further indicators of managers' views on fundamental firm value. The first measure is based on the Compustat data item "Purchases of Common and Preferred Stock". Similar to Kahle (2001) and Grullon and Michaely (2002), we subtract decreases in the value of preferred stock to minimize the effect of redemptions of preferred stock. The second measure of repurchases uses the change in the number of shares outstanding from CRSP, which we adjust for stock grants to top executives and for option exercises. The details of the variable construction are described in Appendix B.

5.3 Sample Screens

Our initial sample comprises all 2,598 firms from the ExecuComp database in an unbalanced panel from 1992 to 2003, and includes 21,732 firm-years. We exclude the 127 firm-years for which our estimate of the total number of options granted is smaller than the options granted to the top five executives as reported in ExecuComp. We eliminate 1,064 observations for which the standard deviation of our estimates of the number of options granted in a given firm-year is greater than 10% of the mean estimate. Finally, we exclude firm-years in which information on at least one of the variables used in our base regressions is missing.[26] The final data set used in our base regressions comprises 2,171 firms and 12,898

[25] The extensive literature on the accrual anomaly shows that firms with signed discretionary accruals in the top 10 to 20 percent have negative subsequent size- and risk-adjusted returns, suggesting that they are overvalued by the market. See, for example, Sloan (1996), Houge and Loughran (2000), and Xie (2001).

[26] The 7,643 deleted firm-years are dropped for the following, non-exclusive reasons: 4,815 because one of the variables necessary to calculate the per-employee dollar value of option grants is missing, 1,580 because KZ cannot

firm-years. Similar screens are applied to the hand-collected data set assembled by Core and Guay (2001) and extended by ourselves. The data set is a subset of our full sample and runs from 1995 to 2000. The final hand-collected sample contains 889 firms and 4,279 firm years.

Table 1 provides some descriptive statistics for the full sample. The firms in our sample have a median equity value of $1.083 billion, median sales of $1.073 billion, and median assets of $1.067 billion. The median number of employees is 5,400. Turning to option grants, the median firm grants options equal to 1.8% of shares outstanding per year. Employees ranking below the top-five executives receive 71% of the options granted. The median per-employee option grant is $1,029 per year for non-executive employees, with a mean of $8,818.[27]

6. Empirical Results

To provide a first impression of the performance of the employee sentiment hypothesis in the data, we assess the relationship between employee option grants and past stock returns in a univariate setting. We sort firms by the value of their per-employee option grants into quintiles and calculate average stock returns over the previous two years for each quintile. Panel A of Table 2 reports results consistent with the sentiment hypothesis: mean (median) prior stock returns are 4 percent (4 percent) for firms with option grants in the lowest quintile and rise to 30 percent (19 percent) for firms with grants in the highest quintile. Similarly, when sorting firms by prior returns in Panel B, firms in the bottom return quintile grant options with a mean (median) value of $7,589 ($1,030) while firms with prior returns in the top quintile grant options worth $21,293 ($2,965). Hence, consistent with hypotheses H1a and H1b from Section 4, intensive use of non-executive options is preceded by extraordinarily good performance.

To control for other cross-sectional determinants of employee option grants, we turn to a regression framework. Our baseline specification is:

$$Ln(1+ \textit{dollar value of option grants per employee})_{it} = \beta_0 + \beta_1 ret_{it-1} + \beta_2 X_{it} + \varepsilon_{it} \quad (7)$$

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be calculated, 1,357 because KZ4 cannot be calculated, 1,484 because the average cash flow shortfall is missing, 2,323 because the average interest burden is missing, 394 because Q is missing, 895 because contemporaneous stock returns are missing, 2,380 because stock returns for the prior two years are missing, 103 because sales are missing, 117 because the long-term debt indicator is missing, and 4 because average R&D is missing.

[27] The average grant values are likely to be overstated because of sample selection bias. We discuss this issue in detail in Section 6.5.

Here ret_{it-1} is a measure of a firm's past stock return, and X_{it} is a vector of firm characteristics. We estimate the baseline regression with different measures of past returns and include several measures of financial constraints. All regressions include industry fixed effects based on 3-digit SIC codes, year fixed effects, and heteroskedasticity-robust standard errors unless explicitly stated otherwise.

6.1 The Effect of Past Performance on Employee Option Grants

Table 3 presents tests of hypothesis H1a, according to which employee option grants increase in prior stock price performance. Past performance is measured as the stock return over the previous two years, and a different measure of financial constraints is included in each regression. The cash constraint measures used are KZ, KZ4, average cash flow shortfall, and interest burden. In all specifications, we further control for log sales and R&D, as well as a dummy variable measuring whether the firm has long term debt.

The first hypothesis is strongly supported by the data. In all specifications in Table 3, the coefficient on prior stock returns is positive and highly statistically and economically significant: a 10 percentage point increase in stock returns is associated with a 5.7 to 8.9 percent increase in the value of options granted. The t-statistics, calculated using robust standard errors with clustering at the firm level, are between 12.94 and 19.21. The coefficient on contemporaneous stock returns is positive and significant in the first specification without Q, and becomes insignificant when the highly collinear Q is included. Since the relationship between grant values and contemporaneous returns may be purely mechanical and driven by inertia in the contracting technology, we focus our analysis on past stock performance. Including firm fixed effects – shown in Table 4 – does not materially change the results.

Hypothesis H1b states that the relationship between prior stock price performance and employee sentiment should be non-linear, with option grants concentrated among the very best performers. To allow for a non-linear relationship, we sort firms by their prior performance into quintiles and assign a dummy variable to each quintile. Cut-off levels are constructed using the entire pooled sample. Table 5 repeats the analysis from Table 3 while replacing the prior return variable with the performance quintile dummies. As predicted, the effect of past returns on option grants is indeed highly non-linear: in each specification the effect of moving from quintile one to quintile four is approximately as large as the effect of moving from quintile four to quintile five.

Hypothesis H1c predicts that firms should be most likely to grant options to employees after their stock price has done well for several years. To test this hypothesis, we sort firms into quintiles based on prior one, two, three, four, and five year returns. From here on we use a base regression specification which includes the usual set of firm characteristics and KZ4, cash flow shortfall, and interest burden as comprehensive measures of financial constraints. Table 6 shows that options are granted in a manner consistent with the results in Benartzi (2001) and the employee sentiment hypothesis: the effect of past returns on option grants is increasing in the window over which the past returns are calculated. When sorting on previous one-year returns, we find option grants which are 32 percent larger in the highest return quintile compared to the lowest quintile. This difference increases to 77 percent when sorting on previous 3-year returns, and to 100 percent when sorting on previous 5-year returns.

6.2 The Effect of Cash Constraints on Employee Option Grants

Several measures of cash constraints are included as control variables in Tables 3 to 6. Examining the coefficients on these composite measures of cash constraints produces conflicting results. Cash flow shortfall is consistently positively related to grants, suggesting that cash poor firms use more options to pay their employees. On the other hand, interest burden is consistently negatively related to grants, implying that cash constrained firms use fewer option grants. Finally, the KZ measure is not significantly related to grants.

To better understand the effect of cash constraints on firms' option granting behavior, we analyze the relationship between option grants and each of the components of the composite measures separately. The results are presented in Table 7. We find that the value of option compensation per non-executive employee is increasing in cash balances, cash flow, and Q, and decreasing in leverage.[28] Firms with large amounts of cash and high cash flows grant more options, while firms with more need for cash to service debt grant fewer options. These results cast serious doubt on the hypothesis that option compensation is motivated by cash constraints. On the other hand, we also find that option compensation is decreasing in dividends, and increasing in cash flow used for investment activities. Taken together, these results seem more supportive of the sentiment hypothesis than the cash constraints hypothesis: variables which are arguably positively related to employee sentiment (Q, cash balances, cash flow, investment) predict greater use of option grants, while variables negatively related to sentiment (leverage, interest burden) are associated with less use of options.[29]

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[28] The same positive relationship between cash balances and option grants shows up strongly in univariate results (untabulated). Sorting firms into quintiles based on cash balances scaled by total assets, we find that firms in the lowest cash balance quintile pay mean (median) option values of $2,274 ($524) to employees while those in the highest cash quintile pay mean (median) values of $30,111 ($10,525).

6.3 Employee Option Grants in Distressed Firms

Hypothesis H2 states that firms in or close to financial or economic distress should be less likely to pay their employees with options, as employees of these firms are unlikely to be exuberant about the prospects for company stock. Thus, even though distressed firms are likely to prefer to compensate their employees with equity in order to save cash, if employee sentiment plays an important role in the ability to use equity compensation, they will be unable to do so.

To test this hypothesis we construct an indicator variable for firms which delist for performance reasons in the first year after the current fiscal year, and a second indicator variable for firms which delist in the second year after the current year. Performance-related delistings are identified through CRSP delisting codes in the 400 to 591 range. In addition, we use the Altman Z-score – a weighted average of accounting and valuation ratios – as a second proxy for the financial health of a firm.[30] Following Altman (1968), firms with a Z-score below 1.81 are classified as distressed, and two indicator variables for distress in the current and distress in the previous year are constructed. We posit that firms which are distressed under either of our proxies have both an urgent need to conserve cash and also employees with low sentiment.

Table 8 shows the results of regressing the log of per-employee option grants on the two delisting dummies in columns 1 and 2, and the two Altman Z-score distress dummies in columns 3 and 4. The control variables are the same as in the base regression. In support of the sentiment hypothesis, distressed firms grant significantly fewer options to their employees. Firms which are one year from delisting grant between 54 and 73 percent less to their employees than firms which do not delist, while firms which are two years from delisting grant between 29 and 39 percent less. Firms which the Altman Z-score classifies as distressed in the current year grant between 19 and 21 percent less options, and firms which were classified as distressed in the previous year grant between 13 and 18 percent fewer options to their employees. We conclude that distressed firms appear unable to use option compensation to conserve on cash.

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[29] The results are unchanged when we repeat the analysis using firm fixed effects, with the positive effect of cash flow on option grants strengthened. These results are available from the authors upon request.

[30] The Altman Z-score is defined as Z = 1.2 · working capital / total assets + 1.4 · retained earnings / total assets + 3.3 · earnings before interest and taxes / total assets + 0.6 · market value of equity / total liabilities + 0.999 · net sales / total assets.

6.4 Employee Options and Growth in Employment

Hypothesis H3 predicts a positive link between employment growth and employee option compensation. This follows from the model prediction that firms which are able to pay with options have lower compensation costs and hire more employees than firms which pay with cash. To test this hypothesis, we define employment growth as the percentage change in the number of employees relative to the number of employees at the beginning of the fiscal year. The employment growth variable is winsorized at the 1 percent level to dampen the effect of outliers.

Table 9 shows the results of adding employment growth to the base regression. Consistent with the model predictions, employment growth and stock option grants are strongly linked, even when controlling for past and contemporaneous stock returns. An increase of ten percentage points in employment growth translates into 6.9 percent larger per-employee option grants in a cross-sectional regression, and into 3.9 percent larger per-employee option grants with firm fixed effects.

6.5 Sample Selection Bias and Robustness Checks

In this section we perform several tests to assess the robustness of the empirical results presented in the previous sections. The ExecuComp database encompasses a wide range of firms with employment size ranging from 5 to 1.4 million. Paying all or the majority of employees with stock options in a firm with few employees can be fully justified as a means to provide incentives to maximize firm value. This raises the concern that our previous results may be driven by small firms. Instead, we find that the base regression results are qualitatively and quantitatively unchanged when we restrict the sample to firms with more than 500 or more than 1,000 employees. A second concern with our analysis is that linear regressions may not be appropriate because the dependent variable is censored at zero. Employee option grants cannot become negative, suggesting that a censored (Tobit) regression model is the correct choice. When we repeat the base regression using a Tobit set-up, we find coefficient estimates that are quite similar to the linear regressions in Tables 3 and 4, even though, as would be expected from censoring-induced attenuation bias, the Tobit coefficients are generally larger and more significant than the coefficients from the linear regressions. Finally, we repeat all regressions using the level instead of the logarithm of per-employee option grants as dependent variable, and find that the results are qualitatively unchanged.[31] All robustness checks are available from the authors.

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[31] We try to formally compare the goodness-of-fit of the log-dependent variable model with the level-dependent variable model using the approach proposed by Wooldridge (2006, p. 220). The intercept-free regression of the level-dependent variable on the exponentiated fitted values from the log-dependent model yields a regression coefficient that is strictly smaller than one. This may indicate that the residuals from the log-dependent variable

A more serious concern is that our calculation of employee option grants from the ExecuComp database requires that at least one top executive receives an option grant in any given year. This implies that we record a missing observation both for firms which do not grant options to anyone, and for firms which grant options to rank-and-file employees but not to top executives. This sample selection procedure biases the estimates of average per-employee grants in Table 1 upwards since firms which do not grant options to anyone drop out. The second effect of the sample selection rule is that the estimated relation between past performance and employee option grants is likely understated; casual inspection of the data suggests that option grants to top executives tend to drop to zero after bad stock price performance. Hence we lose more observations after bad performance, which is when we expect employee option grants to decline due to worsening sentiment.

The only method to confirm that the sample selection bias does in fact work in the direction suggested is to use hand-collected data which contains valid observations on firms which do not grant options to their top executives. We use the data set collected by Core and Guay (2001) for the time period 1995 to 1997 and extended by us to the years 1995 to 2000. The firms in this data set are a subset of the firms in the ExecuComp database. We run the base regression of per-employee option grants on the usual explanatory variables and present the results in Table 10. Regressions (1) and (2) are linear regressions corresponding to the analyses in Tables 3 and 4, while regressions (3) and (4) are Tobit regressions. As hypothesized, the estimated effects of prior performance on employee option grants are larger than the estimates from the full data set: a 10 percentage point increase in past returns is associated with an increase in employee option grants of between 8.2 and 13.2 percent.[32]

6.6 Earnings Manipulation and Insider Trading by Managers

Our model predicts that firms are more likely to use employee options when executives view the stock price as too high. To test this hypothesis, we identify two situations in which we can make inferences about managers' opinion about fundamental firm value in relation to its market value. One such situation is when managers overstate earnings to boost the current stock price, in which case managers have reason to view their stock as overvalued. We measure earnings manipulation using three different measures of signed discretionary accruals, based on Teoh et al.'s (1998 a,b) and Hribar and Collins's (2002) cross-

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model are heteroskedastic, or that the logarithm of per-employee option grants is not in fact linear in our explanatory variables.

[32] For comparison, we have repeated the same regressions for the same set of firms and the same sample period but using options data extrapolated from ExecuComp. As expected, we find consistently smaller effects of past returns on option grants. The results are available from the authors upon request.

sectional adaptations of the modified Jones (1991) model. The details of the calculations are explained in Appendix B and Section 5.2. Firms with signed discretionary accruals in the top 10 percent of all firm-years in our sample are classified as likely manipulators. Table 11 shows the base regression with added indicator variables for earnings manipulators. Consistent with the model prediction, option compensation is strongly positively associated with earnings manipulation. Controlling for industry effects or firm-fixed effects, earnings manipulation predicts a 13 to 23 percent higher value of option grants per employee.

Our second measure of managers' views on firm value is insider trading. We identify firms with high insider selling and firms with high insider buying using the methodology in Jenter (2005). We label firms in which the top five managers' normalized inside buying is in the top 20 percent of all firm-years as firms with "buying managers" and firms in which top managers' inside selling is in the top 20 percent as firms with "selling managers". The regression results for the base regression with indicator variables for buying and selling managers, as well as indicators for earnings manipulation, are presented in Table 12. Across all specifications with industry fixed effects, we consistently find that firms in which the top managers cash out grant between 11 and 18 percent more options to their employees, while firms in which top managers purchase equity for their own account grant between 17 and 19 percent less to employees. These results suggest that top executives increase option grants to rank-and-file employees when they regard the stock as overvalued, and reduce grants when they regard the stock as undervalued. At the same time, though, the relation between insider trading and employee option grants vanishes when firm fixed effects are included. This suggests that it is cross-firm variation in insider trading, rather than changes in insider trading for a given firm, which is correlated with employee option grants. Hence there is a concern that the correlation between insider trading and employee option grants may be due to unobserved differences across firms which are not picked up by our control variables.

Finally, we examine share repurchase decisions by option granting firms to provide further evidence on executives' beliefs on equity mispricing. Prior literature has shown that many firms which use broad-based option compensation are also repurchasing shares in the market. If top executives view their own stock price as too high, they should be reluctant to repurchase shares at market prices, and should instead consider issuing new shares into the market. Weisbenner (2000), Kahle (2001), and Bens, Nagar, Skinner, and Wong (2003) argue that firms with employee option programs repurchase shares to offset the dilution of earnings-per-share (EPS) resulting from employee option grants and exercises. Observing that firms in the same year both grant options to employees and repurchase shares from the market would therefore indicate that any perception of stock prices overvaluation is, at the very least, not strong enough to overcome executives' aversion against EPS dilution.

We use two measures of share repurchases for our analysis. The first measure uses the Compustat data item "Dollar Value of Common and Preferred Repurchased", from which we subtract any decreases in the value of preferred stock in the same year. The second measure of repurchases uses the change in the number of shares outstanding from CRSP, which we adjust for stock grants to top executives and for option exercises. The need for option exercise data implies that the analysis using the second measure is restricted to the smaller, hand-collected sample described in Section 5.1. Table 13 shows share repurchase activity as a function of employee option grants. Neither the incidence nor the intensity of open market share repurchases show a strong relationship with employee option grants. Even among the most intensive users of employee option grants, 38% to 51% of firms are repurchasing shares, and the average repurchaser acquires between 2.61% and 3.85% of shares outstanding per year, depending on the measure used. This is despite the fact that the most intensive option granters have high prior stock returns, which are usually associated with fewer share repurchases. These results indicate that, at least for a sizeable subset of the firms in our sample, equity overvaluation is unlikely to be the main driver behind broad-based option compensation.

7. Summary and Conclusion

In this paper we analyze whether the popularity of option compensation for rank-and-file employees in large firms may be driven by employee optimism. We model the optimal compensation policy of a firm faced with employees who exhibit sentiment towards it, assess whether employee optimism leads to equity compensation, and analyze the ability of firms to extract rents from employees when compensating them with equity. We find that employee optimism by itself is insufficient to make equity compensation optimal for the firm. The crucial insight is that firms compete with financial markets as suppliers of equity to employees; the ability of employees to purchase equity on their own restricts their willingness to pay for equity compensation and hence limits firms' incentive to pay with equity. We show that option compensation is used in equilibrium only if employees are willing to overpay for options. This occurs in our model if employees prefer the (non-traded) options offered by the firm to the (traded) equity offered by the market, or if the (traded) equity is overvalued. We argue that optimistic employees are, in certain situations, willing to overpay for options either because rational option valuation is difficult and beyond their abilities, or because borrowing constraints prevent them from obtaining similar positions in the market. When faced with the need to evaluate options, many employees are likely to rely on heuristics and to value options on the basis of their past experiences with option payoffs. This makes it likely that employees strictly prefer options to both stock and cash after periods with high stock returns and high option payoffs.

We provide empirical evidence confirming that firms use broad-based option compensation when boundedly rational employees are likely to be excessively optimistic about company value, and when employees are likely to have a strict preference for options over stock. We show that employee option grants are positively associated with high prior stock returns, with investment and investment opportunities, and with cash balances and cash flows. In contrast, grants are negatively associated with interest burden and leverage, and firms in distress reduce their option grants. Further, as predicted by our model, firms seem to use the lower compensation costs resulting from overpayment for option compensation to expand in size. These findings are consistent with the view that options are used in firms in which employees are exuberant about their employer, and in which employees prefer the options offered by firms to traded shares.

Finally, we find some evidence that firms use more option compensation for rank-and-file employees when top managers believe that their company stock is overpriced. On the other hand, a sizeable subset of the heaviest option granters in our sample are also active repurchasers of company equity, rendering it unlikely that market prices are viewed as substantially overvalued by top executives. We therefore conclude that a perception of overvaluation by top executives is not sufficient to explain employee option programs. In the framework of our model, and consistent with the empirical evidence found, this leaves an employee preference for options over traded equity as the driving force behind option compensation.

APPENDIX A: Proofs

Proof of Theorem 1

Assuming that the perceived utilities of employees working in the two firms are not equal leads to a contradiction, as the firm whose employees have higher utility could profitably deviate by marginally reducing its compensation costs. Further, differentiating the Lagrangian associated with maximization problem (4) leads immediately to $f'(l_i^*) = W_i^* + N_i^* + M_i^*$.

We now solve for the optimal firm 1 compensation contract assuming that its employee must obtain a utility of $\bar{u}$. Assume first that $s \leq \phi$ so that $\hat{N}_1^1 = 0$. Firm 1's optimization problem is therefore:

$$\underset{W_1, N_1, M_1}{Min} \quad \{W_1 + N_1 + M_1\}$$

$$s.t. \; W_1 + M_1(1+z) + N_1(1+s) - \frac{1}{2}[(N_1 + M_1)^2 \sigma^2 + \sigma_Y^2 + 2(N_1 + M_1)\phi] \geq \bar{u} \qquad \text{(A1)}$$

$$N_1 \geq 0, \quad M_1 \geq 0, \quad W_1 \geq 0$$

The first constraint will be binding, and so we can eliminate W_1 from the maximization problem by representing it as a function of N_1 and M_1. Denoting the Lagrangian of the problem by Γ, we have that $\frac{\partial \Gamma}{N_1} = (N_1 + M_1)\sigma^2 + \phi - s$ and $\frac{\partial \Gamma}{M_1} = (N_1 + M_1)\sigma^2 + \phi - z$. Since $s \leq \phi$, the Kuhn-Tucker complimentary slackness requirements imply that $N_1 = 0$. Also, if $z \leq \phi$, the optimal solution has $M_1 = 0$, while if $z > \phi$, $M_1 = \frac{z - \phi}{\sigma^2}$.

Assume now that $\phi < s < \phi + p - 1$. We have that $\hat{N}_1^1 = 0$, and firm 1's maximization problem is identical to the one above. The Kuhn-Tucker conditions show that when $z \leq s$, the optimal compensation involves $M_1 = 0$ and $N_1 = \frac{s - \phi}{\sigma^2}$, and when $z > s$ we have $M_1 = \frac{z - \phi}{\sigma^2}$ and $N_1 = 0$.

Next, assume that $s > \phi + p - 1$. If $\hat{N}_1^1 = 0$, then the solution is identical to the case where $\phi < s < \phi + p - 1$. If, on the other hand, $\hat{N}_1^1 > 0$, then firm 1's maximization problem is given by:

$$\underset{W_1, N_1, M_1}{Min} \quad \{W_1 + N_1 + M_1\}$$

$$s.t. \; W_1 + M_1(1+z) + (N_1 + \hat{N}_1)(1+s) - p\hat{N}_1 - \frac{(1+s-p-\phi)^2}{2\sigma^2} - \frac{1}{2}\sigma_Y^2 - \frac{(1+s-p-\phi)\phi}{\sigma^2} \geq \bar{u}. \qquad \text{(A2)}$$

Since once again the constraint will be binding, with some algebraic manipulation it is easy to see that the above maximization problem can be written as:

$$\underset{W_1, N_1, M_1}{Min} \quad \{(1-p)N_1 + (1+s-z-p)M_1\}$$
$$s.t. \;\; N_1 \geq 0 \;\;\; and \;\;\; M_1 \geq 0 \tag{A3}$$

Thus, when $p > 1$, the solution to the problem involves $N_1 = \infty$ in contradiction to $\hat{N}_1^1 > 0$. Additionally, when $p = 1$ but $z > s$, the solution involves $M_1 = \infty$ in contradiction once again to $\hat{N}_1^1 > 0$. Finally, when $p = 1$ and $z \leq s$, $M_1 = 0$ will be optimal and the firm is indifferent to any N_1 between 0 and $\frac{s-\phi}{\sigma^2}$. (The upper bound of $\frac{s-\phi}{\sigma^2}$ guarantees that $\hat{N}_1^1 > 0$.)

The optimal compensation of firm 2 $(N_2^* = M_2^* = 0)$ is proven in an analogous way by considering the case of $s = z = 0$ above.

Proof of Theorem 2

Consider first the case where $s \geq z > \phi$ or $s > \phi \geq z$. Using Lemma 1 and parts (d.i) and (d.ii) of Theorem 1 to obtain the values of M_1^*, N_1^*, $\hat{N}_1^1$ and $\hat{N}_1^2$ and substituting these into parts (a) and (b) of Theorem 1 yields after some algebraic manipulation:

$$f'(l_1) - f'(l_2) = \frac{(1+s-p(s))^2}{2\sigma^2} - \frac{(s-\phi)^2}{2\sigma^2}. \tag{A4}$$

Since $f'' < 0$, we have that $l_1 > l_2$ if and only if $p(s) - 1 > \phi$. Finally, since firm i's profits are given by $\Pi_i = f(l_i) - l_i\,(W_i+N_i+M_i) = f(l_i) - l_i f'(l_i)$, it is easy to see that $l_2 > l_1$ if and only if $\Pi_2 > \Pi_1$.

Consider next the case where $z > \phi$ and $z > s$. Using Lemma 1 and part (d.iii) of Theorem 1 to obtain the values of M_1^*, N_1^*, $\hat{N}_1^1$ and $\hat{N}_1^2$ and substituting these into parts (a) and (b) of Theorem 1 yields

$$f'(l_1) - f'(l_2) = \frac{(1+s-p(s))^2}{2\sigma^2} - \frac{(z-\phi)^2}{2\sigma^2}. \tag{A5}$$

Since $f'' < 0$, we have that $l_1 > l_2$ (and $\Pi_1 > \Pi_2$) if and only if $(p(s) - 1) + (z(s) - s) > \phi$.

Finally, consider the case where $0 < \max(s, z) \leq \phi$. Using Lemma 1 and part (d.iv) of Theorem 1, we have that $N_1^* = M_1^* = 0$, $\hat{N}_1^1 = 0$, and $\hat{N}_1^2 = \frac{1+s-p(s)}{\sigma^2} \geq 0$. Plugging these values into part (a) of Theorem 1 yields $W_1 - W_2 = \frac{(1-p(s)+s)^2}{2\sigma^2}$. By part (b) of Theorem 1, we therefore have $f'(l_1) - f'(l_2) = \frac{(1-p(s)+s)^2}{2\sigma^2}$. Since $(1-p(s)+s)^2 \geq 0$ and $f'' < 0$, we have that $l_2 \geq l_1$ and, therefore, also $\Pi_2 \geq \Pi_1$. If *p(s)* < 1+*s* then $\Pi_2 > \Pi_1$, i.e., firm 1 makes strictly smaller profits than firm 2.

APPENDIX B: Variable Definitions

Measures of Cash Constraints

Cash Flow Shortfall: Cash flow shortfall is the three year average of common and preferred dividends (Compustat data items 19 and 21) plus cash flow used in investing activities (data item 311) less cash flow from operations (data item 308), all divided by total assets (data item 6).

Interest Burden: Interest burden is the three-year average of interest expense (data item 15) scaled by operating income before depreciation (data item 13), and is censored from above at one.

KZ Index: The Kaplan-Zingales measure of financial constraints is constructed as:

$$KZ_{it} = -1.002\frac{CF_{it}}{A_{it-1}} - 39.368\frac{DIV_{it}}{A_{it-1}} - 1.315\frac{C_{it}}{A_{it-1}} + 3.139LEV_{it} + 0.283Q_{it}, \tag{B1}$$

where CF_{it} is cash flow (data item 14+data item 18), A_{it-1} is lagged assets (data item 6), DIV_{it} is cash dividends (data item 21+data item 19), C_{it} is cash balances (data item 1), LEV_{it} is leverage ((data item 9 + data item 34)/ (data item 9 + data item 34+data Item 216)), and Q_{it} is the market value of equity (price times shares outstanding from Compustat) plus assets minus the book value of equity (data item 60 + data item 74) all over assets. All ingredients of KZ are winsorized at the 1% level. KZ4 excludes Q and is defined as:

$$KZ4_{it} = -1.002\frac{CF_{it}}{A_{it-1}} - 39.368\frac{DIV_{it}}{A_{it-1}} - 1.315\frac{C_{it}}{A_{it-1}} + 3.139LEV_{it}. \tag{B2}$$

Measures of Earnings Manipulation

The first measure of earnings manipulation is signed discretionary current accruals ((Teoh, Welch and Wong (1998 a,b)). Current accruals are defined from the balance sheet as follows:

$$CA_{BS} = \Delta[CurrAsset - Cash] - \Delta[CurrLiab - CurrLTDebt]. \tag{B3}$$

CurrAsset stands for current assets (Compustat data item 4), *Cash* stands for cash and short-term investments (data item 1), *CurrLiab* stands for current liabilities (data item 5), and *CurrLTDebt* is the current portion of long-term debt (data item 44). A cross-sectional adaptation of the modified Jones (1991) model is used to split current accruals into their discretionary and non-discretionary components. Accruals are regressed on the change in sales in a cross-sectional regression using all firms in the same two-digit SIC code on Compustat, excluding the firm for which discretionary accruals are to be calculated. The cross-sectional regression is performed each fiscal year for each sample firm, and all variables are scaled by lagged assets:

$$\frac{CA_{BS,j,t}}{TA_{j,t-1}} = \alpha\left(\frac{1}{TA_{j,t-1}}\right) + \beta\left(\frac{\Delta Sales_{j,t}}{TA_{j,t-1}}\right) + \varepsilon_{j,t}\,. \tag{B4}$$

$TA_{j,t-1}$ is lagged total assets (data item 6) and $\Delta Sales_{j,t}$ is the change in sales (data item 12) in year *t*. The predicted accruals of the sample firm are calculated using the regression coefficients from (B4) and the actual change in sales net of the change in trade receivables. The fitted accruals are considered to be at the level necessary to support the firm's growth in sales, and hence not caused by manipulation. The residuals are called *discretionary current accruals* (DCA) and signal earnings manipulation:

$$DCA_{i,t} = \frac{CA_{i,t}}{TA_{i,t-1}} - \left(\hat{\alpha}\left(\frac{1}{TA_{i,t-1}}\right) + \hat{\beta}\left(\frac{\Delta Sales_{i,t} - \Delta AccRec_{i,t}}{TA_{i,t-1}}\right)\right). \tag{B5}$$

$\Delta AccRec$ is the change in accounts receivables in year t, and accounts for changes in credit sales. This balance sheet based measure of earnings manipulation has been criticized because it is affected by nonoperating events such as reclassifications, acquisitions, divestitures, and foreign currency translations. Hribar and Collins (2002) propose two more robust definitions of accruals which are computed directly from the cash flow statement. The first measure captures total accruals:

$$TAC_{CF} = EBXI - CFO_{CF}\,, \tag{B6}$$

where TAC_{CF} stands for total accruals, *EBXI* stands for earnings before extraordinary items and discontinued operations (data item 123), and CFO_{CF} stands for operating cash flows from continuing operations (data item 308 – data item 124). The second Hribar and Collins measure of accruals uses only the changes in the non-cash working capital accounts and is more directly comparable to the balance sheet definition of current accruals presented above:

$$CA_{CF} = -\left(\Delta AccRec_{CF} + \Delta Inv_{CF} + \Delta AccPay_{CF} + \Delta Tax_{CF} + \Delta Other_{CF} + Dep_{CF}\right). \tag{B7}$$

$\Delta AccRec_{CF}$ is the decrease in accounts receivable (data item 302), ΔInv_{CF} is the decrease in inventory (data item303), $\Delta AccPay_{CF}$ is the increase in accounts payable (data item 304), ΔTax_{CF} is the increase in taxes payable (data item 305), $\Delta Other_{CF}$ is the net change in other current assets (data item 307), and Dep_{CF} is depreciation expense (data item 125). We again split accruals into their discretionary and nondiscretionary components using the cross-sectional industry regression approach.

Measures of Share Repurchases

The first measure of share repurchases uses the "Purchases of Common and Preferred Stock" from Compustat (data item 115) less any decrease in the par value of preferred stock (data item 130). The second measure calculates share repurchases (and issues) as the difference in shares outstanding between the beginning and the end of the fiscal year. The number of shares outstanding is taken from the monthly CRSP tapes. The decrease in the number of shares outstanding is adjusted for both executive stock grants and stock option exercises. The number of shares granted to executives is calculated as the dollar value of restricted stock grants from ExecuComp divided by an estimate of the stock price on the grant date. We use the average of the midpoints of the month high and month low stock prices as estimate for the stock price. The number of options exercised is hand-collected from annual reports as described in Section 5.1.

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Figure 1: Average option grants per non-executive employee in large firms. Per employee option grants (on the left vertical axis) are the dollar value of options granted to employees divided by the average number of employees during the fiscal year. The options granted to employees are calculated by subtracting the number of options granted to top-five executives from the total number of options granted. The cumulative market return (on the right vertical axis) is calculated using the CRSP value-weighted NYSE/AMEX/NASDAQ index. The sample is restricted to firm-year observations in which the average number of employees exceeds 1000.

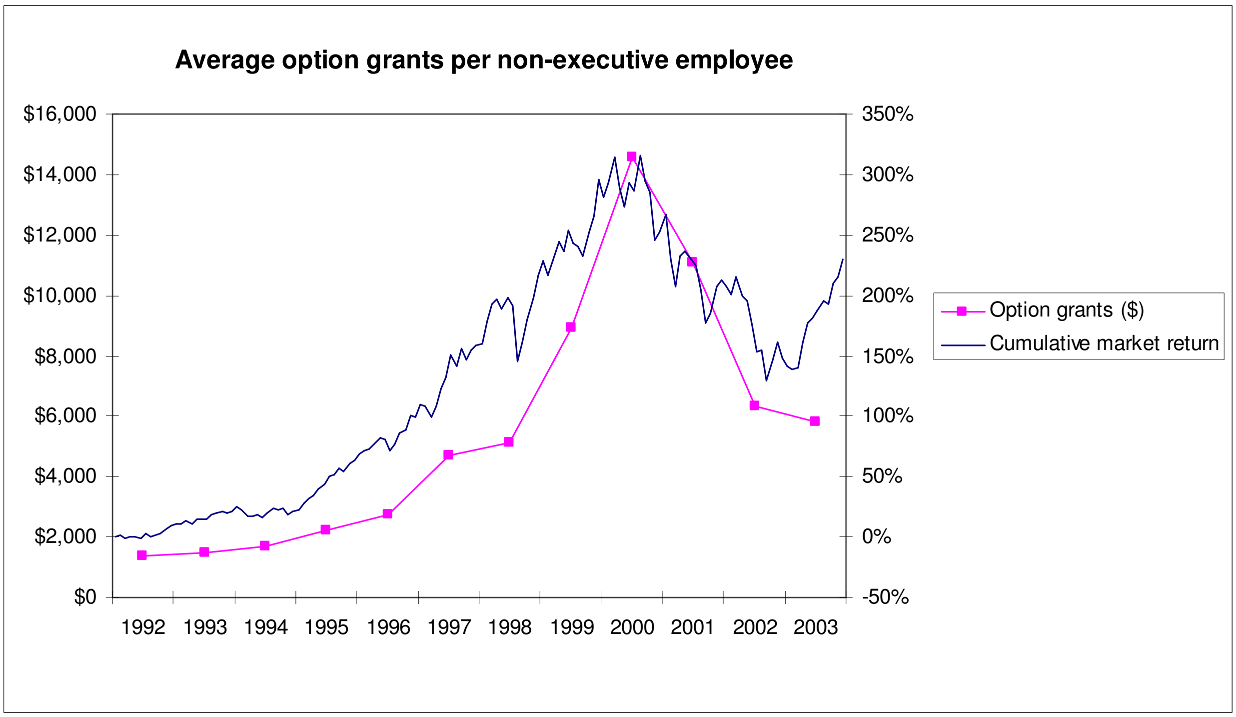

Table 1. Summary statistics. Per employee option grants are the Black-Scholes dollar value of options granted to employees divided by the average number of employees during the firm year. The options granted to employees are calculated by subtracting the number of options granted to top-five executives from the total number of options granted. Q is the market value of equity plus assets (Compustat data item 6) minus the book value of equity (data item 60 + data item 74) all over book assets. R&D is the three-year average of R&D (data item 46) scaled by book assets. The cash constraint measures KZ and KZ4 are calculated as in Baker, Stein, and Wurgler (2003). Cash flow shortfall is the three year average of common and preferred dividends (Compustat data items 19 and 21) plus cash flow used in investing activities (data item 311) less cash flow from operations (data item 308), all divided by book assets. Interest burden is the three-year average of interest expense (data item 15) scaled by operating income before depreciation (data item 13). Interest burden is set to one when interest expense is greater than operating income before depreciation.

Number of observations	12,898	
Panel A: Firm characteristics		
	Mean	Median
Number of employees	19,018	5,400
Total option grants relative to shares outstanding	18%	1.8%
Employee option grants relative to total grants	67%	71%
Per employee option grants	$8,818	$1,029
Market value of equity (millions)	$5,466	$1,083
Book assets (millions)	$6,329	$1,067
Sales (millions)	$3,992	$1,073
Q	2.00	1.51
3-year average of R&D to assets	3.3%	0.00%
Panel B: Measures of cash constraints		
	Mean	Median
Kaplan-Zingales (KZ) measure of cash constraints	0.87	0.88
KZ4 measure of cash constraints	0.30	0.35
3-year average of cash flow shortfall	1.44%	0.59%
3-year average of interest burden	20%	13%

Table 2. Prior stock returns, cash balances and employee option compensation. The per employee option grants are calculated as the Black-Scholes dollar value of options granted to employees divided by the average number of employees during a firm year. The options granted to employees are derived by subtracting the number of options granted to top-five executives from the total number of options granted. Stock returns over the previous two years are calculated as the annualized stock return over fiscal years *t* – 1 and *t* – 2 for employee option grants made in fiscal year *t*. Quintile cutoffs are calculated using the entire pooled sample. The standard errors of the estimated medians are bootstrapped with 1,000 repetitions.

Panel A: Prior stock returns by per employee option grant quintile

	Stock return over the previous two years			
Option grant quintile	Mean [S.E.]	T-test for equality with previous quintile [P-value]	Median [S.E.]	Wilcoxon rank-sum test for equality with previous quintile [P-value]
1	**4.28%**	**-**	**3.57%**	**-**
	[0.55%]		[0.48%]	
2	**11.06%**	**8.1**	**7.49%**	**7.5**
	[0.63%]	[0.00]**	[0.47%]	[0.00] **
3	**12.29%**	**1.4**	**9.66%**	**2.4**
	[0.62%]	[0.16]**	[0.61%]	[0.01] *
4	**17.33%**	**5.0**	**12.18%**	**3.8**
	[0.80%]	[0.00] **	[0.74%]	[0.00] **
5	**30.09%**	**8.6**	**18.53%**	**5.9**
	[1.26%]	[0.00] **	[1.12%]	[0.00] **

* significant at 5%; ** significant at 1%

Panel B: Per employee option grants by prior two-year stock return quintile

	Option grant per employee			
Stock return quintile	Mean [S.E.]	T-test for equality with previous quintile [P-value]	Median [S.E.]	Wilcoxon rank-sum test for equality with previous quintile [P-value]
1	**$7,589**	**-**	**$1,030**	**-**
	[$439]		[$58]	
2	**$4,724**	**-5.0**	**$649**	**-8.1**
	[$373]	[0.00]**	[$31]	[0.00]**
3	**$4,303**	**-0.9**	**$702**	**1.6**
	[$275]	[0.36]	[$27]	[0.12]
4	**$6,183**	**4.0**	**$964**	**6.3**
	[$383]	[0.00]**	[$43]	[0.00]**
5	**$21,293**	**11.2**	**$2,965**	**19.5**
	[$1,296]	[0.00]**	[$154]	[0.00]**

* significant at 5%; ** significant at 1%

Table 3. Regressions of log option grants per employee on past returns and measures of cash constraints. The Long Term Debt Dummy is an indicator variable which takes a value of one if a firm has long term debt and zero otherwise. All other variables are calculated as in Tables 1 and 2. All regressions include year dummies and three-digit SIC industry dummies. T-statistics use heteroskedasticity-robust standard errors and allow for clustering at the firm level.

	Dependent variable: Log option grants per employee				
Independent variables	(1)	(2)	(3)	(4)	(5)
Stock return over previous two years	**0.89**	**0.58**	**0.58**	**0.57**	**0.57**
	[19.21]**	[12.94]**	[13.40]**	[13.01]**	[13.01]**
Contemporaneous stock return	**0.20**	**-0.03**	**-0.02**	**-0.02**	**0.00**
	[9.73]**	[1.03]	[0.92]	[0.78]	[0.04]
Q_t		**0.30**	**0.31**	**0.29**	**0.30**
		[13.95]**	[14.77]**	[14.00]**	[14.00]**
KZ_{t-1}	**0.02**				
	[1.04]				
$KZ4_{t-1}$		**-0.02**			**-0.01**
		[0.95]			[0.27]
Cash flow $shortfall_{t-1}$			**2.11**		**2.36**
			[9.38]**		[10.42]**
Interest $burden_{t-1}$				**-0.34**	**-0.55**
				[2.87]**	[4.05]**
Log sales	**-0.08**	**-0.10**	**-0.07**	**-0.11**	**-0.08**
	[4.56]**	[5.65]**	[3.79]**	[5.95]**	[4.22]**
Long term debt dummy	**-0.51**	**-0.23**	**-0.33**	**-0.22**	**-0.28**
	[6.00]**	[2.98]**	[4.15]**	[2.79]**	[3.63]**
R&D	**5.29**	**4.00**	**3.33**	**4.35**	**3.82**
	[5.85]**	[4.81]**	[3.90]**	[5.00]**	[4.26]**
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	**5.75**	**5.73**	**5.55**	**5.86**	**5.71**
	[34.76]**	[36.18]**	[34.68]**	[34.69]**	[34.10]**
Observations	12,898	12,898	12,898	12,898	12,898
Adjusted R-Squared	0.56	0.58	0.59	0.58	0.59

* significant at 5%; ** significant at 1%

Table 4. Regressions of log option grants per employee on past returns and measures of cash constraints with firm fixed effects. All variables are defined as in Table 3. All regressions include year dummies and firm fixed effects. T-statistics use heteroskedasticity-robust standard errors and allow for clustering at the firm level.

	Dependent variable: Log option grants per employee				
Independent variables	(1)	(2)	(3)	(4)	(5)
Stock return over previous two years	**0.58**	**0.42**	**0.46**	**0.44**	**0.43**
	[15.00]**	[9.81]**	[10.91]**	[10.41]**	[10.13]**
Contemporaneous stock return	**0.13**	**0.03**	**0.02**	**0.03**	**0.04**
	[7.28]**	[1.16]	[0.80]	[1.34]	[2.01]*
Q_t		**0.15**	**0.16**	**0.15**	**0.15**
		[8.30]**	[8.74]**	[8.46]**	[8.40]**
KZ_{t-1}	**-0.03**				
	[1.33]				
$KZ4_{t-1}$		**-0.10**			**-0.07**
		[4.17]**			[2.88]**
Cash flow shortfall_{t-1}			**0.83**		**1.03**
			[3.57]**		[4.33]**
Interest burden_{t-1}				**-0.89**	**-0.79**
				[7.37]**	[6.46]**
Log sales	**-0.02**	**-0.02**	**-0.02**	**-0.06**	**-0.06**
	[0.40]	[0.48]	[0.59]	[1.50]	[1.45]
Long term debt dummy	**-0.04**	**0.04**	**-0.02**	**0.02**	**0.03**
	[0.63]	[0.69]	[0.29]	[0.37]	[0.53]
R&D	**-1.64**	**-2.11**	**-2.32**	**-1.93**	**-1.88**
	[2.08]*	[3.04]**	[3.31]**	[2.72]**	[2.67]**
Company fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	**5.64**	**5.60**	**5.61**	**6.04**	**5.96**
	[20.39]**	[20.78]**	[20.51]**	[22.18]**	[22.13]**
Observations	12,898	12,898	12,898	12,898	12,898
Adjusted R-Squared	0.81	0.82	0.82	0.82	0.82

* significant at 5%; ** significant at 1%

Table 5. Regressions of log option grants per employee on past return quintiles and measures of cash constraints. Quintiles of past stock returns are constructed using the pooled sample. Quintile *i* is a dummy variable taking a value of one when a firm's stock return over fiscal years *t* – 1 and *t* – 2 is in the *i*th quintile, and zero otherwise. All other variables are defined as in Table 3. All regressions include year dummies and three-digit SIC industry dummies. T-statistics use heteroskedasticity-robust standard errors and allow for clustering at the firm level.

	Dependent variable: Log option grants per employee				
Independent variables	(1)	(2)	(3)	(4)	(5)
Stock return over previous two years					
Quintile 1	-	-	-	-	-
Quintile 2	**0.17**	**0.05**	**0.08**	**0.03**	**0.04**
	[3.70]**	[1.03]	[1.84]	[0.66]	[0.86]
Quintile 3	**0.35**	**0.17**	**0.22**	**0.16**	**0.18**
	[8.05]**	[4.06]**	[5.20]**	[3.68]**	[4.10]**
Quintile 4	**0.53**	**0.31**	**0.36**	**0.29**	**0.31**
	[12.41]**	[7.09]**	[8.26]**	[6.75]**	[7.19]**
Quintile 5	**1.02**	**0.60**	**0.64**	**0.59**	**0.61**
	[22.69]**	[13.04]**	[13.96]**	[12.88]**	[13.24]**
Contemporaneous stock return	**0.19**	**-0.04**	**-0.04**	**-0.04**	**-0.02**
	[9.15]**	[1.70]	[1.61]	[1.64]	[0.63]
Q_t		**0.30**	**0.32**	**0.31**	**0.30**
		[14.47]**	[15.41]**	[14.71]**	[14.45]**
KZ_{t-1}	**0.02**				
	[0.78]				
$KZ4_{t-1}$		**-0.04**			**-0.02**
		[1.55]			[0.92]
Cash flow shortfall_{t-1}			**2.19**		**2.45**
			[9.54]**		[10.64]**
Interest burden_{t-1}				**-0.35**	**-0.52**
				[2.89]**	[3.84]**
Log sales	**-0.09**	**-0.10**	**-0.07**	**-0.11**	**-0.08**
	[4.77]**	[5.73]**	[3.91]**	[6.04]**	[4.20]**
Long term debt dummy	**-0.51**	**-0.22**	**-0.33**	**-0.22**	**-0.27**
	[5.92]**	[2.76]**	[4.16]**	[2.73]**	[3.45]**
R&D	**5.23**	**3.92**	**3.22**	**4.25**	**3.69**
	[5.67]**	[4.66]**	[3.73]**	[4.83]**	[4.08]**
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	**6.43**	**6.19**	**6.00**	**6.34**	**6.14**
	[41.15]**	[40.97]**	[39.15]**	[39.07]**	[37.86]**
Observations	12,898	12,898	12,898	12,898	12,898
Adjusted R-Squared	0.55	0.58	0.58	0.58	0.59

* significant at 5%; ** significant at 1%

Table 6. Regressions of log option grants per employee on past return quintiles and measures of cash constraints. The sample is restricted to firms for which 5 years of past returns are available on CRSP. Prior returns for different horizons are defined similarly to prior two-year returns in Table 2. For example, the prior three-year return for year *t* is the annualized three year return over the 36 month period comprising years *t* – 3, *t* – 2, and *t* – 1. All other variables are defined as in Tables 3 and 5. All regressions include year dummies and three-digit SIC industry dummies. T-statistics use heteroskedasticity-robust standard errors and allow for clustering at the firm level.

	Dependent variable: Log option grants per employee				
Independent variables	(1)	(2)	(3)	(4)	(5)
Stock return over the...	**previous year**	**previous two years**	**previous three years**	**previous four years**	**previous five years**
Quintile 1	**-**	**-**	**-**	**-**	**-**
Quintile 2	**-0.03**	**0.03**	**0.15**	**0.22**	**0.22**
	[0.61]	[0.72]	[3.03]**	[4.43]**	[4.51]**
Quintile 3	**0.01**	**0.15**	**0.33**	**0.34**	**0.42**
	[0.26]	[3.18]**	[6.84]**	[6.71]**	[8.12]**
Quintile 4	**0.08**	**0.28**	**0.48**	**0.60**	**0.63**
	[1.80]	[5.97]**	[9.59]**	[11.59]**	[11.38]**
Quintile 5	**0.32**	**0.57**	**0.77**	**0.87**	**1.00**
	[7.27]**	[11.47]**	[14.15]**	[14.94]**	[15.76]**
Contemporaneous stock return	**-0.07**	**-0.03**	**0.00**	**0.01**	**0.02**
	[2.49]*	[0.98]	[0.01]	[0.49]	[0.72]
Q_t	**0.36**	**0.32**	**0.30**	**0.29**	**0.27**
	[14.54]**	[12.92]**	[12.14]**	[11.66]**	[10.96]**
$KZ4_{t-1}$	**0.01**	**0.01**	**0.01**	**0.00**	**0.00**
	[0.19]	[0.24]	[0.29]	[0.09]	[0.09]
Cash flow shortfall_{t-1}	**1.84**	**1.87**	**1.66**	**1.38**	**1.17**
	[6.52]**	[6.64]**	[6.00]**	[4.98]**	[4.19]**
Interest burden_{t-1}	**-0.63**	**-0.57**	**-0.40**	**-0.25**	**-0.14**
	[4.02]**	[3.66]**	[2.59]**	[1.60]	[0.93]
Log sales	**-0.05**	**-0.05**	**-0.05**	**-0.05**	**-0.06**
	[2.35]*	[2.26]*	[2.39]*	[2.49]*	[2.69]**
Long term debt dummy	**-0.27**	**-0.29**	**-0.29**	**-0.28**	**-0.27**
	[3.02]**	[3.31]**	[3.35]**	[3.26]**	[3.18]**
R&D	**3.42**	**3.58**	**3.73**	**3.82**	**3.95**
	[3.61]**	[3.74]**	[3.90]**	[3.99]**	[4.09]**
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	**5.88**	**5.82**	**5.63**	**5.53**	**5.56**
	[32.05]**	[31.86]**	[30.95]**	[30.45]**	[30.89]**
Observations	11,143	11,143	11,143	11,143	11,143
Adjusted R-Squared	0.56	0.57	0.57	0.57	0.58

* significant at 5%; ** significant at 1%

Table 7. Regressions of log option grants per employee on past returns and measures of cash constraints. Dividends (Compustat data item 21 + data item 19), cash balances (data item 1), leverage ((data item 9 + data item 34)/ (data item 9 + data item 34+data item 216)) and cash flow to investment (-data item 311) are normalized by lagged book assets (data item 6). All other variables are defined as in Table 3. All regressions include year dummies and three-digit SIC industry dummies. T-statistics use heteroskedasticity-robust standard errors and allow for clustering at the firm level.

	Dependent variable: Log option grants per employee					
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Stock return over previous two years	**0.87**	**0.55**	**0.37**	**0.55**	**0.56**	**0.30**
	[19.01]**	[11.72]**	[8.56]**	[12.61]**	[13.31]**	[7.16]**
Contemporaneous stock return	**0.19**	**-0.02**	**0.00**	**-0.02**	**0.02**	**0.01**
	[9.52]**	[0.83]	[0.17]	[0.72]	[0.87]	[0.27]
Q_t		**0.29**	**0.27**	**0.29**	**0.27**	**0.28**
		[13.46]**	[13.56]**	[14.05]**	[13.89]**	[14.27]**
$Dividends_{t-1}$	**-10.34**					**-14.38**
	[5.84]**					[8.74]**
Cash $flow_{t-1}$		**0.49**				**-0.06**
		[2.35]*				[0.32]
Cash $balances_{t-1}$			**1.39**			**1.17**
			[15.43]**			[13.75]**
$Leverage_{t-1}$				**-0.63**		**-0.65**
				[5.99]**		[6.31]**
Cash flow to $investment_{t-1}$					**3.39**	**2.67**
					[11.83]**	[9.74]**
Log sales	**-0.05**	**-0.11**	**-0.06**	**-0.08**	**-0.08**	**0.02**
	[2.79]**	[5.80]**	[3.08]**	[4.62]**	[4.60]**	[0.83]
Long term debt dummy	**-0.54**	**-0.24**	**-0.09**	**-0.13**	**-0.28**	**-0.05**
	[6.56]**	[2.99]**	[1.16]	[1.57]	[3.64]**	[0.68]
R&D	**5.26**	**4.34**	**3.12**	**4.01**	**4.98**	**3.77**
	[5.87]**	[4.97]**	[4.25]**	[4.93]**	[6.95]**	[5.97]**
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	**5.79**	**5.75**	**5.33**	**5.75**	**5.30**	**5.13**
	[35.54]**	[35.90]**	[33.89]**	[36.18]**	[33.82]**	[33.97]**
Observations	12,898	12,898	12,898	12,898	12,898	12,898
Adjusted R-Squared	0.56	0.58	0.59	0.58	0.59	0.62

* significant at 5%; ** significant at 1%

Table 8. Regressions of log option grants per employee on past returns, measures of distress, and measures of cash constraints. Distress is measured in columns 1 and 2 by whether a firm delists for performance-related reasons in the next fiscal year (*t* +1) or in the fiscal year after the next (*t* +2). CRSP delisting codes between 400 and 599 are used to identify performance-related delistings. Distress is measured in columns 3 and 4 by an Altman Z-score below 1.81, the bankruptcy threshold determined in Altman (1968). All other variables are defined as in Table 3. Regressions (1) and (3) include year dummies and 3-digit SIC dummies, regressions (2) and (4) include year dummies and firm fixed effects. T-statistics use heteroskedasticity-robust standard errors and allow for clustering at the firm level.

	Dependent variable: Log option grants per employee			
Independent variables	(1)	(2)	(3)	(4)
Delisted in the following year (t+1)	**-0.73**	**-0.54**		
	[3.00]**	[1.90]		
Delisted two years later (t+2)	**-0.39**	**-0.29**		
	[2.13]*	[1.53]		
Distressed in the current year (t)			**-0.19**	**-0.21**
			[3.43]**	[4.02]**
Distressed in the previous year (t-1)			**-0.18**	**-0.13**
			[3.04]**	[2.17]*
Stock return over previous two years	**0.56**	**0.42**	**0.52**	**0.40**
	[12.90]**	[10.06]**	[11.83]**	[9.27]**
Contemporaneous stock return	**-0.01**	**0.04**	**-0.02**	**0.03**
	[0.42]	[1.75]	[0.75]	[1.21]
Q_t	**0.30**	**0.15**	**0.30**	**0.15**
	[14.04]**	[8.45]**	[13.82]**	[8.33]**
$KZ4_{t-1}$	**-0.01**	**-0.07**	**0.00**	**-0.07**
	[0.23]	[2.88]**	[0.00]	[2.55]*
Cash flow $shortfall_{t-1}$	**2.39**	**1.04**	**2.35**	**1.05**
	[10.53]**	[4.38]**	[10.23]**	[4.33]**
Interest $burden_{t-1}$	**-0.52**	**-0.76**	**-0.38**	**-0.68**
	[3.82]**	[6.20]**	[2.61]**	[5.39]**
Log sales	**-0.08**	**-0.06**	**-0.08**	**-0.07**
	[4.30]**	[1.60]	[4.39]**	[1.75]
Long term debt dummy	**-0.28**	**0.03**	**-0.27**	**0.03**
	[3.63]**	[0.51]	[3.46]**	[0.51]
R&D	**3.84**	**-1.80**	**3.80**	**-1.76**
	[4.26]**	[2.46]*	[4.29]**	[2.64]**
Industry fixed effects	Yes		Yes	
Firm fixed effects		Yes		Yes
Year fixed effects	Yes	Yes	Yes	Yes
Constant	**5.73**	**6.00**	**5.78**	**6.10**
	[34.24]**	[22.30]**	[34.62]**	[21.92]**
Observations	12,898	12,898	11,995	11,995
Adjusted R-Squared	0.59	0.82	0.60	0.82

* significant at 5%; ** significant at 1%

Table 9. Regressions of log option grants per employee on past returns, employment growth, and measures of cash constraints. The percentage change in the number of employees for year *t* is calculated as the difference between the employment numbers at the end of fiscal years *t* and *t* – 1, divided by the number of employees at the end of fiscal year *t* – 1. The ratio is winsorized at the 1 percent level to dampen the effect of outliers. All other variables are defined as in Table 3. Regression (1) includes year dummies and 3-digit SIC dummies, regression (2) includes year dummies and firm fixed effects. T-statistics use heteroskedasticity-robust standard errors and allow for clustering at the firm level.

	Dependent variable: Log option grants per employee	
Independent variables	(1)	(2)
Percentage change in number of employees	**0.69**	**0.39**
	[12.20]**	[7.88]**
Stock return over previous two years	**0.46**	**0.38**
	[10.60]**	[8.99]**
Contemporaneous stock return	**-0.04**	**0.02**
	[1.70]	[1.05]
Q_t	**0.29**	**0.15**
	[13.58]**	[8.37]**
$KZ4_{t-1}$	**0.00**	**-0.058**
	[0.02]	[2.26]*
Cash flow $shortfall_{t-1}$	**2.11**	**1.00**
	[9.46]**	[4.28]**
Interest $burden_{t-1}$	**-0.48**	**-0.76**
	[3.60]**	[6.26]**
Log sales	**-0.07**	**-0.06**
	[3.83]**	[1.56]
Long term debt dummy	**-0.30**	**0.01**
	[3.90]**	[0.10]
R&D	**4.02**	**-1.78**
	[4.51]**	[2.63]**
Industry fixed effects	Yes	
Firm fixed effects		Yes
Year fixed effects	Yes	Yes
Constant	**5.81**	**6.06**
	[35.11]**	[22.68]**
Observations	12,898	12,898
Adjusted R-Squared	0.59	0.82

* significant at 5%; ** significant at 1%

Table 10. Regressions of log option grants per employee on past returns and measures of cash constraints using hand-collected data from 1995 to 2000. All variables are defined as in Table 3. Regressions (1) and (2) use standard OLS estimation, regressions (3) and (4) use Tobit estimation with censoring at zero. All regressions include year dummies. Regression (1) includes industry fixed effects, regression (2) includes firm fixed effects, and regression (4) includes firm random effects. T-statistics use heteroskedasticity-robust standard errors and allow for clustering at the firm level in regressions (1) to (3).

	Dependent Variable: Log Option Grants per Employee			
Independent Variables	(1)	(2)	(3)	(4)
Stock return over previous two years	**0.82**	**0.85**	**1.32**	**0.96**
	[6.23]**	[6.96]**	[7.57]**	[12.10]**
Contemporaneous stock return	**0.12**	**0.23**	**0.23**	**0.19**
	[1.67]	[3.55]**	[2.42]*	[4.07]**
Q_t	**0.19**	**0.02**	**0.34**	**0.12**
	[4.02]**	[0.70]	[4.74]**	[3.68]**
$KZ4_{t-1}$	**0.01**	**-0.096**	**0.152**	**-0.075**
	[0.20]	[2.12]*	[2.18]*	[2.14]*
Cash flow $shortfall_{t-1}$	**3.05**	**1.22**	**3.67**	**2.22**
	[5.93]**	[2.45]*	[5.46]**	[6.31]**
Interest $burden_{t-1}$	**-0.82**	**-1.55**	**-1.17**	**-1.19**
	[2.80]**	[4.36]**	[3.23]**	[5.46]**
Log sales	**0.00**	**-0.03**	**-0.07**	**-0.14**
	[0.07]	[0.28]	[1.45]	[3.40]**
Long term debt dummy	**-0.16**	**0.35**	**-0.08**	**0.25**
	[0.66]	[1.52]	[0.27]	[1.93]
R&D	**6.01**	**1.60**	**8.92**	**5.45**
	[4.78]**	[1.36]	[5.80]**	[7.45]**
Industry fixed effects	Yes			
Firm fixed effects		Yes		
Firm random effects				Yes
Year fixed effects	Yes	Yes	Yes	Yes
Constant	**4.67**	**4.89**	**3.93**	**5.26**
	[11.49]**	[6.37]**	[8.03]**	[16.17]**
Observations	4,117	4,117	4,117	4,117
Adjusted R-Squared	0.53	0.83	-	-

* significant at 5%; ** significant at 1%

Table 11. Regressions of log option grants per employee on past returns, earnings manipulation, and measures of cash constraints. Manipulator is a dummy variable taking a value of one if a firm's signed discretionary accruals are in the top 10% of all firm-years in our sample. Three different measures of discretionary accruals are calculated as residuals from industry-year regressions of normalized accruals on normalized sales growth. Balance sheet discretionary accruals (regressions (1) and (2)) are calculated as in Teoh, Welch, and Wong (1998 a,b). Cash flow statement discretionary total accruals (regressions (3) and (4)) and cash flow statement discretionary operating accruals (regressions (5) and (6)) are calculated as in Hribar and Collins (2001). Appendix B describes the calculations in detail. All other variables are defined as in Table 3. Regressions (1), (3), and (5) include year dummies and 3-digit SIC dummies, regressions (2), (4), and (6) include year dummies and firm fixed effects. T-statistics use heteroskedasticity-robust standard errors and allow for clustering at the firm level.

	Dependent variable: Log option grants per employee					
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Manipulator - balance sheet discretionary current accruals	**0.13**	**0.14**				
	[2.69]**	[3.40]**				
Manipulator - cash flow statement discretionary total accruals			**0.15**	**0.13**		
			[3.27]**	[3.23]**		
Manipulator - cash flow statement discretionary operating accruals					**0.22**	**0.23**
					[3.00]**	[3.53]**
Stock return over previous two years	**0.56**	**0.43**	**0.56**	**0.43**	**0.51**	**0.32**
	[11.72]**	[9.07]**	[12.06]**	[9.44]**	[6.90]**	[3.79]**
Contemporaneous stock return	**-0.01**	**0.03**	**0.00**	**0.03**	**-0.06**	**-0.02**
	[0.32]	[1.14]	[0.14]	[1.50]	[1.90]	[0.51]
Q_t	**0.30**	**0.14**	**0.29**	**0.14**	**0.32**	**0.14**
	[13.17]**	[7.45]**	[13.36]**	[7.75]**	[11.45]**	[5.41]**
$KZ4_{t-1}$	**-0.01**	**-0.09**	**0.00**	**-0.09**	**-0.05**	**-0.11**
	[0.20]	[3.72]**	[0.08]	[3.59]**	[1.58]	[2.77]**
Cash flow $shortfall_{t-1}$	**2.27**	**0.98**	**2.27**	**0.95**	**2.15**	**0.85**
	[9.90]**	[4.53]**	[9.99]**	[4.49]**	[7.22]**	[2.49]*
Interest $burden_{t-1}$	**-0.57**	**-0.85**	**-0.57**	**-0.85**	**-0.62**	**-0.89**
	[4.28]**	[6.95]**	[4.26]**	[7.05]**	[3.55]**	[4.32]**
Log sales	**-0.09**	**-0.06**	**-0.09**	**-0.06**	**-0.14**	**-0.08**
	[4.92]**	[1.62]	[4.72]**	[1.56]	[5.32]**	[1.46]
Long term debt dummy	**-0.27**	**0.07**	**-0.27**	**0.07**	**-0.20**	**0.15**
	[3.30]**	[1.09]	[3.38]**	[1.07]	[2.11]*	[2.02]*
R&D	**3.84**	**-1.99**	**3.89**	**-1.92**	**2.84**	**-2.72**
	[4.17]**	[2.61]**	[4.23]**	[2.55]*	[2.34]*	[3.08]**
Industry fixed effects	Yes		Yes		Yes	
Firm fixed effects		Yes		Yes		Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	**5.83**	**6.07**	**5.83**	**6.05**	**6.27**	**6.41**
	[34.93]**	[22.58]**	[34.39]**	[23.02]**	[28.82]**	[17.50]**
Observations	11,700	11,700	12,070	12,070	5,551	5,551
Adjusted R-Squared	0.60	0.83	0.60	0.83	0.65	0.86

* significant at 5%; ** significant at 1%

Table 12. Regressions of log option grants per employee on past returns, insider trading, earnings manipulation, and measures of cash constraints. Buying (selling) managers is a dummy variable taking on a value of one if the average share purchases by a firm's management are in the top (bottom) 20% of all firm-years. Managerial share purchases are calculated as in Jenter (2005). The manipulator variables indicating earnings management are defined as in Table 13. All other variables are defined as in Table 3. Regressions (1), (3), and (5) include year dummies and 3-digit SIC dummies, regressions (2), (4), and (6) include year dummies and firm fixed effects. T-statistics use heteroskedasticity-robust standard errors and allow for clustering at the firm level.

	Dependent variable: Log option grants per employee					
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Buying managers	**-0.17**	**-0.04**	**-0.17**	**-0.04**	**-0.19**	**-0.02**
	[4.84]**	[1.19]	[4.76]**	[1.29]	[3.80]**	[0.30]
Selling managers	**0.11**	**-0.05**	**0.11**	**-0.05**	**0.18**	**-0.01**
	[2.81]**	[1.48]	[2.86]**	[1.66]	[3.20]**	[0.17]
Manipulator - balance sheet discretionary current accruals	**0.09**	**0.14**				
	[1.93]	[3.34]**				
Manipulator - cash flow statement discretionary total accruals			**0.10**	**0.11**		
			[2.06]*	[2.81]**		
Manipulator - cash flow statement discretionary operating accruals					**0.19**	**0.17**
					[2.58]**	[2.88]**
Stock return over previous two years	**0.56**	**0.45**	**0.56**	**0.45**	**0.54**	**0.41**
	[14.06]**	[12.53]**	[14.46]**	[12.87]**	[9.95]**	[8.29]**
Contemporaneous stock return	**-0.04**	**0.03**	**-0.03**	**0.03**	**-0.09**	**0.00**
	[1.37]	[1.12]	[1.08]	[1.44]	[2.43]*	[0.13]
Q_t	**0.29**	**0.13**	**0.29**	**0.13**	**0.31**	**0.12**
	[12.76]**	[7.39]**	[12.91]**	[7.78]**	[10.45]**	[4.77]**
$KZ4_{t-1}$	**-0.01**	**-0.084**	**-0.002**	**-0.08**	**-0.054**	**-0.089**
	[0.23]	[3.36]**	[0.10]	[3.25]**	[1.75]	[2.20]*
Cash flow $shortfall_{t-1}$	**2.16**	**0.84**	**2.17**	**0.82**	**2.05**	**0.60**
	[9.11]**	[3.72]**	[9.23]**	[3.72]**	[6.61]**	[1.68]
Interest $burden_{t-1}$	**-0.56**	**-0.91**	**-0.55**	**-0.92**	**-0.57**	**-0.95**
	[3.97]**	[7.11]**	[3.99]**	[7.25]**	[3.21]**	[4.66]**
Log sales	**-0.09**	**-0.05**	**-0.09**	**-0.04**	**-0.13**	**-0.08**
	[4.59]**	[1.17]	[4.38]**	[1.09]	[4.98]**	[1.38]
Long term debt dummy	**-0.26**	**0.07**	**-0.27**	**0.06**	**-0.20**	**0.11**
	[3.23]**	[1.00]	[3.35]**	[1.00]	[2.00]*	[1.44]
R&D	**3.88**	**-1.92**	**3.93**	**-1.85**	**2.83**	**-2.33**
	[4.01]**	[2.48]*	[4.07]**	[2.43]*	[2.25]*	[2.44]*
Industry fixed effects	Yes		Yes		Yes	
Firm fixed effects		Yes		Yes		Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	**5.88**	**6.03**	**5.86**	**6.01**	**6.24**	**6.42**
	[35.28]**	[21.28]**	[35.04]**	[21.57]**	[28.75]**	[16.78]**
Observations	10,560	10,560	10,898	10,898	4,996	4,996
Adjusted R-Squared	0.60	0.84	0.60	0.83	0.65	0.86

* significant at 5%; ** significant at 1%

Table 13. Share repurchases as a function of employee option grants. Option grants are the Black-Scholes dollar value of options granted to non-executive employees divided by the average number of employees during a firm year. Quintile cutoff points are calculated using the entire pooled sample. For Panel A, share repurchases are calculated from Compustat as the "Purchases of Common and Preferred Stock" (data item 115) less any decrease in the par value of preferred stock (data item 130). For Panel B, share repurchases are calculated as minus the change in the number of shares outstanding from CRSP, adjusted for both executive stock grants from ExecuComp and stock option exercises hand-collected from annual reports.

Panel A: Share repurchases from Compustat in the full sample 1992-2003

A1: Percentage of firm years with positive share repurchases

Option grant quintile	Percentage repurchasers	Observations
1	46%	2478
2	55%	2477
3	58%	2427
4	56%	2403
5	51%	2252

A2: Percentage of outstanding shares repurchased during the year for repurchasing firms

Option grant quintile	Mean	Median	Observations
1	2.81%	1.58%	1138
2	2.87%	1.54%	1364
3	3.11%	1.85%	1417
4	3.12%	1.76%	1356
5	2.61%	1.61%	1147

Panel B: Share repurchases from CRSP adjusted for option exercises and executive stock grants in the hand-collected subsample 1995-2000

B1: Percentage of firm years with positive share repurchases

Option grant quintile	Percentage repurchasers	Observations
1	45%	806
2	60%	818
3	60%	818
4	56%	820
5	38%	819

B2: Percentage of outstanding shares repurchased during the year for repurchasing firms

Option grant quintile	Mean	Median	Observations
1	2.89%	1.19%	363
2	3.32%	1.65%	488
3	3.44%	2.07%	488
4	3.83%	2.05%	456
5	3.85%	1.63%	310