Share Repurchases and Employee Compensation

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Abstract

This paper focuses on the agency problem derived from the conflict of interest between employees and shareholders. I show that if employees are compensated with restricted stock or stock options, shareholders may engage in opportunistic share repurchases. Equityholders have an incentive to buy back stock after employment contracts have been signed because repurchases increase compensation sensitivity to firm cash flows and create stronger incentives for firm employees and executives. When firm cash flows are uncertain, this generates agency costs due to suboptimal risk sharing and external financing costs. I provide new empirical implications and test them using data on announcements of 1,295 open-market share repurchases during 1996-2002. Consistent with the incentive effect of stock buybacks, I find that the market reacts more favorably to repurchase announcements when the firm has many outstanding and few currently exercisable employee stock options, and when management holds a large stake in the firm. In addition, after repurchases, employees and executives receive fewer stock option grants and decrease their risk exposure by exercising more stock options.

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1 Introduction

The most pronounced change in corporate payout practices over the past decade has been the extraordinary growth of share repurchases. As reported by the Securities Data Corporation, the aggregate value spent by companies on stock buyback programs grew from $38 billion in 1993 to over $100 billion in 2003, peaking in 1998 with an astounding value of $230 billion. Traditional explanations for share repurchases include preferential tax treatment, signaling motives, takeover deterrence, adjustments of capital structure, distribution of excess capital, bondholder wealth expropriation, earnings management, and funding of employee stock option programs.

My paper shows that share repurchases implicitly change extant compensation contracts of firm employees and executives. At the time of repurchase, employees are typically not allowed to tender unvested shares, and their fractional holding in firm equity increases. This increased employee ownership or higher pay-for-performance sensitivity (measured by dollar change in compensation for a dollar change in firm value) creates stronger incentives for the employees to provide costly effort, but also exposes them to higher risk. Since employee compensation contracts are incomplete and usually do not have adjustments for the payout, shareholders can benefit from stock buybacks due to increase in incentives of employees. For example, a repurchase of 7% of common shares provides a 7.5% increase in employees' incentives[1] and can substitute for about half of a typical annual equity grant.

Building on insights from the agency theory advanced by Jensen and Meckling (1976), I show that although share repurchases generate *ex post* gains for the shareholders, *ex ante* they may lead to firm value loss. The problem originates from the inability of shareholders to commit to an optimal compensation structure that trades off employees' risk-bearing and incentives. With compensation policies in place, equity-holders have an additional motivation to buy back stock on the open market, because repurchasing shares increases existing incentives. This opportunistic behavior subjects risk-averse employees and executives

[1] If a fraction of shares θ is held by employees, then after repurchase of 7% of equity, the new stake is $\theta' = \frac{\theta}{1-0.07} = 1.075\theta$.

to higher than optimal risk due to random increases in compensation sensitivities, prompting them to request higher fixed wages when they sign employment contracts. Since the size of the repurchase program generally depends on the amount of cash generated by the firm and is unknown when contracts are signed, employees appear either over- or under- incentivized given any initial contract. This generates firm value loss due to suboptimal risk-sharing between employees and shareholders. Additionally, the opportunity cost of financing repurchase programs (e.g., foregoing some positive NPV projects, borrowing costs, increase in the likelihood of financial distress) may increase agency costs since *ex post* shareholders derive benefits from share repurchases even when financing is costly.

I find empirical support for my model. The model predicts that larger than expected buyback announcements will create positive returns (ceteris paribus) due to an increase in incentives of employees and executives. The announcement returns should also be positively related to the fraction of stock the firm is seeking to repurchase. The positive price reaction to buyback announcements is well-documented in the payout literature and usually attributed to signaling benefits (Vermalen, 1981; Comment and Jarrel, 1991; Ikenberry, Lakonishok and Vermaelen, 1995) and reduction in agency costs due to free cash flow (Nohel and Tarhan, 1998). To distinguish the predictions of my model from those made by alternative theories, I hypothesize that announcement returns should be higher when the incentive effect of repurchase is large, i.e., when the firm has many outstanding and few currently exercisable stock options, when executives own a large fraction of stock, and when the firm uses human capital intensively. I test this hypothesis using a sample of 1,295 announcements of open-market share repurchases from SDC database and data on employee stock options from 10K statements during 1996-2002. I find strong empirical support for this hypothesis. The effect is robust to a wide spectrum of alternative specifications, and appears to be economically significant, with an increase in options outstanding of one standard deviation resulting in an increase in three-day announcement returns of 0.6%.

Next, I test the prediction of the model that repurchases increase the risk exposure of all employees who have stock-based compensation. I develop two testable hypotheses: 1) employee turnover is positively related to the target fraction of shares the firm is seeking to repurchase and to the actual repurchased fraction of shares, and 2) repurchases prompt early stock option exercise by risk-averse employees and executives. I find support for these predictions. Since employees usually have to forfeit their options when they leave the company, I use the ratio of forfeited options to outstanding options as my primary measure of employee turnover. I find that employee turnover following repurchase announcements is positively related to both the target fraction of shares listed in the announcement and to the actual fraction of repurchased equity. Moreover, the effect is stronger for highly volatile firms, where the increase in risk should play a more important role. The positive relation of turnover to repurchases appears to be larger when employees have greater mobility, which suggests that employees leave the firm voluntarily.

Stock option exercises are strongly and positively related to the fraction of repurchased equity for both executive and non-executive employees, after controlling for other factors influencing exercise. A standard deviation increase in the fraction of repurchased equity is associated with a 29% increase in stock option exercises by executives and an 18% increase by all other employees, controlling for stock returns, contemporaneous option grants, market-to-strike ratios, dividend yield, and volatility. The increase in stock option exercises is also more pronounced for highly volatile firms.

Since repurchases increase the incentives of employees and executives, the model suggests that new grants of stock-based compensation should decrease following stock buybacks. As there appears to be a strong contemporaneous relation between stock option grants and exercises, with grants affecting exercises, and exercises affecting the grants, I model them as a system of simultaneous equations with appropriate identifying conditions. I find evidence of a substitution of repurchases for new option grants to employees and executives. The economic significance of the substitution effect is modest, with a standard deviation increase in the amount of repurchases associated with a 9% decrease in grants to non-executives and a 10% decrease to executives.

I discuss several extensions of the model. First, I consider the situation where all payout decisions are delegated to the manager, and the shareholders have no power to impose their desired policy. I show that at least in some situations, the manager will engage in opportunistic share repurchases, and the delegation of rights to the manager will not eliminate agency costs. Second, I consider the implications of the absence of dividend protections[2] in executive stock options for payout policy within the context of my model.

The remainder of the paper is organized as follows. Section 2 reviews the relevant theoretical and empirical literature. Section 3.1 develops a model and discusses the nature of the agency problem associated with opportunistic repurchases. Sections 3.2 and 3.3 consider possible extensions of the model. All empirical hypotheses are developed in Section 4. Section 5 describes my sample, and section 6 presents empirical results. The last section offers concluding remarks.

2 Literature Review

The theoretical analysis in this paper draws on the literature on incomplete contracts by Holmstrom (1979) and Holmstrom and Milgrom (1987) and relates to the literature analyzing the impact of debt on compensation contracts. For example, Bronars and Deere (1991) argue that high debt is beneficial for shareholders since debt reduces the surplus over which shareholders and employees bargain and reduces the probability of union formation. Cadenillas, Cvitanic and Zapatero (2004) examine the effects of granting levered stock to a risk-averse manager when the capital structure choice is determined by the trade-off between incentives and optimal risk-sharing. However, the capital structure in both of these models is chosen *ex ante* and there is no room for dynamic adjustments in leverage and payout policy once the contract is signed. Perroti and Spier (1993) analyze leveraged recapitalizations and conclude that the use of strategic debt-for-equity exchanges helps shareholders to extract wage concessions from the firm's workers. My paper is similar to theirs in that debt-for-equity exchanges create gains for the shareholders, but the mechanism and the source of gains is different. In their model, when firm profits are low, shareholders can credibly change firm investment policy by issuing additional debt and can force wage concessions from the union. In my model, there are no financial concessions from employees, and contract renegotia-

[2] Since executive stock options are rarely dividend protected, executives may also substitute share repurchases for dividends in order to preserve the value of their options. In support of this hypothesis, Weisbenner (2000), Fenn and Liang (2001), and Kahle (2002) find a negative relation between the propensity to pay dividends and the number of outstanding executive stock options.

tion is not needed for the shareholders to achieve the gains. Moreover, the gains can be achieved even without debt increases, simply by repurchasing equity using retained cash.

My paper is also related to a rapidly growing literature on certainty-equivalence valuation of illiquid securities by undiversified risk-averse individuals. For example, Kahl, Liu and Longstaff (2003) examine how executives value restricted stock shares if they are not allowed to sell them and can only trade in securities with imperfect correlation to a firm's stock. Similarly, Hall and Murphy (2002) analyze cost, value, and pay-for-performance sensitivity of non-tradable options awarded to executives as a form of compensation.

On the empirical side, my paper is related to the recent work by Bitler, Moskowitz and Vissing-Jorgensen (2005), who use a detailed dataset on entrepreneurs in private firms to document that higher pay-for-performance sensitivity is associated with higher effort, and that effort increases firm performance.

The literature examining the relation between employee stock options and share repurchases is mostly empirical. For example, Bens et al. (2003) find that repurchase decisions are often motivated by the desire of corporate executives to manage diluted earnings per share (EPS). They document that when employee stock options move further in the money and their dilutive effect on EPS increases, firms expand repurchase programs. Fenn and Liang (2001) examine whether higher managerial stock ownership leads to higher firm payout. They find support for this hypothesis for firms with potentially the highest agency problems, i.e., those with high free cash flow, few investment opportunities, and low managerial ownership. Kahle (2002) finds that inflow of cash from stock option exercises may prompt managers to initiate share repurchases in order to distribute cash back to investors.

Much of the payout literature focuses on the choice between dividends and share repurchases as two major forms of returning cash to investors. From a tax perspective, repurchases are beneficial since the long-term capital gains tax rate is generally lower than the tax rate on ordinary income[3]. The signaling literature

[3]Green and Hollifield (2003) show that the tax advantage to share repurchases can be very substantial (40-50%) even when these rates are the same. The tax advantage is due to the value of tax realization deferral and the possibility of step-up on death.

treats dividends and repurchases as close substitutes (e.g., Bhattacharya, 1979; Miller and Rock, 1985) with the exception of John and Williams (1985) and Bernheim (1991), who use the tax differentials at the personal level to establish that dividends must convey a stronger signal. Jaganathan, Stephens and Weisbach (2000) and Guay and Harford (2000) find that repurchases are usually used by firms with higher "temporary" cash flows while dividends are paid by firms with higher "permanent" cash flows[4]. Grinstein and Michaely (2005) investigate how institutional ownership affects firm payout policy and conclude that although institutions generally prefer firms with regular repurchases, high institutional holdings do not cause firms to alter their payout structure. Since the recent explosion in share repurchase programs, much research is also concerned with establishing whether firms substitute repurchases for dividends. In support of this hypothesis, Grullon and Michaely (2002) find that firms often finance their share repurchases with funds that otherwise would have been used to increase dividends, and that young firms have a higher propensity to pay cash through repurchases than they did in the past.

3 Model

3.1 Share Repurchases and Agency Problem

Consider a setting where shareholders wish to hire a risk-averse worker. The employee has an increasing and concave utility function defined over wealth $U(W)$ and a monetary convex disutility of effort $c(e)$. Before signing his employment contract, the worker has an outside opportunity that guarantees him a reservation utility of $\overline{U}$. Since the employee is fully rational, he accepts the contract only if his expected utility from employment is greater than his reservation utility.

The shareholders owning the project start with a clean slate all-equity firm with a total of N shares of common stock at date 0. The project generates random cash flows $\widetilde{X}$, which are increasing in the employee's effort:

$$\widetilde{X} = \overline{X} + p(e) + \widetilde{u} \tag{1}$$

[4] Guay and Harford (2000) use slightly different terminology of "permanent" and "transient" shocks.

where u is drawn from distribution $f_u(u)$ with $E(\widetilde{u}) = 0$ and $p(e)$ is increasing and concave in the employee's effort. I assume that effort level lies in the compact interval $[0, e_{\max}]$, with $p(0) = 0$, and $c(0) = 0$. In order to avoid corner solutions, I also adopt Inada conditions, i.e. $c'(0) = 0$, and $c'(e_{\max}) = \infty$. Part of the cash flows, $\widetilde{Y}$ are realized early at date 1, with $Y \in [0, Y_{\max}]$; and the remaining $\overline{X} - \widetilde{Y} + p(e) + \widetilde{u}$ are available at date 2[5], so that there is a negative correlation between cash flows at dates 1 and 2. The role of uncertain $\widetilde{Y}$ in the model is only important because I want to consider the case when the firm faces financing constraints and because Y captures the idea that payout decisions depend on the information at $t = 1$[6]. For convenience, the risk free rate is set to zero. In order to ensure that the optimal compensation scheme is increasing in firm output, I assume that the conditional distribution of $\widetilde{X}$ satisfies the Monotone Likelihood Ratio Property[7] (MLRP), i.e., for every effort level e, the ratio $\frac{\partial f(X|e)/\partial e}{f(X|e)}$ is increasing in the outcome $\widetilde{X}$.

Since the employee's effort is unobservable, the optimal contract can not be made contingent on a specified level of effort, and the employee must be given a contract with nonzero pay-for-performance sensitivity[8]. I restrict attention to linear contracts[9] consisting of n shares of restricted stock and a fixed wage w, and assume that employees cannot trade on their own account to undo the effects of the financial contract[10]. When short-term cash flows $\widetilde{Y}$ are realized, shareholders

[5] Variable Y can also be interpreted as uncertainty of whether the share repurchase program can be conducted.

[6] The model does not allow for the optimal contract to be conditioned on Y. In practice, we rarely see the provisions for the payout policy in the compensation contracts. In addition, while in theory these provisions may be helpful, the optimal adjustments to the contract may depend on preferences of heterogeneous employees and can be difficult to implement.

[7] The MLRP property captures the idea that larger outcomes are evidence of higher effort by the agent. See Milgrom (1981) for a discussion of this property in various applications.

[8] I abstract from the possibility of free-rider problems and assume that employees can be motivated by incentive plans. Kandel and Lazear (1992) show that employees increase firm value collectively when incentive plans are used because of increased peer pressure, mutual monitoring, guilt, shame, and norms. Core and Guay (2001) find empirical support for the hypothesis that firms use stock-based compensation to provide incentives for the rank-and-file employees.

[9] Holmstrom and Milgrom (1987) show that if the agent has exponential utility function and monetary cost of effort, the optimal schemes are linear in firm output. Moreover, linear contract is robust to changes in the specification of the problem as it applies the same pressure on the agents in all states of the world.

[10] Garvey (1997) demonstrates that trading on secondary markets can be an important limita-

have the choice of either retaining these funds or distributing them back to investors through a share repurchase program[11]. However, if shareholders decide to distribute more than $\widetilde{Y}$, they resort to external financing[12], which is available at an exogenous cost λ. I assume that the debt capacity of the firm is limited, i.e., the firm cannot issue more debt than $D_{\max}$[13].

The timing of events is as follows. At $t = 0$, shareholders specify a compensation contract that consists of a fixed wage w and n shares of restricted stock. At $t = 1$, the uncertainty about early cash flows, Y, is revealed, and shareholders decide how much to distribute. After the payout decision, but before resolution of final uncertainty, the employee chooses an optimal level of effort. Finally, at $t = 2$, long-term cash flows are realized, and the compensation is paid to the employee according to the contract.

Denoting by $\theta = \frac{n}{N}$ the initial sensitivity of compensation to firm cash flows, determined at $t = 0$, the wealth of the employee in the absence of any payout can be written as:

$$W = w + \theta \left(\overline{X} + p(e) + \widetilde{u} \right) \tag{2}$$

I start by writing the optimization problem of the employee who chooses the optimal effort, given his compensation contract and the firm payout policy:

$$\max_{e} E_u \left[U \left(w + \theta_R (\overline{X} + p(e_R) + \widetilde{u} - R) - c(e_R) \right) \right] \tag{3}$$

where R is equal to the total amount firm spends on repurchases, and the expectation is taken with respect to uncertainty about long-term cash flows. The sensitivity to firm cash flows, θ_R, carries a subscript because it may depend on the payout at date 1. Note that θ_R is higher than initial θ because the number

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tion on the use of such contracts. However, my assumption can be justified by trading restrictions that companies regularly place on their employees and management, such as the use of vesting schedules (see Liu, Longstaff and Kahl, 2001 for discussion of trading restrictions).

[11] Although I do not formally consider dividend distributions in this section, paying dividends is strictly suboptimal in this setting since dividends have to be paid to the employee on a pro-rata basis.

[12] I assume that the debt capacity of the firm is limited, i.e., the firm cannot issue more debt than $D_{\max}$. This is a reasonable assumption because firms often have debt covenants that prohibit execessive leverage, especially if increase in leverage is used to finance the increase in payout.

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of shares owned by employee, n, does not change while the number of outstanding shares decreases when firm repurchases stock. The maximization results in a simple, first-order condition for the optimal effort:

$$E_u \left[U' \left(w + \theta_R(\overline{X} + p\left(e_R^*\right) + \widetilde{u} - R) - c\left(e_R^*\right)\right) \left(\theta_R p'\left(e_R^*\right) - c'\left(e_R^*\right)\right)\right] = 0 \qquad (4)$$

Since U' is everywhere positive, this condition can be further simplified to:

$$\theta_R p'\left(e_R^*\right) - c'\left(e_R^*\right) = 0 \qquad (5)$$

Using the first-order condition, I establish next that the optimal effort increases in sensitivity to the firm cash flows, i.e., as the fractional holding of the employee grows, he applies greater effort.

Lemma 1 *If the expected utility maximizer has a monotonically increasing, concave utility function* $U(W)$ $(U' > 0, U'' < 0)$*, increasing, convex and twice differentiable disutility of effort* $c(e)$ $(c' > 0, c'' > 0)$ *satisfying* $c'(0) = 0$*, and* $c'(e_{\max}) = \infty$*, and if the employee's productivity* $p(e)$ *is twice differentiable and exhibits decreasing returns to scale* $(p' > 0, p'' < 0)$*, then optimal effort* e^* *exists and is monotonically increasing in compensation sensitivity to firm cash flows* θ_R*. In addition, if either* $(p''' > \frac{2(p'')^2}{p'}, c''' > p''' + \frac{2p''(p''-c'')}{p'})$ *or* $(p''' < \frac{2(p'')^2}{p'}, c''' > \frac{2p''c''}{p'})$*, then the optimal effort is also concave in sensitivity to firm cash flows.*

Proof. (see Appendix A) ■

Importantly, this result does not rely on particular assumptions about the form of the utility function, the cost of effort, or the employee's productivity. The only assumption made is that effort is set before the realization of final uncertainty and that effort affects cash flow in an additive way, i.e., it takes the same effort to create an additional dollar of value for a large and small companies[14].

Consider now the payout decision by firm shareholders, who maximize equity

[14] This also implies that effort does not affect project risk in my model. Several authors assume that effort can affect both mean and variance of firm returns. However, they model effort choice by a manager who usually has some discretion over project risk selection. For recent examples, see Cadenilas, Cvitanic and Zapatero (2003) and Carpenter (2000).

value[15] at $t = 1$. Since at the time of repurchase the employees cannot tender unvested shares, their fractional holding in firm equity ("percent owned") increases, leading to a higher incentive to provide costly effort. This will imply that shareholders have the incentive to repurchase as many shares as possible using retained cash Y, and even to raise external capital in order to finance distributions, provided that the financing cost is sufficiently small. Denote by D the value of debt[16] issued at $t = 1$, by λ the exogenous financing cost, and by e_R the employee's effort after the repurchase. Once the repurchase is announced, the market value of the equity reflects the increased effort of the employee and the borrowing costs, i.e., $E = \overline{X} - D\lambda + p\left(e_R\right)$. The equity after repurchase are smaller by the value of the distributed amount $Y + D$, i.e., $E' = E - Y - D$. The no arbitrage condition requires that shareholders are indifferent to tendering or holding onto their shares, implying that a non-tendering holder of stake θ in the company receives a stake θ_R of resulting equity after repurchase:

$$\theta_R = \theta \frac{E}{E'} \tag{6}$$

Since the employee is also a shareholder, the condition (6) defines his new fractional holding subsequent to buyback, given initial compensation sensitivity θ. Let e_Y denote the effort level after repurchase of size Y, i.e. effort if repurchase is fully financed with retained cash.

Proposition 1 *Given a fixed non-trivial compensation contract ($\theta \neq 0$), equity-holders have incentives to buy back stock on the open market using internal cash flows and costly external funds. The amount of external capital used for repurchase is constrained by the requirement that the marginal agency benefit of repurchase is at least as large as the cost of capital λ, i.e., ($p'\left(e_Y\right) \frac{de_Y}{d\theta_Y} \frac{d\theta_Y}{dD} \geq \lambda$).*

Proof. (see Appendix A) ■

The intuition behind this proposition is clear. If the contract is in place, shareholders benefit from share repurchases because they increase the sensitivity

[15] Here I assume that outside (non-employee) shareholders are risk-neutral since they can diversify away any firm-specific risk and that shocks to firm assets are idiosyncratic in nature.

[16] For parsimony, I model debt in a simplistic way, abstracting from issues of tax-deductibility of coupons, bankruptcy costs, underinvestment, asset substitution, or other agency costs. The only disadvantage to debt in this model is the exogenous cost of capital λ.

of employees' compensation to effort and motivate employees to increase the value of the firm. Since in the model there are no opportunity costs of using internally generated cash, shareholders will first use internal funds to finance stock buybacks. Moreover, shareholders will issue debt if the marginal benefit of increased effort outweighs the marginal financing cost. Note, that while it is possible to increase the effort of the employee using either internal cash flows or proceeds from debt issue, raising capital via equity issues does not generate greater effort since additional equity dilutes employee ownership.

Corollary 1 *The price reaction at the announcement of repurchase is monotonically increasing in repurchase amount R^*, and is positive when $Y > Y_T$, where threshold Y_T is defined by condition $p\left(e_R\left(Y_T, D(Y_T)\right)\right) - D(Y_T)\lambda = E_Y(p(e_R \widetilde{Y}, D(\widetilde{Y})) - D(\widetilde{Y})\lambda)$*

I established in Proposition 1 that shareholders benefit from share repurchases. The next proposition demonstrates that these benefits are derived in part at the expense of the employees, whose expected utility decreases when there is a share repurchase.

Proposition 2 *If the conditions of Lemma 1 hold and the initial contract is non-trivial ($\theta \neq 0$), then the employee has a lower expected utility when there is a stock buyback $R > 0$ than when there is no stock buyback $R = 0$, i.e. $EU(R) < EU(0)$. Moreover, the expected utility loss for the employee is monotonically increasing in the repurchase amount R^*.*

Proof. (see Appendix A). ■

The employee has a lower expected utility in case of stock buyback for three major reasons. First, after a share repurchase, the employee is forced to bear more risk since his compensation sensitivity increases. Second, to the extent of his ownership, the employee incurs costs associated with the issuance of debt. Finally, since cost of effort is monetary in the model, share repurchases result in a wealth transfer from employees to shareholders. Intuitively, the market reacts positively to the repurchase announcements, fully incorporating in the price the effect of future increases in effort and shares are bought back at this high price.

It is always optimal for the employee to exert greater effort after the repurchase since the sensitivity of his compensation is increased. However, due to the market reaction, a large part of the gains from increased effort accrues to shareholders, while the costs of effort are born exclusively by the employee[17].

Proof. (see Appendix A). ■

Employees rationally anticipate the firm payout policy when they sign employment contracts. Therefore, in order to compensate for increased risk, greater effort, and reduction in firm value due to borrowing costs, employees demand higher compensation for their services *ex ante*. Since shareholders design the original compensation contract, they try to minimize the agency costs associated with future share repurchases[18]. Next, I define the first best case that could be implemented by the "social planner", who can commit to the initially chosen repurchase policy.

Definition 1 *The firm payout policy $R_{FB}(Y)$ and optimal compensation contract (w_{FB}, θ_{FB}) that maximize ex ante firm value net of compensation, subject to the individual rationality constraint are defined to be the first best. Mathematically,*

$$\max_{w_{FB},\theta_{FB},R_{FB}} E_Y(\widetilde{R}_{FB} + \left(1 - \widetilde{\theta}_{FBR}\right)(\overline{X} + p(\widetilde{e}_{FB}) - \widetilde{R}_{FB} - \widetilde{D}_{FB}\lambda)) - w_{FB}$$
$$s.t.\ \overline{U} \leq E_Y E_u U(w_{FB} + \widetilde{\theta}_{FBR}(\overline{X} + p(\widetilde{e}_{FB}) - \widetilde{R}_{FB} - \widetilde{D}_{FB}\lambda + \widetilde{u}) - c(\widetilde{e}_{FB}))$$

where $D_{FB} = R_{FB} - Y$, θ_{FBR} is the compensation sensitivity after repurchase determined by the condition (6) and by sensitivity prior to repurchase θ_{FB}, and effort e_{FB} is chosen optimally by the employee, given θ_{FBR}, i.e., e_{FB} solves (4).

Note that the definition of the first best allows for the repurchased amount R_{FB} to be a function of early cash flows $\widetilde{Y}$. This implies that optimal sensitivity after repurchase θ_{FBR} can depend on the realization of $\widetilde{Y}$; however, as I will

[17] This may seem counterintuitive at first because we generally think that for a risk-neutral employee higher stake in the firm implies higher wealth. This is because when given a higher stake the employee could choose the same effort as before and get a higher value, while optimal choice of effort increases his wealth even further. In my model, this argument does not hold because after a share repurchase the employee holds a larger stake of the *smaller* firm.

[18] In the special case when there is no uncertainty about short-term cash flows and external financing is not available, the shareholders can fully mitigate the agency costs by specifying the initial contract.

show later, this is strictly suboptimal from the point of view of the social planner. The optimal contract chosen by shareholders and the payout policy will generally differ from the first best scenario since shareholders always have an incentive to repurchase shares at date 1 and cannot commit to an initially chosen payout policy. I formalize the optimization problem of the shareholders in the next definition.

Definition 2 *The optimal compensation contract (w_{SB}, θ_{SB}) that maximizes ex ante firm value net of compensation, subject to the repurchase policy $R_{SB}(Y)$ being optimal at $t = 1$, and to the individual rationality constraint, is defined to be the second best. Mathematically,*

$$\max_{w_{SB},\theta_{SB}} E_Y(\widetilde{R}_{SB} + \left(1 - \widetilde{\theta}_{SBR}\right)(\overline{X} + p(\widetilde{e}_{SB}) - \widetilde{R}_{SB} - \widetilde{D}_{SB}\lambda)) - w_{SB}$$
$$s.t.\ R_{SB} = \arg\max_R (R + (1 - \theta_{SBR})\left(\overline{X} + p(e_{SB}) - R - (R - Y)\lambda\right))$$
$$s.t.\ \overline{U} \leq E_Y E_u U(w_{SB} + \widetilde{\theta}_{SBR}(\overline{X} + p(\widetilde{e}_{SB}) - R_{SB} - \widetilde{D}_{SB}\lambda + \widetilde{u}) - c(\widetilde{e}_{SB}))$$

where $D_{SB} = R_{SB} - Y$, θ_{SBR} is the compensation sensitivity after repurchase determined by condition (6) and by sensitivity prior to repurchase θ_{SB}, and effort e_{SB} is chosen optimally by employee, given compensation sensitivity θ_{SBR}, i.e. e_{SB} solves (4).

Definition (2) says that when short-term cash flows $\widetilde{Y}$ are realized, shareholders choose how much to repurchase in order to maximize equity value at date 1, given the compensation contract and borrowing costs. If shareholders choose to distribute more than $\widetilde{Y}$ at date 1, the difference is financed by selling debt[19].

I now show that if there are costs to borrowing it is impossible to reach the first best. The intuition is that the employee's effort and the riskiness of his compensation are completely determined by the final sensitivity of his contract. Since in the model there is no advantage to debt the social planner will never raise external funds for repurchase, since he can always attain the desired level of effort by choosing initial pay–for-performance sensitivity. However, the shareholders cannot commit to the first best policy and will raise costly external funds up to

[19] It is never optimal in this framework to issue and repurchase equity simultaneously since issuance of equity dissolves the ownership of the employee.

the point where the marginal benefit from increased productivity is equal to the cost of funds. The *ex ante* value of equity will be lower when shareholders make the decisions because shareholders incur unnecessary costs without any gains in efficiency. The next proposition demonstrates this point formally.

Proposition 3 *Suppose early cash flows Y are certain. If financing costs are positive but not too large to completely preclude external financing, i.e., $0 < \lambda \leq p'(e_Y) \frac{de_Y}{d\theta_Y} \frac{d\theta_Y}{dD}$, then first best cannot be achieved by shareholders.*

Proof. (see Appendix A). ■

However, even if there are no costs of borrowing, first best may not be reached by shareholders if there is some uncertainty about short-term cash flows Y. The intuition is that there is an optimal level of incentives to be given to the employee that trades off productivity gains from the employee's increased effort and risk-bearing. If cash flows Y are certain, then shareholders start preemptively with lower sensitivity and achieve optimal incentives by buying back an anticipated number of shares. If, however, short-term cash flows are random, then given any initial contract, repurchasing stock using all cash flows will provide incentives that are either too low or too high, depending on the realization of cash flows Y. The next proposition establishes this point.

Proposition 4 *Suppose early cash flows Y are uncertain. If the conditions of Lemma 1 hold, then first best cannot be achieved by shareholders.*

Proof. (see Appendix A). ■

The intuition for the Proposition 4 is the following. The social planner can commit to repurchase policy that maximizes ex ante firm value and chooses not to repurchase any stock at $t = 1$. Given any compensation contract designed by the shareholders (w_{SB}, θ_{SB}), the social planner can on average achieve better efficiency by simply setting the sensitivity of the contract equal to the average final sensitivity $\theta_{SB}\left(\widetilde{R}\right)$ under the contract offered by the shareholders, i.e. to $E\left[\theta_{SB}\left(\widetilde{R}\right)\right]$. Since the contract offered by the social planner will be less risky in the sense of second-order stochastic dominance, the employee will also settle for lower fixed payments[20].

[20] It is interesting to speculate what happens if the renegotiation at date t=1 is allowed. If

3.2 Role of management

In the previous section, I assumed that shareholders make all payout decisions. This may be an unrealistic assumption given that the interests of top management are not fully aligned with those of shareholders, and managers have a lot of decision power within the firm. In this section, I relax this assumption and consider an extension of the model where all payout decisions are delegated to the manager. Both the manager and a regular rank-and-file employee contribute to the value of the firm by providing their costly effort[21], i.e. long-term cash flows of the firm that materialize at date 2 are given by:

$$\widetilde{X} = \overline{X} + p(e) + p^E\left(e^E\right) + \widetilde{u} \tag{7}$$

where $p(e)$, $p^E\left(e^E\right)$ are returns to the manager's and employee's effort, respectively. Using the results of Proposition 2, it is easy to see that the manager has no incentive to repurchase shares if non-executive employees do not have any stock-based compensation. This is because repurchases subject the manager to higher risk by increasing the sensitivity of his compensation. However, when non-executive employees hold a nonzero stake in the firm, the manager may have a reason to do a stock buyback because the repurchase motivates other employees to work harder, creating kickbacks to the manager through his stock ownership. Thus, a manager will repurchase stock (rather than retain cash or pay dividends)

at date t=1 the employee has nonzero pay-performance sensitivity $\theta > 0$, and there is cash available for repurchase $Y > 0$, then shareholders have a credible threat point (threatening to repurchase) according to Proposition 2. Assuming that shareholders have all the bargaining power, the employee will have such pay-performance sensitivity after the renegotiation, that when shareholders repurchase using cash Y, the sensitivity will correctly trade off the risk and incentives. The employee's wage will then be adjusted depending on the newly chosen pay-performance sensitivity, the previous sensitivity θ, and the realization of Y (since Y and θ determine the threat point). However, since wage will now depend on random Y, the employee will be subject to additional risk. To minimize this problem, the *ex ante* optimal contract will then specify $\theta = 0$ (since this eliminates threat point), and at date 1 a brand new contract with correct sensitivity will be signed. The first best will be achieved in this case. Although this solution is optimal within my framework, I argue that such a contract is unrealistic because uncertainty about repurchases may be revealed gradually and because incentives may be needed continuously.

[21] The main distinction between the manager and all other employees is that manager has discretion over payout choices while the other employees do not have any decision-making power (except for the choice of their effort).

if:

$$
\begin{aligned}
&E_u U\left(w + \theta_R\left(\overline{X} + p(e_R) + p^E(e_R^E) + \widetilde{u} - Y\right) - c(e_R)\right) > \\
&E_u U\left(w + \theta\left(\overline{X} + p(e) + p^E(e^E) + \widetilde{u}\right) - c(e)\right) \qquad (8)
\end{aligned}
$$

where θ and θ_R are pay-for-performance sensitivities before and after the repurchase respectively, and $c(e)$ and $c^E\left(e^E\right)$ are function for disutility of effort for manager and employee. Although the outcome of this trade-off generally depends on the managerial attitude towards risk, it is possible to make some observations. For simplicity of exposition, assume that before the repurchase the manager applies the maximal level of effort possible, so that his effort is unaffected by repurchase. Note that for any Y the benefits from repurchase to the manager are increasing in θ^E, the stake owned by non-executive employees. This implies that if the manager is not too risk-averse, he will repurchase at $t = 1$ if his employees hold a sufficiently large equity stake θ^E. Thus, at least for companies that grant stock-based compensation intensively to all employees, the agency problem will not be eliminated. However, the problem is likely to be mitigated by the delegation of decision power to the manager since the manager will never choose to repurchase more than do shareholders. Interestingly, the argument in this paper suggests that captive boards could be more efficient than independent boards in minimizing agency costs stemming from suboptimal risk sharing associated with repurchases.

3.3 Dividend protections

The argument in this paper applies qualitatively to a more general space of financial contracts and could be applied to stock options. However, a peculiar feature of stock option contracts - absence of dividend protections - requires additional consideration. To make things more specific, consider a situation when managers and employees are compensated by stock options and restricted stock. I assume that options have a strike price of zero, so that the only distinction between options and restricted stock awards is in the treatment of dividends: restricted stock entitles its holder to a stream of dividends paid by a company during the vesting period, while employee stock options typically do not have any provisions for dividends[22]. The manager may be pressured by the shareholders to make some distribution at $t = 1$; however, he has discretion over the payout form, i.e., he can choose either dividends or share repurchase[23]. The managerial preference for a particular payout form is driven by maximization of his utility function, which also includes the disutility from effort. Executives may prefer repurchases because they protect their options from value-decreasing dividends and motivate other employees. However, repurchases induce greater managerial effort and subject a manager to higher risk by increasing pay-for-performance sensitivity. Additionally, they protect the value of stock options of all other employees, increasing the dilution of managerial stock. To formalize this trade-off, the CEO will choose repurchase over dividends if the expected utility from a repurchase is larger than the expected utility from a dividend payout. If shareholders compensate manager with n_o stock options, n_s restricted shares, and fixed wage w, and compensate rank-and-file employee with n_o^E stock options, n_s^E restricted shares, and fixed wage w^E, then the manager will prefer repurchase to dividend payout when:

$$\begin{aligned} & E_u U\left(w + (\theta_{oR} + \theta_{sR})\left(\overline{X} + p(e_R) + p^E(e_R^E) + \widetilde{u} - Y\right) - c(e_R)\right) > \\ & E_u U(w + (\theta_o + \theta_s)\left(\overline{X} + p(e) + p^E(e^E) + \widetilde{u} - Y\right) - c(e) + \frac{\theta_s Y}{1 - \theta_o - \theta_o^E}) \end{aligned} \tag{9}$$

Here the expectation is taken with respect to uncertainty in long-term cash flows because at the time of payout, the short-term cash flows have been revealed to the manager. All variables carrying a subscript "R" refer to the situation after repurchase given that all short-term cash flows are used for repurchase. The last term in the second line represents a dividend received by the manager. Since sen-

[22] Under a restricted stock award program, a company issues stock to employees at no cost, but the stock is subject to vesting requirements. At the time of award, employees typically receive both voting rights and dividend rights on the stock. Firms also use securities that are called "Restricted Stock Units", which grant the holder the right to the stock at the end of the vesting period. However, holders of RSUs do not generally receive dividends paid during the vesting period nor receive voting rights.

[23] It is well known that managers and shareholders have different objectives. For example, managers may have an incentive to grow their firms beyond the optimal size (Easterbrook, 1984; Jensen, 1986). Since increase in leverage and payout may help to mitigate this conflict, the shareholders often have an incentive to pressure the board for larger payouts. Morrelec (2004) develops this idea in the framework where both over- and underinvestment can take place.

sitivities θ_{oR} and θ_{sR} are larger after repurchase than their counterparts without buyback θ_o and θ_s, it is clear that the manager has to bear more risk and to exert higher effort e_R if he repurchases instead of paying dividends. Note that in this setting there is still an agency conflict, now between employees, managers, and shareholders. If the manager retains cash, his expected utility is given by $E_u U \left(w + (\theta_o + \theta_s)\left(\overline{X} + p(e) + p^E(e^E) + \widetilde{u}\right) - c(e)\right)$. Although, the choice between repurchases, dividends and cash retention generally depends on managerial preferences, the next proposition considers several particular cases in which some observations about payout choice can be made.

Proposition 5 *The manager prefers:*

1) dividends to retaining cash if $\theta_o = 0$ *and* $\theta_o^E \neq 0$, $\theta_s \neq 0$

2) retaining cash to dividends if $\theta_o \neq 0$ *and either* $\theta_o^E = 0$ *or* $\theta_s = 0$

3) retaining cash to dividends and repurchases if $\theta_o \neq 0$, *and both* $\theta_o^E = 0$ *and* $\theta_s^E = 0$

Proof. (see Appendix A) ■

4 Hypothesis Development

My primary hypothesis is that share repurchases affect the existing compensation contracts with firm employees and that shareholders and employees take it into account in their decisions. To test this hypothesis, I analyze how the market price reaction to announcements of open market share repurchases depends on stock-based compensation of regular employees and executives. I also develop a cross-sectional model of determinants of executive and employee stock option grants and exercises. I define equity incentives from options and stock as the percentage change in the option or stock holder wealth for a 1% change in firm stock price. Previous research on the incentive compensation of CEOs typically measures optimal incentives by either "percent owned" (see Demsetz and Lehn, 1985; Jensen and Murphy, 1990; and Yermack, 1995) or "dollars at stake" (see Core and Guay, 2001). According to Baker and Hall (2004), these two measures represent polar cases, the former implicitly assuming invariance of marginal product of effort to firm size, and the latter assuming proportional one-to-one scaling with firm size[24]. Since in the theoretical model presented above the effort of the employees depends on the "percent owned", I also focus on this measure of incentives in empirical tests. The main predictions of the model are summarized in Table 1; empirical and theoretical support is discussed below.

4.1 Determinants of announcement returns

The positive market price reaction to the announcement of stock buybacks is well documented in the payout literature. For example, Ikenberry, Lakonishok and Vermaelen (1995) find that the average abnormal returns to the initial announcement of the stock buyback is over 3%, while Kahle (2002), who uses a more recent sample, finds a somewhat lower estimate of 1.6%. The positive announcement returns are consistent with predictions of my model since repurchases benefit shareholders by increasing employees' incentives. The announcement returns should also be increasing in the fraction of stock the firm is seeking to repurchase. However, this prediction could also come from many alternative theories (e.g., smaller free-cash flow problem, signaling). To distinguish the incentive effect of repurchases from alternatives, I make the prediction that there should be a positive correlation between announcement returns and outstanding stock options and restricted stock of all rank-and-file employees and executives. To test this hypothesis, I first regress three-day cumulative announcement returns on the number of outstanding stock options (OPTOUT) held by all employees and on the number of shares of stock owned by the top-five executives[25] (EXSTOCK) at the fiscal year-end prior to announcement, normalized by number of outstanding shares at the beginning of the announcement year[26]. Moreover, if the majority of stock options are exercisable,

[24] Baker and Hall (2004) estimate empirically how the marginal product of effort scales with firm size using a panel dataset for CEOs of large companies. They find an estimate of elasticity with respect to size of approximately 0.4, rejecting both an elasticity of zero and an elasticity of 1.

[25] The shares of stock held by rank-and file employees should also have a positive relation to announcement returns; however, I only have stock ownership data for the top-five executives.

[26] In all regressions, I treat stock options as exogenous. Options use may vary across industries and time. The cross-sectional variation may also come from variation in past cash-constraints (Core and Guay, 2001), adoption by firms of accounting changes, history of mergers, needs for non-debt tax shields (Graham, Lang and Shackelford, 2002), needs for retention of human capital and attraction of a particular type of employees (Oyer and Schaefer, 2004).

the incentive effect should be smaller since market participants will rationally anticipate that employees and executives can quickly undo the effect of repurchase by exercising their options. Thus I expect a negative association between exercisable stock options (OPTEXBLE) and abnormal announcement returns, controlling for level of outstanding stock options.

Table 1. Summary of empirical hypotheses for compensation determinants of announcement returns, stock option grants and exercises, and employee turnover following repurchases.

Hypothesized determinant	Sign
1. Announcement returns	
Outstanding stock options	+
Exercisable stock options	-
Executive stock ownership	+
Stock option incentives	+
Exercisable option incentives	-
Percent of shares sought	+
2. Option grants	
Repurchased fraction	-
Option exercises (simultaneous)	+
Outstanding incentives × Repurchased fraction	-

Hypothesized determinant	Sign
3. Employee turnover	
Percent of shares sought	+
Repurchased fraction	+
Repurchase announcement	+
Employee mobility × Percent sought	+
Volatility × Percent sought	+
Low returns × Percent sought	+
4. Option exercises	
Repurchased fraction	+
Option grants (simultaneous)	+
Outstanding incentives × Repurchased fraction	+
Volatility × Repurchased fraction	+

Since some of the outstanding options may be far out-of-the-money with very few incentives, the variables that capture incentives from stock-based compensation, rather than just the number of securities, may have a stronger positive relation to announcement returns. I measure incentives from stock options as the sum of the option deltas multiplied by the number of options, and scaled by the number of outstanding common shares and regress abnormal announcement returns on the incentives from outstanding stock options and from exercisable stock options. I also expect a positive relation between announcement returns and the interactions between stock options and the percentage of shares that the company is seeking to repurchase. The incentive effect of repurchase on non-executives should be especially pronounced for growth firms where sustained success depends crucially on human capital. Thus I expect a stronger relationship between employee stock options and announcement returns for companies where human capital is important for firm performance[27]. I separate firms according to their human capital use by looking at their research and development expenses at the fiscal year-end prior to announcement, and rerun all regressions for the subsamples of firms with positive and zero R&D[28]. In line with previous research, I calculate announcement returns as cumulative abnormal returns (CAR) over a three-day event window (-1,+1) using the market model. The parameters of the market model are estimated over a 200-day period beginning 250 days prior to the announcement and ending 50 days prior to the announcement, using the CRSP value weighted index as the proxy for market returns.

In the analysis, I control for factors that were previously found to explain the announcement returns. I include equity market-to-book ratio (MB) as a proxy for investment opportunities, and the logarithm of book assets (LNASST) at the year-end prior to the repurchase announcement as a measure of size. Size can be used as a proxy for informational asymmetries since smaller firms are typically followed by fewer analysts and have limited access to the financial press. Vermaelen (1981) also finds that a period of negative abnormal performance precedes a repurchase announcement, which can be interpreted as evidence of undervaluation. Similar to Kahle (2002), I measure the degree of undervaluation by runup in the stock price in the 40 days prior to repurchase (RUNUP), calculated as abnormal stock return from day -43 to day -4, using the market model, and I hypothesize that it should be negatively related to announcement returns. The market model is estimated from day -250 to day -50 relative to announcement date, using the value weighted index. Lie and Lie (1999) also argue that a large appreciation in stock price prior to repurchases reduces the tax advantage of repurchases relative to dividends, and thus price runup should be negatively associated with announcement returns. Consistent with signaling literature, I also expect that when a firm is seeking to

[27] In firms that do R&D, the effort of employees should respond more to the stock-based incentives because in these firms the output is often intangible, and it is more difficult to monitor and enforce production with other incentive schemes.

[28] In particular, I consider human capital use to be intensive in the firm if the firm had non-zero R&D expense in the year prior to announcement. Since firms are generally not required to report their R&D expenses when they are insignificant, I treat all missing observations in Compustat as zeros.

buy back a large fraction of shares (PSOUGHT), the market should react more positively. Since repurchases can also be associated with a decrease in the free cash flow problem, I also include cash flow over book assets (CFASST) at the year-end prior to announcement, where the cash flow is constructed as in Lehn and Poulsen (1989)[29]. All empirical variables are defined in Appendix B. In summary, the regression for announcement returns can be written as:

$$\begin{aligned} \text{CAR}_{it} = {} & \beta_0 + \beta_1 \text{OPTOUT}_{it-1} + \beta_2 \text{OPTEXBLE}_{it-1} + \beta_3 \text{EXSTOCK}_{it-1} \\ & + \beta_4 \text{PSOUGHT}_{it} + \beta_5 \text{LNASST}_{it-1} + \beta_6 \text{MB}_{it-1} + \beta_7 \text{RUNUP}_{it-1} \\ & + \beta_8 \text{CFASST}_{it-1} + \varepsilon_{it} \end{aligned} \tag{10}$$

4.2 Determinants of option grants

Theory and empirical findings suggest that executives and non-executives should hold equity incentives in order to keep their interests aligned with those of shareholders, and I posit that there is a target level of incentives[30] that firms pursue. I separate incentives from stock-based compensation into two groups: top management incentives, and incentives of non-executives. Top management is defined as the five highest paid executives in a firm as identified by proxy statements and ExecuComp database. All other employees are considered non-executives. I measure incentives from stock options as the sum of the option deltas multiplied by the number of options, and scaled by the number of outstanding common shares. I assume risk-neutral valuation for stock options and calculate option deltas using the Black-Scholes model, as modified by Merton (1973) to include dividend payouts[31].

My primary hypothesis is that firms use repurchases (REP) as a substitute for

[29] The results are robust to deflating cash flow by the market value of equity, as well as to the use of alternative measures of cash flow, such as cash flow from operations, operating income, and earnings before extraordinary items.

[30] It could be determined by such factors as employee risk aversion (Holmstrom, 1979), severity of agency problems (Jensen and Meckling, 1976), financing constraints (Core and Guay, 2001), retention and attraction motives, importance of human capital, substitution for cash compensation (Yermack, 1995), and costly renegotiation (Oyer, 2004).

[31] Bettis, Bizjak and Lemmon (2005) find that the choice of the model to compute incentives associated with stock options is unlikely to be important for cross-sectional studies examining the relation between firm characteristics and option incentives.

new stock option grants since repurchases increase the incentives of executives and employees by increasing the pay-for-performance sensitivity of their compensation. It is well known that companies repurchase stock for many reasons. For example, buybacks are most commonly used to distribute excess cash, or to take advantage of undervaluation in firm stock. However, regardless of why the buyback program was initiated, the compensation contracts are affected by it since the pay-for-performance sensitivity increases after a repurchase. If the firms pursue a target level of incentives, they should try then to adjust the level of incentives back to its optimum, which can be achieved by reducing the number of new stock option grants[32]. Thus I hypothesize that the larger is the fraction of repurchased equity the smaller should be the new stock option grants after a repurchase.

The incentive effect of repurchase also depends crucially on the incentives of employees and managers that were in place at the time of repurchase. Clearly, if for some reason the incentives were low prior to repurchase, buying back stock will have a very small effect on incentives[33] and on the future grant policy. In my second set of results, I test whether the new grants respond more to repurchases when the incentives prior to the repurchase were high. I regress stock option grants on the fraction of repurchased equity, the outstanding incentives prior to repurchase, and the interaction term between the fraction of repurchased equity and outstanding incentives, and expect the negative sign on the interaction term.

Previous research has identified a number of determinants of CEO stock option grants. Demsetz and Lehn (1985) argue that size is an important consideration in grant decisions and should be negatively correlated with percentage ownership since the risk-aversion effect increases with firm size and ultimately dominates the cost of shirking. In addition, size has been used in previous studies as a proxy for monitoring difficulty and noise in the firm environment. I use the logarithm of book assets (Compustat item #6) in the beginning of the grant year as my measure

[32] One might speculate that firms could start preemptively with a lower than optimal pay-performance sensitivity so that after repurchase it becomes optimal. In this case, there would be no need to adjust the grant policy after repurchase. However, this argument assumes that shareholders can predict a repurchase with a perfect certainty, while we know (for example, from price reactions at announcements of buybacks) this is not true in the real world.

[33] It will have no effect at all in an extreme case when employees and executives hold no stock based compensation prior to repurchase.

of firm size (LNASST). Following Demsetz and Lehn (1985), I also include a measure of idiosyncratic risk as a proxy for noise in the firm operating environment. They hypothesize that greater noise makes monitoring more costly and should result in more concentrated executive ownership. However, managerial risk aversion implies that ownership should increase at a decreasing rate with risk. As a proxy for firm idiosyncratic risk, I include a volatility of log returns over three years prior to the grant year (VOLLOG). Stock option exercises (EXERCISES) can be an important determinant of executives' grants, since option exercise mechanistically leads to an increased managerial ownership. However, exercise can also lead to an increased selling of stock by executives for tax or diversification purposes. In line with this argument, Ofek and Yermack (2000) find that executives' stock ownership decreases following stock option exercises. If selling is a dominating factor, I hypothesize that higher stock option exercises should lead to higher grants. However, higher option grants might also be associated with higher option exercises. To incorporate their interdependencies, I model stock option grants and exercises as a system of simultaneous equations, identifying it by exclusion restrictions similar to Core and Guay (2001). I estimate the model using two-stage least squares; full information maximum likelihood estimation produces almost identical results.

When a firm repurchases its own stock, the leverage ratio increases. If the management desires to bring down the leverage after stock buyback, it may do so by granting more stock options. To control for adjustments in leverage, I construct a variable that proxies for the deviation of firm leverage from its optimal value. Similar to Bens et al. (2003), the predicted value for optimal firm leverage comes from a Tobit model estimated on the population of Compustat firms over the period of 1996-2002, where the dependent variable is firm market leverage and the explanatory variables include firm size (logarithm of firm assets), collateral (proxied by net PP&E deflated by assets), growth opportunities and uniqueness (proxied by R&D deflated by sales), SG&A expense deflated by sales, year, and industry dummies. The deviation from the optimal leverage (LEVDEV) is then calculated as the difference between the actual firm leverage and the predicted value. If this deviation is positive, the firm is overleveraged; if it is negative, the firm is underleveraged[34].

[34] The leverage ratio may also be an important explanatory variable for stock option grants

Since different industries might have different regulatory and monitoring mechanisms, I also expect their stock option grant practices to differ. I construct 11 industry dummies, grouping them using Fama-French's classification, and include them in my grant model. Past stock returns can also be an important determinant of grants to executives because the board may use past returns in evaluating managerial performance. To control for these effects, I include firm stock returns for two years prior to year of grant (RET), and for the year of grant. Yermack (1997) finds that grants of stock options are often timed by managers, implying that CEOs receive stock options shortly before favorable news. Since future returns are not available for the most recent years, and since this substantially reduces my sample size, I present results without future returns and check that they are robust to this inclusion. Finally, my annual model for top management stock option grants (GRANTS) can be summarized as follows:

$$\begin{aligned} \text{GRANTS}_{it} &= \beta_0 + \beta_1 \text{REP}_{it-1} + \beta_2 \text{EXERCISES}_{it} + \beta_3 \text{GRANTS}_{it-1} + \beta_4 \text{RD}_{it-1} \\ &+ \beta_5 \text{RET}_{it-1} + \beta_6 \text{RET}_{it} + \beta_7 \text{LNASST}_{it-1} + \beta_8 \text{LEVDEV}_{it-1} \\ &+ \beta_9 \text{VOLLOG}_{it-1} + \beta_{10} \text{INDUST}_{it-1} + \beta_{11} \text{YEAR}_{it} + \varepsilon_{it} \end{aligned} \tag{11}$$

4.3 Determinants of option exercises

The model shows that the risk exposure of employees and executives increases following buybacks, and that their need for diversification grows. I hypothesize that both employees and top management should reduce their risk exposure by exercising their stock options earlier and selling the stock afterwards. Generally, employees cannot completely undo the incentive effect of repurchase, because they can only exercise fully vested options. To determine if there is an increase in stock option exercises, I examine the relation between the amount of dollars spent on repurchases (REP) in the year of and the year after the announcement and the

for another reason. John and John (1993) develop a theoretical model in which they show that an optimal CEO's compensation contract depends on the firm leverage. In particular, firms with larger leverage should choose smaller pay-for-performance sensitivity and give smaller equity grants. The intuition is that the managerial contracts serve as a precommitment device to minimize agency costs of debt, and when debt is large, it becomes suboptimal to fully align managerial interests with those of shareholders. In robustness checks, I also include book leverage in regressions to control for this effect.

exercise of stock option incentives in the fiscal year following the announcement.

In my analysis, I control for many important factors of option exercise. Since share repurchases are generally associated with high post-announcement returns (e.g., Ikenberry, Lakonishok and Vermaelen, 2000), this price increase can trigger early exercise by risk-averse individuals, according to recent theoretical models by Huddart (1994) and Hall and Murphy (2002), and empirical evidence by Huddart and Lang (1996). In addition, the upward move in the stock prices increases the weight of firm stock in the portfolio, increasing the need to diversify and prompting early option exercise. Moreover, there may be some information effects present. Managers often initiate share repurchases to convey to the markets their optimism about firm prospects. If undervaluation was a primary reason for holding onto their options, and if managers believe that repurchases correct the mispricing, then this could also lead to the increased exercise of stock options. To control for all these effects, I include in my analysis returns during the year of exercise (RET), as well as returns for the previous year, market-to-strike ratio of the options (MTS) and market-to strike ratio squared at the beginning of the exercise year. I also check that results are robust to inclusion the returns in the future three months following exercise year.

Repurchases are often initiated when the company has a lot of unused cash, and thus they might be correlated with dividends increases. Since a high dividend yield (DIVYLD) may warrant early exercise, I also include it as a control variable. To incorporate the feedback between stock option grants (GRANTS) and exercises, I model them as a system of simultaneous equations, identifying it by exclusion restrictions. Exercise behavior may also vary in time because of change in macroeconomic conditions and across industries. I include indicator variables for each year (6 in total) and 11 dummies for industries. The model for stock option exercises (EXERCISES) is presented below:

$$\begin{aligned}\text{EXERCISES}_{it} \;=\;& \beta_0+\beta_1\text{REP}_{it-1}+\beta_2\text{GRANTS}_{it}+\beta_3\text{VOLLOG}_{it-1}+\beta_4\text{RET}_{it-1}\\ &+\beta_5\text{RET}_{it}+\beta_6\text{MTS}_{it-1}+\beta_7\text{MTS}^2_{it-1}+\beta_8\text{DIVYLD}_{it-1}\\ &+\beta_9\text{EXERCISES}_{it-1}+\beta_{10}\text{INDUST}_{it-1}+\beta_{11}\text{YEAR}_{it}+\varepsilon_{it} \qquad (12)\end{aligned}$$

The volatility measure (VOLLOG) captures the notion that increased price variability makes options more valuable, and early exercises forfeit a larger value. On the other hand, increase in volatility can also change the threshold at which risk-averse individuals are willing to exercise their options. The relation between volatility and option exercise is ambiguous. I measure volatility as the standard deviation of log returns over the past 36 months prior to year of exercise.

There are several other effects which work in the opposite direction and bias me against finding the diversification effect and increase in options exercise. One issue concerns undervaluation motives in share repurchases, since managers may want to hold onto their options and stock if they believe their stock is largely undervalued. In the survey by Brav et al. (2004), managers mentioned undervaluation as their main reason for buybacks, and previous research has documented that undervaluation plays an important role in the initiation of repurchase programs. Managers themselves often say that undervaluation is of the order of 50%, and price appreciation following repurchase is typically not sufficient to remove this mispricing. Moreover, executives may face board pressure not to exercise their options in order to signal their optimism to the market. Another aspect which may also obstruct empirical support for my hypothesis is the change in corporate liquidity during the repurchase period. Barclay and Smith (1988) predict that the presence of informed executives can decrease secondary market liquidity of repurchasing firms. In confirmation of this hypothesis, Brockman and Chung (2001) find that bid-ask spreads widen, and depths narrow, during repurchase periods; they use data from the Stock Exchange of Hong Kong.

4.4 Determinants of employee turnover

Consistent with the model, I predict that share repurchases trigger increased employee turnover, because employees become worse-off after repurchase due to additional risk and wealth transfer at the time of repurchase. I focus on overall employee turnover and not on executive turnover for several reasons. First, the human capital of top executives is highly firm-specific, and executives typically have limited outside opportunities. Gilson (1989) documents that CEOs leave firms only in exceptional circumstances, while Gibbons and Murphy (1992) argue that CEOs have implicit reputation incentives. Second, it is known empirically that executive turnover is not very sensitive to changes in executive wealth. For example, Carter and Lynch (2004) find that executive turnover is not affected by repricing of their stock options, while employee turnover significantly decreases following repricing. Furthermore, if top executives have discretion over firm payout decisions, and a share repurchase is an outcome of their direct influence, they are less likely to become worse-off as a result of it.

To test this hypothesis, I analyze how employee turnover is related to the fraction of shares the company announces to repurchase as well as to the actual fraction of repurchased equity. Additionally, I look at the sample of firms increasing payout (i.e., increasing dividends or announcing a repurchase) and hypothesize that employee turnover is positively affected by the firm's decision to repurchase shares. Finally, since repurchases may increase employee turnover only when there are no positive shocks to stock prices, I look at the interaction terms between repurchased amount and poor prior stock performance, and expect positive coefficients on interaction terms.

Since employees usually have to forfeit their options when they leave the company, I use as my primary measure of employee turnover the total number of options forfeited during the year of and year after the announcement, deflated by the total number of options outstanding at the end of year prior to announcement. As a robustness check, I also look at decreases in the number of total employees working in the firm (Compustat item #29) in the year of and year after the announcement as a fraction of the initial number employed in the year prior to announcement[35]. Since both proxies for employee turnover cannot be negative, I do Tobit regressions with censoring at zero in order to avoid bias in coefficients[36]. However, all results are qualitatively the same when OLS regressions are used and

[35] The correlation coefficient between two proxies for employee turnover is 0.25 (p-value <0.0001). I use options forfeited over options outstanding as my primary measure for overall employee turnover because Carter and Lynch (2004) suggest that options forfeited divided by outstanding options present a very accurate measure of employee turnover by comparing it to actual industry-level turnover data from the Saratoga Institute.

[36] Since the Tobit model does not account for heteroskedasticity, I first perform a White's test for the homoskedasticity of residuals of all fitted models. The homoskedasticity is never rejected at 10% for the models that use options forfeited divided by options outstanding as a dependent variable. However, it is sometimes rejected for the model that uses employment declines from Compustat.

when the standard errors are corrected for the correlation at the firm level.

In all regressions, I include control variables shown in previous research (e.g., Carter and Lynch, 2004) to affect employee turnover. I use stock returns in the year prior and the year of the repurchase announcement as proxies for firm performance and expect a negative relation between turnover and firm performance. I also include a logarithm of firm assets as a measure of size, a market-to-book equity ratio as a proxy for investment opportunities, and the volatility of stock returns as a proxy for noise in firm operating environment. Finally, I add the ratio of cash from operations to assets as a determinant of employee turnover, hypothesizing that companies with larger cash flows face smaller pressure from creditors and treat their employees better, which translates into smaller employee turnover.

5 Sample Selection

I collect the initial sample of all authorization announcements of open-market share repurchases that are listed in the SDC database with original announcement dates between 1996 and 2002. The Securities Data Corporation (SDC) database is known to be the most comprehensive source for share repurchase programs and contains announcements that are published in many media sources, including the *Wall Street Journal Index*. SDC occasionally contains duplicate observations of announcements since firms may publish their announcements in several media sources. To avoid duplication, I retain only the first announcement if the firm makes several announcements on the same day. I restrict attention to firms that are listed on Compustat and CRSP and have nonmissing information on the value of repurchases in Compustat (item #115). I only include US listed firms with share codes 11 and 10 as identified by the CRSP database. I also require that firms have the information on managerial compensation in the ExecuComp database for the year prior, year of, and year after the announcement date. ExecuComp contains annual compensation data for the five highest paid executives for all firms in the S&P500, S&P MidCap 400, and S&P SmallCap600 since 1992. To avoid confounding effects, I exclude the group of firms that announced a dividend increase during the calendar year of repurchase announcement[37]. Similar to Grullon and Michaely (2004), I do not exclude financial and regulated companies, for they represent a significant portion of my sample[38]; however, most results (not reported) are unchanged if I remove this group. This produces a sample of 1,327 open-market repurchase announcements. For these firms, I then extract the information on the number of employee stock options and the weighted average strike prices[39] from the firms' individual 10K statements for the year prior, year of and year after payout change. Since option data is usually restated each year to reflect stock splits and stock dividends, I collect option data from the actual 10K report for each year. I am unable to find 10K statements for 32 (2.5% of sample) firm-years. My final sample contains 1,295 share repurchase announcements during 1996-2002.

The number of share repurchase announcements increased before 1998 and decreased steadily thereon, with 187 announcements in 1996, 191 in 1997, 292 in 1998, 232 in 1999, 170 in 2000, 122 in 2001, and 100 in 2002, with an average target fraction of shares over this period of 7.19%. The average three-day abnormal return at announcement of share repurchase is 1.74%, consistent with previous empirical studies by Vermaelen (1981), Comment and Jarrel (1991), and Kahle (2002)[40]. The distribution of share repurchases across industries is presented in Table 2. Repurchases are usually favored by industries that rely considerably on human capital, with most announcements in Business Equipment industry (251 announcements), followed by Wholesale and Retail Trade (220 announcements) and Manufacturing (177 announcements).

Stock options are used extensively by repurchasing companies, as documented in Table 3. In my sample the average (median) Black-Scholes value of the options portfolio per non-executive employee is $43,891 ($5,030). The options also represent a considerable fraction of market value of firm equity, with an average

[37] I identify dividend increases by looking at dividends payments in the CRSP database.

[38] Utilities (SIC codes 4900-4949) and Finance and Insurance (SIC codes 6000-6999) comprise 8.2% of my sample.

[39] In particular, I collect information on the number of stock options outstanding, exercised, granted, forfeited, and exercisable as well as strike prices for options outstanding, exercised, and granted.

[40] All averages have been winsorized at 1% to remove the effect of outliers.

(median) value of 5.5% (3.9%). Non-executives hold, on average, 70% of all outstanding options, which is consistent with evidence presented in Core and Guay (2001).

To construct the actual fraction of repurchased equity (Repurchases), I sum dollars spent on repurchases (Compustat item #115) in the year of and year after the announcement, reducing it by any decrease in par value of preferred stock (Compustat item#130), and then divide it by the market value of equity at the beginning of announcement year. Jaganathan et al. (2000) state that "Purchases of Common and Preferred Stock" (Compustat item #115) might overstate the real amount of repurchases since it aggregates many types of transactions and includes 1) self-tender offers and privately negotiated repurchases; 2) retirement of preferred stock, redemption of redeemable preferred stock, and conversion of preferred stock into common stock; and 3) conversion of other classes of stock (e.g., class A, class B, special stock) into common stock. Since I look at the sample of firms that make announcements of open-market share repurchases, the impact of the first item is minimized. The adjustment for decreases in par value of preferred stock controls for most of the second item. Jaganathan et al. (2000) compare a similar measure to the data on actual share repurchases disclosed voluntarily by 35 companies and conclude that although it overestimates actual repurchases, the deviation is not very large. Moreover, they find that this measure performs better than the CRSP measure based on the number of shares outstanding, originally introduced by Stephens and Weisbach (1998).

6 Results

6.1 Announcement Returns

The preliminary results can be seen in Table 4. In panel A of Table 4, the mean announcement returns are presented for portfolios sorted across options outstanding and options exercisable. The number of announcements in each cell is approximately equal to 160. It can be easily seen that announcement returns are typically larger for firms that have a higher number of outstanding options relative to the number of outstanding common shares, and are smaller when a large fraction of these options is exercisable. For example, for firms with exercisable options below the median, the move from the 1st quartile to the 4th quartile in options outstanding is associated with a change in three-day announcement returns from 1.40% to 2.97%. Similarly, in panel B of Table 4, the mean announcement returns are listed for portfolios sorted on options outstanding and on research and development expense. The announcement returns again tend to increase as options outstanding increase and are typically larger for firms with high R&D.

The regression results for three-day announcement returns are presented in Table 5. The coefficients on control variables are sensible. Consistent with undervaluation motives as well as with tax effects, the coefficient on price runup in the previous 40 days is negative and statistically significant in all regressions. The percent of shares sought is always positive and sometimes significant, which is in line with the market signaling hypothesis. Perhaps a surprising finding is that the market reacts less favorably to announcements of buybacks when the firm has large cash flow[41].

Regression results support the hypothesis that the market reacts more favorably to announcements of open-market share repurchases when employees and executives hold more stock-based incentives[42]. The first column of Table 5 displays how the market reaction depends on the number of employee stock options, executive stock options, and executive stock normalized by firm outstanding shares. Since the same firm may make announcements several times in my sample, I adjust test-statistics for non-independence of observations within firms and report p-values based on Huber-White standard errors. Consistent with the incentive effect of repurchases, the coefficient on total stock options is positive and significant. This result is at variance with Kahle (2002), who uses a smaller sample over different time period[43]. The coefficient on executive stock is also positive in

[41] I have checked several alternative measures of cash flow and they all yield similar conclusions.

[42] Results are robust to using abnormal returns relative to equally-weighted CRSP index as a benchmark, as well as to calculating returns over different event windows, i.e., over windows (-1,+3) and (-1,+5) days.

[43] Kahle (2002) uses a sample of 712 repurchase announcements over 1993-1996. There is a number of differences in econometric specifications between this paper and that of Kahle (2002). First, unlike Kahle who uses stock options in the year following repurchase, I use stock options in the year prior to announcement in order to avoid endogeneity issues. For example, firms that did not experience positive price reaction at announcement may grant a larger number

all regressions and statistically significant. As predicted, the exercisable options always enter with a negative sign, and the coefficient is statistically significant for the full sample. The second column presents results for the regression of announcement returns on the total incentives from stock options and stock. Again, the coefficient is positive on outstanding incentives and is negative for exercisable incentives. I check that results are not driven by any particular industry by removing one industry group at a time from my sample. Column 3 of Table 5 exhibits the results of the same regression as in column 1 but with the addition of 11 industry dummies[44]. Finally, the last two columns document the results of regressions separately for firms that have positive and for firms that have zero research and development expenses in Compustat. The effect appears to be stronger for companies that do R&D, with the coefficient on stock options more than doubling. This is consistent with the notion that the repurchasing companies that benefit the most from increase in incentives are those where human capital is a key to production.

The effect of stock options and executive stock on announcement returns also appears to be economically significant. For example, the move from 25th to 75th percentile by number of stock options divided by number of outstanding shares is associated with increase in announcement returns of +0.59%. The negative effect of exercisable options is typically smaller in magnitude (−0.16%) and is not sufficient to offset the positive incentive effect. The move from 25th to 75th percentile in executive stock ownership is associated with +0.19% in announcement returns.

I control for the most important determinants of announcement returns; however it is still possible that my findings have an alternative explanation. The three most common conjectures explored in the literature that link repurchases and stock options are the stock option funding hypothesis, the earnings management hypothesis (see Bens et al. (2003)), and managerial substitution of repurchases

of stock options in order to compensate for poor stock performance, which would bias against finding a positive relation between options and announcement returns. Second, I separate options into exercisable and unexercisable components, which helps me to uncover the positive effect of unexercisable options. Third, I include managerial stock ownership in my regressions, which is negatively correlated with the stock options variable.

[44] The results are very similar if, instead of 12 groups, Fama-French's classifications into 10 or 17 industry groups are used to generate industry dummies.

for dividends to preserve the value of their unprotected stock options. The option funding hypothesis states that when firm employees exercise many stock options, there is an inflow of additional cash in the firm, and in order to distribute these funds to investors, the firm initiates the repurchase program[45]. This hypothesis would be consistent with my evidence if there is a benefit to distributing extra cash (e.g., better management discipline). Although I control for firm cash flow in all regressions, I address this concern explicitly by including proceeds from stock options exercises in the year prior to repurchase announcement and by performing all analyses with this additional control (results not shown). The coefficients on incentive variables always retain the correct signs, and statistical significance is unchanged. The earnings management hypothesis works against me finding any incentive effect, for it suggests that companies with large ESO plans experience considerable earnings dilution and often buy back shares in order to boost diluted EPS. The market, however, should see through this veil and react less favorably to announcements of repurchase programs that tend to focus on earnings management[46]. Finally, if repurchases are an outcome of managerial wealth maximization to avoid paying dividends when they hold many stock options, then the market should also react less positively to announcements of repurchases when a firm has many outstanding stock options, particularly when executives hold many options. This also biases me against finding the results and is perhaps a reason why I do not find a positive coefficient on executive stock options.

Grullon and Michaely (2002) find that repurchases are often initiated by mature companies that experience a decline in their growth opportunities. Since growth opportunities typically comprise a larger fraction of firm market value in companies with broad-based option plans, these firms should experience smaller

[45] Hall and Murphy (2003) state that many companies offer "cashless exercise programs", in which employees do not have to pay strike price in cash, but rather receive the spread between strike price and current stock price in cash or in shares of firms stock. In this case, there is no inflow of funds in the firm at the time of exercise.

[46] In support of this, I find that a positive relationship of announcement returns to outstanding stock options is stronger for firms that have high P/E ratios. Bens, et al. (2003) show that diluted earnings per share increase following repurchases only if a company has low P/E ratio as judged by condition $\frac{P}{E} < \frac{1}{r_d}$, where r_d is the cost of capital. I assign firms to the high P/E category if their P/E ratio, measured as (item # 24) *(item # 25)/ (item # 18), is higher than the inverse of risk free rate over this period.

announcement returns if the market was previously unaware of the growth opportunity decline. This again works in the opposite direction to the repurchase incentive effect and biases against finding results.

Finally, an alternative explanation of my evidence could be that firms with many stock options tend to be young growth firms that are strongly affected by informational asymmetries[47]. To the extent that repurchases alleviate information asymmetries, firms with more stock options should have higher abnormal announcement returns. To address this issue, I separate my sample into two equally sized samples by the book value of assets. If stock options proxying for informational asymmetries are driving my results, then I should see weaker results for large firms that are followed by many analysts and less prone to these problems. I rerun my regressions for two subsamples based on firm size and find that evidence of a positive link between employee stock options and announcement returns is stronger for the sample of large firms (results not reported).

6.2 Option grants

Results in Table 6 support the prediction of the model that shareholders decrease new grants of stock options to employees and executives following large share repurchases. This can be seen by the negative and statistically significant coefficient on repurchases in columns 1 and 4, where the dependent variable is option incentives granted in the year after the repurchase announcement (to executives and employees, respectively)[48]. The economic effect of the decrease in grants is modest. On average, firms grant 0.55 % in incentives to the top-five executives, and 2.83% to non-executives annually. A standard deviation increase in the fraction of repurchased shares lowers the annual incentives granted to executives by approximately 0.05%, and to non-executives by 0.25%, which represent 10% and 9% of the annual grant to executives and non-executives respectively. The effect

[47] The opposite, however, may also be true since firms with wide options use tend to be large public companies that are followed by many analysts and thus should be less prone to asymmetric information concerns.

[48] To check that the results for non-executive stock option grants are not driven primarily by the decrease in the number of employees, I perform similar analysis using grants and exercises per employee. The results are qualitatively similar with the coefficient on repurchases being negative with p-value of 0.08.

is also confirmed in regressions on cross-terms between repurchases and outstanding incentives, with the results presented in columns 2 and 5. The results are largely unaffected if any single industry or year is omitted from the sample. For the employee stock option grants, the coefficients always retain their signs and are statistically different from zero at least at the 5% level. For the executive stock option grants, the omission of the Wholesale and Retail industry from the sample (17%) results into p-values of 0.09, and of Consumer Nondurables (10%) p-values of 0.07; omission of any other industry retains the significance of coefficients at least at the 5% level.

Most of the control variables enter with expected signs. Incentives exercised appear to have a strong positive relation to incentives granted, which is consistent with the hypothesis that firms actively manage the level of incentives. As can be seen in columns 1 and 3, the firms grant on average 0.6% incentives to executives, and 1.1% to other employees, for each 1% of exercised incentives. Past grants of incentives also appear to be a significant determinant of new grants. The firms with high returns volatility and high research and development expenses tend to make larger stock option grants. Smaller firms also make larger grants to their executives, but not to other employees.

6.3 Option exercises

Option exercises tend to increase following stock repurchases, consistent with the notion that executives and employees are subject to higher risk after buybacks. The results for stock option exercises are displayed in Table 7. The coefficient on the repurchased amount is always positive and statistically significant at 1%[49]. The economic significance is modest, suggesting that a standard deviation increase in repurchases leads executives to increase their stock option exercises by approximately 30%, and leads employees to increase theirs by 18%. The regressions on cross-terms between repurchases and outstanding incentives yield similar results. Additionally, the increase in stock option exercises is more pronounced for highly volatile firms. This is documented by the positive and significant coefficient on cross-terms between the fraction of repurchased equity and the volatility of log

[49] When incentives granted and exercised per employee are used the coefficient on repurchases remains positive with p-value of 0.02.

returns (columns 4 and 6 of Table 7). The omission of any single industry or year from the sample does not change the conclusions for the coefficients retain the correct signs and statistical significance at least at the 5% level.

As anticipated, the options grants tend to be an important determinant of option exercises, with an average increase in exercises of 0.2% for every 1% increase in grants. Past exercises tend to be a significant predictor of current exercises for regular employees, but not for executives. High returns in the previous year as well as high market-to-strike ratios at the beginning of the year are also associated with higher options exercises. High contemporaneous returns and high dividend yield also seem to prompt larger exercises, as expected; however, the coefficients are not statistically significant.

6.4 Employee turnover

Results for employee turnover and employment declines are displayed in Table 8 and Table 9, respectively. As expected, the employee turnover is positively and significantly related to the fraction of repurchased equity[50]. This holds for both proxy variables for employee turnover and controlling for such factors as firm size, book-to-market ratio, volatility, cash flow, and returns. The effect appears to be economically significant. In particular, if the firm announces a stock buyback of 10%, the annual employee turnover increases from its average of 8.9% to 10.2% when options forfeited are used to proxy for turnover, and from an average of 3.9% to 4.8% when employment declines from Compustat annual data is used as a proxy for turnover. Employee turnover is also positively associated with the announcement of a repurchase, with an announcement linked to a change in annual turnover from 8.9% to 9.9%. Since the model predicts that employee turnover will increase after repurchases only if past returns were low, I also include the interaction of the indicator for low past returns with fraction of repurchased equity, controlling for the past returns. As predicted, the coefficient on interaction is positive and significant.

[50] I check that both the actual fraction of repurchased equity and the target fraction listed in the announcement are negatively related to the outstanding shares. The correlation of change in outstanding shares with the target fraction is -0.09 (p-value 0.0007) and with the actual repurchased fraction -0.15 (p-value <0.0001).

It is possible that alternative explanations could generate similar results that provide a link between the level of repurchases and employee turnover. For example, Nohel and Tarhan (1998) and Grullon and Michaely (2004) argue that repurchases may be associated with firms becoming more mature and facing smaller growth opportunities, which may lead to asset sales and smaller investments in R&D. This argument could potentially be extended to firms laying off some employees in order to liquidate unprofitable lines of business. However, the evidence seems to be at odds with a downsizing story. First, if large distributions to investors signal a decrease in growth options, then one should see the increase in employee turnover following any increase in distribution (be it either in the form of dividends or share repurchase). But this is inconsistent with positive coefficients on repurchase announcements in column 4 of Table 8, where dividend increasing firms and repurchasing firms are contrasted. To investigate this issue further, I remove from the sample firms that could benefit the most from a decrease in asset base and that face poor investments opportunities, as proxied by Tobin's $q<1$, and I redo the analysis. All results are virtually unchanged. Additionally, I test whether employee turnover seems to respond more to large repurchase programs when the mobility of employees is high. I construct the proxy for immobility of employees by creating a Herfindahl index of concentration of jobs, similar to Massa, Rehman and Vermaelen (2005). The index is constructed as a ratio of the number of firm employees squared to the sum of squares of number of employees at all firms within this industry. When the value of the index is close to one, the mobility of employees is low, and when it is close to zero, the mobility is high[51]. I interact this variable with the fraction of repurchased equity and report the results in columns 4-5 of Table 8 and Table 9. I find that in firms where employees are more mobile, the positive link between turnover and repurchases appears to be stronger, which cannot be easily explained by repurchasing firms laying off their workers.

[51] I check that immobility is indeed strongly and negatively correlated with employee turnover if used by itself. However, since this variable strongly correlates with firm size, it becomes insignificant in the regressions in Tables 8 and 9.

Conclusion

This paper analyzes the effect of share repurchases on the employee compensation contracts. I show that shareholders may engage in opportunistic stock buybacks once employment contracts have been signed because repurchases increase employees' incentives by making their compensation more sensitive to firm cash flows. *Ex post* shareholders do not have to pay for the increase in employees' effort since the contracts remain unchanged. Since the workers are fully rational and correctly anticipate the increased riskiness of their compensation that comes with repurchase, they request higher compensation *ex ante*. When firm cash flows are uncertain, and/or there are costs of financing, this conflict of interest between employees and shareholders results in agency costs because of the inefficient allocation of risk and incurred costs.

I derive empirical implications for firm payout choice, executive and non-executive stock option grants and exercises, employee turnover, and announcement returns, and test them using data on firms that announced an open-market share repurchase during 1996-2002. Consistent with the model, I find that employee turnover increases following open-market repurchases, especially when employees have greater mobility and firm returns are highly volatile. To diversify away additional risk created by repurchases, executives and employees exercise more stock options, controlling for other factors of exercise. Shareholders seem to recognize the positive effect of repurchases on incentives and so make fewer new stock options grants to rank-and-file employees and to top management following stock buybacks. In addition, the market reacts more favorably to announcements of open-market share repurchases when the incentive effect of a repurchase is large.

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Appendix A: Proofs of lemmas and propositions

Proof of Lemma 1. First, I establish the existence of e^*. The problem is well-defined, and SOC is satisfied, given the assumptions on functions of $p(e)$ and $c(e)$, i.e.,

$$\begin{aligned} & E_u\left[U''(W)\left(\theta_R p'\left(e_R^*\right)-c'\left(e_R^*\right)\right)^2\right]+E_u\left[U'(W)\left(\theta_R p''\left(e_R^*\right)-c''\left(e_R^*\right)\right)\right] \\ = \; & E_u\left[U'(W)\left(\theta_R p''\left(e_R^*\right)-c''\left(e_R^*\right)\right)\right]<0 \end{aligned} \tag{13}$$

where $W = w+\theta_R(\overline{X}+p\left(e_R^*\right)-R+\widetilde{u})$. The first order condition can be written as $\theta_R p'(e_R^*)-c'(e_R^*)=0$. Since $c'(0)=0$, and $c'(e_{\max})=\infty$ this implies that $\theta_R p'(0)-c'(0)>0$ and $\theta_R p'(\infty)-c'(\infty)<0$. Since effort is bounded on $[0,e_{\max}]$, and $\theta_R p'(e)-c'(e)$ is monotonically decreasing in e, this implies that optimal e^* exists.

Denoting by $f(\theta_R,e_R)=\theta_R p'(e_R)-c'(e_R)$ and totally differentiating this condition, yields:

$$\frac{de_R^*}{d\theta_R}=-\frac{\frac{\partial f(\theta_R,e_R)}{\partial\theta_R}}{\frac{\partial f(\theta_R,e_R)}{\partial e}}=\frac{p'\left(e_R^*\right)}{c''\left(e_R^*\right)-\theta_R p''\left(e_R^*\right)} \tag{14}$$

Taking into account that $p'>0$, $p''<0$, and $c''>0$ yields the desired result $\frac{de^*}{d\theta_R}>0$. The concavity of optimal effort in sensitivity to firm cash flows θ_R can be shown by differentiating expression (14) with respect to θ_R. For notational brevity, I omit arguments of all functions:

$$\frac{d^2e_R^*}{d\theta_R^2}=\frac{2p''\left(c''-\theta_R p''\right)-p'\left(c'''-\theta_R p'''\right)}{\left(c''-\theta_R p''\right)^2}\frac{de_R^*}{d\theta_R} \tag{15}$$

Since the first derivative is positive $\frac{de^*}{d\theta_R}>0$, the effort is concave in sensitivity θ_R if the numerator in (15) is negative, i.e., $2p''c''-p'c'''+\theta_R\left(p'p'''-2\left(p''\right)^2\right)<0$. Taking into account that $\theta_R\in[0,1]$, I can rewrite the sufficient condition placing restrictions only on functions $p(e)$ and $c(e)$, independent of θ_R. For this note, if $p'p'''-2\left(p''\right)^2>0$ for any θ, then the condition is the most stringent at $\theta_R=1$, i.e., for concavity we need $\frac{2p''\left(c''-p''\right)'}{p'}+p'''<c'''$. If $p'p'''-2\left(p''\right)^2<0$ for any θ, then condition is the most stringent at $\theta_R=0$, and we should require that $\frac{2p''c''{}'}{p'}<c'''$. ■

Proof of Proposition 1. The condition for fair share repurchase (6) can be written equivalently as:

$$\theta_R=\theta+\frac{\theta\left(Y+D\right)}{\overline{X}+p\left(e_R\right)-Y-D\left(1+\lambda\right)} \tag{16}$$

Since effort after the repurchase e_R depends on sensitivity θ_R, expression (16) does not present a closed-form solution for θ_R. However, it can be seen from (16) that θ_R is always higher than original θ (provided that either Y and/or D is positive) and increases with the amount of short-term cash flows Y and the amount of issued debt D used for share repurchase, i.e., $\frac{\partial\theta_R}{\partial Y}\geq 0$, $\frac{\partial\theta_R}{\partial D}\geq 0$.

Since short-term cash flows have no opportunity cost, it follows directly from Lemma 1 and the fact that $\frac{\partial\theta_R}{\partial Y}\geq 0$ that shareholders will use all available cash flows Y for repurchase. Issuing debt is costly, and in deciding on the amount of additional financing, shareholders trade off greater effort from additional repurchases and exogenous costs of raising additional capital. Formally, shareholders maximize equity value at $t = 1$ subject to condition (16), i.e.,:

$$\max_{D\in[0,D_{\max}]} \left[(1-\theta)\left(\overline{X} - D\lambda + p\left(e_R\right)\right) - w\right] \tag{17}$$
$$s.t.\ \ \theta_R = \theta + \frac{\theta\left(Y+D\right)}{\overline{X} + p\left(e_R\right) - Y - D\left(1+\lambda\right)}$$

where $D_{\max}$ is the maximum amount of debt that can be issued by shareholders. It is easy to see that FOC for the optimal amount of additional financing is:

$$(1-\theta)\left(p'\left(e_R\right)\frac{de_R}{d\theta_R}\frac{d\theta_R}{dD} - \lambda\right) = 0 \tag{18}$$

Given that shareholders first use all internal cash for payout, they will only tap debt markets if the marginal benefit of an additional repurchase outweighs the cost, i.e., if $\lambda < p'\left(e_Y\right)\frac{de_Y}{d\theta_Y}\frac{d\theta_Y}{dD}$. In general, when $\lambda > 0$ the solution to (18) is interior because under mild restrictions on third derivatives of $c\left(e\right)$ and $p\left(e\right)$ (see Lemma 1), the marginal benefit is concave in distribution amount. ■

Proof of Corollary 1. The price reaction at the announcement of repurchase, which is partially financed with retained cash Y and partially with proceeds from issued debt D, is:

$$p\left(e_R\left(Y, D\left(Y\right)\right)\right) - D\left(Y\right)\lambda - E_Y\left[p\left(e_R\left(\widetilde{Y}, D\left(\widetilde{Y}\right)\right)\right) - D\left(\widetilde{Y}\right)\lambda\right] \tag{19}$$

Note that announcement price reaction is increasing in realization of Y. This can be seen by examining term $p\left(e_R\left(Y, D\left(Y\right)\right)\right) - D\left(Y\right)\lambda$. If $Y_2 > Y_1$, then $p\left(e_R\left(Y_2, D\left(Y_1\right)\right)\right) - D\left(Y_1\right)\lambda > p\left(e_R\left(Y_1, D\left(Y_1\right)\right)\right) - D\left(Y_1\right)\lambda$. Since the issue of debt is chosen optimally by shareholders, it must also be true that $p\left(e_R\left(Y_2, D\left(Y_2\right)\right)\right) - D\left(Y_2\right)\lambda > p\left(e_R\left(Y_2, D\left(Y_1\right)\right)\right) - D\left(Y_1\right)\lambda$. Thus $p\left(e_R\left(Y, D\left(Y\right)\right)\right) - D\left(Y\right)\lambda$, and the price reaction at announcement is increasing in Y. Since larger optimal repurchased amount R^* ($R^* = Y + D^*\left(Y\right)$) necessarily implies larger Y, this implies that announcement price reaction is also increasing in R^*. The price reaction is positive when $Y > Y_T$, where threshold Y_T is determined by condition:

$$p\left(e_R\left(Y_T, D\left(Y_T\right)\right)\right) - D\left(Y_T\right)\lambda = E_Y\left[p\left(e_R\left(\widetilde{Y}, D\left(\widetilde{Y}\right)\right)\right) - D\left(\widetilde{Y}\right)\lambda\right] \tag{20}$$

■

Proof of Proposition 2. From the optimality of the employee's effort in absence of any repurchase programs $R = 0$, it follows that for any effort level $e \neq e^*$ the following relation holds:

$$EU\left(w + \theta\left(\overline{X} + p\left(e^*\right) + \widetilde{u}\right) - c\left(e^*\right)\right) > \tag{21}$$
$$EU\left(w + \theta\left(\overline{X} + p\left(e\right) + \widetilde{u}\right) - c\left(e\right)\right) \tag{22}$$

Since utility is monotonically increasing, this implies that:

$$\theta p\left(e^{*}\right)-c\left(e^{*}\right)\geq\theta p\left(e\right)-c\left(e\right) \tag{23}$$

where the inequality is strict unless $\theta=0$. In absence of share repurchase, employee's wealth net of the costs of effort is given by:

$$W=w+\theta\left(\overline{X}+p\left(e^{*}\right)+\widetilde{u}\right)-c\left(e^{*}\right) \tag{24}$$

If there is a share repurchase, i.e., $R>0$, then the employee's wealth net of the costs of effort is:

$$W_{R}=w+\theta_{R}\left(\overline{X}+p\left(e_{R}\right)-Y-D\left(1+\lambda\right)+\widetilde{u}\right)-c\left(e_{R}\right) \tag{25}$$

Substituting the condition for fair share repurchase (16) into expression (25) gives:

$$\begin{aligned} W_{R} &= w+\theta\left(\overline{X}+p\left(e_{R}\right)-D\lambda\right)+\theta_{R}\widetilde{u}-c\left(e_{R}\right) \\ &\leq w+\theta\left(\overline{X}+p\left(e^{*}\right)-D\lambda\right)+\theta_{R}\widetilde{u}-c\left(e^{*}\right)=W-\theta D\lambda+\left(\theta_{R}-\theta\right)\widetilde{u} \end{aligned} \tag{26}$$

where the inequality in the second line follows from optimality of original effort, captured by equation (23). Note that expression (26) also implies that the wealth of the employee is reduced due to the borrowing costs to the extent of his ownership. The last term of (26) has zero expected value and shows that the employee is forced to bear more risk after a share repurchase. Note that the larger the repurchased amount, the larger the divergence between values $\theta p\left(e^{*}\right)-c\left(e^{*}\right)$ and $\theta p\left(e_{R}\right)-c\left(e_{R}\right)$, and the larger the increase in risk for employee. Thus, the larger the repurchase, the larger are the losses to the employee (in expected utility sense). ■

Proof of Proposition 3. First, note that if financing costs are very large as identified by condition $\lambda>p'\left(e_{Y}\right)\frac{de_{Y}}{d\theta_{Y}}\frac{d\theta_{Y}}{dD}$, then shareholders will not issue debt since the marginal cost exceeds the benefit. The final pay-for-performance sensitivity will be identical to the one chosen by the social planner. If $\lambda=0$, then shareholders will always issue maximum possible amount of debt $\mathrm{D}_{\max}$, but since this does no generate any costs, the value achieved by the shareholders will be identical to the value achieved by the social planner. Thus in case when $\lambda=0$ or $\lambda>p'\left(e_{Y}\right)\frac{de_{Y}}{d\theta_{Y}}\frac{d\theta_{Y}}{dD}$ and Y is certain, the first best will be achieved. Without loss of generality, assume that cash flows at $t=1$ are zero, i.e., $Y=0$. The social planner does not repurchase any stock at $t=1$, and the date zero equity value under social planner' policy is be given by:

$$V_{FB}=\left(1-\theta_{FB}\right)\left(\overline{X}+p\left(e_{FB}\right)\right)-w_{FB} \tag{27}$$

where the optimal sensitivity θ_{FB} is chosen to maximize equity value subject to the binding participation constraint of the employee.

$$\theta_{FB}=\arg\max_{\theta,w}\left(1-\theta\right)\left(\overline{X}+p\left(e\right)\right)-w \tag{28}$$

$$\overline{U}=EU\left(w+\theta\left(\overline{X}+p\left(e\right)+\widetilde{u}\right)-c\left(e\right)\right) \tag{29}$$

Shareholders cannot commit to such policy, and repurchase at date $t=1$ until the marginal benefit of increase in productivity equals marginal cost of funds. The equity value at $t = 0$ is equal to:

$$V_{SB} = (1 - \theta_{SBR}) \left(\overline{X} + p(e_{SB}) - R_{SB}(1 + \lambda)\right) + R_{SB} - w_{SB} \tag{30}$$

where the sensitivity after repurchase θ_{SBR} is determined by the sensitivity of initial contract θ_{SB} and repurchased amount at date 1, R_{SB}. The initial sensitivity θ_{SB} is chosen to maximize date zero equity value, taking into account the future repurchase policy R_{SB}., and the wage w_{SB} is set to satisfy the individual rationality constraint of the employee, i.e.,

$$\overline{U} = EU\left(w_{SB} + \theta_{SBR}\left(\overline{X} + p(e_{SB}) - R_{SB}(1 + \lambda) + \widetilde{u}\right) - c(e_{SB})\right) \tag{31}$$

Define a new variable $\widehat{w}_{SB} = w_{SB} - \theta_{SBR} R_{SB}(1 + \lambda)$. Rewriting expressions (30) and (31) in terms of $\widehat{w}_{SB}$ yields, respectively:

$$V_{SB} = (1 - \theta_{SBR})\left(\overline{X} + p(e_{SB})\right) - \widehat{w}_{SB} - R_{SB}\lambda \tag{32}$$

$$\overline{U} = EU\left(\widehat{w}_{SB} + \theta_{SBR}\left(\overline{X} + p(e_{SB}) + \widetilde{u}\right) - c(e_{SB})\right) \tag{33}$$

Note that equity value V_{SB} is the same as in (27) except that shareholders may choose different optimal controls θ_{SB}, $\widehat{w}_{SB}$ and that there is an additional term due to the borrowing costs $-R_{SB}\lambda$. Since θ_{FB}, w_{FB} maximize equity value subject to identical constraint, then necessarily for any controls θ_{SBR}, $\widehat{w}_{SB}$:

$$(1 - \theta_{SBR})\left(\overline{X} + p(e_{SB})\right) - \widehat{w}_{SB} \leq (1 - \theta_{FB})\left(\overline{X} + p(e_{FB})\right) - w_{FB} \tag{34}$$

Since shareholders will also incur nonzero borrowing costs in the amount of $R_{SB}\lambda$ when they raise external funds, the value of equity at date 0 is always smaller when shareholders cannot commit not to repurchase any shares at date 1, i.e.,

$$\begin{aligned} V_{SB} &\leq V_{FB} - R_{SB}\lambda \Rightarrow \\ V_{SB} &< V_{FB} \end{aligned} \tag{35}$$

The difference between equity value under a policy of no repurchases that would be implemented by the social planner and equity value under a policy of maximizing *ex post* gains that is implemented by shareholders is attributed to agency costs. The proof assumed that $Y = 0$. If $Y \neq 0$ then any policy that uses not more than Y for the repurchase will achieve first best value. However since $\lambda < p'(e_Y)\frac{de_Y}{d\theta_Y}\frac{d\theta_Y}{dD}$ the shareholders will use more than Y, and will use costly financing. ■

Proof of Proposition 4. Prove by contradiction. Suppose that *ex ante* maximizing repurchase policy is the one that is followed by shareholders, who maximize equity value at date $t = 1$. Denote by θ_{SB} the initial sensitivity of the contract that maximizes *ex ante* firm value under shareholders' policy and by V_{SB} the firm value achieved in this case. By assumption, any other repurchase policy should yield a firm value smaller than V_{SB}. Consider first the case of very large financing costs (equivalent to no external financing). From Proposition 2 we know that shareholders will use all internal cash at date 1 for the repurchase. Note that since cash flows at date 1, Y, are uncertain, both the amount used for repurchase R_{SB} and the final sensitivity of the contract θ_{SBR} will also be uncertain at $t = 0$. Suppose now that the social planner chooses a policy of no repurchases and sets an initial sensitivity of the contract θ_{FB}, such that $\theta_{FB} = E_Y \left[\widetilde{\theta}_{SBR} \right]$. The value under the social planner's policy is:

$$V_{FB} = (1 - \theta_{FB}) \left(\overline{X} + p(e_{FB}) \right) - w_{FB} \tag{36}$$

$$\overline{U} = E_u U \left(w_{FB} + \theta_{FB} \left(\overline{X} + p(e_{FB}) + \widetilde{u} \right) - c(e_{FB}) \right) \tag{37}$$

where the second condition is the employee's individual rationality constraint, which pins down fixed wage w_{FB}. From the definition 2, the equity value achieved by the shareholders under their policy of opportunistic repurchases is given by:

$$V_{SB} = E_Y \left[\widetilde{Y} + \left(1 - \widetilde{\theta}_{SBR} \right) \left(\overline{X} + p(\widetilde{e}_{SBR}) - \widetilde{Y} \right) \right] - w_{SB} \tag{38}$$

$$\overline{U} = E_Y E_u U \left(w_{SB} + \widetilde{\theta}_{SBR} \left(\overline{X} + p(\widetilde{e}_{SBR}) - \widetilde{Y} + \widetilde{u} \right) - c(\widetilde{e}_{SBR}) \right) \tag{39}$$

Introduce new notation of $\widehat{w}_{SB} = w_{SB} + E_Y \left[\widetilde{\theta}_{SBR} \left(\overline{X} + p(\widetilde{e}_{SBR}) - \widetilde{Y} \right) - c(\widetilde{e}_{SBR}) \right]$ and $\widehat{w}_{FB} = w_{FB} + \theta_{FB} \left(\overline{X} + p(e_{FB}) \right) - c(e_{FB})$, and rewrite expressions (36)-(39). For the social planner, we have:

$$V_{FB} = \overline{X} + p(e_{FB}) - c(e_{FB}) - \widehat{w}_{FB} \tag{40}$$

$$\overline{U} = E_u U \left(\widehat{w}_{FB} + \theta_{FB} \widetilde{u} \right) \tag{41}$$

For the shareholders, we have:

$$V_{SB} = \overline{X} + E_Y \left[p(\widetilde{e}_{SBR}) - c(\widetilde{e}_{SBR}) \right] - \widehat{w}_{SB} \tag{42}$$

$$\begin{aligned} \overline{U} = {} & E_Y E_u U (\widehat{w}_{SB} + \widetilde{\theta}_{SBR} \widetilde{u} + \widetilde{\theta}_{SBR} \left(\overline{X} + p(\widetilde{e}_{SBR}) - \widetilde{Y} \right) - c(\widetilde{e}_{SBR}) \\ & - E_Y \left[\widetilde{\theta}_{SBR} \left(\overline{X} + p(\widetilde{e}_{SBR}) - \widetilde{Y} \right) - c(\widetilde{e}_{SBR}) \right]) \end{aligned} \tag{43}$$

Since $p(e) - c(e)$ is concave in effort, and effort is concave in distribution amount by Lemma 1, it follows from Jensen's inequality:

$$\begin{aligned} E_Y \left[p(\widetilde{e}_{SBR}) - c(\widetilde{e}_{SBR}) \right] & < p\left(E_Y \left[\widetilde{e}_{SBR} \right] \right) - c\left(E_Y \left[\widetilde{e}_{SBR} \right] \right) \\ & < p\left(e\left(E_Y \left[\widetilde{\theta}_{SBR} \right] \right) \right) - c\left(e\left(E_Y \left[\widetilde{\theta}_{SBR} \right] \right) \right) \\ & = p(e(\theta_{FB})) - c(e(\theta_{FB})) = p(e_{FB}) - c(e_{FB}) \end{aligned} \tag{44}$$

The last equality follows since we consider the case when the social planner chooses sensitivity $\theta_{FB} = E_Y \left[\widetilde{\theta}_{SBR} \right]$. Inequality (44) shows that revenues under the social planner's policy are larger than under the shareholders' policy. Now we only have to show that when the social planner sets sensitivity to $\theta_{FB} = E_Y \left[\widetilde{\theta}_{SBR} \right]$, the fixed wage required by employee is smaller, i.e., $\widehat{w}_{FB} < \widehat{w}_{SB}$. The wealth of the employee net of fixed wage under shareholders' policy is:

$$\widetilde{W}_{SB} = \widetilde{\theta}_{SBR}\widetilde{u}+\widetilde{\theta}_{SBR}(\overline{X}+p(\widetilde{e}_{SBR})-\widetilde{Y})-c(\widetilde{e}_{SBR})-E_Y(\widetilde{\theta}_{SBR}(\overline{X}+p(\widetilde{e}_{SBR})-\widetilde{Y})-c(\widetilde{e}_{SBR})) \tag{45}$$

Note that wealth of the employee net of fixed wage under the policy of social planner, $\widetilde{W}_{FB} = \theta_{FB}\widetilde{u}$, second-order stochastically dominates $\widetilde{W}_{SB}$. This can be seen by verifying the condition that $E\left[\widetilde{W}_{SB} - \widetilde{W}_{FB}|\widetilde{W}_{FB}\right] = 0$, i.e.,

$$E\left[\left(\widetilde{\theta}_{SBR} - \theta_{FB}\right)\widetilde{u} \mid \widetilde{u}\right] = 0 \tag{46}$$

Since $\widetilde{W}_{FB}$ second-order stochastically dominates $\widetilde{W}_{SB}$, and the individual rationality constraint binds, it implies that necessarily $\widehat{w}_{FB} < \widehat{w}_{SB}$ and thus $V_{FB} > V_{SB}$. But this is a contradiction since I assumed at the beginning of the proof that *ex ante* maximizing repurchase policy is the one that is followed by shareholders. This establishes that first best is not achieved by shareholders when external financing is not available (λ is large).

Now consider the case when $\lambda = 0$. When $\lambda = 0$ the shareholders issue the maximum possible amount of debt $D_{\max}$ at date $t = 1$ to finance repurchases. Since Y is random, repurchased amount $D_{\max} + Y$ and the contract sensitivity θ_R will also be random, and the argument used above can be applied to establish the result.

If financing costs are in the range $0 < \lambda < p'(e_Y)\frac{de_Y}{d\theta_Y}\frac{d\theta_Y}{dD}$, then shareholders will issue debt at $t = 1$ and will incur the borrowing costs. In this case, the argument in proof of proposition 3 could be used to establish the result and we would be done. The rest of the proof shows that suboptimality in this case is not only due to the financing costs, but also from suboptimal risk-sharing associated with randomness in pay-for-performance sensitivity created by repurchases, i.e., I need to establish that contract sensitivity after repurchase is still a function of Y when we allow for optimal choice of external financing. This can also be proved by contradiction. In particular, assume that the contract sensitivity after repurchase is not a function of Y, i.e., $\theta_R = const$. Consider two different realizations of cash flows Y_1 and Y_2. If sensitivity is constant, $\theta_R = const$, regardless of realization Y, then it must be true that debt levels D_1 and D_2 satisfy $\theta_R(Y_1, D_1) = \theta_R(Y_2, D_2)$. Using equation (16), one can see that this is equivalent to level of debt D_2 being related to D_1, Y_1, Y_2 in the following way:

$$D_2 = \frac{(Y_1 - Y_2)\left(\overline{X} + p(e_R)\right) + D_1\left(\overline{X} + p(e_R) + Y_2\lambda\right)}{\overline{X} + p(e_R) + Y_1\lambda} \tag{47}$$

Now I need to check whether the level of debt D_2 given by (47) satisfies the first-order condition (18) when the realization of short-term cash flows is Y_2, provided that D_1 is optimal when the realization of short-term cash flows is Y_1.Since D_1 is optimal given Y_1, it should satisfy FOC (18)

$$\lambda = p'(e_R)\frac{de_R}{d\theta_R}\frac{d\theta_R(Y_1)}{dD_1} \tag{48}$$

where $\frac{d\theta_R(Y_1)}{dD_1}$ is calculated from equation (16):

$$\frac{d\theta_R\left(Y_1\right)}{dD_1}=\frac{\theta\left(\overline{X}+p\left(e_R\right)+Y_1\lambda\right)}{\left(\overline{X}+p\left(e_R\right)-Y_1-D_1\left(1+\lambda\right)\right)^2+\theta\left(Y_1+D_1\right)p'\left(e_R\right)\frac{de_R}{d\theta_R}} \tag{49}$$

The debt level D_2 satisfies (18) if:

$$\lambda=p'\left(e_R\right)\frac{de_R}{d\theta_R}\frac{d\theta_R\left(Y_2\right)}{dD_2} \tag{50}$$

Since by assumption sensitivity θ_R is constant regardless of realization of Y and thus e_R is constant regardless of realization of Y, and since D_1 is optimal given realization Y_1, the condition (50) will only hold if: $\frac{d\theta_R(Y_2)}{dD_2}=\frac{d\theta_R(Y_1)}{dD_1}$. Calculating $\frac{d\theta_R(Y_2)}{dD_2}$ from (16) and substituting for D_2 expression (47) gives:

$$\frac{d\theta_R\left(Y_2\right)}{dD_2}=\frac{\theta\left(\overline{X}+p\left(e_R\right)+Y_1\lambda\right)}{\frac{\left(\overline{X}+p(e_R)+Y_2\lambda\right)\left(\overline{X}+p(e_R)-Y_1-D_1(1+\lambda)\right)^2}{\left(\overline{X}+p(e_R)+Y_1\lambda\right)}+\theta\left(D_1+Y_1\right)p'\left(e_R\right)\frac{de_R}{d\theta_R}} \tag{51}$$

But this is a contradiction since $\frac{d\theta_R(Y_2)}{dD_2}\neq\frac{d\theta_R(Y_1)}{dD_1}$ and thus D_2 given by (47) is not the optimal choice of debt at $t=1$. Thus, in the case when the cost of capital is such that the choice of debt is interior, the compensation sensitivity is a function of realization Y and by argument in the beginning of the proof.the first best will not be achieved because of suboptimal risk-sharing. ■

Proof of Proposition 5. The manager maximizes his expected utility and prefers dividends to no distribution when:

$$\begin{aligned}&E_uU(w+(\theta_o+\theta_s)\left(\overline{X}+p(e)+p^E(e^E)+\widetilde{u}-Y\right)-c(e)+\frac{\theta_sY}{1-\theta_o-\theta_o^E})>\\&E_uU\left(w+(\theta_o+\theta_s)\left(\overline{X}+p(e)+p^E(e^E)+\widetilde{u}\right)-c(e)\right)\end{aligned} \tag{52}$$

1) If manager has no options $\theta_o=0$, this simplifies to $-\theta_sY+\frac{\theta_sY}{1-\theta_o^E}=\frac{Y\theta_s\theta_o^E}{1-\theta_o^E}>0$, which is positive when both $\theta_o^E\neq0$, and $\theta_s\neq0$. 2) If non-executive employees hold no stock options, $\theta_o^E=0$, dividends are preferred to no distribution if $-\left(\theta_o+\theta_s\right)Y+\frac{\theta_sY}{1-\theta_o}=Y\theta_o\left(\frac{-1+\theta_o+\theta_s}{1-\theta_o}\right)>0$. Since the total stake of manager and employees in the firm is less than 1, this condition is not satisfied. Thus the manager prefers to retain cash rather than to pay dividends if $\theta_o^E=0$ and $\theta_o\neq0$. If manager holds no stock in the firm $\theta_s=0$, but holds stock options $\theta_o\neq0$, then the condition for dividends preference is $-\theta_oY>0$, which is clearly violated. 3) From 2) it follows that when $\theta_o\neq0$, and $\theta_o^E=0$, choosing dividends is suboptimal for the manager. Thus I only need to compare repurchase to no distribution. When $\theta_s^E=0$, the manager is made worse off by a share repurchase according to proposition 2, since this is equivalent to the case when there are no other employees. This establishes that retaining cash is optimal for the manager in this case. ■

Appendix B: Variable definitions

Repurchases	Dollars spent on repurchases (Compustat item #115) in the year of and the year after the repurchase announcement, reduced by any decrease in par value of preferred stock (Compustat item#130) and divided by the market value of equity at the beginning of announcement year, times 100.
Percent Sought	Percent of outstanding shares the company announces it is going to repurchase, as listed in SDC database. When this variable is missing, it is calculated as the value of repurchase listed in the announcement divided by the market equity value at the beginning of the announcement year.
Announcement Return	Cumulative abnormal stock return over (-1,+1) announcement window in percentage terms, calculated using the market model with value-weighted CRSP index.
Cash Flow	After-tax cash flow that was not distributed to security holders as either interest or dividend payments deflated by the market value of common equity in the year preceding the year of payout change. The after-tax cash flow is calculated as operating income before depreciation (Compustat item #13), minus total income taxes (Compustat item #16), minus gross interest expense on short- and long-term debt (Compustat item #15), minus total amount of preferred dividend requirement on cumulative preferred stock and dividends paid on noncumulative preferred stock (Compustat item #19), minus total dollar amount of dividends declared on common stock (item #21).
Operating cash	Ratio of cash from operations (Compustat item #308) to book assets at the beginning of announcement year.
Dividend Yield	Value of common dividends paid (Compustat #21) in the year prior to year of payout change, scaled by the market value of equity at the beginning of the year, times 100.
Log of Assets	Logarithm of total assets (Compustat item #6) at year-end prior to payout change.
Market-to-Book	Average ratio of market value of equity given by the year-end price per share (Compustat item #24) times the number of shares outstanding (item #25), to the book value of equity (item #60).
Runup	Abnormal stock price return from day -43 to day -4 prior to the announcement (%), calculated using the market model with value-weighted index. The parameters of the market model are estimated over a 200-day period, beginning from day -250 and ending at day -50 relative to the announcement.
R&D	Research and Development expenses (Compustat item #46) deflated by book assets (Compustat item #6) at the year end prior to payout change, times 100.
Volatility	Volatility of logreturns, measured as the standard deviation of firm logreturns over 36 months prior to date of payout change, in percent.
Leverage Deviation	Difference between actual firm leverage ratio and the predicted leverage ratio. The predicted value is obtained from a Tobit model estimated on the population of Compustat firms over the period of 1996-2002, where the dependent variable is firm market leverage and explanatory variables include firm size (logarithm of firm assets), collateral (proxied by net PP&E deflated by assets), growth opportunities and uniqueness (proxied by R&D deflated by sales), SG&A expense deflated by sales, year, and industry dummies.

Employee Turnover	Number of options forfeited during the year of and year after the announcement, deflated by the number of options outstanding at the year-end prior to year of the announcement, times 100.
Employment Declines	Sum of annual decreases in the number of people employed by the firm (Compustat item #29) in the year of and year after the announcement as a fraction of the initial number employed at the year-end prior to the announcement, times 100. Decreases are not offset with subsequent increases.
MTS	Market-to-strike ratio of outstanding options at the fiscal year-end following the announcement.
Outstanding Options	Number of outstanding options at the fiscal year-end prior to the announcement as listed in firm 10K statement, divided by the number of outstanding shares at the beginning of the announcement year, times 100. The variable is winsorized at 1% tails.
Exercisable Options	Number of exercisable options at the fiscal year-end prior to the announcement as listed in firm 10K statement, divided by the number of outstanding shares at the beginning of announcement year, times 100. The variable is winsorized at 1% tails.
Executive Options	Number of stock options held by top-five executives at the fiscal year-end prior to the announcement (ExecuComp), divided by the number of outstanding shares at the beginning of the announcement year, times 100.
Executive Stock	Number of shares of stock owned by top five executives at the fiscal year-end prior to the announcement (ExecuComp), divided by the number of outstanding shares at the beginning of announcement year, times 100.
Option Incentives	Number of outstanding options at the fiscal year-end prior to the announcement as listed in firm 10K statement times the delta of outstanding options, divided by the number of outstanding shares at the beginning of announcement year, times 100. The variable is winsorized at 1% tails.
Exercisable Option Incentives	Number of exercisable options at the fiscal year-end prior to announcement as listed in firm 10K statement times the delta of options, divided by the number of outstanding shares at the beginning of announcement year, times 100. The variable is winsorized at 1% tails.
Incentives Exercised	Stock option incentives exercised by top five executives in the fiscal year following repurchase announcement, measured as the number of options exercised, times the delta of options exercised, divided by the number of outstanding shares at the beginning of the announcement year, times 100. The variable is winsorized at 1% tails.
Incentives Granted	Stock option incentives granted to top five executives in the fiscal year following repurchase announcement, measured as the number of options granted, times the delta of options granted, divided by the number of outstanding shares at the beginning of the announcement year, times 100. The variable is winsorized at 1% tails.
Immobility	Given by Herfindahl index of the number of employees, calculated as a ratio of the number of firm employees squared to sum of squares of number of employees working at all firms within this industry.
Mobility	Inverse of immobility

Appendix C: Tables

Table 2. Industry and year distribution of open-market repurchase announcements during 1996-2002. Industries are classified into 12 groups using classifications from the Kenneth French website. The third and fourth columns contain the number of announcements and the percentage of the sample represented by this industry.

Industry name	SIC codes	Number of Announcements	Fraction (%)
Consumer NonDurables (Food, Tobacco, Textiles, Apparel, Toys)	0100-0999, 2000-2399, 2700-2749, 2770-2799, 3100-3199, 3940-3989	134	10.4
Consumer Durables (Cars, TVs, Furniture, Household Appliances)	2500-2519, 2590-2599, 3630-3659, 3710-3711, 3714, 3716, 3750-3751, 3792, 3900-3939, 3990-3999	30	2.3
Manufacturing (Machinery, Trucks, Planes, Off Furn, Paper, Printing)	2520-2589, 2600-2699, 2750-2769, 3000-3099, 3200-3569, 3580-3629, 3700-3709, 3712-3713, 3715, 3717-3749, 3752-3791, 3793-3799, 3830-3839, 3860-3899	177	13.7
Energy, Oil, Gas, Coal Extraction	1200-1399, 2900-2999	38	2.9
Chemicals and Allied Products	2800-2829, 2840-2899	46	3.6
Business Equipment (Computers, Software, Electronic Equipment)	3570-3579, 3660-3692, 3694-3699, 3810-3829, 7370-7379	251	19.4
Telephone, Television Transmission	4800-4899	26	2.0
Utilities	4900-4949	23	1.8
Wholesale, Retail, Some Services	5000-5999, 7200-7299, 7600-7699	220	17.0
Healthcare, Medical Equipment, Drugs	2830-2839, 3693, 3840-3859, 8000-8099	78	6.0
Money, Finance	6000-6999	83	6.4
Other (Mines, Constr, BldMt, Trans, Hotels, Bus Serv, Entmnt)	other	189	14.6
Total		1,295	100

Table 3. Summary statistics of options use by repurchasing companies during 1996-2002. The value of options has been calculated by the Black-Scholes formula, as modified by Merton (1973) to account for dividend payouts. The numbers of outstanding and exercisable stock options, and the associated strike prices are taken from firms' 10K statements; the data is not winsorized in the table. The volatility of stock returns is calculated as the standard deviation of log returns over past 36 months prior to repurchase authorization. All options are assumed to have a remaining life of 5 years. Non-executives are defined to be all employees except for the top-five executives as identified by the ExecuComp database.

Variable	Mean	Std.Dev.	Minimum	Q1	Median	Q3	Maximum
Number of options outstanding scaled by shares outstanding (%)	9.5	7.0	0	5.0	8.2	12.2	77.9
Fraction of outstanding options currently exercisable (%)	48.0	29.8	0	33.4	46.0	60.7	100
Black-Scholes value of options outstanding scaled by MV of equity (%)	5.5	5.5	0	2.0	3.9	7.0	59
Fraction of total options held by non-executives (%)	69.7	18.8	0	59.1	72.5	84.0	100
Number of options held by non-executives scaled by shares outstanding (%)	6.8	5.8	0	3.0	5.2	8.6	70.2
Black-Scholes option portfolio value per non-executive employee ($)	43,891	241,578	0	1,662	5,030	20,605	5,851,090
Number of shares of stock held by executives scaled by shares outstanding (%)	4.5	8.5	0	0.3	0.9	3.8	61.2

Table 4. Mean abnormal returns at announcements of repurchase authorizations. In panel A, the firms are double-sorted by outstanding options/outstanding common shares and by exercisable options/outstanding common shares. In panel B, the firms are double-sorted by outstanding options/outstanding common shares and by their research and development expenses in the year prior to payout change. The sample consists of 1,295 announcements of open-market share repurchases during 1996-2002. Abnormal returns are calculated in (-1,+1) three-days window, using the market model. The parameters of the market model are estimated from day -250 to day -50 relative to announcement, with the CRSP value-weighted index used as a proxy for market returns.

Panel A

	Options Outstanding < 25th percentile	Options Outstanding in 25-49th percentile	Options Outstanding in 50-74th percentile	Options Outstanding ≥ 75th percentile
Options Exercisable > 50th percentile	1.33%	0.95%	1.40%	2.29%
Options Exercisable < 50th percentile	1.40%	1.50%	2.14%	2.97%

Panel B

	Options Outstanding < 25th percentile	Options Outstanding in 25-49th percentile	Options Outstanding in 50-74th percentile	Options Outstanding ≥ 75th percentile
Research and Development < 50th percentile	1.29%	1.31%	1.42%	2.13%
Research and Development > 50th percentile	1.49%	1.11%	2.24%	2.74%

Table 5. Announcement-day returns for repurchasing firms. The dependent variable is cumulative abnormal return over (-1,+1) window. Runup is abnormal stock return from day -43 to day -4 prior to the announcement, calculated using market model. Percent sought is the percent of total shares the company announces to repurchase. Cash flow is calculated as in Lehn and Poulsen (1989). Market-to-Book is the market value of equity to book value of equity at the beginning of the announcement year. Outstanding options is the number of all outstanding options at fiscal year-end prior to the announcement, divided by number of outstanding shares. Executive stock is the number of shares owned by executives to number of outstanding shares. Option incentives are incentives from outstanding options, measured by option deltas times number of options, and scaled by outstanding shares. Columns 4 and 5 present results for subsamples of firms that have respectively nonzero R&D expenses and zero R&D expense in the year prior to announcement. P-values based on Huber-White standard errors are listed in parentheses. *,**,*** denote significance at 10%, 5% and 1%.

	(1)	(2)	(3)	(4)	(5)
Intercept	0.512	0.562	0.224	-2.207	2.934*
	(0.656)	(0.627)	(0.859)	(0.344)	(0.070)
Log of assets	-0.028	-0.017	-0.052	0.235	-0.349*
	(0.818)	(0.893)	(0.690)	(0.246)	(0.060)
Market-to-book	0.026	0.027	0.024	0.012	0.029
	(0.176)	(0.166)	(0.185)	(0.549)	(0.408)
Percent sought	0.130***	0.128***	0.137***	0.148**	0.139***
	(0.002)	(0.003)	(0.001)	(0.019)	(0.010)
Runup	-0.031**	-0.031**	-0.030**	-0.055***	-0.004
	(0.024)	(0.029)	(0.032)	(0.006)	(0.844)
Cash flow/Assets	-0.046**	-0.049**	-0.044**	-0.022	-0.049*
	(0.042)	(0.033)	(0.046)	(0.541)	(0.077)
Outstanding options	0.082**		0.064*	0.183**	-0.015
	(0.019)		(0.084)	(0.016)	(0.781)
Exercisable options	-0.058**		-0.052**	-0.096	-0.045**
	(0.011)		(0.016)	(0.455)	(0.049)
Executive stock	0.054*	0.058**	0.055**	0.058	0.061
	(0.051)	(0.048)	(0.048)	(0.157)	(0.106)
Option incentives		0.081**			
		(0.033)			
Exercisable option incentives		-0.065***			
		(0.006)			
Industry Controls	No	No	Yes	Yes	Yes
Observations	1,219	1,152	1,219	540	679
Adjusted R^2	0.024	0.023	0.020	0.014	0.022

Table 6. Simultaneous equations model for executive and non-executive option exercises and grants (Grant Model). The model is estimated by 2SLS. The dependent variable in columns 1-2 is incentives granted to top five executives; the dependent variable in columns 3-4 is incentives granted to all other employees in the year following repurchase announcement. Incentives granted (exercised, outstanding) are measured by options delta times the number of options granted (exercised, outstanding), scaled by the number of outstanding shares (%). Repurchases are the dollars spent on the repurchases in the year of and after the announcement, reduced by the decrease in par value of preferred stock, scaled by the market equity value (%). Leverage Deviation is the difference between actual market leverage ratio and the predicted value. Volatility is the standard deviation of log returns over past 36 months. Coefficients on 11 industries and 6 year dummies are not shown. P-values are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.629***	0.469***	0.633***	-0.072	-0.156	-0.020
	(0.000)	(0.007)	(0.000)	(0.903)	(0.793)	(0.972)
Log of Assets	-0.094***	-0.079***	-0.095***	0.002	-0.008	-0.002
	(0.000)	(0.000)	(0.000)	(0.978)	(0.891)	(0.969)
R&D / Assets	0.016***	0.012**	0.016***	0.067***	0.070***	0.069***
	(0.007)	(0.034)	(0.007)	(0.001)	(0.000)	(0.000)
Volatility	0.004**	0.004**	0.004**	0.021***	0.017***	0.020***
	(0.019)	(0.023)	(0.017)	(0.000)	(0.006)	(0.000)
Past Returns	0.001**	0.001	0.001**	-0.004	-0.002	-0.003
	(0.045)	(0.116)	(0.028)	(0.174)	(0.555)	(0.248)
Contemporaneous Returns	-0.000	-0.000	-0.000	0.001	0.001	0.001
	(0.493)	(0.687)	(0.500)	(0.398)	(0.401)	(0.411)
Leverage Deviation	0.269**	0.182	0.262**	0.580	0.570	0.579
	(0.038)	(0.159)	(0.043)	(0.170)	(0.168)	(0.167)
Incentives exercised (simultaneous)	0.606***	0.656***	0.544***	1.102***	0.942***	1.046***
	(0.001)	(0.001)	(0.003)	(0.000)	(0.000)	(0.000)
Past incentives granted	0.343***	0.302***	0.348***	0.449***	0.441***	0.458***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Outstanding Incentives		0.153***			0.072**	
		(0.000)			(0.032)	
Repurchases	-0.007**	0.004	-0.006**	-0.032***	0.010	-0.031***
	(0.032)	(0.263)	(0.044)	(0.006)	(0.517)	(0.008)
Repurchases×Outstanding incentives/100		-0.008***			-0.006***	
		(0.000)			(0.002)	
Observations	1,208	1,205	1,208	1,229	1,229	1,229
Adjusted R^2	0.227	0.245	0.228	0.429	0.443	0.432

Table 7. Simultaneous equations model for executive and non-executive option exercises and grants (Exercise Model). The model is estimated by 2SLS. The dependent variable in columns 1-3 is incentives exercised by top five executives, in columns 4-6 incentives exercised by all other employees in the year following repurchase announcement. Incentives exercised (granted, outstanding) are measured by options delta times the number of options exercised (granted, outstanding), scaled by the number of outstanding shares (%). Dividend yield is common dividends paid in the year prior to the announcement scaled by the market equity (%). MTS is the market-to-strike ratio of outstanding options at the beginning of the exercise year. Volatility is the standard deviation of log returns over the 36 months prior to announcement (%). Repurchases are the dollars spent on repurchases in the year of and after the announcement, reduced by decrease in par value of preferred stock, scaled by the market equity (%). Coefficients on 11 industry dummies and 6 year dummies are not shown. P-values are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-0.377***	-0.382***	-0.301***	-0.598***	-0.470***	-0.351*
	(0.000)	(0.000)	(0.000)	(0.002)	(0.008)	(0.096)
MTS	0.229***	0.213**	0.222***	0.738***	0.685***	0.713***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MTS^2	-0.018**	-0.014**	-0.017**	-0.105***	-0.103***	-0.102***
	(0.016)	(0.038)	(0.021)	(0.000)	(0.000)	(0.000)
Dividend yield	0.001	0.001	0.001	0.008	0.011**	0.008
	(0.744)	(0.603)	(0.731)	(0.198)	(0.044)	(0.180)
Volatility	-0.000	0.000	-0.001	-0.006**	-0.005**	-0.011***
	(0.954)	(0.829)	(0.305)	(0.018)	(0.046)	(0.000)
Past Returns	0.001***	0.001***	0.001***	0.009***	0.010***	0.009***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Contemporaneous Returns	0.000	0.000	0.000	-0.000	-0.000	-0.000
	(0.130)	(0.209)	(0.150)	(0.765)	(0.681)	(0.680)
Incentives granted (simultaneous)	0.231***	0.088***	0.229***	0.232***	0.137***	0.231***
	(0.000)	(0.129)	(0.000)	(0.000)	(0.000)	(0.000)
Past incentives exercised	-0.025	-0.014	-0.022	0.109***	0.066**	0.113***
	(0.553)	(0.725)	(0.603)	(0.000)	(0.021)	(0.000)
Repurchases	0.005***	-0.001	-0.004	0.027***	0.004	-0.004
	(0.009)	(0.733)	(0.389)	(0.000)	(0.450)	(0.756)
Outstanding incentives		0.085***			0.034**	
		(0.000)			(0.018)	
Repurchases×Outstanding incentives/100		0.0014*			0.003***	
		(0.098)			(0.000)	
Repurchases×Volatility/100			0.021*			0.073***
			(0.053)			(0.007)
Observations	1,208	1,205	1,208	1,229	1,229	1,229
Adjusted R^2	0.115	0.172	0.115	0.370	0.430	0.374

Table 8. Tobit estimates of the determinants of employee turnover. The dependent variable is the average number of options forfeited in the year of and after announcement, scaled by the options outstanding (%). Percent sought is the target fraction listed in the announcement (%). Repurchases are the dollars spent on repurchases in the year of and after the announcement, reduced by the decrease in preferred stock, scaled by the market equity (%). Repurchase announcement is 1 if the firm makes announcement of repurchase, and 0 if it declares dividends increase. Immobility is constructed as Herfindahl index of the number of employees; mobility is equal to inverse of immobility. All variables are described in Appendix B. Coefficients on 11 industry and 6 year dummies are not shown. The first entry is the marginal effect; the second entry (in parentheses) is the p-value.

	(1)	(2)	(3)	(4)	(5)	(6)
Log of assets	-0.361*	-0.436**	-0.419***	-0.353*	-0.417**	-0.345*
	(0.060)	(0.022)	(0.001)	(0.065)	(0.028)	(0.072)
Market-to-book	-0.001	0.001	-0.007	0.000	0.002	0.004
	(0.979)	(0.963)	(0.729)	(0.986)	(0.953)	(0.877)
Operating Cash / Assets	-0.114***	-0.118***	-0.087***	-0.104***	-0.109***	-0.115***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Volatility	0.140***	0.142***	0.119***	0.136***	0.138***	0.141***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Returns(-1)	-0.024***	-0.026***	-0.019***	-0.025***	-0.028***	-0.014**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.049)
Returns(0)	-0.014**	-0.015***	-0.014***	-0.015***	-0.016***	-0.014**
	(0.011)	(0.007)	(0.001)	(0.007)	(0.005)	(0.013)
Returns(+1)	0.001	0.000	0.002	0.000	-0.001	0.002
	(0.822)	(0.979)	(0.617)	(0.924)	(0.905)	(0.687)
Immobility	-0.047	-0.050	0.019	-0.054	-0.058	-0.043
	(0.759)	(0.746)	(0.833)	(0.722)	(0.701)	(0.778)
Percent sought	0.128***			0.124***		0.066
	(0.004)			(0.005)		(0.197)
Repurchases		0.078**			0.079**	
		(0.019)			(0.018)	
Repurchase announcement			1.290***			
			(0.001)			
Mobility × Percent sought				0.116**		
				(0.022)		
Mobility × Repurchases					0.278**	
					(0.019)	
Percent sought × Low returns						0.154**
						(0.021)
Observations	1,253	1,256	2,046	1,253	1,256	1,253

Table 9. Tobit estimates of the determinants of employment declines. The dependent variable is the average decrease in employment in the year of and after the announcement, scaled by the number of employees prior to the announcement (%). Percent sought is the target fraction listed in the announcement (%). Repurchases are the dollars spent on repurchases in the year of and after the announcement, reduced by the decrease in preferred stock, scaled by the equity value (%). Repurchase announcement is 1 if the firm makes announcement of repurchase, and 0 if it declares dividends increase. Immobility is constructed as Herfindahl index of number of employees; mobility is equal to inverse of immobility. All variables are described in Appendix B. Coefficients on 11 industry and 6 year dummies are not shown. The first entry is the marginal effect; the second entry (in parentheses) is the p-value.

	(1)	(2)	(3)	(4)	(5)	(6)
Log of assets	0.260**	0.212*	0.222***	0.271**	0.234*	0.259**
	(0.046)	(0.100)	(0.008)	(0.035)	(0.065)	(0.047)
Market-to-book	-0.016	-0.014	-0.013	-0.015	-0.013	-0.016
	(0.412)	(0.457)	(0.353)	(0.424)	(0.475)	(0.405)
Operating Cash / Assets	-0.092***	-0.094***	-0.070***	-0.075***	-0.077***	-0.092***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Volatility	0.016	0.019	0.020	0.090	0.012	0.015
	(0.213)	(0.125)	(0.026)	(0.454)	(0.320)	(0.215)
Returns(-1)	-0.014***	-0.016***	-0.014***	-0.011***	-0.019***	-0.015***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.005)
Returns(0)	-0.010**	-0.010***	-0.010***	-0.011***	-0.012***	-0.010**
	(0.012)	(0.006)	(0.001)	(0.004)	(0.002)	(0.012)
Returns(+1)	0.001	0.000	0.003	0.000	-0.000	0.001
	(0.732)	(0.898)	(0.207)	(0.946)	(0.858)	(0.744)
Immobility	-0.074	-0.070	-0.042	-0.081	-0.077	-0.074
	(0.426)	(0.449)	(0.387)	(0.384)	(0.400)	(0.425)
Percent sought	0.087***			0.076**		0.086**
	(0.006)			(0.011)		(0.016)
Repurchases		0.078***			0.078***	
		(0.001)			(0.001)	
Repurchase announcement			1.023***			
			(0.000)			
Mobility × Percent sought				0.156***		
				(0.000)		
Mobility × Repurchases					0.396***	
					(0.000)	
Percent sought × Low returns						-0.008
						(0.854)
Observations	1,268	1,271	2,306	1,268	1,271	1,268