Employee Sentiment and Stock Option Compensation

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Abstract

The use of broad 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 undiversified employees should discount company equity heavily. We point out that employees do not appear to value company stock as prescribed by extant theory. Employees frequently purchase company stock for their 401(k) plans at market prices, and especially so after company stock has performed well, implying that their private valuation must at least equal the market price. We begin by developing a model of optimal compensation policy for a firm faced with employees with positive sentiment. Our goal is to establish the conditions necessary for the firm to compensate its employees with options 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 using option compensation under these circumstances is not a puzzle 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 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 the most common method being stock option plans. 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] Since employees are risk averse and likely to have firm-specific human capital, they should be an inefficient source of capital, at least compared to well-diversified outside investors. Standard portfolio selection theory would imply that employees should not own equity in their employer.

Several studies show, however, that employees do not value company stock and options as described by extant theory. For example, Benartzi (2001), Liang and Weisbenner (2002), and Huberman and Sengmüller (2002) show that 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. In a portfolio selection framework, this observation strongly suggests that employees' valuation of company stock is higher than the prevailing market price. Additionally, with regard to stock options, Lambert and Larcker (2001) report that many employees have unrealistic expectations about future stock prices and frequently value their options substantially above Black-Scholes values. We therefore propose that stock option grants to non-executive employees are driven by a behavioral phenomenon: firms pay their employees in equity when employees are irrationally optimistic about the offered compensation instrument. We develop a model of optimal compensation policy for a firm faced with employees exhibiting sentiment towards it. We then test several predictions of the model using a large sample of firms from the ExecuComp database.

Our goal in developing the model is to establish the conditions necessary for a firm to compensate its employees with options in equilibrium, while explicitly taking into account that current and potential employees are also able to purchase equity in the firm through the stock market. It is crucial to recognize that the firm competes with financial markets as supplier of equity to employees: the ability of employees to purchase equity on their own restricts the firm's capacity to profit off employees' optimism, and hence

[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".

restricts or even eliminates the firm's incentive to compensate with equity. Indeed, employee optimism about firm equity is sufficient to make firms indifferent between paying their employees in equity or cash, but it is insufficient, by itself, to *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.

Our model identifies two reasons why firms compensate optimistic employees with options: the first reason is that firms are able to extract a sentiment premium for non-traded compensation instruments if such a sentiment premium exists. If employees, for behavioral or rational reasons, value non-traded options more highly than traded stock, then firms, as the monopoly suppliers of options, are able to profitably extract the valuation premium of options over stock from their employees. What matters for the extraction of such rents are not employees' optimistic valuations for stock and options, but rather their willingness to pay for these instruments. 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 employees refuse to pay more than the market value for the equity offered by the firm. Only when this implicit no-arbitrage relation between the stock price and the fair value of the compensation instrument is ignored by employees does equity compensation become profitable for the firm, and only then do firms need and want to use it to attract and retain employees. We argue below that there are good reasons to believe that this no-arbitrage relation may indeed break down when employees are compensated with options. That is, employees are, in certain situations, willing to overpay for options relative to their fair market value.

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.[6] Due to the overvaluation, this is profitable even if the price the firm is able to charge is no higher than the market price, i.e. even if the firm is not able to charge an additional premium for non-traded equity.

[6] 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).

Moving beyond the two motivations for paying employees with equity, the model allows us to analyze the effects of sentiment-induced option compensation on profitability and labor market outcomes. Perhaps somewhat surprisingly, positive employee sentiment is not always beneficial to the firm subject to it. The model recognizes that employees' human capital covaries positively with stock returns, and allows optimistic employees to work at a different firm while still investing in the one they are optimistic about, thereby avoiding the positive correlation between their human capital and their 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 option compensation if there is a significant preference for non-traded options over traded stock combined with moderate levels of firm-specific human capital risk, or when equity markets are comparatively inefficient. We argue that the stock option boom of the late 1990s is best understood as a situation in which firms subject to positive sentiment and overvalued equity benefited through lower compensation costs, a larger number of employees, and higher profits.

How realistic is the idea that employees have (at least in some situations) a strict preference for the options offered by firms over the shares offered in the market? If employees recognize that the market enables them to take positions which are equivalent to the option compensation offered by the firm, then employees cannot have a preference for the one over the other. In reality, though, rational option valuation on the basis of observed stock prices and volatilities is clearly difficult and beyond the capabilities of essentially all employees. Instead, employees are likely to rely on heuristics and to value options on the basis of their own or their associates' past experience with option payoffs.[7] Lambert and Larcker (2001) conduct a small survey and report that many employees have unrealistic expectations about future stock prices and frequently value their options substantially above Black-Scholes values. Employees' excessive value assessments for options are likely related to the high payoffs many option holders experienced during the late 1990s. The leverage feature of options amplifies the effect of returns on payoffs, and employees are likely to prefer options to plain stock after periods with high stock returns

[7] The most obvious example in which employees are unable to value options from observed stock prices is that of a pre-IPO firm in which company equity is not yet traded. Even for firms with publicly traded equity, option valuation is sufficiently complex to exceed the abilities of most employees. Lambert and Larcker (2001) report survey evidence that employees tend not to understand the basic economics of stock options.

and high option payoffs.[8] Once again, this requires that employees do not recognize that traded stock allows them to take (levered) positions which are similar to holding options on company stock. Recognition of the close substitutability between options and (a levered position in) traded stock would make employees indifferent between the two assets, and restrict their willingness to pay for options to the price of the equivalent position in traded stock.

Several pieces of evidence provide further support for a model in which employees overpay for equity compensation. The survey evidence of Ittner, Lambert, and Larcker (2003), according to which firms need to compensate with options in order to attract and retain employees, suggests an equilibrium in which employees strictly prefer the equity instrument to its market value in cash. Anecdotal evidence from the dot-com era fits well the model prediction that, all else equal, an improvement in employee sentiment towards option compensation in one firm can lead to an increase in compensation and a reduction in employment in its competitors. Snider (2000) reports how law firms were forced to massively increase the salaries for associates to prevent them from leaving to internet start-ups offering equity-based compensation.[9] At the same time, newly minted MBAs from top business schools shunned previously coveted jobs in consulting and investment banking, and instead chose option compensation at new economy firms. Further evidence comes from the empirical dominance of options over restricted stock, which is predicted by our model on the basis that employees are more likely to overpay for options since a close substitute to restricted stock is traded in the market.[10] Finally, the observation that firms simultaneously pay with equity and repurchase shares in the market suggests that overvaluation is not the sole driver behind option compensation, as firms would clearly not choose to repurchase overvalued equity. A model incorporating a sentiment premium for options relative to stock seems, therefore, to be a better description of reality.

[8] Besides bounded rationality, there may be other reasons for employees to strictly prefer the options offered by the firm to traded shares. Employees may, for purely rational reasons, prefer a leveraged, option-like position in their employer, and borrowing constraints may make it impossible to replicate the option position using traded shares. 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).

[9] Snider (2000) quotes the chairman of one law firms as follows: “[...] the increases in associate salaries had more to do with competition for talent from companies engaged in the new economy than from law firms. We're not losing people to other law firms. [....] We're losing people to .com companies because they can offer very attractive options."

[10] It is possible in our model for a firm to pay its optimistic employees with options even without a sentiment premium of options over stock and without overvalued equity. Such a firm sells equity to optimistic employees at fundamental value solely as a means to raise funds. Our empirical evidence in Section 6 shows that cash rich firms

Our results have implications for the ongoing discussion about how to interpret broad-based option compensation in light of current theories of capital structure. Fama and French (2003) note that many fast-growing and highly profitable firms issue moderate amounts of equity every year, in apparent contradiction to the Myers-Majluf (1984) pecking order theory. They also find that on average more than half of each year's dividend paying firms issue equity, again seemingly contradicting the pecking order theory. Fama and French note that employee stock options, grants, and other employee benefit plans are likely to play a significant role in their findings. We propose that equity based compensation is not primarily driven by firms' intention to raise equity, but argue instead that the impetus comes from exuberant employees who want to be paid with options. Firms then need to decide whether to offset the effect of option grants on their capital structure. This hypothesis is consistent with Kahle's (2001) finding that many firms repurchase (rather than issue) shares to fund option exercises by employees, and with the observation that firms issue equity and pay dividends in the same year.[11]

Our paper is not the first to consider employee sentiment as a factor in option compensation.[12] 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 company stock and options. The main difference to our approach is that their calibration exercise does not consider employees' ability to purchase equity by themselves. Our analysis shows that financial markets as alternative supplier of equity to employees put a crucial constraint on firms' ability to extract rents from employees. The profitability of option compensation from the firm's perspective depends on employees' willingness to pay for options as determined by the best alternative asset offered by the equity market. If the compensation instrument itself (or a perfect substitute) is traded and fairly valued by the market, then employees can by themselves invest into what they perceive as undervalued equity, and the firm is not able to lower its compensation expense, independently of how optimistic employees are. Our analysis differs further from Oyer and Schaefer in that we explicitly model firm-specific human capital risk and analyze its effect on the equilibrium in the labor market. Further, since small investors in the equity market and rank-and-file employees are likely to have correlated sentiment, our model allows for equity to be mispriced by the market. We show that the level of firm specific human capital risk borne by

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use option compensation the most. These firms have little reason to sell equity, be it to employees or the equity market, unless the recipient of the equity is willing to overpay.

[11] The share repurchases occur when options are exercised, which is several years after they were granted. Since firms with broad-based option programs tend to grant options every year, there are nevertheless many examples of firms which broadly grant options and repurchase shares in the same year.

[12] Core and Guay (2001) write in their conclusion that "the willingness of firm's lower-level employees to accept options instead of cash compensation likely depends on firm-specific factors such as the pay-off they [...] have received from previously granted options. In turn, these firm-specific factors are likely to affect how stock option plans evolve over time." This statement describes the research agenda of our project remarkably well.

employees and the quality of arbitrage in the equity market partly determine the benefits firms receive from paying with options, and hence the allocation of labor between firms.

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. It is difficult to directly test whether employees are irrationally exuberant about stock options, as sentiment and expectations are unobservable. Our model of optimal employee compensation 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. Greater employee exuberance about firm equity should therefore lead to more equity compensation. Prior literature suggests that employee sentiment improves with prior stock price performance. We also expect employees to extrapolate more strongly from past returns when valuing options than when valuing restricted stock because of the amplified nature of option payoffs. We make use of the psychology literature on expectations formation to develop testable hypotheses on employee sentiment in general, and excessive extrapolation in particular. Our theoretical model delivers further predictions on the relation between option compensation and labor market outcomes, and on the relation between option compensation and overvaluation. All hypotheses are developed in detail in Section 4.

The predictions of the employee sentiment hypothesis are strongly confirmed by the data. Option grants to non-executives are widespread in our sample of 2,099 publicly traded firms from 1992 to 2002. The average firm grants options corresponding to 1.8% of shares outstanding per year, and non-executive employees receive 71% of these grants.[13] As predicted, equity-based compensation 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. It is 35% p.a. for firms with granting activity in the top quintile. Sorting firms by prior year returns, we find average (median) grants of $22,295 ($3,037) among firms in the top return quintile, and average (median) grants of only $6,735 ($862) among firms in the bottom return quintile. Consistent with Griffin and Tversky (1992), we find the effect of past returns on granting activity to be non-linear, with granting activity concentrated among the very best prior performers. Consistent with Benartzi (2001), we find that the positive relationship between stock returns and option grants becomes stronger when we enlarge the window over which past returns

[13] 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. In the remainder of the paper we use the term "employee options" as equivalent to "non-executive employee options".

are measured. We also find that firms in distress 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, we confirm that firms which grant more options have faster employment growth than firms which use fewer or no options, again consistent with the predictions of our model.

These results hold up in a regression framework controlling for numerous other potential determinants of employee option grants. Several such determinants of the use of option compensation for employees below the executive rank have been discussed in the literature. Some authors have argued that firms with cash constraints use option grants to compensate their employees because options require no contemporaneous cash payout (Yermack (1995), Dechow et al. (1996), Core and Guay (2001)). Since employees are risk averse and likely to have firm-specific human capital, they should be an inefficient source of capital, at least compared to well-diversified outside investors. That they are nevertheless used as a source of capital has been attributed to lower information asymmetries (Core and Guay (2001), Fama and French (2003)): if the information asymmetries between the firm and its employees are lower than those between the firm and outside investors, equity compensation can have cost advantages relative to external financing. The finding by Kahle (2001) that many firms repurchase shares on the open market to fund employee option exercises seems to speak against this cash constraints hypothesis: firms are using actual cash to repurchase shares which are then given to exercising employees.[14] We nevertheless control for several measures of cash constraints in our empirical analysis. The finding that stock option grants are strongly determined by past stock price performance is robust to these controls.

The estimated coefficients on the various measures of cash constraints provide further insights into the option granting behavior of firms. We find that 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).[15] Grants are also positively related to investment levels and proxies for investment opportunities. These findings cast doubt on the hypotheses that option granting behavior is determined by corporate cash constraints. Instead, they are 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

[14] It is theoretically possible that firms were cash constrained when granting options and are no longer cash constrained when the options are exercised. Given the persistence of option granting behavior though it is likely that grants and exercises occur in the same year for many firms.

[15] Most authors (Kaplan and Zingales 1997, Core and Guay 2001) interpret large corporate cash holdings as a sign that a firm is not financially constrained: large cash holdings indicate that a firm has excess funds and no need to raise funds in the foreseeable future. Almeida, Campello, and Weisbach (2002) raise the possibility that large

investment opportunities, and worse sentiment towards firms with higher levels of debt and higher interest payments.[16]

As a last empirical test, we examine the model prediction that firms are more likely to pay with options when managers view their own stock as overvalued. We attempt to identify situations in which we can make inferences about managers' opinion about the fundamental value of the firm. One such situation is when managers manipulate earnings to boost the current stock price. If managers know that the current stock price is inflated because of earnings manipulation, and if earnings manipulation is not (fully) taken into account by employees and the market, management may take advantage of the overvaluation by substituting more options for cash compensation. We measure earnings manipulation using versions of the modified Jones model (Teoh, Welch, and Wong, (1998 a,b), Hribar and Collins (2002)), and find that firms likely to have manipulated earnings grant between 12 and 25 percent more options than firms with no manipulation. Our second measure of managers' views on firm value is insider trading. We identify firms with large insider selling and firms with large insider buying using a measure from Jenter (2004). Our results indicate that firms in which the top five managers cash out grant 12 to 16% more options to their employees than comparable firms, while firms in which top managers purchase equity for their own account grant around 16 to 20% less to employees than comparable firms. 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.

We conclude that the documented empirical patterns of broad-based equity compensation can be explained as a behavioral phenomenon in which employees excessively extrapolate the value of options from their firm's recent performance and financial condition, and in which employees prefer the options offered by their firm to the shares traded in the market. Employees' willingness to accept options as payment seems contingent on good news about the firm which employees (incorrectly) associate with positive future stock price performance and option payoffs. The data is consistent with the hypothesis that firms respond to employee exuberance about option compensation by paying them in their preferred equity instrument, and with the hypothesis that firms use the resulting lower compensation costs to expand in size relative to firms not subject to positive sentiment.

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corporate cash holdings may indicate that managers have reacted to asymmetric information problems by hording cash, and may hence be positively related to financing constraints.

[16] The observation that new economy firms were the most aggressive users of broad-based stock option plans during the dot-com bubble in the late 1990s (Anderson, Banker, and Ravindran, 2000; Ittner, Lambert, and Larcker, 2002; Meulbroek, 2001 and 2002; Murphy, 2003) seems similarly difficult to reconcile with the asymmetric information-induced cash constraints hypothesis: The equity market in the late 1990s was irrationally receptive to equity issues

In the next section we present a simple model of optimal employee compensation when employees display sentiment towards the firm. Section 3 briefly reviews the prior literature analyzing employee stock option plans, and discusses the literature on psychological biases that employees may exhibit when thinking about company equity. 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, which, for simplicity, we take to be either stock or options. 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 Y_1 and Y_2:

$$\begin{aligned} Y_1 &= f(l_1) \\ & \qquad\qquad \textit{with } f(0)=0, f'(.)>0, f'(0)=\infty, f''(.)<0. \qquad (1) \\ Y_2 &= f(l_2) \end{aligned}$$

The two firms offer to hire l_1 and l_2 employees respectively in a competitive labor market. Each firm offers a compensation contracts consisting of W_i in cash wage, N_i shares of its stock, and M_i units of its options.

The sole, but crucial, difference between stock and options in the model is that employees can purchase company stock in the market on their own, but employees are either unable or unwilling to purchase options or any close substitute to them by themselves. Said differently, we assume that employees do not regard the non-traded options offered by the firms as (perfectly) replicable by the traded equity offered by the market. This assumption can be justified by the observations that options on company stock are usually not traded, and that constructing adequate substitutes for options from traded securities is costly. More importantly, most employees are unsure about the workings of options and how

by new economy firms (Ofek and Richardson, 2002 and 2003). Turning to employees as a source of funds in this market environment does only make sense if employees are even more exuberant than the already irrational market.

option values can be derived from stock prices and volatilities. This lack of knowledge may lead them to disregard the close substitutability of company stock and options, and to value options using heuristics unrelated to current stock prices and volatilities. One should think of the options in our model as corresponding to the restricted options used in broad-based option programs, and of the stock in our model as the closest traded substitute asset or trading strategy to these options available in the equity market which is recognized by employees

The assumption that each firm competes with the market in offering stock, while being, in essence, a monopoly supplier of its own options, will drive much of the model analysis. To emphasize the fundamental equivalence of stock and options in our model, aside from their differing tradability, we assume that for each firm, the payoff of a unit of stock and a unit of options are *identical* and given by the random variable $\tilde{X}_i$, with mean normalized to 1 and variance σ^2. Thus, our results are not driven by different payoff structures of the two equity instruments. The modeling assumption that both options and stock are simple, linear claims is a convenient simplification; assuming instead that options are non-linear claims and replacing "stock" by the corresponding levered position in traded shares would deliver identical results. 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.[17] We further assume that the equity market is risk neutral with a riskless rate of zero, which implies that the fair market value of a unit of stock or options of either firm is equal to 1.

There is a homogeneous mass of potential employees which we normalize to 1. Potential 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 two equity compensation instruments of firm 1. Parameterizing employee sentiment by s, employees believe the payoff of a unit of stock to be $\tilde{X}_1 + s$, and the payoff of a unit of options to be $\tilde{X}_1 + t(s)$, with $t'(s) > 0$. Thus, we allow employee sentiment towards stock s and options $t(s)$ to be different. This is possible due to the assumption that employees do not recognize that options and stock are fundamentally equivalent. The sentiment measures s and $t(s)$ can take both positive and negative values, with positive values corresponding to exuberance about equity compensation. We impose the natural restriction that $t'(s) \geq 0$, and normalize $t(0)$ to be equal to zero. Given that employees are risk-averse and the stock market risk-

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

neutral, employees rationally value equity less highly than does the market. Positive sentiment is thus required for employees to value a unit of equity compensation at or above its fair market price.[18] In contrast to firm 1, potential employees do not display sentiment towards firm 2's equity. 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 much of the intuition behind our results, but greatly complicates the exposition.

The assumption that employee sentiment towards options and stock may differ is important and deserves further discussion. Whether employees prefer options to stock, and the determinants of any preference for one over the other, are ultimately empirical questions. Intuitively, due to the leverage feature embedded in options, it may well be the case that positive sentiment towards firm prospects has a larger effect on employee valuations of options than stock, or formally, that it is indeed the case that $t(s) > s$ for $s > 0$. This seems particularly plausible if employees develop sentiment toward equity compensation based on experienced performance, given that the leverage of options amplifies the effect of past returns on payoffs. This argument implicitly requires that employees, because of lack of knowledge or for other reasons, cannot create an equivalent levered claim to the option using traded stock.

Our analysis 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 with $Cov(\widetilde{Y}_i, \widetilde{X}_i) \equiv \phi_i \geq 0$. To simplify notation, we assume that 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 assume that the market price of a unit of stock of firm 1 may deviate from fundamental value. Specifically, noise trader sentiment may affect the price of firm 1 stock due to limited arbitrage. For simplicity, we take employee sentiment and noise trader sentiment to be identical, although allowing these to differ does not materially change our results. Formally, we assume that a unit of firm 1 stock can be purchased in the market for $p(s)$, where $p(0) = 1$, and $0 \leq p'(s) \leq 1$. In this formulation, $p'(s)$ can be viewed as a measure of the effectiveness of arbitrage. With $p'(s) = 0$ for all s, there are no limits to

[18] These assumptions are a simplified version of a more realistic setting in which systematic risk is priced and employees are allowed to invest into the risky market asset (Jenter (2002)). In both settings, non-exuberant employees would never purchase the equity instrument at fair market value. This captures the intuition described among others in Lambert, Larcker, and Verecchia (1991), Murphy (1999), Hall and Murphy (2001), and Meulbroek (2001 and 2002) that holdings of company equity by employees are inefficient.

arbitrage and capital markets are perfectly efficient. As arbitrage becomes more limited, the effect of sentiment on prices increases, reflected by an increase in $p'(s)$. When $p'(s) = 1$, arbitrage has no effect and prices move one for one with sentiment.[19] As there is no sentiment towards firm 2 stock, its market price equals its fundamental value of 1.

Potential employees evaluate compensation contracts (W_i, N_i, M_i) using their subjective beliefs about firm value, taking into account their ability to purchase stock on their own. Employees choose to work for the firm whose compensation package (combined with the employees' optimal stock purchases) offers the higher expected utility, assuming that this firm is in fact seeking additional employees. For empirical realism, we assume that employees cannot sell the equity they receive as compensation, even though our results are unchanged without this assumption.

We begin solving the model by calculating the stock purchases of employees with a given compensation package. Since employees are risk averse and since they value firm 2 stock correctly, it easy to see that employees never purchase firm 2 stock on their own. In contrast, firm 1 stock may appear to be cheap to optimistic employees of either of the two firms, leading them, in some situations, to buy it for their own account. The optimal purchase of firm 1 stock 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:

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

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

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

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

Lemma 1 states that upon receiving (W_1, N_1, M_1) from firm 1, employees of firm 1 purchase shares in their employer until they reach their optimal portfolio of $\frac{1+s-p(s)-\phi}{\sigma^2}$ units of stock, taking into account the number of shares and options received from the firm. If an employee has received more than her desired allocation of firm 1 equity as compensation, then she does not add any more on her own. She would prefer to sell units of the compensation instruments, but is by assumption precluded from doing so.

From Lemma 1 it is apparent that an increase in sentiment s increases the demand for shares in firm 1 by both sets of employees, despite the fact that an increase in sentiment also tends to increase firm 1 stock price. This is because of the presence of arbitrageurs who mitigate the effect of sentiment on price, causing the increase in stock price to be smaller than the increase in sentiment. Thus, employees' purchases of stock are non-decreasing in sentiment, and indeed increasing in sentiment as long as $p'(s) < 1$. 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 stock 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 stock on their own, and that employees will work for the competing firm if its contract is more attractive:

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

$$\begin{aligned} s.t. \ \ & \hat{E}\left[U(W_i, N_i, \hat{N}_1^i, M_i; s, t(s), \phi, p(s))\right] \geq 0 \\ & \hat{E}\left[U(W_i, N_i, \hat{N}_1^i, M_i; s, t(s), \phi, p(s))\right] \geq \hat{E}\left[U(W_j, N_j, \hat{N}_1^j, M_j; s, t(s), \phi, p(s))\right] \ for\, i \neq j. \end{aligned} \quad (5)$$

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 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^*). The following theorem describes the equilibrium:

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

(a) The perceived expected utility from working for each firm is equalized:

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

where $\hat{N}_1^1$ and $\hat{N}_1^2$ are the optimal portfolio purchases of firm 1 stock 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.

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

(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:

$$(i)\, N_1^* \in [0, \frac{s-\phi}{\sigma^2}] \text{ and } M_1^* = 0 \text{ if } s > \phi \text{ and } t(s) \le s \text{ and } p'(s) = 0$$

$$(ii)\, N_1^* = \frac{s-\phi}{\sigma^2} \text{ and } M_1^* = 0 \text{ if } s > \phi \text{ and } t(s) \le s \text{ and } p'(s) > 0$$

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

$$(iv)\, N_1^* = 0 \text{ and } M_1^* = \frac{t(s)-\phi}{\sigma^2} \text{ if } s \le \phi \text{ and } t(s) > \phi$$

$$(v)\, N_1^* = 0 \text{ and } M_1^* = 0 \text{ if } s \le \phi \text{ and } t(s) \le \phi$$

Proof See Appendix A.

In equilibrium the compensation packages offered by both firms are perceived to be of equal value by potential employees, which is the only way both firms can simultaneously attract employees (part a).[20] 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 stock or options in its compensation package (part c). In contrast, firm 1 offers either stock or options whenever the employees' willingness-to-pay for equity exceeds its fundamental value (part d). Understanding the determination of this willingness-to-pay is the key to understanding option compensation. When paying in equity, the firm offers the equity instrument (stock or options) towards which employees exhibit higher positive sentiment. The number of units of the equity instrument provided equals the number of units the employee would purchase herself if offered to her at a price of 1. This is because the firm is effectively issuing equity to employees at a cost equal to the fundamental value of 1 per unit. The optimal size of this equity "issue" increases in employees' sentiment towards the equity instrument, and decreases in the degree of firm-specific human capital risk borne by employees.

But at what price is firm 1 "issuing" equity to its employees? What determines employees willingness-to-pay for a share or an option in firm 1? The essential insight implicit in Theorem 1 is that the firm is directly competing with the stock market as supplier of equity to employees. To illustrate the implications of this, we first focus on the cases in which optimistic employees (weakly) prefer stock to options, and the firm is considering whether to pay its employees with stock or cash. In equilibrium, since firm 1 employees can purchase stock on their own, they never give up more than the market price *p* for each share with which they are compensated. Employees' willingness-to-pay for stock is effectively capped by the market price of stock, *independently of their degree of optimism*. This insight helps to explain case (d.i) of Theorem 1 in which the firm 1 turns out to be indifferent between paying with cash and paying with stock of the same market value, as long as the equity component is weakly smaller than the employees' desired holdings of shares.[21] This indifference, even in the face of positive sentiment, is explained by the fact that with perfectly efficient markets, the cost to the firm of providing a unit of stock – its fundamental value – exactly equals the price which employees are willing to pay. This result has been largely overlooked by the prior literature, which has focused on employees' valuations of stock and options rather than on employees' willingness to pay for these equity instruments.

When markets are not perfectly efficient, in the sense that sentiment does affect stock prices (case (d.ii) of Theorem 1 above), then firm 1 is no longer indifferent to the amount of stock it "issues" to its employees. Because optimistic employees' willingness to pay for stock goes as high as the (overvalued) market price, compensating employees with stock becomes profitable for the firm. Viewing cases (d.i) and (d.ii) of Theorem 3 together, we see that compensating employees with a *traded* equity instrument *cannot* be motivated by employee sentiment alone. A necessary additional ingredient for compensation with traded stock to be profitable is an overvalued stock price which allows the firm to benefit even if the wages given up in exchange are capped at the market price. If markets are indeed inefficient and stock prices overvalued, then compensating optimistic employees with stock is equivalent to issuing overvalued seasoned equity directly into the market.[22]

In contrast, compensating employees with a *non-traded* equity instrument, such as options, *can* be explained by employee sentiment alone. The crucial difference is that employees' willingness to pay for non-traded options may exceed their fair market value.[23] Because firm 1 is a monopoly supplier of its own options, it is able to extract any sentiment premium of options over stock, which, in the notation of the model, is given by $t(s) - s$. The availability of traded stock continues to place a cap on the amount of rents the firm can extract: with positive sentiment, the maximum amount employees are willing to pay for an option is the market price of a share plus the employees' excess valuation of options over stock. For

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

[21] To be more precise, $\frac{s-\phi}{\sigma^2}$ is employees' desired holding of shares if the shares are offered to them at a price equal to the fundamental value of 1.

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

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

example, if the market price of firm 1 stock is \$5 per share, and optimistic employees value the stock at \$10 per share and options at \$11, then employees are willing to forgo at most \$6 (= \$5 + (\$11 – \$10)) in cash wages for a unit of options (and only \$5 in wages for a unit of stock). The sentiment premium of options over stock $t(s) - s$ is equal to \$1 and is successfully extracted by firm 1. It is this ability to extract part of the rents associated with sentiment towards non-traded equity that leads firm 1 to compensate its employees with options. This occurs whenever sentiment towards options is sufficiently high to overcome the cost of being exposed to both equity and firm specific human capital risk ($t(s) > \phi$), and when sentiment towards options is greater than that for stock ($t(s) > s$), (cases (d.iii) and (d.iv) of Theorem 1).

Theorem 1 helps us identify 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 stock and options. When sentiment towards (non-traded) options exceeds that for (traded) stock, firm 1 is able to extract some of the rents associated with employees' overvaluation of options. The second channel through which sentiment can affect profits and compensation policies is through its effect on stock prices. Positive sentiment combined with imperfect arbitrage can lead to overvalued stock prices, allowing firm 1 to profit by, in effect, selling overvalued stock or options to its optimistic employees.

We next demonstrate formally how sentiment affects the levels of employment and profits of the two firms in equilibrium. We assume at first that the equity market is perfectly efficient ($p'(s) = 0$ and hence $p(s) \equiv 1$). This serves to close the overvaluation channel through which sentiment affects firm 1 profits, and focuses attention on firm 1's ability to profit from the sentiment premium for options over stock. We relax the assumption of perfectly efficient markets later. To unclutter the presentation, the following theorem describes the effect of sentiment on profits only. It is straightforward to show that employment levels (firm size) and profits are strictly increasing functions of each other in our model, and hence the same results apply to employment levels as well.

Theorem 2 Assume that sentiment for stock and options is positive: $s > 0$ and hence $t(s) > 0$. Assume further that markets are perfectly efficient ($p'(s) = 0$, and hence $p(s) = 1\ \forall s$). We have that:

(a) If stock is (weakly) preferred to options ($s \geq t(s)$), then

(i) firm 1 makes smaller profits than firm 2 if there is any firm-specific human capital risk ($\phi > 0$).

(ii) firm 1 and firm 2 have the same level of profits if firm-specific human capital risk is completely absent ($\phi = 0$).

(b) If options are preferred to stock ($t(s) > s$), then

(i) if $t > \phi$, so that firm 1 pays with options, firm 1 has larger profits than firm 2 if the option premium exceeds the level of human capital risk ($t - s > \phi$), and smaller profits otherwise.

(ii) if $t \leq \phi$, so that firm 1 pays with cash, firm 1 has smaller profits than firm 2.

Proof See Appendix A.

The intuition behind Theorem 2 is straightforward. Consider part (a) first: if traded stock is preferred to non-traded options, then firm 1 enjoys no benefits from the optimism of its employees. The reason is that employees never pay more than the market price of 1 for a unit of stock given to them. In fact, with firm-specific human capital risk present, it is more efficient for optimistic employees to work for firm 2 and hold equity in firm 1, than to work for firm 1. Firm 1 needs to compensate its employees for the correlation between their human capital and their financial wealth, and ends up with lower profits and fewer employees than firm 2. Consider now part (b) of the theorem: if non-traded options are preferred to traded stock, then firm 1 may be able to benefit from the optimism of its employees. In particular, firm 1 benefits if its employees' preference for options over stock is larger than the negative effect of firm-specific human capital risk, i.e., if $t - s > \phi$. Said differently, firm 1 benefits if the rents it extracts from the sentiment premium are larger than its losses caused by firm specific human capital risk. If, on the other hand, the preference for options over stock is smaller than the level of human capital risk, then firm 1 ends up with lower profits and fewer employees than firm 2. This second case encompasses both situations in which firm 1 pays its employees with options ($t > \phi$ but $t - s < \phi$), and situations in which firm 1 pays in cash ($t < \phi$).

It is interesting to note that when ϕ, the level of firm specific human capital risk, is sufficiently high in comparison to the sentiment premium $t(s) - s$, positive sentiment towards firm 1 is associated with lower profits and employment levels for firm 1 relative to firm 2. The empirical and experimental evidence (Benartzi (2001), Degeorge et al. (2004), Klos and Weber (2004)) suggests, however, that employees are likely to ignore the correlation between human capital and stock returns when evaluating investments. If employees, rightly or wrongly, act as if the firm-specific human capital risk ϕ is low, then these subcases, while interesting, may not be very relevant, and positive sentiment for firm 1 benefits firm 1 rather than firm 2 as long as employees prefer options to stock.

We now relax the assumption of perfectly efficient markets made in Theorem 2. In reality, positive sentiment by employees likely goes hand in hand with positive sentiment by small investors, and, when there are limits to arbitrage, with overvalued stock prices. Introducing inefficient markets adds a second channel through which sentiment, through its effect on stock prices, affects firm profits and size.

Theorem 3 Assume that markets are *not* perfectly efficient ($p'(s) > 0$), and that sentiment is positive ($s > 0$). Then the stock price is overvalued ($p(s) > 1$), and we have that:

(a) If stock is (weakly) preferred to options ($s \geq t(s)$), then

(i) if $s > \phi$, so that firm 1 pays with stock, firm 1 has larger profits than firm 2 if the overvaluation exceeds the level of human capital risk ($p(s) - 1 > \phi$), and smaller profits otherwise.

(ii)) if $s \leq \phi$, so that firm 1 pays with cash, firm 1 has smaller profits than firm 2.

(b) If options are preferred to stock ($t(s) > s$), then

(i) if $t > \phi$, so that firm 1 pays with options, firm 1 has larger profits than firm 2 if the sum of overvaluation and option premium exceeds the level of human capital risk ($(p(s) - 1) + (t - s) > \phi$), and smaller profits otherwise.

(ii) if $t \leq \phi$, so that firm 1 pays with cash, firm 1 has smaller profits than firm 2.

Proof See Appendix A.

Theorem 3 confirms the intuitive notion that overvalued stock prices tend to make equity compensation more profitable for firm 1. When employees exhibit high enough positive sentiment, firm 1 is able to, in effect, issue overvalued equity to them. Part (a) of Theorem 3 shows that positive employee sentiment leads to higher profits and employment levels at firm 1 if the overvaluation exceeds the human capital risk, that is, if $p(s) - 1$ is larger than ϕ. This contrasts with the corresponding result in Theorem 2 which shows that firm 1 receives no benefit from the optimism of its employees if traded stock is preferred to non-traded options, and equity is valued correctly.

Part (b) of Theorem 3 considers the case in which non-traded options are preferred to traded stock. Overvalued stock prices once more expand the subset of the parameter space in which firm 1 benefits from positive sentiment. Firm 1 benefits from positive sentiment if the combined overvaluation ($p(s) - 1$) and option premium ($t(s) - s$) exceed the level of firm-specific human capital risk, ϕ. If these conditions are fulfilled, then firm 1 ends up with higher profits and more employees than firm 2. It is straightforward to show that the strength of this stock price channel depends on the severity of the limits to arbitrage: as $p'(s)$ becomes larger, a given increase in sentiment has a larger affect on the price of firm 1 stock. This makes employees' outside option to purchase shares in the market less attractive, and implies that an increase in sentiment has a larger effect on employees' willingness to pay for option compensation.[24]

In summary, our model has identified two reasons why firms pay optimistic employees with options. The first reason is that firms extract a sentiment premium for non-traded compensation instruments when such a sentiment premium exists. We argue in the next section that employees are likely to extrapolate from past performance when comparing stock and options, and are therefore likely to prefer non-traded options to traded stock after periods of high stock returns. 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. Moving beyond the two motivations 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 there is a preference for non-traded options over traded stock combined with moderate levels of firm-specific human capital risk in firm 1, 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.

With the theoretical proposition relating employee sentiment to option compensation and firm profits established, we next review the prior empirical and theoretical literature on broad-based option 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.

3. Literature Review

[24] The stock option boom during the technology bubble at the end of the 1990s corresponds well to part (b) of Theorem 3, that is, to the case of positive sentiment towards options combined with overvalued stock prices. Employee exuberance towards options and overvalued stock prices combine to make option compensation most attractive, and lead to an expansion of firms with positive sentiment at the expense of other firms. Interestingly,

The question as to why some firms encourage or even mandate holdings of company equity by non-executive employees, either through option plans or other means, 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 (2003) 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 usage of stock option grants to non-executive employees in a sample of 756 firms during 1994 to 1997. They present evidence that firms use greater stock option compensation when facing capital requirements and financing constraints. In particular, they find 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"). They also argue that their results are consistent with firms using options to attract and retain certain types

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employees of no-sentiment firms are better off ex-post due to their increased wages. On net, asymmetric sentiment leads to a social welfare loss due to the misallocation of labor in the economy.

[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) are aware of the Lazear (1999) argument and argue that options may nevertheless be useful for retention purposes based on an argument in Oyer (2004). He shows that if stock prices and labor market conditions are positively correlated, then unvested options serve to index employees' deferred compensation to their outside opportunities, and hence 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), and Kahl, Liu, and Longstaff (2003).

of employees as well as to create incentives to increase firm value. Anderson, Banker and Ravindran (2000) as well as Ittner, Lambert and Larcker (2001) document that stock option compensation is used most extensively in "new economy" firms. Interestingly, and consistent with the evidence we present below, Ittner, Lambert and Larcker (2001) show that new economy companies with greater cash flows use employee options more extensively, contradicting the notion that options are used to alleviate cash constraints. Murphy (2002, 2003) discusses these findings and proposes that firms' compensation policies are based on the "perceived cost" of options rather than their true economic cost. Since options bear no accounting charge and incur no outlay of cash, firms may perceive the cost of option compensation as low and, therefore, prefer it to cash compensation. 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 (2002) 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 extend 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. Lambert and Larcker (2001) report tentative survey evidence which suggests that many employees have unrealistic expectations about future stock prices and frequently value their options substantially above Black-Scholes values.

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[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.

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, when making decisions, 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 considerable 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 (2002), and Liang and Weisbenner (2002) analyze 401(k) plans and document that employees invest significant portions of their retirement funds voluntarily into company stock. Degeorge et al. (2004) show that during the partial privatization of France Telecom in 1997, employees who were more likely to have high firm-specific human capital risk invested more in their employer's equity. 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 presented in Section 2 predicts that option compensation is used when employees are optimistic about options and value them above their fair market value ($t(s) > 0$), and when employees strictly prefer (non-traded) options to the equity instruments available in the market ($t(s) > s$). 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. The results in Benartzi (2001) and Huberman and Sengmüller (2002) suggest that prior stock returns are a major determinant of employees' willingness

[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.

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.

The hypothesized link between past stock returns and employee sentiment towards option compensation is likely to be strongest when employees find it difficult to calculate the fair (market) value of the compensation instrument from observed stock prices. Valuing options from observed stock prices is obviously difficult and likely beyond the capabilities of almost all employees. If employees do not know how to value options correctly, then learning and extrapolating from past option payoff realizations is an obvious heuristic. Employees are likely to view options as desirable after a period in which options have done well, and are likely to assign low values to options after periods with low payoffs. We also expect employees to extrapolate more strongly from past performance when valuing options than when valuing restricted stock because of the amplified nature of option payoffs. In terms of the notation of our model, we expect option sentiment to react more strongly to past performance then stock sentiment ($t'(s) > 1$), and thus the employee sentiment premium of options over stock to increase in past performance ($t(s) - s$ 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 ($t(s) - s > \phi$).

The observation that employees' private valuations of company equity increase in past performance (and for many rise above the market price), in combination with the amplified effect of past stock returns on experienced option payoffs, leads to our first testable hypothesis:

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 stock sentiment. 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 options 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 options (or other forms of 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 (and other compensation variables) 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 2002 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 the total options granted to all employees. Hence, each reported executive grant provides us with an estimate of the number of options granted to all employees in the same firm during the fiscal year. We use the mean of the estimates generated from all grants provided to the top five executives 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.

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 $1/12^{th}$ 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.[31] The estimates of dividend yield and stock price volatility used in the Black-Scholes formula are taken from ExecuComp.[32] The risk-free rate is set to 6 percent, and option maturity is uniformly set to ten years. 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. 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 exercise 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. The only method to obtain complete data on employee option grants and holdings is hand-collection from the footnotes of annual reports. Hand collection is costly and inevitably results in small sample sizes and especially short sample periods.[33] We instead follow Desai (2002) and focus on option grants as measure of the intensity of option compensation. This enables us to look at a large cross-section of firms for the 1992 to 2002 period. A common weakness across both types of studies 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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[31] 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.

[32] 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.

Guay (2001) for the years 1995 to 1997 for a subset of the companies in our full sample.[34] 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 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. Stock returns are constructed from the CRSP monthly return files. 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 regression models 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 measures found in the prior literature. Conceptually, cash constraint measures are constructed using variables measuring the supply of cash to the firm (e.g. cash flow, cash balances, and dividends) and variables representing the demand for cash in the firm (e.g. investment opportunities, debt service). In our subsequent analysis, we use both the 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 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

[33] For examples of papers using hand-collected employee options data see Core and Guay (2001), Aboody, Barth, and Kasznik (2001), Graham, Lang and Shackelford (2002), Kedia and Mozumdar (2002), and Oyer and Schaefer (2004).

[34] We are grateful to John Core and Wayne Guay for kindly making their data available to us.

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:

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

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 the greater are 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 number of shares bought and 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 2,540 firms from the ExecuComp database in an unbalanced panel from 1992 to 2002. We exclude the 122 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 1,005 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 7,169 firm-years because information on at least one of the variables used in our base regressions is missing.[35] The final data set used in our base regressions comprises 2,099 firms and 11,735 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 $1.046 billion, median sales of $ 1.06 billion, and median assets of $1.041 billion. The median number of employees is 5,430. 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

[35] The 7,169 deleted firm-years are dropped for the following, non-exclusive reasons: 4,533 because one of the variables necessary to calculate the per-employee dollar value of option grants is missing, 1,510 because KZ cannot be calculated, 1,284 because KZ4 cannot be calculated, 1,392 because the average cash flow shortfall is missing, 2,112 because the average interest burden is missing, 435 because Q is missing, 882 because contemporaneous stock returns are missing, 2,306 because stock returns for the prior two years are missing, 127 because sales are missing, 142 because the long-term debt indicator is missing, and 8 because average R&D is missing.

the options granted. The median per-employee option grant is $946 per year for non-executive employees, with a mean of $8,734.[36]

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 35 percent (23 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 $6,735 ($862) while firms with prior returns in the top quintile grant options worth $22,295 ($3,037). Hence, consistent with out first hypothesis, intensive use of non-executive options is preceded by extraordinarily good performance.

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

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

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. The firm characteristics used as control variables include various measures of financial constraints which are described in detail in the next section. Other firm characteristics included in the regressions are firm size as measured by log sales, R&D intensity, use of long-term debt, and Q. 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

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

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 firm sales and R&D, as well as add 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 significant. The effect is also economically significant: a 10 percentage point increase in stock returns is associated with a 5.8 to 9.0 percent increase in the value of options granted. The t-statistics, calculated using robust standard errors with clustering at the firm level, are between 12.25 and 17.70. Hence the univariate relationship between grants and past returns is confirmed in the regression framework. 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.[37] Including firm fixed effects in Table 4 does not materially change the results. Since employee sentiment is likely determined more by the level of past stock returns than by the deviations of past returns from their mean, the fixed effects framework may not be appropriate to examine the effect of sentiment on option grants. It is nonetheless reassuring that the relationship between past returns and option grants holds in the firm fixed effects regressions as well.

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. We then repeat the analysis from Table 3, but replace the prior return variable by the performance quintile dummies. The results in Table 5 show that the effect of past returns on option grants is indeed highly non-linear. Moving from the lowest to the fourth highest return quintile increases the per-employee value of options granted by between 30 and 56 percent. When moving from quintile four to quintile five, the average grant size jumps by between 31 and 49 percent, and in each specification the effect of moving from quintile one to four is approximately equal to the effect of moving from quintile four to five.

[37] Contemporaneous returns may be positively related to grant values because the number of at-the-money options to be granted may be fixed at the beginning of the year, and hence high returns translate into high grant prices and Black-Scholes values. On the other hand, extraordinary high or low stock returns may occur after options have been granted, and hence the effect of "contemporaneous" returns on sentiment may not yet be reflected in grants.

Benartzi (2001) shows that the effect of past returns on employees' purchases of company stock increases in the time frame over which past returns are measured. This leads to our third hypothesis: firms should be most likely to grant options to employees after the stock price has done well for several years. To test this hypothesis, we sort firms into quintiles based on prior one, two, three, four, and five year returns.[38] 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 Benartzi's results and the employee sentiment hypothesis: the effect of past returns on option grants is increasing in the window over which the past returns are calculated. When sorting on previous one-year returns, we find option grants which are 32 percent larger in the highest return quintile compared to the lowest quintile. This difference increases to 74 percent when sorting on previous 3-year returns, and to 88 percent when sorting on previous 5-year returns.

6.2 The effect of cash constraints on employee option grants

The finding that stock option grants are related to our proxies for employee sentiment is robust to the inclusion of several measures of cash constraints in Tables 3 to 6. However, 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. Similarly, access to long-term debt is associated with less option compensation. 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, and KZ4 is negatively related to grants when firm fixed effects are included, again suggesting fewer option grants when cash constraints worsen.

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 components are cash balances, cash flow, investment, leverage, dividends, and Q. The results are presented in Table 7. We find that the value of option compensation per non-executive employee is

[38] For this exercise we restrict the sample 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. 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.

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 option grants. 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 relationships to 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 of 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 twelve months 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 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. Depending on the specification, firms which are one year from delisting give between 58 and 79 percent less grants to their employees than firms which do not delist, while firms which are two years from delisting give between 33 and 44 percent less grants.[41]

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[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 $2,238 ($504) to each employee while those in the highest cash quintile pay a mean (median) value of $30,104 ($10,217).

[40] The results remain 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.

[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

6.4 Employee Options and Growth in Employment

Our model of employee option compensation predicts that firms which pay their employees with options expand in size at the expense of firms which do not benefit (as much) from positive employee sentiment. This leads to our fifth hypothesis, which 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 regressing the log of per-employee option grants on employment growth and the same control variables as in the base regression. Consistent with the model predictions, employment growth and stock option grants are strongly linked, even when controlling for past and contemporaneous stock returns. An increase of ten percentage points in employment growth translates into 6.8 percent larger per-employee option grants in a cross-sectional regression, and into 3.6 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. First, we examine whether the strongly positive relation between past performance and employee option grants is driven by very small firms. Second, we examine whether accounting for the censoring of employee option grants at zero changes the empirical results. Finally, we discuss and examine the effects of sample selection bias on the empirical results.

The ExecuComp database encompasses a wide range of firms whose numbers of employees range 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 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,

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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.

even though the Tobit coefficients tend to be somewhat larger and more significant than the coefficients from the linear regressions. Censoring causes the coefficients in the linear model to be attenuated, and any bias induced by censoring is likely to work against us finding significant results in 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. Two types of firms appear with missing observations for employee stock options in our sample. First, we record a missing observation for firms which do not grant options to anyone, executive or non-executive. Second, firms which grant options to rank-and-file employees but not to top executives also have employee option grants incorrectly coded as missing. The first effect of this sample selection is that the estimates of average per-employee grants in Table 1 are biased upwards since firms which do not grant options to anyone drop out of the sample. 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 tend to lose more observations on employee options after bad performance, which is when we expect employee stock option grants to drop 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, in order to obtain 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 extend it through additional data collection to the years 1998 to 2000. The firms in this data set are a subset of the firms in the ExecuComp database.[42] 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, and 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.

[42] Core and Guay (2001) collect data from the 1997 annual reports for all firms (excluding banks) with fiscal year 1997 data in the ExecuComp database.

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. The second situation we examine is identified by managers engaging in aggressive inside sales, which, again, we interpret as a sign that managers regard their stock price as too high.

We measure earnings manipulation using three different measures of discretionary accruals. All measures of discretionary accruals use a cross-sectional adaptation of the modified Jones (1991) model as developed by Teoh, Welch, and Wong (1998 a,b). The first measure of discretionary accruals is based on current accruals calculated from year-to-year changes of the balance sheet and follows Teoh et al. (1998 a,b). Hribar and Collins propose two alternative definitions of accruals (total accruals and operating 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 12 to 25 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 same methodology as 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 of all firm-years 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 12 and 16 percent more options to their employees than comparable firms, while firms in which top managers purchase equity for their own account grant between 16 and 20 percent less to employees than comparable firms. These results suggest that top executives increase option grants to rank-and-file employees when they regard the stock as overvalued, and reduce employee option 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 propose that stock option grants to non-executive employees are a behavioral phenomenon: firms pay their employees in equity when employees are irrationally optimistic about the value of the offered compensation instrument. We model the optimal compensation policy of a firm faced with employees with positive sentiment towards equity compensation, and identify the conditions under which option compensation is part of an optimal compensation strategy. Our model identifies two reasons why firms compensate optimistic employees with options: the first reason is that firms are able to extract a sentiment premium for non-traded compensation instruments when such a sentiment premium exists. If employees value non-traded options more highly than traded equity, then firms, as the monopoly suppliers of options, are able to profitably extract this valuation premium from their employees. 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.

We base the hypothesis that employees are (in some situations) willing to overpay for options on the observation that rational option valuation is difficult and beyond the abilities of almost all employees. 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 associates' past experience with option payoffs. This makes it likely that employees strictly prefer options to cash and stock after periods with high stock returns and high option payoffs.

We then examine the empirical determinants of employee stock option compensation in a broad cross-section of firms. Our results show that non-executive employee option grants are positively associated with previous stock returns, investment and investment opportunities, and with cash balances and cash flows. Grants are negatively associated with interest burden and leverage, and firms in distress reduce their option grants in the periods before they delist. We also find that firms which grant more options have faster employment growth than firms which use fewer or no options. 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. As predicted by the model presented in Section 2, firms seem to use the lower compensation costs resulting from option compensation to expand in size. Furthermore, also consistent with the model, managers seem to use option compensation for rank-and-file employees more aggressively when managers believe that the 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 $s \leq \phi$, so that $\hat{N}_1^1 = 0$. Firm 1's optimization problem is therefore:

$$\begin{aligned} &\underset{W_1, N_1, M_1}{Min} \quad \{W_1 + N_1 + M_1\} \\ &s.t.\ W_1 + M_1(1+t) + N_1(1+s) - \frac{1}{2}[(N_1 + M_1)^2\sigma^2 + \sigma_Y^2 + 2(N_1 + M_1)\phi] \geq \bar{u} \end{aligned} \tag{A1}$$

Differentiating the Lagrangian of the problem, it is easy to see that the optimal solution involves $N_1 = 0$. Also, if $t \leq \phi$, the optimal solution has $M_1 = 0$ and otherwise, $M_1 = \dfrac{t-\phi}{\sigma^2}$.

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 $t \leq s$, the optimal compensation involves $M_1 = 0$ and $N_1 = \dfrac{s-\phi}{\sigma^2}$, and when $t > s$ we have $M_1 = \dfrac{t-\phi}{\sigma^2}$ and $N_1 = 0$. Assume now 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:

$$\begin{aligned} &\underset{W_1, N_1, M_1}{Min} \quad \{W_1 + N_1 + M_1\} \\ &s.t.\ W_1 + M_1(1+t) + (N_1 + \hat{N}_1)(1+s) - p\hat{N}_1 - \frac{(1+s-p-\phi)^2}{2\sigma^2} - \frac{1}{2}\sigma_Y^2 - \frac{(1+s-p-\phi)\phi}{\sigma^2} \geq \bar{u}. \end{aligned} \tag{A2}$$

Writing out the Lagrangian, it is easy to see that 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 $t > s$, the solution involves $M_1 = \infty$ in contradiction once again to $\hat{N}_1^1 > 0$. Finally, when $p = 1$ and $t \leq s$, the solution has $M_1 = 0$ and the firm is indifferent to any N_1 between 0 and $\dfrac{s-\phi}{\sigma^2}$.

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 $s = t = 0$ above.

Proof of Theorem 2

(a) Consider first the case where $s > \phi$. Using part (d.i) of Theorem 1, we have that $N_1^* \in [0, \frac{s-\phi}{\sigma^2}]$ and $M_1^* = 0$. Without loss of generality, we assume that $N_1^* = 0$, so that by Lemma 1 we have that $\hat{N}_1^1 = \frac{1+s-p(s)-\phi}{\sigma^2} = \frac{s-\phi}{\sigma^2}$, and $\hat{N}_1^2 = \frac{1+s-p(s)}{\sigma^2} = \frac{s}{\sigma^2}$. Plugging these values of M_1^*, N_1^*, $\hat{N}_1^1$ and $\hat{N}_1^2$ into the equation in part (a) of Theorem 1 yields after some algebraic manipulation:

$$W_1 + \frac{(s-\phi)^2}{2\sigma^2} = W_2 + \frac{s^2}{2\sigma^2}. \tag{A3}$$

By part (b) of Theorem 1 we thus have that:

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

Now, since $f'' < 0$, we have that $l_2 > l_1$ if and only if $s^2 > (s-\phi)^2$. Since $s > \phi$, this occurs unless $\phi = 0$, in which case $l_2 = l_1$. 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 $\Pi_2 > \Pi_1$.

Suppose now that $s \le \phi$. Using part (d.v) of Theorem 1, we have that $N_1^* = M_1^* = 0$. By Lemma 1 we have that $\hat{N}_1^1 = 0$, and $\hat{N}_1^2 = \frac{1+s-p(s)}{\sigma^2} = \frac{s}{\sigma^2}$. As above, plugging these values into the equation in part (a) of Theorem 1 yields $W_1 - W_2 = \frac{s^2}{2\sigma^2}$. By part (b) of Theorem 1, we therefore have $f'(l_1) - f'(l_2) = \frac{s^2}{2\sigma^2}$. Since $s > 0$ by assumption, we have that $l_2 > l_1$ and, therefore, also $\Pi_2 > \Pi_1$.

Regardless of the relationship between s and ϕ, firm 2 profits and employment are larger than that of firm 1 when $\phi > 0$, while the two are equal when $\phi = 0$.

(b) Consider first the case where $t > \phi$. Using part (d.iv) of Theorem 1, we have that $N_1^* = 0$ and $M_1^* = \frac{t-\phi}{\sigma^2}$. By Lemma 1 we have that $\hat{N}_1^1 = 0$, and $\hat{N}_1^2 = \frac{1+s-p(s)}{\sigma^2} = \frac{s}{\sigma^2}$.
Plugging these values into the equation in part (a) of Theorem 1, and using the fact that $f'(l_1) = W_1 + \frac{t-\phi}{\sigma^2}$ and $f'(l_2) = W_2$, yields, after some algebraic manipulation,
$f'(l_1) - f'(l_2) = \frac{s^2}{2\sigma^2} - \frac{(t-\phi)^2}{2\sigma^2}$. Since $f'' < 0$, we have that $l_2 > l_1$ if and only if $s^2 > (t-\phi)^2$, or equivalently if $t - s < \phi$. As shown above, the same requirement holds for the condition that $\Pi_2 > \Pi_1$.

Now, consider the case where $t \le \phi$. Using part (d.v) of Theorem 1, we have that $N_1^* = 0$ and $M_1^* = 0$. By Lemma 1 we have that $\hat{N}_1^1 = 0$, and $\hat{N}_1^2 = \frac{1+s-p(s)}{\sigma^2} = \frac{s}{\sigma^2}$.

Once again, plugging these values into the equation in part (a) of Theorem 1 yields

$f'(l_1) - f'(l_2) = \frac{s^2}{2\sigma^2}$. Since $f'' < 0$ and $s > 0$, we have that $l_2 > l_1$ and also $\Pi_2 > \Pi_1$.

Proof of Theorem 3

The proof follows closely that of Theorem 2.

(a) Consider first the case where $s > \phi$. Using part (d.ii) of Theorem 1, we have that $N_1^* = \frac{s-\phi}{\sigma^2}$ and $M_1^* = 0$. Using Lemma 1 we have that $\hat{N}_1^1 = 0$, and $\hat{N}_1^2 = \frac{1+s-p(s)}{\sigma^2}$. As in the proof above, applying parts (a) and (b) of Theorem 1 yields after some algebraic manipulation

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

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

The case in which $s \leq \phi$ is analogous to that in Theorem 2 above.

(b) Consider first the case where $t > \phi$. Using part (d.iv) of Theorem 1, we have that $N_1^* = 0$ and $M_1^* = \frac{t-\phi}{\sigma^2}$, 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

$$f'(l_1) - f'(l_2) = \frac{(1+s-p(s))^2}{2\sigma^2} - \frac{(t-\phi)^2}{2\sigma^2}. \quad \text{(A6)}$$

Since $f'' < 0$, we have that $l_1 > l_2$ (and $\Pi_1 > \Pi_2$) if and only if $(p(s) - 1) + (t(s) - s) > \phi$.

The case in which $t \leq \phi$ is analogous to that in Theorem 2 above.

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.[43] 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 the current portion of long-term debt (data item 44). Teoh et al. use a cross-sectional adaptation of the

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

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:

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

$TA_{j,t-1}$ 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.

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

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:

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

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

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

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:

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

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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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	11,735	
Panel A: Firm characteristics		
	Mean	Median
Number of employees	18,917	5,430
Total option grants to shares outstanding	19%	1.8%
Employee option grants to total grants	67%	71%
Per employee option grants	$8,734	$964
Market value of equity (billions)	$5,287	$1,046
Book assets (billions)	$5,930	$1,041
Sales (billions)	$3,872	$1,060
Q	2.01	1.51
3-year R&D average	3.3%	0.00%
Panel B: Measures of cash constraints		
	Mean	Median
Kaplan-Zingales (KZ) measure of cash constraints	0.86	0.87
KZ4 measure of cash constraints	0.29	0.34
3-year cash flow shortfall average	1.62%	0.76%
3-year interest burden average	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%	11%
3	15%	13%
4	21%	16%
5	35%	23%

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

	Option grant per employee	
Stock return quintile over previous two years	Mean	Median
1	$6,735	$862
2	$4,326	$657
3	$4,377	$668
4	$5,937	$920
5	$22,295	$3,037

Panel C: Per employee option grants by cash balance quintile

	Option grant per employee	
Cash balance quintile	Mean	Median
1	$2,238	$504
2	$2,359	$560
3	$3,296	$672
4	$5,684	$1,289
5	$30,104	$10,217

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	**0.90**	**0.59**	**0.59**	**0.59**	**0.58**
	[17.70]**	[12.25]**	[12.61]**	[12.38]**	[12.33]**
Contemporaneous stock return	**0.20**	**-0.04**	**-0.04**	**-0.04**	**-0.02**
	[9.19]**	[1.60]	[1.40]	[1.36]	[0.73]
Q_t		**0.30**	**0.31**	**0.29**	**0.29**
		[13.42]**	[14.13]**	[13.34]**	[13.40]**
KZ_{t-1}	**0.04**				
	[1.41]				
$KZ4_{t-1}$		**-0.02**			**0.00**
		[0.72]			[0.09]
Cash flow $shortfall_{t-1}$			**2.16**		**2.40**
			[9.28]**		[10.28]**
Interest $burden_{t-1}$				**-0.37**	**-0.58**
				[2.86]**	[4.01]**
Log sales	**-0.10**	**-0.11**	**-0.08**	**-0.12**	**-0.09**
	[5.08]**	[6.07]**	[4.22]**	[6.36]**	[4.64]**
Long term debt dummy	**-0.53**	**-0.25**	**-0.35**	**-0.24**	**-0.30**
	[6.02]**	[3.09]**	[4.18]**	[2.81]**	[3.68]**
R&D	**5.39**	**4.09**	**3.45**	**4.46**	**3.98**
	[5.68]**	[4.63]**	[3.82]**	[4.83]**	[4.15]**
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	**5.80**	**5.81**	**5.62**	**5.93**	**5.79**
	[34.02]**	[35.42]**	[34.04]**	[34.18]**	[33.69]**
Observations	11735	11735	11735	11735	11735
Adjusted R-Squared	0.56	0.58	0.59	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	**0.58**	**0.42**	**0.47**	**0.44**	**0.43**
	[13.76]**	[9.33]**	[10.30]**	[9.92]**	[9.61]**
Contemporaneous stock return	**0.14**	**0.04**	**0.03**	**0.04**	**0.05**
	[7.16]**	[1.50]	[1.23]	[1.68]	[2.23]*
Q_t		**0.14**	**0.15**	**0.14**	**0.14**
		[7.40]**	[7.76]**	[7.47]**	[7.48]**
KZ_{t-1}	**-0.03**				
	[1.12]				
$KZ4_{t-1}$		**-0.11**			**-0.08**
		[3.87]**			[2.60]**
Cash flow $shortfall_{t-1}$			**0.84**		**1.03**
			[3.52]**		[4.29]**
Interest $burden_{t-1}$				**-0.94**	**-0.83**
				[7.33]**	[6.48]**
Log sales	**-0.02**	**-0.02**	**-0.03**	**-0.06**	**-0.06**
	[0.45]	[0.47]	[0.72]	[1.31]	[1.35]
Long term debt dummy	**-0.04**	**0.03**	**-0.02**	**0.02**	**0.03**
	[0.63]	[0.51]	[0.32]	[0.31]	[0.42]
R&D	**-1.75**	**-2.15**	**-2.35**	**-1.92**	**-1.83**
	[2.09]*	[2.89]**	[3.12]**	[2.48]*	[2.37]*
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	**5.63**	**5.60**	**5.64**	**6.02**	**5.97**
	[19.04]**	[19.35]**	[19.25]**	[20.46]**	[20.58]**
Observations	11735	11735	11735	11735	11735
Adjusted R-Squared	0.82	0.82	0.82	0.83	0.83

* 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	**0.24**	**0.11**	**0.14**	**0.09**	**0.10**
	[5.04]**	[2.42]*	[3.05]**	[2.10]*	[2.16]*
Quintile 3	**0.37**	**0.19**	**0.23**	**0.18**	**0.19**
	[8.10]**	[4.23]**	[5.12]**	[3.94]**	[4.14]**
Quintile 4	**0.56**	**0.31**	**0.35**	**0.30**	**0.31**
	[12.10]**	[6.83]**	[7.87]**	[6.60]**	[6.92]**
Quintile 5	**1.05**	**0.63**	**0.66**	**0.62**	**0.63**
	[21.24]**	[12.62]**	[13.41]**	[12.62]**	[12.76]**
Contemporaneous stock return	**0.18**	**-0.06**	**-0.05**	**-0.06**	**-0.03**
	[8.63]**	[2.23]*	[2.01]*	[2.15]*	[1.29]
Q_t		**0.30**	**0.32**	**0.30**	**0.30**
		[13.95]**	[14.73]**	[14.05]**	[13.88]**
KZ_{t-1}	**0.03**				
	[1.29]				
$KZ4_{t-1}$		**-0.03**			**-0.02**
		[1.23]			[0.70]
Cash flow $shortfall_{t-1}$			**2.25**		**2.49**
			[9.49]**		[10.55]**
Interest $burden_{t-1}$				**-0.36**	**-0.54**
				[2.77]**	[3.72]**
Log sales	**-0.10**	**-0.12**	**-0.08**	**-0.12**	**-0.09**
	[5.42]**	[6.20]**	[4.40]**	[6.49]**	[4.65]**
Long term debt dummy	**-0.52**	**-0.23**	**-0.34**	**-0.23**	**-0.28**
	[5.88]**	[2.82]**	[4.12]**	[2.70]**	[3.46]**
R&D	**5.31**	**3.99**	**3.34**	**4.33**	**3.81**
	[5.49]**	[4.47]**	[3.64]**	[4.66]**	[3.96]**
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	**6.51**	**6.28**	**6.08**	**6.42**	**6.23**
	[40.65]**	[40.43]**	[38.69]**	[38.60]**	[37.58]**
Observations	11735	11735	11735	11735	11735
Adjusted R-Squared	0.56	0.58	0.59	0.58	0.59

* 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. 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**	**0.11**	**0.18**	**0.16**	**0.19**
	[0.14]	[2.23]*	[3.74]**	[3.07]**	[3.76]**
Quintile 3	**0.02**	**0.19**	**0.34**	**0.26**	**0.31**
	[0.46]	[3.92]**	[6.77]**	[4.89]**	[5.74]**
Quintile 4	**0.07**	**0.30**	**0.47**	**0.51**	**0.51**
	[1.42]	[6.13]**	[8.96]**	[9.03]**	[8.61]**
Quintile 5	**0.32**	**0.59**	**0.74**	**0.78**	**0.88**
	[7.16]**	[11.15]**	[13.12]**	[12.38]**	[13.05]**
Contemporaneous stock return	**-0.09**	**-0.04**	**-0.02**	**-0.01**	**0.00**
	[2.89]**	[1.46]	[0.72]	[0.39]	[0.07]
Q_t	**0.36**	**0.32**	**0.30**	**0.29**	**0.28**
	[13.80]**	[12.26]**	[11.53]**	[11.08]**	[10.43]**
$KZ4_{t-1}$	**0.01**	**0.02**	**0.02**	**0.01**	**0.01**
	[0.33]	[0.53]	[0.57]	[0.33]	[0.16]
Cash flow $shortfall_{t-1}$	**1.86**	**1.87**	**1.67**	**1.42**	**1.26**
	[6.30]**	[6.36]**	[5.75]**	[4.88]**	[4.32]**
Interest $burden_{t-1}$	**-0.67**	**-0.61**	**-0.46**	**-0.34**	**-0.25**
	[3.98]**	[3.67]**	[2.77]**	[2.04]*	[1.47]
Log sales	**-0.06**	**-0.06**	**-0.06**	**-0.06**	**-0.07**
	[2.72]**	[2.81]**	[3.00]**	[3.05]**	[3.15]**
Long term debt dummy	**-0.28**	**-0.31**	**-0.30**	**-0.29**	**-0.29**
	[3.04]**	[3.34]**	[3.33]**	[3.20]**	[3.28]**
R&D	**3.54**	**3.71**	**3.83**	**3.94**	**4.01**
	[3.46]**	[3.59]**	[3.69]**	[3.79]**	[3.81]**
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	**5.99**	**5.92**	**5.77**	**5.73**	**5.76**
	[31.91]**	[31.77]**	[30.89]**	[30.96]**	[31.43]**
Observations	10103	10103	10103	10103	10103
Adjusted R-Squared	0.57	0.57	0.58	0.58	0.58

* 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	**0.89**	**0.55**	**0.38**	**0.57**	**0.57**	**0.30**
	[17.52]**	[11.16]**	[8.08]**	[11.95]**	[12.68]**	[6.93]**
Contemporaneous stock return	**0.19**	**-0.03**	**-0.01**	**-0.04**	**0.01**	**-0.01**
	[9.06]**	[1.22]	[0.54]	[1.37]	[0.23]	[0.36]
Q_t		**0.28**	**0.27**	**0.29**	**0.26**	**0.28**
		[12.60]**	[13.19]**	[13.43]**	[13.37]**	[13.69]**
$Dividends_{t-1}$	**-11.42**					**-15.50**
	[6.16]**					[9.08]**
Cash $flow_{t-1}$		**0.66**				**0.09**
		[2.98]**				[0.41]
Cash $balances_{t-1}$			**1.33**			**1.11**
			[14.40]**			[12.86]**
$Leverage_{t-1}$				**-0.66**		**-0.71**
				[5.87]**		[6.29]**
Cash flow to $investment_{t-1}$					**3.48**	**2.74**
					[11.83]**	[9.71]**
Log sales	**-0.06**	**-0.12**	**-0.06**	**-0.09**	**-0.09**	**0.01**
	[3.14]**	[6.29]**	[3.51]**	[4.98]**	[5.01]**	[0.58]
Long term debt dummy	**-0.56**	**-0.25**	**-0.11**	**-0.14**	**-0.29**	**-0.05**
	[6.55]**	[2.96]**	[1.33]	[1.62]	[3.66]**	[0.75]
R&D	**5.34**	**4.56**	**3.15**	**4.06**	**5.08**	**3.82**
	[5.69]**	[4.91]**	[3.99]**	[4.70]**	[6.73]**	[5.65]**
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	**5.83**	**5.82**	**5.43**	**5.84**	**5.35**	**5.20**
	[34.78]**	[35.17]**	[33.35]**	[35.46]**	[33.25]**	[33.64]**
Observations	11735	11735	11735	11735	11735	11735
Adjusted R-Squared	0.57	0.58	0.6	0.59	0.6	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)	**-0.76**	**-0.58**	**-0.79**	**-0.65**
	[3.11]**	[1.97]*	[3.20]**	[2.20]*
Delisted two years later (t+2)			**-0.44**	**-0.33**
			[2.29]*	[1.65]
Stock return over previous two years	**0.57**	**0.43**	**0.57**	**0.42**
	[12.24]**	[9.55]**	[12.18]**	[9.51]**
Contemporaneous stock return	**-0.03**	**0.05**	**-0.03**	**0.05**
	[0.98]	[1.99]*	[1.12]	[1.90]
Q_t	**0.30**	**0.14**	**0.30**	**0.14**
	[13.40]**	[7.54]**	[13.45]**	[7.56]**
$KZ4_{t-1}$	**0.00**	**-0.077**	**-0.002**	**-0.076**
	[0.09]	[2.66]**	[0.07]	[2.65]**
Cash flow $shortfall_{t-1}$	**2.42**	**1.06**	**2.43**	**1.07**
	[10.37]**	[4.39]**	[10.45]**	[4.42]**
Interest $burden_{t-1}$	**-0.55**	**-0.80**	**-0.54**	**-0.79**
	[3.81]**	[6.16]**	[3.74]**	[6.07]**
Log sales	**-0.09**	**-0.06**	**-0.09**	**-0.06**
	[4.67]**	[1.46]	[4.72]**	[1.54]
Long term debt dummy	**-0.30**	**0.02**	**-0.30**	**0.03**
	[3.70]**	[0.34]	[3.68]**	[0.38]
R&D	**3.96**	**-1.80**	**3.97**	**-1.77**
	[4.12]**	[2.29]*	[4.12]**	[2.22]*
Industry fixed effects	Yes		Yes	
Firm fixed effects		Yes		Yes
Year fixed effects	Yes	Yes	Yes	Yes
Constant	**5.80**	**6.00**	**5.81**	**6.02**
	[33.78]**	[20.67]**	[33.85]**	[20.80]**
Observations	11735	11735	11735	11735
Adjusted R-Squared	0.59	0.83	0.59	0.83

* 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	**0.68**	**0.36**
	[11.82]**	[7.02]**
Stock return over previous two years	**0.47**	**0.39**
	[10.11]**	[8.59]**
Contemporaneous stock return	**-0.06**	**0.03**
	[2.30]*	[1.37]
Q_t	**0.28**	**0.14**
	[13.00]**	[7.45]**
$KZ4_{t-1}$	**0.00**	**-0.059**
	[0.15]	[2.06]*
Cash flow $shortfall_{t-1}$	**2.13**	**1.03**
	[9.26]**	[4.28]**
Interest $burden_{t-1}$	**-0.52**	**-0.80**
	[3.63]**	[6.30]**
Log sales	**-0.08**	**-0.06**
	[4.24]**	[1.52]
Long term debt dummy	**-0.32**	**0.00**
	[3.94]**	[0.04]
R&D	**4.17**	**-1.76**
	[4.38]**	[2.37]*
Industry fixed effects	Yes	
Firm fixed effects		Yes
Year fixed effects	Yes	Yes
Constant	**5.89**	**6.08**
	[34.65]**	[21.14]**
Observations	11735	11735
Adjusted R-Squared	0.60	0.83

* 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	**0.59**	**0.47**	**0.60**	**0.47**
	[13.66]**	[11.92]**	[12.47]**	[10.54]**
Contemporaneous stock return	**-0.03**	**0.06**	**-0.03**	**0.05**
	[0.95]	[2.23]*	[1.02]	[1.67]
Q_t	**0.32**	**0.14**	**0.33**	**0.15**
	[15.68]**	[7.48]**	[14.51]**	[6.94]**
$KZ4_{t-1}$	**0.04**	**-0.053**	**0.048**	**-0.041**
	[1.36]	[1.71]	[1.68]	[1.21]
Cash flow $shortfall_{t-1}$	**2.76**	**0.91**	**2.57**	**1.00**
	[12.45]**	[3.63]**	[10.85]**	[3.81]**
Interest $burden_{t-1}$	**-0.69**	**-0.83**	**-0.68**	**-0.83**
	[4.61]**	[5.63]**	[3.90]**	[5.02]**
Log sales	**-0.05**	**-0.03**	**-0.01**	**-0.04**
	[2.39]*	[0.61]	[0.43]	[0.85]
Long term debt dummy	**-0.26**	**0.09**	**-0.24**	**0.10**
	[2.97]**	[1.36]	[2.44]*	[1.25]
R&D	**9.09**	**-0.57**	**10.10**	**-0.46**
	[11.88]**	[0.62]	[11.74]**	[0.41]
Industry fixed effects	Yes		Yes	
Firm fixed effects		Yes		Yes
Year fixed effects	Yes	Yes	Yes	Yes
Constant	**5.13**	**5.42**	**4.74**	**5.36**
	[30.75]**	[16.96]**	[26.77]**	[15.31]**
Observations	10850	10850	10012	10012
Adjusted R-Squared	0.59	0.82	0.57	0.81

* 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	**0.82**	**0.51**
	[14.88]**	[17.84]**
Contemporaneous stock return	**0.05**	**0.04**
	[1.83]	[1.90]
Q_t	**0.33**	**0.20**
	[12.62]**	[15.23]**
$KZ4_{t-1}$	**0.04**	**-0.105**
	[1.30]	[6.84]**
Cash flow $shortfall_{t-1}$	**2.64**	**1.90**
	[7.86]**	[12.72]**
Interest $burden_{t-1}$	**-0.69**	**-0.73**
	[4.03]**	[8.58]**
Log sales	**-0.12**	**-0.21**
	[5.19]**	[13.91]**
Long term debt dummy	**-0.45**	**-0.14**
	[4.18]**	[2.72]**
R&D	**8.05**	**3.24**
	[7.88]**	[11.27]**
Firm random effects		Yes
Year fixed effects	Yes	Yes
Constant	**5.52**	**6.76**
	[26.61]**	[53.82]**
Observations	11735	11735

* 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

Independent variables	Dependent variable: Log option grants per employee (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**				
	[2.53]*	[3.20]**				
Manipulator - cash flow statement discretionary total accruals			**0.14**	**0.12**		
			[2.86]**	[2.53]*		
Manipulator - cash flow statement discretionary operating accruals					**0.25**	**0.24**
					[3.29]**	[3.47]**
Stock return over previous two years	**0.57**	**0.43**	**0.57**	**0.43**	**0.50**	**0.35**
	[11.06]**	[8.55]**	[11.48]**	[8.99]**	[6.32]**	[3.78]**
Contemporaneous stock return	**-0.03**	**0.03**	**-0.02**	**0.04**	**-0.07**	**0.00**
	[0.92]	[1.31]	[0.78]	[1.69]	[2.14]*	[0.05]
Q_t	**0.29**	**0.12**	**0.29**	**0.12**	**0.32**	**0.13**
	[12.50]**	[6.60]**	[12.73]**	[6.94]**	[11.00]**	[4.83]**
$KZ4_{t-1}$	**0.00**	**-0.09**	**0.00**	**-0.09**	**-0.05**	**-0.11**
	[0.12]	[3.57]**	[0.03]	[3.42]**	[1.57]	[2.56]*
Cash flow $shortfall_{t-1}$	**2.30**	**0.95**	**2.29**	**0.92**	**2.18**	**0.82**
	[9.57]**	[4.11]**	[9.63]**	[4.07]**	[7.09]**	[2.25]*
Interest $burden_{t-1}$	**-0.59**	**-0.84**	**-0.60**	**-0.88**	**-0.63**	**-0.84**
	[4.19]**	[6.75]**	[4.24]**	[7.09]**	[3.49]**	[4.32]**
Log sales	**-0.10**	**-0.06**	**-0.10**	**-0.06**	**-0.15**	**-0.08**
	[5.45]**	[1.49]	[5.24]**	[1.50]	[5.51]**	[1.41]
Long term debt dummy	**-0.28**	**0.07**	**-0.29**	**0.06**	**-0.23**	**0.11**
	[3.41]**	[0.95]	[3.45]**	[0.92]	[2.26]*	[1.35]
R&D	**3.99**	**-1.99**	**4.04**	**-1.93**	**2.84**	**-2.72**
	[4.07]**	[2.40]*	[4.13]**	[2.36]*	[2.26]*	[2.99]**
Industry fixed effects	Yes		Yes		Yes	
Firm fixed effects		Yes		Yes		Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	**5.92**	**6.07**	**5.91**	**6.07**	**6.36**	**6.42**
	[34.90]**	[21.37]**	[34.22]**	[21.82]**	[28.97]**	[16.28]**
Observations	10695	10695	11021	11021	5100	5100
Adjusted R-Squared	0.61	0.84	0.61	0.84	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 (2004). The manipulator variables indicating earnings management are defined as in Table 13. All other variables are defined as in Table 3. Regressions (1), (3), and (5) include year dummies and 3-digit SIC dummies, regressions (2), (4), and (6) include year dummies and firm fixed effects. T-statistics use heteroskedasticity-robust standard errors and allow for clustering at the firm level.

	Dependent variable: Log option grants per employee					
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Buying managers	**-0.17**	**-0.04**	**-0.16**	**-0.04**	**-0.20**	**-0.03**
	[4.46]**	[1.08]	[4.37]**	[1.20]	[3.66]**	[0.47]
Selling managers	**0.12**	**-0.04**	**0.12**	**-0.05**	**0.16**	**-0.03**
	[3.15]**	[1.29]	[3.04]**	[1.60]	[2.58]**	[0.59]
Manipulator - balance sheet discretionary current accruals	**0.10**	**0.14**				
	[1.85]	[3.15]**				
Manipulator - cash flow statement discretionary total accruals			**0.09**	**0.10**		
			[1.64]	[2.28]*		
Manipulator - cash flow statement discretionary operating accruals					**0.23**	**0.20**
					[2.90]**	[3.08]**
Stock return over previous two years	**0.58**	**0.45**	**0.58**	**0.45**	**0.53**	**0.43**
	[13.63]**	[11.17]**	[14.18]**	[11.59]**	[9.06]**	[7.39]**
Contemporaneous stock return	**-0.06**	**0.03**	**-0.04**	**0.04**	**-0.10**	**0.01**
	[1.94]	[1.19]	[1.64]	[1.51]	[2.41]*	[0.36]
Q_t	**0.28**	**0.12**	**0.28**	**0.12**	**0.30**	**0.11**
	[12.07]**	[6.31]**	[12.24]**	[6.76]**	[9.95]**	[4.10]**
$KZ4_{t-1}$	**0.00**	**-0.089**	**0.002**	**-0.083**	**-0.057**	**-0.092**
	[0.09]	[3.25]**	[0.08]	[3.10]**	[1.71]	[2.03]*
Cash flow $shortfall_{t-1}$	**2.16**	**0.82**	**2.15**	**0.79**	**2.08**	**0.56**
	[8.64]**	[3.34]**	[8.74]**	[3.33]**	[6.43]**	[1.42]
Interest $burden_{t-1}$	**-0.59**	**-0.89**	**-0.60**	**-0.94**	**-0.59**	**-0.88**
	[4.00]**	[6.62]**	[4.09]**	[6.97]**	[3.16]**	[4.58]**
Log sales	**-0.10**	**-0.04**	**-0.10**	**-0.04**	**-0.14**	**-0.08**
	[5.18]**	[1.00]	[4.96]**	[1.00]	[5.14]**	[1.30]
Long term debt dummy	**-0.29**	**0.06**	**-0.29**	**0.05**	**-0.23**	**0.07**
	[3.38]**	[0.78]	[3.48]**	[0.79]	[2.23]*	[0.77]
R&D	**4.06**	**-1.89**	**4.12**	**-1.81**	**2.83**	**-2.34**
	[3.89]**	[2.17]*	[3.97]**	[2.12]*	[2.13]*	[2.34]*
Industry fixed effects	Yes		Yes		Yes	
Firm fixed effects		Yes		Yes		Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	**5.98**	**6.02**	**5.97**	**6.03**	**6.34**	**6.44**
	[35.76]**	[19.85]**	[35.30]**	[20.14]**	[28.90]**	[15.42]**
Observations	9583	9583	9876	9876	4558	4558
Adjusted R-Squared	0.61	0.84	0.61	0.84	0.66	0.87

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