Employee Sentiment and Stock Option Compensation

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Abstract

The use of equity-based compensation for employees in the lower ranks of an organization 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 develop a model of optimal compensation policy for a firm faced with employees with positive or negative sentiment. We establish the conditions necessary for the firm to compensate its employees with equity in equilibrium, while explicitly taking into account that current and potential employees are able to purchase equity in the firm through the stock market. We show that equity compensation is used in equilibrium only when employees are willing to overpay for it. This occurs if employees prefer the non-traded equity compensation instrument offered by the firm to the traded equity offered by the market, or if the traded equity is overvalued. We then 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. We also provide evidence that managers grant more options to rank-and-file employees when management believes its stock to be overvalued, again consistent with our model.

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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 equity-based compensation for employees in the lower ranks of an organization 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.[4] Holding stock options in their employer exposes employees to price risk which is highly correlated with the risk in their human capital.[5] Hence employees should be an inefficient source of 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 purchase company stock (at market prices) for their 401(k) and ESOP plans on a large scale, and especially so after company stock has performed well.[6] In any portfolio selection framework, this observation strongly suggests that employees' valuation of company stock is higher than the prevailing market price. With regard to stock options, survey evidence suggests that many employees have unrealistic expectations about future stock prices and frequently value their options substantially above Black-Scholes values.[7] Motivated by these observations, we analyze the role of employee optimism in option compensation for rank and file employees.[8]

We develop a model of optimal compensation policy for a firm faced with employees that exhibit either positive or negative sentiment towards it, and assess whether employee optimism leads to equity-based compensation. The somewhat surprising answer is 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 firms' capacity to profit off employees' optimism, and hence restricts or even eliminates firms' incentive to compensate with equity. Indeed, employee optimism about traded firm equity is sufficient to make firms indifferent between paying their employees in equity or cash, but it is insufficient, by itself, to

[4] See Core and Guay (2001) and Oyer and Schaefer (2004), as well as Lazear (1999).
[5] In the remainder of the paper we use the term "employees" as equivalent to "non-executive employees".
[6] See Benartzi (2001), Liang and Weisbenner (2002), and Huberman and Sengmüller (2004).
[7] See Lambert and Larcker (2001).
[8] The behavioral finance literature provides further evidence suggesting that employees are more likely to be optimistic about their firm than other investors in the equity market: Employees may "root for the home team" and

force firms away from cash wages. Firms could simply pay employees a cash amount equal to the market value of the desired equity, and leave the decision whether to purchase equity up to the employees.

For equity compensation to become optimal in the model, employees must overpay for the compensation instruments offered. The model allows for two channels through which firms can extract such rents from overoptimistic employees. The first channel is operative if employees, for behavioral or rational reasons, value a non-traded compensation instrument more highly than positions in traded equity of similar fundamental value. In this case, as the monopoly suppliers of the compensation instrument, firms are able to profitably extract this valuation premium from their employees. We show that the feasibility and magnitude of the rent extraction is determined by employees' willingness to pay for the non-traded compensation instrument (rather than by employees' optimistic valuations of the instrument). This willingness to pay is, in turn, determined by what employees can purchase in the equity market on their own. If employees recognize that the stock market offers an equivalent bet on the firm, then they refuse to pay more than the market value for the equity offered by their firm.

Recognizing that the market offers equivalent or superior bets on the firm is much harder for employees when firms offer options as compensation instrument as compared to when they offer stock. The reason is that rational option valuation on the basis of observed stock prices and volatilities is difficult and likely beyond the capabilities of almost all employees. Instead, they are likely to rely on heuristics and to value options on the basis of their own or their peers' past experience with option payoffs. When looking for possible alternative methods for investing in their employer, employees are likely to simply compare the options offered by the firm to traded shares, which are the most salient alternative offered by the market, and then use their valuation heuristics to decide which of the two assets they prefer.[9] Evidence consistent with this hypothesis is provided by Lambert and Larcker (2001) who conduct a small survey and report that many employees value their options substantially above Black-Scholes values. These excessive option valuations are likely caused by naive extrapolation from the high payoffs many employees experienced during the late 1990s.[10]

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feel loyalty towards their employer (Baker, Jensen, and Murphy (1988), Cohen (2004)), and employees' familiarity with their employer may increase their valuations for employer equity (Huberman (2001)).

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

[10] Besides bounded rationality, there may be other reasons for employees to strictly prefer the options offered by the firm to traded shares. Employees may prefer a levered, option-like position in their employer and may face borrowing constraints. Alternatively, transaction costs of trading in the stock market may make the provision of options by the firm more efficient than purchases of equity by employees in the market. Transaction costs can give an advantage to firms paying with equity, even though this advantage is arguably too small to explain the massive increases in salary required in non-sentiment firms to retain their employees (Snider, 2000).

The second reason for paying optimistic employees with equity, in either traded or non-traded form, comes into effect when the equity is overvalued by the market. If equity is overvalued, and optimistic employees' private valuations are even higher, then firms are able to profit by effectively selling overvalued equity to their employees. In fact, firms are on the margin indifferent between paying their employees with equity, and issuing equity directly into the market.[11] Due to the overvaluation, this is profitable even if the price the firm is able to charge is no higher than the market price.

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 the firm subject to it. 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 highly 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, the model shows that firms subject to positive sentiment are the net beneficiaries of equity compensation if there is a significant preference for the non-traded compensation instrument over traded stock combined with moderate levels of firm-specific human capital risk, 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.

Having established a theoretical foundation for the use of equity compensation, we empirically test whether the observable cross-sectional and time-series patterns of broad-based option grants are 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. Prior literature suggests that employee sentiment improves with prior stock price performance. In addition, we

[11] If firms face downward-sloping demand curves for their shares in the market, and employees are subject to an endowment effect (so that once granted shares they do not sell them, even though they would not have gone out and purchased any by themselves), then paying optimistic employees with shares may be cheaper than issuing equity into the market (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 (Core and Guay 2001, Fama and French 2003).

expect boundedly rational employees to extrapolate more strongly from past returns when valuing options than when valuing restricted stock because of the amplified nature of option payoffs. Thus, our model predicts that better stock price performance is associated with greater use of stock option compensation. We make use of the psychology literature on expectations formation and excessive extrapolation to develop additional testable hypotheses relating stock return patterns and firm characteristics to employee sentiment and stock option compensation. All hypotheses are developed in detail in Section 4.

Diagram 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 some 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 strongly 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 bottom quintile is 7% per annum compared to 30% p.a. for firms in the top quintile.[12] Sorting firms by prior year returns yields average (median) grants of $21,155 ($2,838) among firms in the top return quintile compared to only $7,850 ($1,116) 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. Distressed firms which are about to delist for performance reasons 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.

Finally, we test the model prediction that firms are more likely to pay with options when managers view their own stock as overvalued. We identify situations in which managers are likely to view their firm's stock price as too high by looking at firms in which managers have manipulated earnings and at firms in which 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 manipulated earnings upwards grant between 13 and 23% more options than firms with no manipulation. The insider trading results indicate that firms in which the top five managers cash out grant 11 to 19% 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 overvaluation reason 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.[13] Core and Guay (2001) argue that equity compensation is efficient if firms need to raise cash and if the information asymmetries between firms and their employees are smaller than those between firms and outside investors. We therefore control for several measures of cash constraints in our empirical analysis. We find that option grants are strongly *positively* associated with corporate cash balances and contemporaneous cash flows, and *negatively* related to cash outflows for debt service (interest burden, leverage). These findings cast doubt on the hypotheses that option grants are motivated by asymmetric information and cash constraints. Instead, the results are again supportive of the idea that employee sentiment determines the ability of firms to compensate their employees with equity: employees are likely to display 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-Majluf (1984) pecking order theory. We propose that equity based compensation is not driven by firms' intention to raise funds, but instead by exuberant employees who want to be paid with options. This explanation is also consistent with Kahle's (2001) finding that many firms repurchase (rather than issue) shares to fund option exercises by employees.[14]

Beyond our own empirical results, our model can explain the survey evidence of Ittner, Lambert, and Larcker (2003) that firms need to compensate with options in order to attract and retain employees. 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 in its competitors: Snider (2000) reports that top law firms were forced to massively increase the salaries for associates to prevent them from leaving to internet start-ups offering equity-based compensation. In

[12] We define non-executive employees as all employees except the five most highly paid executives identified in the proxy statement. This definition is used by several studies (Core and Guay, 2001; Desai 2002) and is imposed by the available data.

[13] See, for example, Yermack (1995), Dechow et al. (1996), and Core and Guay (2001).

addition, our model is consistent with the empirical dominance of options over restricted stock as employees are more likely to overpay for options given that a close substitute to restricted stock is traded in the market.[15]

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 (2004), who perform a calibration exercise to assess the effect of optimism about future returns on employees' relative valuations of stock and options. In addition to the novel empirical evidence presented here, the main difference in our approach is that their analysis does not consider employees' ability to purchase equity in the market. Our model shows that financial markets put a crucial constraint on firms' ability to extract rents from employees, and that employees' relative valuations for stock and options are of only secondary importance. Our analysis differs further from Oyer and Schaefer in that we explicitly model the effect of employee sentiment on labor market equilibria, taking into account firm-specific human capital risk and allowing for equity to be mispriced by the market. Another related paper is that by Liang and Weisbenner (2001), in which options are viewed as a reward for past performance, leading to a positive relationship between firm stock prices and option grants. Liang and Weisbenner also discuss the possibility that employee demand for options may be a function of past performance.

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 on employee option plans and on employees' psychological biases until section 3. Section 4 translates the model and the prior literature on the formation of 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 firm compete in the labor market and compensate their employees using cash and equity instruments. 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

[14] There are many examples of firms which broadly grant options and repurchase shares in the same year, even though the repurchases occur when options are exercised, often several years after their granting.

$f(0) = 0$, $f' > 0$, $f'(0) = \infty$, and $f'' < 0$. The two firms hire employees in a competitive labor market by 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.

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 offered by the firms only. We call the former simply "traded equity" and the latter the "non-traded equity 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 differing tradability, we assume that for each firm, the payoff of a unit of the traded and of the non-traded equity is *identical* and given by the random variable $\widetilde{X}_i$ ($i \in \{1,2\}$), 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 to be issued is small relative to the number of equity instruments outstanding so that the expected payoff to an instrument does not change when more instruments are issued.[16] 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 with regard to the expected payoffs to the equity instruments of firm 1. Parameterizing employee sentiment by s, employees believe the payoff of a unit of traded equity to be $\widetilde{X}_1 + s$, and the payoff of a unit of the non-traded compensation instrument to be $\widetilde{X}_1 + z(s)$, with $z'(s) > 0$. Thus, we assume that employees do not recognize the fundamental equivalence in payoffs between the non-traded compensation instrument and traded equity, and allow employees to exhibit differing sentiment towards each.

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

[15] The greater popularity of options compared to stock is usually attributed to their favorable accounting treatment (Murphy (2002)).

both possibilities (i.e. $s \geq z$ and $s < z$) in the analysis below. We motivate the assumption that employees do not recognize the equivalence between traded equity and the non-traded compensation instrument by the observation that most employees are completely unfamiliar with asset pricing techniques. Deriving the value of a non-traded compensation instrument from the observed prices and volatilities of traded equity is potentially difficult and beyond the abilities of employees. They may therefore disregard the close substitutability of the traded and non-traded equity, and value the non-traded compensation instrument using simple heuristics based on, say, experienced 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.

In contrast to firm 1, potential employees do not display sentiment 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 an "old economy" industry for which sentiment plays no role. Modeling two firms with non-zero sentiment does not change the results, but greatly complicates the exposition . Similarly, the modeling assumption that the traded and non-traded equity instruments are identical and linear claims is a convenient simplification; assuming instead that the non-traded compensation instrument is, for example, an option-like claim and replacing the traded equity by employees' preferred trading strategy would deliver similar results. In this context, the difference in sentiment between traded equity and the non-traded compensation instrument would measure whether employees prefer the compensation instrument to the best asset or trading strategy the employees are able to identify in the market.[17]

The model takes into account that employees bear risk associated with firm-specific human capital correlated with the equity values of their employer. We model this risk in a reduced form manner, assuming that when working for firm *i*, employees obtain implicit random compensation $\widetilde{Y}_i$, with mean 0, variance σ_{Yi}, and $Cov(\widetilde{Y}_i, \widetilde{X}_i) \equiv \phi_i \geq 0$. To simplify notation, the level of firm-specific human capital risk is the same in both firms, so that $\sigma_{Y1} = \sigma_{Y2} = \sigma_Y$ and $\phi_1 = \phi_2 = \phi$. 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 $0 \leq p'(s) \leq 1$. In this

[16] This assumption of infinitesimal dilution is similar in spirit to the "infinitesimal new loans" assumption in Stein (1998).

[17] Borrowing constraints and transaction costs may be reasons different from bounded rationality for why employees are unable to use traded equity to create claims that they prefer to the compensation instruments offered by the firm.

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.[18] As there is no sentiment towards firm 2 equity, its market price equals its fundamental value of 1.

Potential employees evaluate compensation contracts offered by each firm (W_i, N_i, M_i) using their subjective beliefs about firm value, taking into account their ability to purchase traded equity on their own. For empirical realism, we assume that employees cannot 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 equity correctly, it is easy to see that employees never purchase firm 2 equity on their own. In contrast, traded 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:

$$\begin{aligned}\hat{E}\left[U(\hat{N}_1;W_1,N_1,s)\right] &= \hat{E}\left[W_1+(N_1+\hat{N}_1)\cdot\tilde{X}_1+M_1\cdot\tilde{X}_1+\tilde{Y}_1\right]-\frac{1}{2}Var\left[W_1+(N_1+\hat{N}_1)\cdot\tilde{X}_1+M_1\cdot\tilde{X}_1+\tilde{Y}_1\right]-p(s)\hat{N}_1\\ &= W_1+(N_1+\hat{N}_1)\cdot(1+s)-p(s)\hat{N}_1+M_1(1+z(s))-\frac{1}{2}[(N_1+\hat{N}_1+M_1)^2\cdot\sigma_1^2+\sigma_Y^2+2(N_1+\hat{N}_1+M_1)\phi]\end{aligned} \quad (2)$$

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

Lemma 1 The solution of the portfolio choice problem is given by:

(a) for firm 1 employees: $$\hat{N}_1^1 = Max\ \ \{0, \frac{1+s-p(s)-\phi}{\sigma^2} - N_1 - M_1\} \quad (3)$$

(b) for firm 2 employees: $$\hat{N}_1^2 = Max\ \ \{0, \frac{1+s-p(s)}{\sigma^2}\} \quad (4)$$

[18] This price structure is the outcome of standard models of financial markets with noise traders and limited arbitrage (see, for example, Shleifer (2000)).

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. If an employee has received more than her desired allocation of firm 1 equity as compensation, she would prefer to sell units of the traded equity instrument, but is by assumption precluded from doing so. 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 firm-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 the fact that employees may purchase equity on their own, and that employees will work for the competing firm if its contract is more attractive:

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

$$s.t.\quad \hat{E}\left[U(W_i, N_i, \hat{N}_1^i, M_i; s, z(s), \phi, p(s))\right] \geq 0 \tag{5}$$

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

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. However, as will be shown, this conclusion may be reversed by sufficiently positive employee sentiment.

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:

$$\hat{E}\left[U(W_1^*, N_1^*, \hat{N}_1^1, M_1^*; s, z(s), \phi, p(s))\right] = \hat{E}\left[U(W_2^*, N_2^*, \hat{N}_1^2, M_2^*; s, z(s), \phi, p(s))\right],$$

where $\hat{N}_1^1$ and $\hat{N}_1^2$ are the optimal portfolio purchases of traded firm 1 equity by firm 1 and firm 2 employees respectively given in equations (3) and (4).

(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.

$$(i)\ \ f'(l_1^*) = W_1^* + N_1^* + M_1^*$$
$$(ii)\ \ f'(l_2^*) = W_2^*$$
$$(iii)\ \ l_1^* + l_2^* = 1$$

(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:

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

Proof See Appendix A.

The equilibrium 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).[19] Also, as is standard, 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). In contrast, firm 1 offers either traded or non-traded equity whenever the employees' willingness-to-pay for equity exceeds its fundamental value (part d). When doing so, the firm offers the equity claim towards which employees exhibit higher positive sentiment. The number of units of the equity claim provided equals the number of units the employee would purchase herself if offered to her at a price of 1 per unit. This is because the firm is effectively issuing equity to employees at a cost equal to the fundamental value of 1 per unit.

Understanding employees' willingness-to-pay for the offered equity is the key to understanding equity compensation. Part (d) of Theorem 1 shows that employee optimism is, by itself, insufficient to make equity compensation profitable and to force firms away from cash wages. The essential insight is that the firm is directly competing with the stock market as supplier of traded equity to employees. As a result, employees' willingness-to-pay for traded equity is capped by the market price of equity, *independently of their degree of optimism*. The implication can be most easily seen in the case in which markets are efficient and optimistic employees prefer traded equity to the compensation instrument (case (d.i)), so that, following Theorem 1, the firm is considering whether to pay its employees with traded equity or cash. In equilibrium, since employees can purchase traded equity on their own, they never give up more than the market price p for each unit with which they are compensated. With perfectly efficient markets, the cost to the firm of providing a unit of traded equity – its fundamental value – exactly equals the price which employees are willing to pay. Firm 1 is therefore indifferent between paying with cash and paying with traded equity of the same market value.[20] This result has been largely overlooked by the prior literature, which has focused on employees' valuations of equity claims rather than their willingness to pay for equity .

When markets are not perfectly efficient, in the sense that sentiment does affect equity prices (case (d.ii)), then firm 1 is no longer indifferent to the amount of traded equity it "issues" to its employees. Because optimistic employees' willingness to pay for traded equity goes as high as the (overvalued) market price, compensating employees with traded equity becomes profitable for the firm, as it is, in

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

[20] To be more precise, firm 1 is indifferent between paying with cash and paying with stock of the same market value up to $\frac{s-\phi}{\sigma^2}$ shares, at which point the employees' marginal willingness to pay exactly equals the fundamental value of 1 per share.

effect, equivalent to issuing overvalued equity to the market.[21] Viewing cases (d.i) and (d.ii) of Theorem 1 together, we see that compensating employees with the traded equity instrument *cannot* be motivated by employee sentiment alone. A necessary additional ingredient for compensation with traded equity to be profitable is an overvalued equity price.

In contrast, compensating employees with the *non-traded* equity instrument *can* be explained by employee sentiment alone. The crucial difference is that employees' willingness to pay for non-traded equity may exceed its fair market value.[22] Because firm 1 is a monopoly supplier of its non-traded compensation instrument, it is able to extract any sentiment premium for the compensation instrument over the traded equity (given by $z(s) - s$). The availability of traded equity continues to place a cap on the amount of rents the firm can extract: the maximum amount optimistic employees are willing to pay for the compensation instrument is the market price of a unit of traded equity plus the employees' excess valuation of the compensation instrument over traded equity. For example, if the market price of traded firm 1 equity is \$5 per share, and optimistic employees value the traded equity at \$10 and the compensation instrument at \$11, then employees are willing to forgo at most \$6 (= \$5 + (\$11 – \$10)) in cash wages for a unit of the compensation instrument (and only \$5 in wages for a unit of traded equity). The sentiment premium for the compensation instrument over traded equity ($z(s) - s$) is equal to \$1 and is successfully extracted by firm 1. As can be seen from case (d.iii) of Theorem 1, this occurs whenever sentiment towards the non-traded compensation instrument is sufficiently high to overcome the cost of being exposed to both equity and firm specific human capital risk ($z(s) > \phi$), and when sentiment towards the compensation instrument is greater than towards traded equity ($z(s) > s$).

Theorem 1 identifies two channels through which sentiment-induced equity compensation affects the profits and relative sizes of the two firms. First, sentiment directly affects employees' valuations of the two equity claims, and second, sentiment may affect stock prices. The following theorem demonstrates formally how sentiment affects the profit levels of the two firms in equilibrium. It is straightforward to show that employment levels (firm size) and profits are strictly increasing functions of each other in our model, and hence identical results apply to employment levels as well.

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[21] See footnote 6 for reasons why firms may prefer either equity compensation or direct equity issuance in this situation.

[22] Recall that even though options are not traded, their fair market value can be deduced from the price of the fundamentally equivalent traded shares.

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:

$$\max(z - s, 0) + (p(s) - 1) > \phi. \tag{6}$$

(b) If $\max(s, z) \leq \phi$, so that firm 1 pays in 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 firm extracts a sentiment premium for the non-traded compensation instrument over the traded equity when such a sentiment premium exists, as represented by the $\max(z - s, 0)$ term in (6). When traded equity is preferred to the compensation instrument ($s > z$), this channel shuts down because employees can buy their preferred equity instrument in the market with no need for the firm. The second channel works through sentiment's effect on stock prices as represented by the $(p(s) - 1)$ term in (6). Positive sentiment combined with imperfect arbitrage leads 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 combined overvaluation $(p(s) - 1)$ and option premium $(z(s) - s)$ exceed 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.[23] All else equal, this places firm 1 at a disadvantage relative to firm 2; indeed, as can be seen from part (b) of the theorem, when employees are excited about traded firm 1 equity, but not sufficiently excited to

[23] Recall that, because employees exhibit sentiment only towards firm 1, they hold firm 1 but not firm 2 equity in our model. In general, if employees exhibit positive sentiment towards both firms, the firm with greater positive sentiment is the one towards which, ceteris paribus, employees have more equity exposure, and therefore the one which must compensate its employees more for their attendant firm specific human capital risk.

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 work in firm 2 and invest in firm 1.

In summary, the model has identified two reasons why firms pay optimistic employees with a non-traded equity compensation instrument: the extraction of a sentiment premium and the issuing of overvalued equity to employees. In both cases, firms pay with the compensation instrument because employees are willing to overpay for equity compensation. Beyond the motivation for paying employees with equity, the model 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.

Thus, which firm benefits from employee sentiment in reality depends on the level of 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. Market overvaluation of firm 1 stock caused by positive sentiment and limits to arbitrage advantages firm 1 further.[24] In light of our model, the stock option boom of the 1990s' technology bubble likely represents a case of positive sentiment towards options combined with overvalued stock prices, which lead to an expansion of technology firms at the expense of other firms.

With the theoretical foundation for the use of equity compensation to optimistic employees established, we next review the prior empirical and theoretical literature on broad-based equity compensation. We pay particular attention to the behavioral literature on expectations formation and to the empirical literature on employee behavior towards company stock, in order to derive predictions about where and when employee sentiment is likely to induce equity-based compensation.

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[24] A natural extension of our model would allow for employee sentiment to affect also employees' perception of the value of their human capital. Positive sentiment towards firm 1 then gives employees a direct preference for

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 (2004) 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.[25] 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.[26] A large number of papers quantify the deadweight loss from selling company equity and options to employees, with a general consensus that employees' rational valuations of company stock and options are significantly below fair market values.[27] Inderst and Müller (2004) show that 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 (2004) argue that option compensation allows firms to screen for optimistic employees. As we discuss in the introduction, Oyer and Schaefer focus on employees' valuations rather than their willingness-to-pay for equity compensation, and they do not incorporate firms' competition with the stock market as supplier of equity to employees into their analysis. The model in the previous section demonstrates the importance of the constraints this competition imposes on the firm.

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 (2001) document that stock option compensation is used

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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.

[25] Kruse and Blasi (1997) and Kruse (2002) review the evidence on the hypothesis that equity ownership by employees helps to align stakeholder interests and find mixed results at best.

[26] Oyer and Schaefer (2004) 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.

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

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. 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 incur no outlay of cash. We view this hypothesis as complimentary to the employee sentiment hypothesis, though we note that it does not explain the cross-sectional and time series patterns of option compensation presented in Section 6. 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.[28]

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 stock performance allocate 40%. There is no evidence that allocations to company stock predict future performance.[29] Huberman and Sengmüller (2004) analyze 401(k) allocations in a larger sample and find that employees choose higher inflow allocations and transfers to company stock based on past returns over a three-year window, and to a much smaller extent based on volatility and business performance. Liang and Weisbenner (2002) show that the average share of participants' discretionary 401(k) allocations in company stock is almost 20%, and 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: excessive extrapolation can be attributed to the representativeness heuristic described by Tversky and Kahneman (1974). They show that people expect that a sequence of events generated by a random process will resemble the essential characteristics of that process even when the sequence is short. In an extension, Griffin and Tversky (1992) document that

[28] 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. See also Core and Guay (2001).

[29] 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. Despite the fact that individual stock returns are largely unpredictable, the respondents' past and future ratings where positively correlated with a ρ of 0.52, consistent with excessive extrapolation.

people tend to focus on the strength or extremeness of the 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 high firm-specific human capital risk invested more in their employer's equity. Consistent with this, Klos and Weber (2004) report evidence from laboratory experiments showing that investors fail to take background risk into account when making investment decisions. The empirical evidence, therefore, 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.[30]

4. Empirical Predictions

The model in Section 2 predicts that equity-based compensation is used when employees are optimistic about the non-traded equity compensation instrument and value it above its fair market value ($z(s) > 0$), and when employees strictly prefer the non-traded compensation instrument to the equity available in the market ($z(s) > s$). Greater employee exuberance about firm equity 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: for most firms, 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

[30] An alternative interpretation suggested by Huberman (2001) is that concerns about firm-specific human capital risk are counterbalanced and outweighed by employees' desire to invest into firms they are "familiar" with.

exceed the abilities of almost all employees.[31] Most employees are likely to simply compare the compensation instrument 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.

The results in Benartzi (2001) and Huberman and Sengmüller (2002) suggest that prior stock returns are a major determinant of employees' willingness to invest in company stock, with sentiment improving 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 (high leverage, high interest burden) are associated with worsening sentiment. Finally, we make use of the psychology literature on expectations formation reviewed above to understand the factors determining excessive extrapolation. These considerations lead to a number of testable hypotheses.

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, we conjecture that employees extrapolate more strongly from past performance when valuing options than when valuing stock or any other simple traded equity position which they recognize. 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 notation of our model, we expect employee sentiment for the non-traded compensation instrument (options) to react more strongly to past performance than sentiment for traded equity ($z'(s) > 1$), and thus the sentiment premium of 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 equity compensation after periods of high stock returns ($z(s) - s > \phi$).

The observation that employees' private valuations of company equity increase in past performance (and for many rise above the market price), combined with the hypothesized increase in the sentiment premium of options over stock in past performance, leads to our first testable hypothesis[32]:

[31] 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.
[32] A similar hypothesis appears in Liang and Weisbenner (2001).

H1: 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 conjecture that the relationship between past performance and employee sentiment is non-linear, with employee exuberance associated mostly with extraordinarily good returns. Extraordinarily good returns are further amplified in option payoffs, making it likely that option sentiment exceeds sentiment for traded equity. This leads to our second hypothesis:

H2: 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:

H3: 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 indeed are likely to 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. Our fourth hypothesis is therefore:

H4: Firms in financial or economic distress should be less likely to pay their employees with options.

Our model of employee compensation predicts 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 fifth hypothesis predicts a positive link between option compensation and employment growth:

> *H5: Firms which pay their employees with options are characterized by 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. With our without sentiment premium for options, managers are likely to use actual or perceived inside information about firm value when deciding on the optimal compensation mix. This leads to our final hypothesis:

> *H6: Firms are more likely to use options and grant more options to employees whenever managers have reason to view the stock as overvalued.*

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 represented by grants to the top five executives. In particular, the ExecuComp variable "pcttotop" reports the percentage which each grant to executives represents of all options granted to employees. Hence, each reported executive grant provides an estimate of the number of options granted to all employees during the fiscal year. We use the mean of these estimates as a proxy for the number of options granted to all employees 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.[33] The estimates of dividend yield and stock price volatility used in the Black-Scholes formula are taken from ExecuComp.[34] The risk-free rate is set to 6 percent, and option maturity is uniformly set to ten years.[35] Finally, we calculate the per-employee value of options granted by dividing the value of options granted to all non-executive employees by the average of the beginning-of-the-year and end-of-the-year number of employees.

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 options grants, introducing noise into the grant valuations. Finally, 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. This introduces a sample selection bias which we discuss in detail in Section 6.5. An additional weakness of the data, common to all studies on this topic, 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 on employee option grants. We obtain the data on option grants collected from annual reports by Core and

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[33] Our results do not materially change when the price at which the options are valued and their exercise price are taken to be the midpoint of the year high and year low stock price, or the midpoint of the year open and close stock prices. The results are similarly unchanged when the per-option value of the executive options reported in ExecuComp is used as estimate of the value of the employee options.

[34] 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.

[35] The last assumption likely overstates the estimated life of the options since employees tend to exercise options early (Huddart and Lang (1996)) and because some options are forfeited. Assuming shorter maturities of five or seven years does not change our results.

Guay (2001) for the years 1995 to 1997 for a subset of the companies in our full sample.[36] We then extend the Core and Guay data through further hand collection to the years 1998 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 data set are robust and usually stronger in the hand-collected data.

5.2 Variable Definitions

Our main measure of past performance (and hence sentiment) in year t is the annualized stock return, taken from CRSP, over the previous two years 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. A 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 Saa-Requejo (2001). We follow Baker, Stein and Wurgler (2003) and calculate the Kaplan Zingales (KZ) measure of financial constraints as:

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

[36] Core and Guay (2001) collect data from annual reports for 1997 for all firms (excluding banks) with fiscal year 1997 data in the ExecuComp database. We are grateful to John Core and Wayne Guay for kindly making their data available to us.

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 the previous literature, we further control for investment opportunities, hypothesizing that employees in firms with higher growth opportunities will be granted more options. This could be the case because providing incentives to employees is more important with greater growth opportunities, because growth firms need to preserve cash, or because employee sentiment is higher in growth firms. As in Core and Guay (2001), we use the three-year average of R&D scaled by assets as a proxy for growth opportunities. We include Q as an alternative measure of growth opportunities in most regressions. Finally, we also control for sales as measure of firm size, and use a long-term debt indicator as a proxy for access to debt markets.

Our model predicts that managers' perception of misvaluation is a determinant of employee option grants. To assess the effect of managerial inside information on compensation policy, we examine the relationship between option grants to non-executive employees and earnings manipulation. We use 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. This measure has been criticized by Hribar and Collins (2001) who show that it is prone to misinterpret merger effects and foreign currency adjustments as earnings manipulation. Hribar and Collins 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 a year-by-year industry level regression model. 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 discretionary accruals in the top 10% of all firm-years as "manipulators".

Finally, we use insider trading by managers as another indicator of manager opinion about fundamental firm value. Managerial insider trading is calculated as in Jenter (2004) 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.

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 because information on at least one of the variables used in our base regressions is missing.[37] The final data set used in our base regressions comprises 2,171 firms and 12,898 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.[38]

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[37] 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 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.

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

6. Empirical Results

As an initial test of the employee sentiment hypothesis, 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 7 percent (7 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 lowest return quintile grant options with a mean (median) value of $7,850 ($1,116) while firms with prior returns in the top quintile grant options worth $21,155 ($2,838). Hence, consistent with out first hypothesis, intensive use of non-executive options is preceded by extraordinarily good performance.

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

$$Ln(1 + grants \quad per \quad employee)_{it} = \beta_0 + \beta_1 ret_{it-1} + \beta_2 X_{it} + \varepsilon_{it}. \tag{7}$$

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

6.1 The effect of past performance on employee option grants

We first test the hypothesis that employee option grants increase in prior stock price performance. In each column of Table 3 a different measure of financial constraints is included as explanatory variable, and past performance is measured as the stock return over the previous two years. 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 5.3 to 8.6 percent increase in the value of options granted. The t-statistics, calculated using robust standard errors with clustering at the firm level, are between 12.29 and 18.93. We thus confirm the results in Liang and Weisbenner (2001) showing that employee option grants are used more intensively by firms with better past stock price performance. 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 (Table 4) does not materially change the results.

Our second hypothesis is that the relationship between stock price performance and employee sentiment should be non-linear, so that option grants are 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. Repeating the analysis from Table 3 while replacing the prior return variable with the performance quintile dummies shows that the effect of past returns on option grants is indeed highly non-linear (Table 5): in each specification the effect of moving from quintile one to quintile four is smaller than the effect of moving from quintile four to quintile five.

To test our third hypothesis that firms should be most likely to grant options to employees after the stock price has done well for several years, 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 29 percent larger in the highest return quintile compared to the lowest quintile. This difference increases to 67 percent when sorting on previous 3-year returns, and to 87 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, increasing in cash flow, increasing in Q, and decreasing in leverage.[39] 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. 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 are supportive of the sentiment 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 like leverage and interest burden are associated with less use of options. Since composite measures of cash constraints include both components which are positively related to sentiment as well as components negatively related to sentiment, these results explain why different composite measures of cash constraints show conflicting correlations with option grants.[40]

6.3 Employee option grants in distressed firms

The fourth hypothesis 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 face binding cash constraints and would like to compensate their employees with equity, 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 end of the current fiscal year, and a second indicator variable for firms which delist in the second year after the end of the current fiscal year. Performance-related delistings are identified through CRSP delisting codes in the 400 to 591 range. We propose that these firms have both employees with low sentiment and an urgent need to conserve cash. Table 8 shows the results of

[39] The same positive relationship between cash balances and option grants shows up in the univariate results in Table 2C. Firms in the lowest cash balance quintile pay a mean (median) option value of $2,274 ($524) to each employee while those in the highest cash quintile pay a mean (median) value of $30,111 ($10,525).

[40] 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.

regressing the log of per-employee option grants on the two delisting dummies and the same control variables as in the base regression. In support of the sentiment hypothesis, firms which are about to delist grant significantly fewer options to their employees. In the specifications with industry fixed effects, firms which are one year from delisting grant between 72 and 74 percent less to their employees than firms which do not delist, while firms which are two years from delisting grant 40 percent less, with all coefficients highly significant. The coefficients are smaller and less significant when firm fixed effects are included, indicating that firms one year from delisting grant between 48 (p-value 0.088) and 54 (p-value 0.055) percent less, and firms two years from delisting 30 percent less than firms which do not delist (p-value 0.123).[41]

6.4 Employee Options and Growth in Employment

Our fifth hypothesis predicts a positive link between employment growth and employee option compensation. 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 7.1 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 various 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. Table 10 shows that our base regression results are robust to restricting the sample to firms with more than 500 and to firms with 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

[41] This analysis does not necessarily generalize to all distressed firms. We identify firms which are subsequently delisted, i.e. most likely firms which did not manage to recover, and show that they were unable or unwilling to conserve cash by paying their employees in options. It is possible that other firms were able to substitute options for cash pay and to avert the delisting.

negative, suggesting that a censored (Tobit) regression model is the appropriate choice. Table 11 repeats the base regression using a Tobit set-up. The coefficient estimates are quite similar to the linear regressions in Tables 3 and 4, even though, as would be expected from the censoring- induced attenuation bias, the Tobit coefficients are generally larger and more significant than the coefficients from the linear regressions.

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. We lose firm-years in which no top executive receives options, leading to a sample selection problem. 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 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 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 stock option grants to decline due to worsening sentiment.

The only method to confirm that the sample selection bias does indeed 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 1998 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 12. Regressions (1) and (2) are linear regressions corresponding to the analyses in Tables 3 and 4, while regressions (3) and (4) are Tobit regressions corresponding to the analyses in Table 11. 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 7.4 and 10.9 percent. For comparison, Panel B shows the same regressions for the same set of firms and the same sample period but using options data extrapolated from ExecuComp rather than the hand-collected data.

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 the fundamental value of the firm in relation to its market value. One such situation is when managers manipulate 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 discretionary accruals, based on Teoh et al.'s (1998 a,b) cross-sectional adaptation of the modified Jones (1991) model. The first measure of discretionary accruals is based on current accruals calculated from year-to-year changes of the balance sheet. Hribar and Collins (2001) propose two alternative definitions of accruals which are computed directly from the cash flow statement and therefore not affected by non-operating changes in accounts. The details of the calculations are explained in Appendix B. Firms with discretionary accruals in the top 10 percent of all firm-years in our sample are classified as likely manipulators. Table 13 shows the base regression with added indicator variables for earnings manipulators. Consistent with our hypothesis, 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 (2004). We label firms in which managers' normalized inside buying is in the top 20 percent of all firm-years as firms with "buying managers" and firms in which 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 14. Across all specifications with industry fixed effects, we consistently find that firms in which the top five managers cash out grant between 11 and 19 percent more options to their employees than comparable firms, 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.

7. Conclusion

We model the optimal compensation policy of a firm faced with employees who exhibit sentiment towards it, and assess whether employee optimism leads to option compensation. The somewhat surprising answer is 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 restricts or even eliminates firms' incentive to pay with equity. We show that option compensation is used in equilibrium only if employees are willing to overpay for equity. 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 employees are (in some situations) willing to overpay for options because rational option valuation is difficult and beyond their abilities. When faced with the need to evaluate options, employees are likely to rely on heuristics and to value options on the basis of their own or their peers' past experience 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 proceed by providing 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 previous stock returns, 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 in the periods before they delist. 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 the firm to traded shares. Further, as predicted by our model, firms seem to use the lower compensation costs resulting from overpayment for option compensation to expand in size. Finally, also consistent with the model, managers appear to use option compensation for rank-and-file employees more aggressively when managers believe that their company stock is overvalued.

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 (6) 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 $s \le \phi$, so that $\hat{N}_1^1 = 0$. Firm 1's optimization problem is therefore:

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

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

$$N_1 \ge 0, \ \ M_1 \ge 0, \ \ W_1 \ge 0$$

It is easy to see that the first inequality constraint will be binding, and so we can easily 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 $s \le \phi$, it is easy to see from the Kuhn-Tucker complimentary slackness requirements that $N_1 = 0$. Also, if $z \le \phi$, the optimal solution has $M_1 = 0$ and otherwise, $M_1 = \frac{z - \phi}{\sigma^2}$.

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 that written above. The Kuhn-Tucker conditions show that when $z \le s$, 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:

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

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

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

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

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 $\hat{N}_1^1 > 0$.)

Putting it all together, we see that firm 1's optimal compensation policy follows that described in part (d) of Theorem 1. The optimal compensation of firm 2, whereby $N_2^* = M_2^* = 0$, 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 parts (d.i) and (d.ii) of Theorem 1, we have that $N_1^* = \frac{s-\phi}{\sigma^2}$ and $M_1^* = 0$ are optimal for Firm 1. By Lemma 1 we have that $\hat{N}_1^1 = 0$, and $\hat{N}_1^2 = \frac{1+s-p(s)}{\sigma^2}$. Plugging these values of M_1^*, N_1^*, $\hat{N}_1^1$ and $\hat{N}_1^2$ into the equations in 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 part (d.iii) of Theorem 1, we have that $N_1^* = 0$ and $M_1^* = \frac{z-\phi}{\sigma^2}$, so that $\hat{N}_1^1 = 0$, and $\hat{N}_1^2 = \frac{1+s-p(s)}{\sigma^2}$. Applying 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) ≤ ϕ. Using part (d.iv) of Theorem 1, we have that $N_1^* = M_1^* = 0$. By Lemma 1 we have that $\hat{N}_1^1 = 0$, and $\hat{N}_1^2 = \frac{1+s-p(s)}{\sigma^2} \geq 0$. As above, plugging these values into the equation in 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
We use both composite measures of cash constraints developed in other papers as well as their disaggregated components. Core and Guay (2001) propose two measures of financial constraints: cash flow shortfall and interest burden. They define cash flow shortfall as 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 is the three-year average of interest expense (data item 15) scaled by operating income before depreciation (data item 13), where interest burden is set to one when interest expense is greater than operating income before depreciation.

A 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 Saa-Requejo (2001). We follow Baker, Stein and Wurgler (2003) and calculate the Kaplan Zingales (KZ) measure of financial constraints as:

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

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 before the measure is constructed. One conceptual difficulty with the KZ measure for our purposes 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. It is defined as:

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

We interpret KZ4 as a measure of the availability of cash with which a firm can finance its investment opportunities. Thus, in the calculus of supply and demand of cash used to construct a measure of financial constraints, we view KZ4 as representing the supply of cash to a firm.[42] Similarly, Q represents investment opportunities and hence the demand for cash in this calculus.

Measures of earnings manipulation
We use discretionary current accruals as calculated in Teoh, Welch and Wong (1998 a,b) as our first measure of earnings manipulation. Current accruals are defined from the balance sheet as follows:

$$CA_{BS} = \Delta[CurrAsset - Cash] - \Delta[CurrLiab - CurrLTDebt] \qquad \text{(B3)}$$

Here *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

[42] Firms with a high KZ4 measure have a *low* supply of cash.

the current portion of long-term debt (data item 44). Teoh et al. use a cross-sectional adaptation of the modified Jones (1991) model to split current accruals into their discretionary and non-discretionary components. This entails regressing accruals 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:

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

$TA_{j,t-1}$ 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 (fitted) accruals of the sample firm are calculated using the estimated 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.

$$NDCA_{i,t} = \hat{\alpha}\left(\frac{1}{TA_{i,t-1}}\right) + \hat{\beta}\left(\frac{\Delta Sales_{i,t} - \Delta AccRec_{i,t}}{TA_{i,t-1}}\right) \quad \text{(B5)}$$

Here $\Delta AccRec$ is the change in accounts receivables in year t, and is meant to account for changes in credit sales. The remaining current accruals are the residual discretionary current accruals and are the portion of current accruals which are interpreted as signaling earnings manipulation. High values of $DCA_{i,t}$ indicate that earnings have been managed upwards:

$$DCA_{i,t} = \frac{CA_{i,t}}{TA_{i,t-1}} - NDCA_{i,t} \quad \text{(B6)}$$

The balance sheet based measure of earnings manipulation used by Teoh et al. has been criticized by Hribar and Collins (2001) who show that $DCA_{i,t}$ is affected by nonoperating events such as reclassifications, acquisitions, divestitures, accounting changes, and foreign currency translations. In particular, Hribar and Collins show that the misclassification of merger effects as earnings manipulation is empirically important and can lead to incorrect inferences about the presence and effects of earnings manipulation. Hribar and Collins propose two alternative definitions of accruals which are computed directly from the cash flow statement and therefore not affected by non-operating changes in accounts. The first measure captures total accruals and is calculated as

$$TAC_{CF} = EBXI - CFO_{CF} \quad \text{(B7)}$$

where TAC_{CF} stands for total accruals, *EBXI* stands for earnings before extraordinary items and discontinued operations (Compustat 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. Hribar and Collins compute this measure as follows:

$$CA_{CF} = -\left(\Delta AccRec_{CF} + \Delta Inv_{CF} + \Delta AccPay_{CF} + \Delta Tax_{CF} + \Delta Other_{CF} + Dep_{CF}\right) \quad \text{(B8)}$$

Here $\Delta AccRec_{CF}$ 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 on other current assets (data item 307), and Dep_{CF} is depreciation expense (data item 125). Given the two Hribar and Collins measures of accruals, we again split accruals into their discretionary and nondiscretionary components using the cross-sectional industry regression approach as in Teoh et al. and presented above in equations (B4) to (B6).

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Diagram 1: Average option grants per non-executive employee in large firms. Per employee option grants (left y-axis) are the 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. Market cumulative return (right y-axis) is calculated using CRSP value weighted NYSE/AMEX/NASDAQ data. The sample is restricted to firm-year observations in which the average number of employees exceeds 1000.

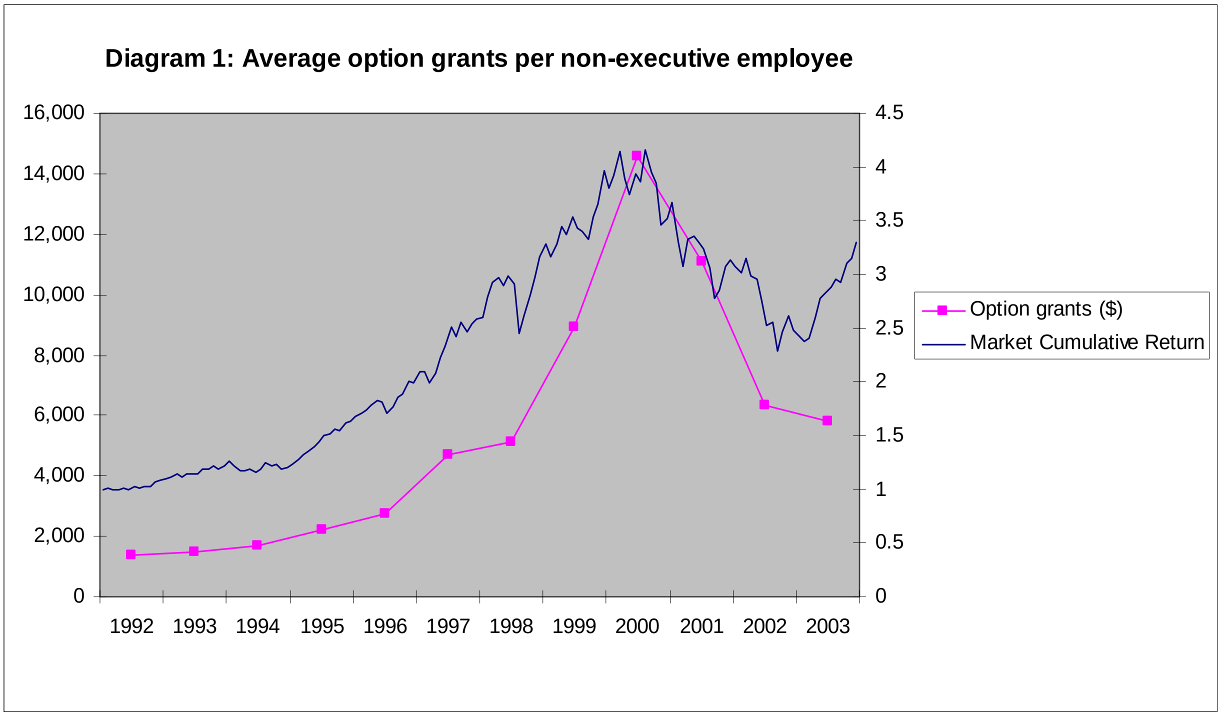

Table 1. Summary statistics. Per employee option grants are the dollar value of options granted to employees divided by the average number of employees during the firm year. The options granted to employees are calculated by subtracting the number of options granted to top-five executives from the total 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 assets. R&D is the three-year average of R&D (data item 46) scaled by 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 total 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 cashflow shortfall	1.44%	0.59%
3-year average of interest burden	20%	13%

Table 2. Prior returns, cash balances and employee option compensation. The per employee option grants are the dollar value of options granted to employees divided by the average number of employees during a 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. Normalized cash balances are calculated as cash balances (Compustat data item 1) divided by lagged assets (data item 6). Stock returns are constructed from the CRSP monthly return files. The stock return over the previous two years is calculated as the annualized stock return over fiscal years t-1 and t-2 for employee option grants made in fiscal year t. Quintile cutoff points are calculated using the entire pooled sample.

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

	Stock return over previous two years	
Option grant quintile	Mean	Median
1	7%	7%
2	13%	10%
3	14%	12%
4	18%	14%
5	30%	19%

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

Stock return quintile over previous two years	Option grant per employee	
	Mean	Median
1	$7,850	$1,116
2	$4,987	$718
3	$4,469	$692
4	$5,632	$888
5	$21,155	$2,838

Panel C: Per employee option grants by cash balance quintile

	Option grant per employee	
Cash balance quintile	Mean	Median
1	$2,274	$524
2	$2,445	$574
3	$3,592	$746
4	$5,674	$1,366
5	$30,111	$10,525

Table 3. Regression 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	**0.86**	**0.54**	**0.55**	**0.54**	**0.53**
	[18.93]**	[12.29]**	[12.79]**	[12.34]**	[12.38]**
Contemporaneous stock return	**0.19**	**-0.04**	**-0.04**	**-0.04**	**-0.02**
	[9.34]**	[1.74]	[1.58]	[1.47]	[0.74]
Q_t		**0.31**	**0.32**	**0.30**	**0.31**
		[14.30]**	[15.10]**	[14.36]**	[14.36]**
KZ_{t-1}	**0.03**				
	[1.26]				
$KZ4_{t-1}$		**-0.02**			**-0.01**
		[0.85]			[0.19]
Cash flow shortfall_{t-1}			**2.11**		**2.36**
			[9.37]**		[10.40]**
Interest burden_{t-1}				**-0.34**	**-0.55**
				[2.84]**	[4.06]**
Log sales	**-0.09**	**-0.10**	**-0.07**	**-0.11**	**-0.08**
	[4.69]**	[5.75]**	[3.89]**	[6.04]**	[4.32]**
Long term debt dummy	**-0.51**	**-0.23**	**-0.33**	**-0.22**	**-0.28**
	[6.04]**	[2.95]**	[4.10]**	[2.74]**	[3.60]**
R&D	**5.28**	**3.96**	**3.29**	**4.30**	**3.79**
	[5.82]**	[4.76]**	[3.85]**	[4.95]**	[4.21]**
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	**5.80**	**5.78**	**5.60**	**5.91**	**5.76**
	[35.02]**	[36.49]**	[34.96]**	[34.97]**	[34.36]**
Observations	12898	12898	12898	12898	12898
Adjusted R-Squared	0.55	0.58	0.58	0.58	0.59

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

Table 4. Regression 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	**0.57**	**0.41**	**0.45**	**0.43**	**0.42**
	[14.86]**	[9.58]**	[10.69]**	[10.17]**	[9.91]**
Contemporaneous stock return	**0.12**	**0.02**	**0.01**	**0.03**	**0.04**
	[7.12]**	[0.93]	[0.58]	[1.11]	[1.77]
Q_t		**0.15**	**0.16**	**0.16**	**0.15**
		[8.46]**	[8.89]**	[8.62]**	[8.57]**
KZ_{t-1}	**-0.03**				
	[1.27]				
$KZ4_{t-1}$		**-0.11**			**-0.07**
		[4.18]**			[2.88]**
Cash flow $shortfall_{t-1}$			**0.83**		**1.03**
			[3.56]**		[4.32]**
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]	[0.60]	[1.50]	[1.45]
Long term debt dummy	**-0.04**	**0.05**	**-0.02**	**0.02**	**0.03**
	[0.64]	[0.70]	[0.28]	[0.38]	[0.54]
R&D	**-1.65**	**-2.13**	**-2.34**	**-1.95**	**-1.89**
	[2.09]*	[3.07]**	[3.34]**	[2.75]**	[2.70]**
Company fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	**5.64**	**5.61**	**5.61**	**6.05**	**5.97**
	[20.37]**	[20.77]**	[20.50]**	[22.18]**	[22.13]**
Observations	12898	12898	12898	12898	12898
Adjusted R-Squared	0.81	0.82	0.82	0.82	0.82

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

Table 5. Regression 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	**0.19**	**0.07**	**0.10**	**0.05**	**0.06**
	[4.28]**	[1.49]	[2.31]*	[1.10]	[1.34]
Quintile 3	**0.32**	**0.13**	**0.18**	**0.11**	**0.13**
	[7.16]**	[2.93]**	[4.01]**	[2.53]*	[2.90]**
Quintile 4	**0.48**	**0.23**	**0.28**	**0.21**	**0.24**
	[11.01]**	[5.35]**	[6.57]**	[4.96]**	[5.47]**
Quintile 5	**0.98**	**0.55**	**0.59**	**0.54**	**0.56**
	[21.90]**	[11.90]**	[12.88]**	[11.72]**	[12.10]**
Contemporaneous stock return	**0.18**	**-0.06**	**-0.06**	**-0.06**	**-0.03**
	[8.72]**	[2.51]*	[2.37]*	[2.41]*	[1.44]
Q_t		**0.32**	**0.33**	**0.32**	**0.31**
		[14.91]**	[15.82]**	[15.15]**	[14.90]**
KZ_{t-1}	**0.02**				
	[1.04]				
$KZ4_{t-1}$		**-0.03**			**-0.02**
		[1.44]			[0.77]
Cash flow $shortfall_{t-1}$			**2.18**		**2.44**
			[9.48]**		[10.57]**
Interest $burden_{t-1}$				**-0.36**	**-0.54**
				[2.94]**	[3.92]**
Log sales	**-0.09**	**-0.10**	**-0.07**	**-0.11**	**-0.08**
	[4.86]**	[5.76]**	[3.96]**	[6.07]**	[4.26]**
Long term debt dummy	**-0.51**	**-0.21**	**-0.32**	**-0.21**	**-0.26**
	[5.92]**	[2.67]**	[4.04]**	[2.61]**	[3.36]**
R&D	**5.19**	**3.84**	**3.16**	**4.18**	**3.64**
	[5.62]**	[4.59]**	[3.66]**	[4.78]**	[4.03]**
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	**6.47**	**6.22**	**6.03**	**6.37**	**6.18**
	[41.16]**	[41.03]**	[39.24]**	[39.10]**	[37.93]**
Observations	12898	12898	12898	12898	12898
Adjusted R-Squared	0.55	0.57	0.58	0.58	0.58

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

Table 6. Regression 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	**-0.01**	**0.07**	**0.11**	**0.16**	**0.19**
	[0.19]	[1.37]	[2.39]*	[3.29]**	[3.99]**
Quintile 3	**0.01**	**0.11**	**0.25**	**0.28**	**0.31**
	[0.11]	[2.39]*	[5.11]**	[5.47]**	[5.86]**
Quintile 4	**0.05**	**0.20**	**0.39**	**0.49**	**0.52**
	[1.01]	[4.21]**	[7.78]**	[9.17]**	[9.29]**
Quintile 5	**0.29**	**0.52**	**0.67**	**0.77**	**0.87**
	[6.59]**	[10.50]**	[12.67]**	[12.94]**	[13.70]**
Contemporaneous stock return	**-0.08**	**-0.05**	**-0.03**	**-0.01**	**-0.01**
	[3.08]**	[1.76]	[0.95]	[0.44]	[0.18]
Q_t	**0.37**	**0.34**	**0.32**	**0.30**	**0.29**
	[14.80]**	[13.32]**	[12.68]**	[12.12]**	[11.52]**
$KZ4_{t-1}$	**0.01**	**0.01**	**0.01**	**0.01**	**0.00**
	[0.27]	[0.39]	[0.45]	[0.36]	[0.15]
Cash flow $shortfall_{t-1}$	**1.83**	**1.85**	**1.69**	**1.42**	**1.27**
	[6.45]**	[6.56]**	[6.05]**	[5.13]**	[4.55]**
Interest $burden_{t-1}$	**-0.63**	**-0.58**	**-0.44**	**-0.32**	**-0.22**
	[4.00]**	[3.70]**	[2.83]**	[2.02]*	[1.43]
Log sales	**-0.05**	**-0.05**	**-0.05**	**-0.05**	**-0.06**
	[2.37]*	[2.33]*	[2.48]*	[2.57]*	[2.73]**
Long term debt dummy	**-0.26**	**-0.29**	**-0.29**	**-0.28**	**-0.27**
	[3.01]**	[3.27]**	[3.27]**	[3.23]**	[3.16]**
R&D	**3.39**	**3.55**	**3.66**	**3.80**	**3.89**
	[3.58]**	[3.70]**	[3.81]**	[3.95]**	[4.01]**
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	**5.91**	**5.86**	**5.71**	**5.62**	**5.65**
	[32.20]**	[31.98]**	[31.34]**	[30.86]**	[31.30]**
Observations	11143	11143	11143	11143	11143
Adjusted R-Squared	0.56	0.57	0.57	0.57	0.57

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

Table 7. Regression 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 assets (data item 6). All other variables are defined as in Tables 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	**0.85**	**0.51**	**0.33**	**0.51**	**0.53**	**0.27**
	[18.76]**	[11.00]**	[7.79]**	[11.92]**	[12.72]**	[6.60]**
Contemporaneous stock return	**0.19**	**-0.04**	**-0.01**	**-0.03**	**0.01**	**0.00**
	[9.20]**	[1.47]	[0.50]	[1.42]	[0.24]	[0.17]
Q_t		**0.30**	**0.28**	**0.30**	**0.28**	**0.29**
		[13.76]**	[13.91]**	[14.40]**	[14.24]**	[14.51]**
Dividends_{t-1}	**-10.85**					**-14.63**
	[6.09]**					[8.89]**
Cash flow_{t-1}		**0.52**				**-0.04**
		[2.49]*				[0.21]
$\text{Cash balances}_{t-1}$			**1.41**			**1.18**
			[15.63]**			[13.88]**
Leverage_{t-1}				**-0.63**		**-0.65**
				[6.01]**		[6.32]**
$\text{Cash flow to investment}_{t-1}$					**3.41**	**2.67**
					[11.84]**	[9.70]**
Log sales	**-0.05**	**-0.11**	**-0.06**	**-0.09**	**-0.08**	**0.02**
	[2.84]**	[5.91]**	[3.12]**	[4.71]**	[4.70]**	[0.81]
Long term debt dummy	**-0.54**	**-0.23**	**-0.08**	**-0.12**	**-0.28**	**-0.04**
	[6.58]**	[2.92]**	[1.08]	[1.51]	[3.59]**	[0.63]
R&D	**5.26**	**4.32**	**3.07**	**3.97**	**4.95**	**3.74**
	[5.85]**	[4.95]**	[4.19]**	[4.88]**	[6.90]**	[5.94]**
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	**5.83**	**5.80**	**5.38**	**5.80**	**5.34**	**5.16**
	[35.75]**	[36.21]**	[34.22]**	[36.51]**	[34.10]**	[34.16]**
Observations	12898	12898	12898	12898	12898	12898
Adjusted R-Squared	0.56	0.58	0.59	0.58	0.59	0.62

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

Table 8. Regression of log option grants per employee on past returns, measures of distress, and measures of cash constraints. Distress is measured 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. 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)	**-0.72**	**-0.48**	**-0.74**	**-0.54**
	[2.98]**	[1.71]	[3.06]**	[1.92]
Delisted two years later (t+2)			**-0.40**	**-0.30**
			[2.18]*	[1.54]
Stock return over previous two years	**0.53**	**0.41**	**0.52**	**0.41**
	[12.30]**	[9.88]**	[12.26]**	[9.85]**
Contemporaneous stock return	**-0.02**	**0.04**	**-0.03**	**0.03**
	[0.98]	[1.60]	[1.12]	[1.52]
Q_t	**0.31**	**0.15**	**0.31**	**0.16**
	[14.35]**	[8.59]**	[14.39]**	[8.61]**
$KZ4_{t-1}$	**-0.01**	**-0.075**	**-0.004**	**-0.075**
	[0.17]	[2.90]**	[0.15]	[2.88]**
Cash flow $shortfall_{t-1}$	**2.38**	**1.04**	**2.39**	**1.04**
	[10.46]**	[4.37]**	[10.51]**	[4.37]**
Interest $burden_{t-1}$	**-0.53**	**-0.77**	**-0.52**	**-0.76**
	[3.90]**	[6.27]**	[3.83]**	[6.20]**
Log sales	**-0.08**	**-0.06**	**-0.08**	**-0.06**
	[4.35]**	[1.53]	[4.40]**	[1.60]
Long term debt dummy	**-0.28**	**0.03**	**-0.28**	**0.03**
	[3.62]**	[0.49]	[3.60]**	[0.52]
R&D	**3.79**	**-1.84**	**3.80**	**-1.81**
	[4.21]**	[2.55]*	[4.21]**	[2.49]*
Industry fixed effects	Yes		Yes	
Firm fixed effects		Yes		Yes
Year fixed effects	Yes	Yes	Yes	Yes
Constant	**5.77**	**5.99**	**5.78**	**6.01**
	[34.44]**	[22.19]**	[34.50]**	[22.30]**
Observations	12898	12898	12898	12898
Adjusted R-Squared	0.59	0.82	0.59	0.82

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

Table 9. Regression 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	**0.71**	**0.39**
	[12.48]**	[7.95]**
Stock return over previous two years	**0.42**	**0.37**
	[9.88]**	[8.77]**
Contemporaneous stock return	**-0.06**	**0.02**
	[2.39]*	[0.81]
Q_t	**0.30**	**0.15**
	[13.90]**	[8.52]**
$KZ4_{t-1}$	**0.00**	**-0.058**
	[0.05]	[2.26]*
Cash flow $shortfall_{t-1}$	**2.10**	**1.00**
	[9.41]**	[4.27]**
Interest $burden_{t-1}$	**-0.48**	**-0.76**
	[3.59]**	[6.26]**
Log sales	**-0.07**	**-0.06**
	[3.90]**	[1.56]
Long term debt dummy	**-0.30**	**0.01**
	[3.88]**	[0.11]
R&D	**3.99**	**-1.80**
	[4.47]**	[2.66]**
Industry fixed effects	Yes	
Firm fixed effects		Yes
Year fixed effects	Yes	Yes
Constant	**5.86**	**6.07**
	[35.40]**	[22.69]**
Observations	12898	12898
Adjusted R-Squared	0.59	0.82

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

Table 10. Regression of log option grants per employee on past returns and measures of cash constraints for large firms only. Regressions (1) and (2) exclude firm years with average employment of less than 500 employees, regressions (3) and (4) exclude firms with average employment of less than 1,000 employees. All 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)
Stock return over previous two years	**0.54**	**0.44**	**0.52**	**0.45**
	[13.27]**	[12.41]**	[11.75]**	[11.14]**
Contemporaneous stock return	**-0.03**	**0.04**	**-0.04**	**0.04**
	[1.16]	[1.73]	[1.28]	[1.30]
Q_t	**0.33**	**0.16**	**0.35**	**0.17**
	[16.26]**	[8.61]**	[15.55]**	[7.97]**
$KZ4_{t-1}$	**0.03**	**-0.06**	**0.04**	**-0.05**
	[1.29]	[2.08]*	[1.56]	[1.57]
Cash flow $shortfall_{t-1}$	**2.74**	**0.97**	**2.60**	**1.09**
	[12.59]**	[4.24]**	[11.35]**	[4.57]**
Interest $burden_{t-1}$	**-0.65**	**-0.78**	**-0.63**	**-0.78**
	[4.61]**	[5.58]**	[3.94]**	[4.90]**
Log sales	**-0.04**	**-0.04**	**-0.01**	**-0.06**
	[1.99]*	[0.86]	[0.27]	[1.21]
Long term debt dummy	**-0.23**	**0.10**	**-0.20**	**0.10**
	[2.74]**	[1.59]	[2.12]*	[1.45]
R&D	**8.79**	**-0.93**	**9.83**	**-0.74**
	[11.84]**	[1.17]	[11.83]**	[0.76]
Industry fixed effects	Yes		Yes	
Firm fixed effects		Yes		Yes
Year fixed effects	Yes	Yes	Yes	Yes
Constant	**5.10**	**5.50**	**4.73**	**5.47**
	[31.16]**	[18.39]**	[27.43]**	[16.71]**
Observations	11924	11924	10991	10991
Adjusted R-Squared	0.58	0.81	0.57	0.8

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

Table 11. Tobit regression of log option grants per employee on past returns and measures of cash constraints. Regressions (1) and (2) use Tobit estimation with censoring at zero. All variables are defined as in Table 3. Regressions (1) includes year dummies, regression (2) includes year dummies and firm random 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)
Stock return over previous two years	**0.73**	**0.47**
	[14.50]**	[17.55]**
Contemporaneous stock return	**0.06**	**0.02**
	[2.09]*	[1.32]
Q_t	**0.35**	**0.21**
	[13.39]**	[17.13]**
$KZ4_{t-1}$	**0.03**	**-0.105**
	[0.83]	[6.92]**
Cash flow $shortfall_{t-1}$	**2.67**	**1.78**
	[8.25]**	[12.44]**
Interest $burden_{t-1}$	**-0.61**	**-0.68**
	[3.72]**	[8.70]**
Log sales	**-0.11**	**-0.21**
	[4.97]**	[14.87]**
Long term debt dummy	**-0.44**	**-0.12**
	[4.28]**	[2.62]**
R&D	**7.92**	**3.09**
	[7.84]**	[10.39]**
Firm random effects		Yes
Year fixed effects	Yes	Yes
Constant	**5.52**	**6.81**
	[27.37]**	[56.45]**
Observations	12898	12898

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

Table 12. Regression 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).

Panel A: Hand-collected data				
	Dependent Variable: Log Option Grants per Employee			
Independent Variables	(1)	(2)	(3)	(4)
Stock return over previous two years	**0.74**	**0.79**	**1.09**	**0.96**
	[6.49]**	[7.28]**	[6.96]**	[13.53]**
Contemporaneous stock return	**0.05**	**0.20**	**0.10**	**0.17**
	[0.72]	[3.24]**	[1.08]	[3.81]**
Q_t	**0.21**	**0.04**	**0.38**	**0.13**
	[4.69]**	[1.30]	[5.35]**	[4.96]**
$KZ4_{t-1}$	**0.02**	**-0.087**	**0.166**	**0.002**
	[0.40]	[1.88]	[2.44]*	[0.06]
Cash flow $shortfall_{t-1}$	**3.20**	**1.30**	**3.90**	**2.41**
	[6.55]**	[2.68]**	[6.10]**	[7.90]**
Interest $burden_{t-1}$	**-0.73**	**-1.47**	**-1.14**	**-0.91**
	[2.52]*	[4.28]**	[3.15]**	[4.22]**
Log sales	**-0.02**	**-0.08**	**-0.08**	**-0.18**
	[0.33]	[0.82]	[1.64]	[8.65]**
Long term debt dummy	**-0.19**	**0.34**	**-0.12**	**0.21**
	[0.81]	[1.57]	[0.41]	[1.59]
R&D	**5.64**	**1.41**	**8.58**	**4.85**
	[4.55]**	[1.24]	[5.55]**	[8.16]**
Industry fixed effects	Yes			
Firm fixed effects		Yes		
Firm random effects				Yes
Year fixed effects	Yes	Yes	Yes	Yes
Constant	**4.92**	**5.34**	**4.36**	**5.63**
	[12.61]**	[7.21]**	[9.29]**	[.]
Observations	4208	4208	4208	4208
Adjusted R-Squared	0.53	0.84	-	-

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

Panel B: ExecuComp data				
	Dependent Variable: Log Option Grants per Employee			
Independent Variables	(1)	(2)	(3)	(4)
Stock return over previous two years	**0.66**	**0.70**	**0.99**	**0.80**
	[5.45]**	[6.28]**	[7.24]**	[12.02]**
Contemporaneous stock return	**-0.02**	**0.21**	**0.13**	**0.12**
	[0.29]	[3.51]**	[2.06]*	[2.95]**
Q_t	**0.29**	**0.02**	**0.34**	**0.15**
	[6.44]**	[0.52]	[7.93]**	[6.32]**
$KZ4_{t-1}$	**0.03**	**-0.04**	**0.062**	**-0.047**
	[0.64]	[0.73]	[1.30]	[1.77]
Cash flow $shortfall_{t-1}$	**2.58**	**0.81**	**3.35**	**2.26**
	[6.41]**	[1.85]	[6.80]**	[7.91]**
Interest $burden_{t-1}$	**-0.22**	**-1.11**	**-0.45**	**-0.59**
	[0.83]	[4.22]**	[1.58]	[3.39]**
Log sales	**-0.09**	**0.04**	**-0.12**	**-0.17**
	[2.47]*	[0.38]	[3.43]**	[6.52]**
Long term debt dummy	**-0.32**	**0.25**	**-0.22**	**0.01**
	[1.77]	[1.66]	[1.04]	[0.10]
R&D	**2.28**	**-2.14**	**4.29**	**2.07**
	[1.49]	[1.70]	[2.92]**	[4.38]**
Industry fixed effects	Yes			
Firm fixed effects		Yes		
Firm random effects				Yes
Year fixed effects	Yes	Yes	Yes	Yes
Constant	**6.09**	**5.29**	**5.57**	**6.31**
	[18.83]**	[7.51]**	[15.87]**	[28.89]**
Observations	3146	3146	3146	3146
Adjusted R-Squared	0.58	0.84	-	-

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

Table 13. Regression 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 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 A 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**				
	[2.80]**	[3.43]**				
Manipulator - cash flow statement discretionary total accruals			**0.16**	**0.13**		
			[3.40]**	[3.26]**		
Manipulator - cash flow statement discretionary operating accruals					**0.23**	**0.23**
					[3.07]**	[3.55]**
Stock return over previous two years	**0.52**	**0.41**	**0.52**	**0.41**	**0.48**	**0.32**
	[11.17]**	[8.86]**	[11.50]**	[9.23]**	[6.57]**	[3.73]**
Contemporaneous stock return	**-0.02**	**0.02**	**-0.02**	**0.03**	**-0.07**	**-0.02**
	[0.93]	[0.90]	[0.76]	[1.25]	[2.30]*	[0.62]
Q_t	**0.30**	**0.14**	**0.30**	**0.14**	**0.33**	**0.15**
	[13.49]**	[7.61]**	[13.68]**	[7.91]**	[11.66]**	[5.47]**
$KZ4_{t-1}$	**0.00**	**-0.09**	**0.00**	**-0.09**	**-0.05**	**-0.11**
	[0.16]	[3.74]**	[0.05]	[3.62]**	[1.58]	[2.78]**
Cash flow $shortfall_{t-1}$	**2.27**	**0.98**	**2.27**	**0.95**	**2.15**	**0.84**
	[9.88]**	[4.53]**	[9.97]**	[4.48]**	[7.22]**	[2.49]*
Interest $burden_{t-1}$	**-0.57**	**-0.85**	**-0.57**	**-0.85**	**-0.62**	**-0.89**
	[4.27]**	[6.94]**	[4.24]**	[7.04]**	[3.54]**	[4.32]**
Log sales	**-0.10**	**-0.06**	**-0.09**	**-0.06**	**-0.14**	**-0.08**
	[5.00]**	[1.61]	[4.80]**	[1.56]	[5.35]**	[1.46]
Long term debt dummy	**-0.26**	**0.07**	**-0.27**	**0.07**	**-0.20**	**0.15**
	[3.27]**	[1.11]	[3.34]**	[1.09]	[2.09]*	[2.03]*
R&D	**3.81**	**-2.00**	**3.85**	**-1.94**	**2.81**	**-2.72**
	[4.12]**	[2.63]**	[4.18]**	[2.57]*	[2.31]*	[3.09]**
Industry fixed effects	Yes		Yes		Yes	
Firm fixed effects		Yes		Yes		Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	**5.88**	**6.07**	**5.86**	**6.06**	**6.29**	**6.41**
	[35.12]**	[22.62]**	[34.63]**	[23.08]**	[28.98]**	[17.55]**
Observations	11710	11710	12080	12080	5551	5551
Adjusted R-Squared	0.6	0.83	0.6	0.83	0.65	0.86

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

Table 14. Regression 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	**-0.18**	**-0.04**	**-0.17**	**-0.04**	**-0.19**	**-0.02**
	[4.87]**	[1.20]	[4.79]**	[1.29]	[3.80]**	[0.30]
Selling managers	**0.11**	**-0.05**	**0.11**	**-0.05**	**0.19**	**-0.01**
	[2.93]**	[1.47]	[2.97]**	[1.65]	[3.27]**	[0.16]
Manipulator - balance sheet discretionary current accruals	**0.10**	**0.14**				
	[2.03]*	[3.36]**				
Manipulator - cash flow statement discretionary total accruals			**0.10**	**0.11**		
			[2.18]*	[2.83]**		
Manipulator - cash flow statement discretionary operating accruals					**0.20**	**0.18**
					[2.65]**	[2.89]**
Stock return over previous two years	**0.52**	**0.44**	**0.52**	**0.44**	**0.50**	**0.40**
	[13.33]**	[12.22]**	[13.72]**	[12.55]**	[9.42]**	[8.16]**
Contemporaneous stock return	**-0.05**	**0.02**	**-0.04**	**0.03**	**-0.10**	**-0.01**
	[1.99]*	[0.90]	[1.70]	[1.21]	[2.74]**	[0.25]
Q_t	**0.30**	**0.13**	**0.29**	**0.13**	**0.31**	**0.12**
	[13.04]**	[7.53]**	[13.19]**	[7.93]**	[10.62]**	[4.83]**
$KZ4_{t-1}$	**-0.01**	**-0.084**	**-0.002**	**-0.08**	**-0.054**	**-0.09**
	[0.21]	[3.39]**	[0.07]	[3.28]**	[1.76]	[2.21]*
Cash flow $shortfall_{t-1}$	**2.16**	**0.85**	**2.17**	**0.82**	**2.05**	**0.60**
	[9.08]**	[3.72]**	[9.21]**	[3.72]**	[6.62]**	[1.68]
Interest $burden_{t-1}$	**-0.55**	**-0.91**	**-0.55**	**-0.92**	**-0.57**	**-0.95**
	[3.95]**	[7.10]**	[3.97]**	[7.24]**	[3.20]**	[4.65]**
Log sales	**-0.09**	**-0.05**	**-0.09**	**-0.04**	**-0.13**	**-0.08**
	[4.65]**	[1.16]	[4.44]**	[1.08]	[5.01]**	[1.38]
Long term debt dummy	**-0.26**	**0.07**	**-0.27**	**0.07**	**-0.20**	**0.11**
	[3.18]**	[1.03]	[3.31]**	[1.02]	[1.98]*	[1.44]
R&D	**3.84**	**-1.93**	**3.89**	**-1.87**	**2.80**	**-2.34**
	[3.97]**	[2.50]*	[4.04]**	[2.45]*	[2.22]*	[2.45]*
Industry fixed effects	Yes		Yes		Yes	
Firm fixed effects		Yes		Yes		Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	**5.93**	**6.04**	**5.91**	**6.01**	**6.28**	**6.42**
	[35.54]**	[21.27]**	[35.29]**	[21.56]**	[28.90]**	[16.78]**
Observations	10560	10560	10898	10898	4996	4996
Adjusted R-Squared	0.6	0.84	0.6	0.83	0.65	0.86

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