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Share Repurchases and Pay-Performance Sensitivity of Employee Compensation Contracts

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ABSTRACT

I show that share repurchases increase pay-performance sensitivity of employee compensation and lead to greater employee effort and higher stock prices. Consistent with the model, I find that after repurchases, employees and managers receive fewer stock option and equity grants, and that the market reacts favorably to repurchase announcements when employees have many unvested stock options. Managers are more likely to initiate share repurchases when employees hold a large stake in the firm. Moreover, since employees are forced to bear more risk in firms that repurchase shares, they exercise their stock options earlier and receive higher compensation.

IN RECENT YEARS, CORPORATIONS HAVE DISTRIBUTED increasing amounts of cash to shareholders through share repurchases. As reported by the Securities Data Corporation (SDC), the aggregate amount spent by companies on stock repurchase programs grew from $38 billion in 1993 to over $100 billion in 2003, peaking in 1998 with an astounding value of $230 billion.

In this paper I explore how share repurchases affect existing employee compensation contracts and offer a new explanation for the popularity of stock buybacks. Specifically, at the time of a share repurchase, employees are not permitted to tender their unvested shares, and the pay-performance sensitivity of their contracts increases. This increased employee ownership (measured by the dollar change in compensation per dollar change in firm value) creates stronger incentives for employees to provide effort, but also exposes them to greater risk. For example, a repurchase of 7% of common shares provides a 7.5% increase in employee incentives and can substitute for about half of a typical annual equity grant.[1] Given the incentive effect of stock buybacks, managers (who make payout decisions) can benefit from stock repurchases by effectively

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[1] If a fraction of shares θ is held by employees, then after a repurchase of 7% of equity, the new stake is $\theta' = \frac{\theta}{1-0.07} = 1.075\theta$. Typical stock option grants comprise approximately 15% of all outstanding options for firms in my sample.

forcing higher incentives on employees (who do not influence the firm's payout policy).

The rationale for open market share repurchases proposed in this paper is unrelated to the undervaluation and excess cash distribution motives explored elsewhere in the payout literature (e.g., Ikenberry, Lakonishok, and Vermaelen, (1995), Louis and White (2007), Lie (2000), Grullon and Michaely (2004)). While my empirical and theoretical results do not rule out undervaluation or other repurchase motives, the argument of this paper is that managers also repurchase stock to boost employee incentives. Based upon this insight, I test whether the greater incentives created by stock buybacks translate into higher stock returns, whether compensation structure affects a firm's payout method, whether employees dislike increases in risk, and whether firms make fewer option and stock awards after repurchases.

The data lend support to the incentive effect of repurchases. Using a sample of 1,295 open market repurchase announcements and hand-collected data on employee stock option programs over the period 1996 to 2002, I find that announcement returns are larger in firms with larger repurchase programs and many unvested stock options. The effect is most powerful when employees (not managers) have large amounts of unvested ownership and when firms intensively use human capital. Since dividend increases do not change the number of outstanding shares, they should not have any positive effect on pay-performance sensitivity and employee effort. Using dividend increases as a control sample, I show that there is no significant relationship between announcement returns for dividend increases and employee stock options.

In addition, I find that the method of payout chosen by the firm (stock repurchase versus dividend increase) is affected by the compensation structure at the firm. The model predicts that the propensity of managers to repurchase shares increases with the incentives of their employees. Confirming this prediction, I find that repurchases are more likely to be announced when employees hold many unvested stock options, particularly when firms have a greater need for human capital, as measured by their R&D expenses and Tobin's Q.

By focusing on the increase in pay-performance sensitivity associated with share repurchases, I also examine whether employees dislike increases in compensation risk. The tests of this prediction are relevant in light of the review by Prendergast (2002), who notes that the evidence on the tradeoff between risk and incentives is mixed. I hypothesize that repurchases prompt the early exercise of stock options by risk-averse employees and that employees demand larger compensation in repurchasing firms. Consistent with the diversification motive of risk-averse employees, I find that stock option exercises are positively related to the fraction of repurchased equity. A one-standard deviation increase in the fraction of repurchased equity is associated with a 30% increase in stock option exercises by managers and a 19% increase by employees, controlling for factors such as stock returns, market-to-strike ratios, and contemporaneous option grants, among others. The increase in stock option exercises is more pronounced for firms with highly volatile stock returns, supporting the view that employees exercise their stock options because of the increased risk exposure.

The evidence also indicates that employees demand a premium for bearing extra risk. In particular, employee compensation prior to a repurchase announcement is positively related to the fraction of shares the firm plans to repurchase, with a stronger effect for firms with highly volatile stock returns. In addition, I find that employee turnover following repurchases is positively related to both the target fraction of shares the firm plans to repurchase and the actual fraction of equity that is repurchased. Turnover is higher in riskier firms and among employees with higher pay-performance sensitivity.

Since repurchases always increase pay-performance sensitivity but may be conducted for other reasons,[2] I expect new grants of stock-based compensation to decrease following buybacks. As there appears to be a strong contemporaneous relation between stock option grants and exercises, with grants affecting exercises and exercises affecting grants, I model them as a system of simultaneous equations with appropriate identifying conditions. I find evidence that firms substitute repurchases for new stock option grants and restricted stock grants to employees and managers, which is consistent with boards reducing grants when incentives are above the optimal level. Unlike repurchases, dividend increases do not have any significant effect on grants to managers. I find weak evidence that stock option grants to employees grow with larger dividend increases.

The link between repurchases and stock option awards highlighted in this paper has been previously investigated by the literature studying the effect of stock dilution caused by the exercise of stock options (Kahle (2002), Bens et al. (2003), Brav et al. (2005)). For example, Kahle (2002) argues that managers tend to buy back shares after stock option exercises in order to prevent dilution. The insight of this paper is that there is a more subtle effect at work through the action on employee incentives. The intuition is as follows. The incentives of employees decline over time as the number of outstanding shares increases with new option exercises. Given that the firm wants to pursue a target level of incentives, the board of directors can either authorize new option grants or make a share repurchase, the latter usually being a less costly alternative. My findings that firms make fewer option and equity grants following repurchases are consistent with this view.

The effect of repurchases on employee incentives appears to have a lot of explanatory power for various patterns around share repurchases. In particular, it explains the abnormal returns around the announcement of a stock buyback. It also explains why announcement returns tend to be positively related to the program size, why firms with many employee stock options prefer stock buybacks to dividends, and why blockholders may want to push management to make more share repurchases.

The remainder of the paper is organized as follows. Section I considers the effects of any stock repurchase on compensation contracts and analyzes the

[2] See Vermaelen (1981), Comment and Jarrel (1991), Ikenberry, Lakonishok, and Vermaelen (1995) for signalling; Massa, Rehman, and Vermaelen (2007) for mimicking signalling of competitors; Dittmar (2000) for capital structure adjustments; Stulz (1988) and Bagwell (1991) for takeover deterrence; and Grullon and Michaely (2004) for distribution of excess capital.

managerial decision to initiate a repurchase. The empirical hypotheses are formulated in Section II. The sample is described in Section III.A, and the empirical results are presented in Sections III.B–III.G. Section IV offers concluding remarks.

I. Model

The theoretical model in this paper draws on analysis by Holmstrom (1979) and papers analyzing the impact of debt on compensation contracts (Bronars and Deere (1991), Perotti and Spier (1993)). The model uses standard assumptions and is mainly used to motivate the empirical analysis. Consider a setting where the owners of the firm start with a clean-slate all-equity firm at $t = 0$. The project generates random cash flows $\tilde{X}$, which increase with employee effort:

$$\tilde{X} = \bar{X} + p(e) + \tilde{u}, \tag{1}$$

where $E(\tilde{u}) = 0, \text{Var}(\tilde{u}) = \sigma^2$, and the function $p(e)$ is increasing and concave.[3] Part of the cash flow, $\tilde{R}$, is realized at $t = 1$ and the remaining $\bar{X} - \tilde{R} + p(e) + \tilde{u}$ is available at $t = 2$. The realized cash flows $\tilde{R}$ are distributed back to investors through a share repurchase program at $t = 1$.[4] The riskfree rate is set to zero.

I make the assumption that the firm's employee has an increasing and concave utility function $U(W)$ and a monetary convex disutility of effort $c(e)$. The employee is compensated by n shares of restricted stock and a fixed wage w, and cannot trade on his own account to undo the effects of the financial contract.[5] The employee signs a contract at $t = 0$ only if his expected utility is greater than or equal to the reservation value $\bar{W}$. After the payout date but before the resolution of final uncertainty, the employee chooses an optimal effort level.[6] The final cash flows are realized at $t = 2$ and the compensation is paid to the employee.

Denoting by N the total number of shares of common stock at $t = 0$, by $\theta = \frac{n}{N}$ the initial pay-performance sensitivity, and by θ_R the pay-performance

[3] I assume that employee productivity $p(e)$ is common knowledge, which implies no updating of employee ability and no adjustments in wages over time. See Berk, Stanton, and Zechner (2007) for the model with learning about employee productivity.

[4] The uncertain interim cash flows $\tilde{R}$ are unrelated to the effort supplied and capture the idea that payout decisions cannot be predicted with certainty.

[5] Garvey (1997) demonstrates that trading on secondary markets can be an important limitation on the use of such contracts. However, companies regularly place trading restrictions on their employees and management (see Bettis, Coles, and Lemmon (2000)).

[6] I abstract from free-rider problems and assume that employees can be motivated by compensation contracts. Kandel and Lazear (1992) show that employees increase firm value collectively when incentive plans are used. DeFusco, Johnson, and Zorn (1990) find that increases in pay-performance sensitivity are met with positive price reactions. Similarly, Bitler, Moskowitz, and Vissing-Jorgensen (2005) document that higher pay-performance sensitivity of entrepreneurs is associated with greater effort, and Lazear (2000) finds that an increase in pay-performance sensitivity at Safelite Glass Corporation leads to a 44% increase in output.

sensitivity after a repurchase, I can write the optimization problem of the employee as

$$\max_{e} E_u[U(w + \theta_R(\bar{X} + p(e_R) + \tilde{u} - R) - c(e_R))], \tag{2}$$

where R is the amount the firm spends on repurchases, e_R is employee effort after the repurchase, and the expectation is with respect to uncertainty about the terminal cash flows. Since at the time of repurchase the employee cannot tender unvested shares, his fractional holding in firm equity θ_R ("percent owned") increases, leading to a greater incentive to provide costly effort.

PROPOSITION 1: *Pay-performance sensitivity θ_R and employee effort e_R increase monotonically with the repurchase amount R.*

Proof: All proofs are in Appendix A.

Note that although the model considers a simple linear contract with restricted stock, Proposition 1 also holds under more complex convex contracts, such as employee stock options. For the option holder, pay-performance sensitivity will be greater, following a repurchase because of two effects: a decrease in the number of outstanding shares (as for a stockholder) and an increase in the option delta due to positive price changes at the repurchase announcement.

Since cash flows available at $t = 1$ are random and stock buybacks cannot be predicted with certainty, generally there will be a price reaction at the time of a repurchase announcement. Intuitively, larger repurchases will result in a higher pay-performance sensitivity for the employee, increasing firm value by more than expected and producing positive announcement returns.

PROPOSITION 2: *Larger than expected buybacks are followed by positive announcement returns, which increase with the initial pay-performance sensitivity θ and the repurchase amount R.*

The next proposition demonstrates that positive returns are derived at the employee's expense, as his expected utility decreases when there is a share repurchase.[7] The employee has a lower expected utility in the event of a stock buyback for two reasons. First, after a share repurchase, he bears more risk as the pay-performance sensitivity of his contract increases. Second, since the cost of effort is monetary, share repurchases result in a wealth transfer. Intuitively, the market reacts positively to repurchase announcements, fully incorporating in the price the effect of future increases in effort, and hence shares are bought back at a high price. It is always optimal for the employee to exert greater effort after the repurchase since the sensitivity of his compensation has increased. However, due to the market reaction, a large part of the gains from increased

[7] Note that I consider a single group of employees, whose utility is unambiguously lower after a repurchase. Introducing another group, for example, managers, may also lead to one group benefiting at the expense of the other.

employee effort accrues to shareholders, while the costs of effort are borne exclusively by the employee.

PROPOSITION 3: *The employee has a lower expected utility when there is a stock buyback. The expected utility loss increases with the repurchase amount R, the initial pay-performance sensitivity θ, and firm riskiness σ.*

The fact that an employee has lower utility when his pay-performance sensitivity increases may seem counterintuitive because we generally think that having a higher stake in the firm implies greater wealth. The employee who receives a higher stake in the firm could choose to exert the same effort as before and get a higher value, while optimal choice of effort increases his wealth even more. In my model this argument does not hold because, after a share repurchase, the employee holds a larger stake in a *smaller* firm.

The rational employee anticipates the firm payout policy when he signs an employment contract. Since the employee dislikes the increased risk and greater effort that come with a repurchase, he demands greater compensation for his services ex ante.[8]

COROLLARY 1: *Employee compensation increases with the expected repurchase amount $\bar{R}$, particularly in firms that are risky.*

Consider now the decision to repurchase stock by a firm's managers. I focus on managerial decisions because, in practice, managers make all payout decisions (see Graham and Harvey (2001) and Brav et al. (2005)).[9] If managers were acting in the interest of shareholders, then, given sufficient cash reserves, they would always buy back stock in order to increase pay-performance sensitivity and indirectly expropriate employees. However, even if managers pursued only their own personal interest they could benefit from repurchases. Unlike Berk, Stanton, and Zechner (2007), I assume that managers cannot commit to an ex ante optimal contract, that is, managers cannot commit to a no-repurchase policy.

Suppose that both managers (who are assumed to be the decision makers) and employees contribute to the value of the firm by providing costly effort, that is, the long-term cash flows of the firm that materialize at date 2 are

$$\tilde{X} = \bar{X} + p_M(e_M) + p_E(e_E) + \tilde{u}, \tag{3}$$

where $p_M(e_M)$ and $p_E(e_E)$ are the returns to the effort of managers and employees, respectively. It follows from Proposition 3 that managers have no incentive to buy back shares if employees do not have any stock-based compensation. This

[8] The optimal contract takes into account that, *with some probability*, the firm will repurchase stock in the future and that given repurchases employees require higher compensation. I assume that the firm cannot commit to a no-repurchase policy (although this commitment would allow the firm to reduce compensation costs).

[9] Although the board of directors decides whether to authorize a stock repurchase, this decision is often influenced by the views of top management. Moreover, managers have significant discretion whether to repurchase stock following such authorizations.

is because, in this case, a stock repurchase subjects the managers to higher risk but does not change employee productivity. However, when employees hold a significant stake in the firm, managers may have a reason to conduct a stock buyback because the repurchase motivates employees to work harder, creating kickbacks to the managers through their stock ownership.

PROPOSITION 4: *Managers have an incentive to buy back stock if employees hold a sufficiently large stake in the firm. The probability of initiating a repurchase increases with the pay-performance sensitivity of employees and decreases with managerial risk aversion.*

Intuitively, managers should never want to repurchase more than is desired by shareholders. Yet, since individual managers hold a significant stake in the firm, they are exerting close to maximum effort before a repurchase. From a managerial perspective, the main downside of a repurchase is that it forces them to bear additional risk, while the main benefit is that it motivates employees and thereby increases the stock price. Clearly, motivation becomes more important when employees collectively hold a large stake.

In a recent paper Brav et al. (2008) document a surge in hedge fund activism with approximately 20% of intervention targeting firm payout policy. Since blockholders are typically better diversified than managers and do not have a significant amount of human capital invested in the firm, the model also offers an explanation for why blockholders have an incentive to demand a larger payout through share repurchases. Like management, they benefit by expropriating employees because higher employee effort translates into higher stock returns. This explanation is different from the commonly cited motive of redeploying excess cash and suggests that gains to blockholders (through share repurchases) should be larger for human capital-intensive firms where employees hold many unvested options.

II. Hypothesis Development

Since share repurchases increase employee pay-performance sensitivity and in turn employee effort, shareholders enjoy positive returns at the time of repurchase announcement.[10] The testable hypothesis below directly reflects Proposition 2.

Hypothesis 1: *Repurchase announcement returns increase with the size of a repurchase program and with employee pay-performance sensitivity*.

When share repurchases are made for exogenous reasons the increase in pay-performance sensitivity may raise incentives above their optimal level. If

[10] The model is parsimonious and does not allow for uncertain stock grants at $t = 0$. Had this uncertainty been incorporated, the model would also predict positive returns at the announcement of stock grants that would increase with the expected repurchase amount.

companies pursue a target level of incentives,[11] they will need to adjust downward the level of incentives after a repurchase. I thus hypothesize that new stock option and equity grants are negatively related to the fraction of repurchased equity, particularly when pay-performance sensitivity is high prior to the repurchase. This constitutes the empirical test of Proposition 1.

Hypothesis 2: *The grants of options and restricted stock decrease with the fraction of repurchased equity, particularly for firms in which employees have high pay-performance sensitivity prior to the repurchase*.

Brav et al. (2005) and Bens et al. (2003) document the tendency of firms to repurchase stock to counteract the dilution caused by the exercise of stock options. My model provides a rationale for such behavior. Even if employees hold stock after exercising their options, their pay-performance sensitivity necessarily decreases over time simply because the number of the firm's outstanding shares grows as options are exercised. In order to keep the pay-performance sensitivity constant, the firm should either make new option grants after options are exercised or repurchase stock, the latter often being the cheaper option.

The next three hypotheses follow from Proposition 3 and test whether employees recognize the increase in their risk exposure following buybacks. Since theoretical models such as Hall and Murphy (2002) and the empirical evidence in Huddart and Lang (1996), suggest that higher risk exposure increases the diversification needs of risk-averse employees and prompts them to exercise their stock options earlier, I hypothesize that following share repurchases, employees and managers exercise their options earlier. This effect should be particularly pronounced for risky firms and for employees with high pay-performance sensitivity.

Hypothesis 3: *Stock option exercises increase with the fraction of equity that is repurchased, particularly in risky firms or in firms in which employees have high pay-performance sensitivity prior to the repurchase*.

If employees perceive that they are hurt by additional risk, share repurchases may also be associated with higher employee turnover. I do not expect that otherwise happy employees quit their jobs after repurchases. However, employees who were uncertain about staying may choose to quit their jobs at this time. I also expect that higher pay-performance sensitivity of employees prior to the repurchase is associated with higher turnover, particularly in riskier firms.[12]

[11] The target level could be determined by such factors as risk aversion (Holmstrom (1979)), agency problems (Jensen and Meckling (1976)), financing constraints (Core and Guay (2001)), retention and attraction motives (Yermack (1995)), and costly renegotiation (Oyer (2004)).

[12] This effect will be present in cross-sectional regressions only if employees do not completely anticipate a share repurchase when they sign their contracts.

Hypothesis 4: *Employee turnover increases with the fraction equity that is repurchased and is higher in riskier firms, where employee pay–performance sensitivity is higher prior to repurchase*.

Following the intuition of Corollary 1, I hypothesize that employees are paid more when the firm is expected to repurchase more stock. Since managers may be pressed to repurchase stock by large institutional shareholders, the firm's activists, or the board of directors,[13] they may anticipate such pressure to repurchase stock when they sign employment contracts and demand higher compensation. Whether managers receive larger compensation when they repurchase more stock is an empirical question, but to the extent that managers influence payout decisions, I expect the relation between repurchases and total compensation to be weaker for managers than for employees.

Hypothesis 5: *The compensation of managers and employees increases with the expected repurchase amount, particularly in risky firms*.

Finally, I formulate the hypothesis that managers are more likely to initiate buyback programs when the employees have higher pay-performance sensitivity prior to repurchase (Proposition 4). I expect this effect to be more pronounced for human capital–intensive firms because, for these firms, higher pay-performance sensitivity translates into larger increases in firm value.

Hypothesis 6: *The probability of initiating a share repurchase is positively related to the level of employee incentives prior to the buyback, particularly in firms that use human capital intensively*.

III. RESULTS

A. Sample Selection

I collect the initial sample of authorization announcements of open market share repurchases from the SDC database with announcement dates between 1996 and 2002. Privately negotiated repurchases are excluded from my sample. If the firm makes several announcements on the same day, I retain only the first announcement. I restrict attention to U.S. listed firms with share codes 11 and 10 that are listed on Compustat, Execucomp, and CRSP and have data on repurchases and managerial compensation.

I also gather a sample of dividend increases by picking firms that increased common dividends (item 21) from 1996 to 2002. I consider the date of announcement for the dividend increase to be the date on which the board declares the increased dividend (monthly CRSP). Following Guay and Harford (2000) and Grullon and Michaely (2004), I exclude firms that both announced a share

[13] For example, when activist hedge fund manager Carl Icahn, who held 3% of stock in Motorola, called on the board to buy back $15 billion in stock, the management executed an immediate $2 billion buyback and committed an additional $3 billion to future repurchases (CNN).

repurchase and increased dividends or that both increased and decreased dividends during the same year.[14]

For repurchasing and dividend-increasing firms, I then extract the information on employee stock options from the firms' 10K statements for the year prior to, the year of, and the year after the payout change. Since option data are usually restated each year to reflect stock splits and stock dividends, I collect option data from the actual 10K report for each year.[15] My final sample contains 1,295 share repurchase announcements and 1,047 dividend increases for the period 1996 to 2002.

The number of stock buybacks increased before 1998 and decreased steadily thereafter, 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 of 7.2%. The average 3-day abnormal return at the announcement of a share repurchase is 1.7%, consistent with empirical studies by Vermaelen (1981) and Kahle (2002). The dividend increases are distributed fairly evenly throughout the period, with the largest number of increases in 1996 (180) and the smallest in 2000 (131). The distribution of share repurchases and dividend increases across industries is presented in Table I. Repurchases are favored by human capital–intensive industries, with most of the announcements in Business Equipment (251) and Wholesale and Retail Trade (220). The industries with the largest number of dividend increases are Manufacturing (190) and Utilities (172).

Stock options are used extensively by repurchasing companies, as documented in Table II. Employees (defined as all employees other than the top five managers) hold, on average, 70% of the outstanding options, which is consistent with the evidence by Core and Guay (2001). For firms announcing repurchases, the average Black–Scholes value of the options portfolio per employee is $43,891, while it is only $18,093 for firms increasing dividends. Options also represent a considerable fraction of firm equity, with an average value of 5.5% for repurchasing firms and 2.4% for dividend-increasing firms.

III. B. Determinants of Announcement Returns

To test the hypothesis that repurchase announcement returns increase with the size of the repurchase program and with employee pay-performance sensitivity, I regress the 3-day cumulative abnormal returns around repurchase authorizations on the incentives from stock options held by employees and on the incentives from options and stock held by the top five managers.[16] The abnormal returns are calculated using the market model, where the parameters are estimated over a 200-day period, ending 50 days prior to the announcement.

[14] This helps to avoid confounding effects and to minimize the hand-collection of stock option data from individual 10K statements.

[15] I am unable to find 10K statements for 32 firm-years in the repurchase sample and 61 firm-years in the sample of dividend increases.

[16] The stock held by employees should also have a positive relation to announcement returns, but data on the stock holdings of employees are not available.

Table I
Industry Distribution of Open Market Repurchase Announcements and Dividend Increases during the Period 1996 to 2002

The sample consists of Execucomp firms that authorized open market share repurchases (SDC database) or increased dividends between 1996 and 2002. Firms that are not listed in the U.S., that have missing compensation data, as well as firms that both announced a share repurchase and increased dividends, or that both increased and decreased dividends during the same year are excluded. Industries are classified into 12 groups using classifications from Kenneth French's website. The second and third columns contain the number of repurchase announcements and dividend increases, respectively.

Industry Name	Rep. Announcements	Div. Increases
Consumer nondurables (food, toys, etc.)	134	132
Consumer durables (cars, TVs, furniture, etc.)	30	53
Manufacturing (machinery, planes, paper, etc.)	177	190
Energy, oil, gas, coal extraction	38	24
Chemicals and allied products	46	71
Business equipment (computers, software, etc.)	251	57
Telephone and television transmission	26	26
Utilities	23	172
Wholesale, retail, some services	220	81
Healthcare, medical equipment, drugs	78	53
Money, finance, insurance	83	107
Other (mines, transport, hotels, etc.)	189	81
Total	1,295	1,047

I define incentives from options and stock as the percentage change in the option or stockholder wealth for a 1% change in the firm's stock price. Previous research on the incentive compensation of CEOs measures incentives by either "percent owned" (see Demsetz and Lehn (1985), Jensen and Murphy (1990), Yermack (1995)) or "dollars at stake" (see Core and Guay (2001)). Since in my model employee effort depends on the percent owned, I focus on this measure in empirical tests. The incentives from options are equal to the number of options multiplied by average option delta and scaled by the number of the firm's outstanding shares.[17] The option delta is calculated using the Black–Scholes model, as modified by Merton (1973) to include dividend payouts.[18] Since the delta of a stock is one, the managers' incentives from stock are equal to the number of shares held by managers, scaled by the number of outstanding shares.

Since the effect of a repurchase is smaller if employees can quickly unwind incentives, I expect that, controlling for outstanding options, the announcement

[17] In all of the regressions, I treat stock options as exogenous. Cross-sectional variation within an industry may stem from variation in past cash constraints (Core and Guay (2001)), adoption by firms of accounting changes, a history of mergers, or the need to retain human capital and attract particular employee types (Oyer and Schaefer (2005)).

[18] 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.

Table II
Summary Statistics of Option Use by Repurchasing and Dividend-Increasing Firms during the Period 1996 to 2002

The value of options is calculated by the Black–Scholes formula, modified to account for dividend payouts. The number of outstanding and exercisable stock options and the associated strike prices are taken from firms' 10K statements. The volatility of stock returns is calculated as the standard deviation of log returns over the 36 months prior to the repurchase authorization. All options are assumed to have a remaining life of 5 years. Employees are defined as all employees other than the top five managers, identified by the Execucomp database.

	Repurchasing Firms				Dividend-Increasing Firms			
	Mean	Q1	Q2	Q3	Mean	Q1	Q2	Q3
Outstanding options scaled by outstanding shares (%)	9.5	5.0	8.0	12.2	5.4	2.5	4.7	7.4
Fraction of options currently exercisable (%)	48.0	33.4	46.0	60.7	53.4	40.8	54.4	66.1
BS options value scaled by MV of equity (%)	5.5	2.0	3.9	7.0	2.4	0.9	1.8	3.0
Fraction of total options held by employees (%)	69.7	59.1	72.5	84.0	69.8	58.9	72.9	85.5
BS option portfolio value per employee ($)	43,891	1,662	5,030	20,605	18,093	1,729	4,479	12,814
Employee options multiplied by option delta scaled by shares outstanding (%)	5.7	2.3	4.2	7.3	3.0	1.2	2.4	4.0

returns are negatively related to the exercisable options. The incentives from exercisable options are defined as the number of fully vested options multiplied by the option delta and divided by the number of outstanding shares. I expect a stronger positive relationship between employees' outstanding incentives and announcement returns for companies in which sustained success depends on human capital. In particular, in firms that do R&D, the effort of employees should be more sensitive to stock-based incentives because in these firms output is often intangible, and it is more difficult to monitor and enforce production with other incentive schemes.

In the analysis, I control for the market-to-book ratio of equity as a proxy for investment opportunities, the logarithm of book assets as a proxy for informational asymmetries, and cash flow over book assets as a proxy for agency problems, where cash flow is constructed as in Lehn and Poulsen (1989). Following Kahle (2002), I include the stock price runup in the 40 days prior to repurchase. Since equity-based compensation may be related to announcement returns because it proxies for better corporate governance, I also control for firm governance. I include the G-index based on 24 antitakeover provisions (Gompers, Ishii, and Metrick (2003)),[19] institutional ownership

[19] Results are not sensitive to using the staggered board dummy, Cremers and Nair's (2005) index based on three antitakeover provisions, or Bebchuk, Cohen, and Ferrrel's (2006) entrenchment index based on six antitakeover provisions.

(CDA Spectrum), the number of blockholders, managers' stock, and the median industry ratio of selling expenses to sales (48 Fama–French industries) to control for product market competition. Since Daines (2001) finds that Delaware firms are more likely to receive a takeover bid, I also add an indicator for Delaware incorporation. All empirical variables are defined in Appendix B. The model is estimated by regressions with industry- and year-fixed effects. Since the same firm may make an announcement several times in my sample, the test statistics are adjusted for non-independence of observations within firms, and *p*-values based on Huber–White standard errors are reported.

The regression results in Table III confirm that the market reacts more favorably to repurchase announcements when employees and managers hold more stock-based incentives.[20] The coefficients on the employees' and managers' outstanding incentives are positive and significant (column 1),[21] with the more powerful effect for employee incentives. For example, a one-standard deviation increase in outstanding employee incentives increases announcement returns by 0.62% when the mean returns are 1.74%. The regression results differ from those of Kahle (2002), who uses a smaller sample over a different time period.[22] The coefficient on managerial stock is also positive, consistent with Vermaelen (1981), who documents a similar relation for tender offer repurchases. The results are not affected if repurchases announced in 1998 are removed from the sample. As predicted, the incentives from exercisable options enter with a negative sign. When governance controls are added, the variables of interest retain their signs and significance (column 2). Finally, the effect of employee incentives appears to be stronger for companies that do R&D (columns 3 and 4), supporting the notion that human capital–intensive firms benefit more from the increase in pay-performance sensitivity. The last column in Table III shows the same regression for the returns around dividend increases: The incentives of employees and managers are not significant. This is consistent with the intuition that, unlike repurchases, dividends do not have a positive effect on pay-performance sensitivity.

[20] The unreported results show that stock option grants to managers are met with a more positive stock price reaction when the firm plans to repurchase more shares in the near future.

[21] To address the possible sample selection concern, I check whether the results hold when I follow the two-stage Heckman procedure (Heckman (1979)). I estimate an inverse Mills ratio with a probit regression on the sample of repurchasing and dividend-increasing firms and include this estimate in the regression of announcement returns. The results show an insignificant coefficient on the inverse Mills ratio, while the signs and the magnitudes of coefficients are preserved.

[22] Kahle (2002) uses a sample of 712 repurchase announcements over the period 1993 to 1996. There are differences in the 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 prior to announcement in order to avoid endogeneity issues. For example, firms that did not experience a positive price reaction at announcement may grant a larger number 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 use the incentives from options, whereas Kahle (2002) uses the number of options and does not consider option delta.

Table III
Announcement-Day Returns for Repurchasing and Dividend-Increasing Firms

The table reports fixed industry- and year-effects regression results, where the dependent variable in columns 1–4 (5) is the 3-day CAR (in %) around repurchase (dividend increase) announcements, respectively. All variables are described in Appendix B. Columns 3 and 4 present results for firms that have respectively nonzero and zero R&D expenses in the year prior to announcement. The *p*-values based on robust standard errors (clustered at the firm level) are in parentheses. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)	(5)
Log of assets	−0.162	−0.172	0.048	−0.406*	−0.208
	(0.282)	(0.324)	(0.838)	(0.070)	(0.102)
Market-to-book	0.016	0.018	0.004	0.008	0.005
	(0.385)	(0.321)	(0.842)	(0.821)	(0.827)
Percent sought	0.173***	0.170***	0.167**	0.179***	
	(0.000)	(0.000)	(0.012)	(0.001)	
Stock price runup	−0.045**	−0.037**	−0.072***	−0.014	−0.031**
	(0.014)	(0.043)	(0.006)	(0.563)	(0.022)
Cash flow/assets	−0.041*	−0.058**	−0.038	−0.041	0.018
	(0.075)	(0.017)	(0.314)	(0.151)	(0.573)
Dividend size increase					0.024***
					(0.003)
G-index		−0.104			−0.005
		(0.232)			(0.919)
Delaware Inc.		0.131			−0.320
		(0.796)			(0.268)
Inst. ownership		0.000			0.038***
		(0.992)			(0.002)
Blockholders		0.129			−0.243
		(0.507)			(0.111)
Median SGA /sales		0.995			1.569
		(0.674)			(0.475)
Managers' stock	0.094***	0.100***	0.091*	0.095**	0.016
	(0.005)	(0.005)	(0.074)	(0.034)	(0.447)
Employees' outstanding incentives	0.157**	0.158**	0.384**	0.019	0.014
	(0.026)	(0.039)	(0.011)	(0.859)	(0.899)
Employees' exercisable incentives	−0.055**	−0.054**	−0.297	−0.055***	0.022
	(0.016)	(0.012)	(0.415)	(0.008)	(0.887)
Managers' outstanding incentives	0.033*	0.032*	0.511	0.035**	0.030
	(0.055)	(0.091)	(0.450)	(0.016)	(0.917)
Managers' exercisable incentives	−0.343	−0.358	0.415	−0.480	−0.291
	(0.137)	(0.138)	(0.557)	(0.122)	(0.500)
Observations	1,174	1,112	523	651	817
Adjusted-R^2	0.031	0.030	0.016	0.035	0.021

The alternative explanation for my findings is that higher pay-performance sensitivity at the time of repurchase signals that management is optimistic about the firm's prospects and increases payouts to convey this optimism. While the signalling hypothesis can explain the positive coefficient on managers'

incentives, it is less appealing as an explanation of positive coefficients on employee incentives since employees are unlikely to have inside information. In addition, the announcement returns at the time of dividend increases do not show any significant relation to the pay-performance sensitivity of either employees or managers.

A related alternative explanation could be that firms with high employee pay-performance sensitivity tend to be young growth firms that are strongly affected by informational asymmetries and could trade at prices that deviate substantially from fundamentals.[23] To address this issue, I separate my sample into two equally sized groups by the book value of assets and by the standard dispersion of analysts' forecasts. If employee stock options proxy for informational asymmetry, then I should see weaker results for large firms and firms with a small dispersion of analysts' forecasts. I find the opposite, with the coefficient on employees' outstanding incentives being significant only for large firms, and significant in both subsamples by the dispersion of analysts' forecasts (untabulated).

III. C. Determinants of Option and Equity Grants

My primary hypothesis is that firms substitute repurchases for new option and equity grants since repurchases increase pay-performance sensitivity. I separate the incentives from stock-based compensation into managers' and employees' incentives, and I further decompose incentives into incentives from stock options and restricted stock: I expect that repurchases should affect new grants in all categories.[24]

I construct the fraction of repurchased equity as the sum of dollars spent on repurchases (item 115) in the year of and year after the announcement, reduced by decreases in preferred stock (item 130) and divided by the market value of equity at the beginning of the announcement year. Jagannathan, Stephens, and Weisbach (2000) conclude that although this measure overestimates actual repurchases, the deviation is not large and is smaller than that of the CRSP measure based on the number of shares outstanding, introduced by Stephens and Weisbach (1998).

Previous research has identified a number of determinants of stock-based compensation grants, and I include them in my specifications. I control for firm size because Demsetz and Lehn (1985) argue that firm size should be negatively correlated with equity-based grants. Since greater noise in the firm's operating environment makes monitoring more costly and should result in more grants, I include the volatility of log returns over the 36 months prior to the grant year. To control for the possible need to adjust leverage after

[23] The opposite, however, may also be true since firms with broad-based option plans tend to be large public companies that are followed by many analysts and media.

[24] The data on resticted stock grants is only available for top five managers. Although restricted stock grants to all employees are sometimes described in 10Ks, their disclosure during 1996 to 2002 is sporadic and not standardized.

a buyback and for the fact that under high leverage it becomes suboptimal to fully align the incentives of managers and shareholders (John and John (1993)), I construct a variable that proxies for the deviation of firm leverage from its optimal value.[25] Past and contemporaneous stock returns can affect grants because the board may use stock returns in evaluating managerial performance or because CEOs prefer to get their option grants shortly before favorable news (Yermack (1997)). I also control for the quality of the firm's corporate governance since poorly governed firms may make larger grants. I include G-index, institutional ownership, number of blockholders, managers' stock, and a Delaware incorporation indicator. Since managers in more competitive industries are less likely to shirk and may need fewer option grants for motivation, I also add the median ratio of selling expense to sales in a given industry (using the 48 Fama–French industries) as a proxy for industry competitiveness.

Finally, stock option exercises can be an important determinant of option grants, since the exercise of options can lead to the increased sale of stock by employees for tax or diversification purposes (Ofek and Yermack (2000)). Accordingly, I hypothesize that when the number of stock option exercises goes up, so does the number of stock option grants. However, a greater number of option grants might also lead to more option exercises. To incorporate their interdependencies, I model stock option grants and exercises as a system of simultaneous equations, identifying the system by exclusion restrictions similar to Core and Guay (2001). I estimate the model using two-stage least squares. In particular, I assume that option exercises are not affected by firm size, R&D spending, or leverage policy. Similarly, I assume that market-to-strike ratios and dividend yield can be excluded from the grant equation. I apply a similar model for grants of restricted stock to the top five managers, with the exception that option exercises are not included and the Tobit estimation is used.

Results in Panel A of Table IV support the prediction of the model that option and equity grants decrease with repurchases. The coefficient on repurchases is negative and statistically significant in columns 1, 3, and 5, where the dependent variables are the option incentives granted to managers, the option incentives granted to employees, and the restricted stock granted to managers, respectively. The effect is also confirmed in regressions on cross-terms between repurchases and outstanding incentives (columns 2, 4, and 6).

The results in Panel B of Table IV are for dividend-increasing firms. There is no significant negative relation between option and equity grants to managers and the size of a dividend increase (columns 1 and 2 and 5 and 6). There is weak evidence that option grants to employees increase with dividend increases (column 3).

[25] The predicted value for optimal leverage comes from a Tobit model estimated on Compustat firms over the period 1996 to 2002, where the dependent variable is market leverage and the explanatory variables are log(assets), PPE/assets, RD/sales, SGA/sales, year, and industry dummies. The deviation is the difference between the actual and predicted leverage.

Table IV
Option and Equity Grants in Repurchasing and Dividend-Increasing Firms

The model in columns 1–4 is the simultaneous equations model, estimated by 2SLS. The model in columns 5–6 is the Tobit model, estimated by maximum likelihood. The dependent variable in columns 1 and 2 (3 and 4) is the number of options granted to managers (employees) in the year after repurchase announcement, multiplied by option delta, scaled by outstanding shares (%). The dependent variable in columns 5–6 is the value of restricted stock granted to managers in the year after the repurchase announcement, scaled by market equity (%). All variables are described in Appendix B. Also included are 11 industry and 6-year dummies. Panels A and B are for repurchasing and dividend-increasing firms, respectively. The *p*-values are in parentheses. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Panel A: Repurchasing Firms

	Granted Options (Managers)		Granted Options (Employees)		Granted Stock (Managers)	
Log of assets	−0.138***	−0.102***	−0.065	−0.068	0.004	0.002
	(0.000)	(0.000)	(0.372)	(0.320)	(0.272)	(0.480)
RD/ assets	0.019***	0.019***	0.117***	0.104***	0.075	0.075
	(0.005)	(0.004)	(0.000)	(0.000)	(0.498)	(0.497)
Volatility	0.533***	0.342*	4.384***	2.738***	−0.067**	−0.064*
	(0.004)	(0.061)	(0.000)	(0.000)	(0.049)	(0.062)
Past returns	0.095	0.115*	−0.629*	−0.005	−0.021**	−0.022**
	(0.163)	(0.095)	(0.055)	(0.991)	(0.050)	(0.042)
Contemporaneous returns	−0.039	−0.029	0.317*	0.236	0.006	0.007
	(0.475)	(0.577)	(0.095)	(0.191)	(0.555)	(0.487)
Leverage deviation	0.351**	0.173	0.240	0.261	0.108***	0.111***
	(0.015)	(0.238)	(0.625)	(0.571)	(0.000)	(0.000)
Exercised options (simultaneous)	0.703***	0.576**	1.083***	0.534		
	(0.000)	(0.011)	(0.000)	(0.112)		
G-index	0.020**	0.020**	−0.007	−0.005	0.003*	0.003*
	(0.045)	(0.039)	(0.843)	(0.887)	(0.057)	(0.058)
Delaware inc.	0.127**	0.096*	0.278	0.213	0.014	0.014
	(0.014)	(0.057)	(0.123)	(0.204)	(0.140)	(0.119)
Inst. ownership	−0.000	−0.002	0.009	0.010	−0.000	−0.000
	(0.917)	(0.391)	(0.193)	(0.124)	(0.371)	(0.372)
Blockholders	−0.003	−0.008	−0.055	−0.091	0.006	0.006
	(0.891)	(0.731)	(0.493)	(0.240)	(0.138)	(0.155)
Median SGA/sales	0.060	0.004	3.457***	2.474***	0.209***	0.207***
	(0.827)	(0.988)	(0.000)	(0.007)	(0.000)	(0.000)
Managers' stock	−0.001	0.002	0.002	0.003	−0.002	−0.002***
	(0.795)	(0.634)	(0.841)	(0.813)	(0.002)	(0.002)
Repurchases	−0.007**	0.005	−0.030**	0.002	−0.001*	0.001
	(0.029)	(0.224)	(0.020)	(0.873)	(0.084)	(0.524)
Outstanding incentives		0.260***		0.196***		0.005***
		(0.000)		(0.000)		(0.445)
Repurchases × Outstanding incentives		−0.011***		−0.004**		−0.001**
		(0.000)		(0.020)		(0.021)
Observations	1,131	1,128	1,151	1,151	1,198	1,188
Adjusted-R^2	0.148	0.214	0.327	0.414		

(*continued*)

Table IV—*Continued*

Panel B: Dividend-Increasing Firms						
	Granted Options (Managers)		Granted Options (Employees)		Granted Stock (Managers)	
Log of assets	−0.053***	−0.050***	0.014	0.022	−0.006***	−0.007***
	(0.000)	(0.000)	(0.712)	(0.590)	(0.001)	(0.000)
RD/assets	0.005	0.003	−0.027	−0.031	0.400***	0.393***
	(0.379)	(0.531)	(0.272)	(0.235)	(0.002)	(0.003)
Volatility	−0.023	−0.112	0.851*	1.147*	−0.047*	−0.051**
	(0.852)	(0.334)	(0.078)	(0.061)	(0.064)	(0.047)
Past returns	0.091**	0.090**	−0.299	−0.613	0.012	0.012
	(0.033)	(0.029)	(0.235)	(0.174)	(0.171)	(0.175)
Contemporaneous returns	0.101***	0.085**	−0.029	−0.006	−0.001	−0.002
	(0.004)	(0.015)	(0.822)	(0.968)	(0.940)	(0.805)
Leverage deviation	0.245***	0.179***	0.177	0.151	0.065***	0.059***
	(0.000)	(0.002)	(0.381)	(0.501)	(0.000)	(0.000)
Exercised options (simultaneous)	0.724**	0.416	1.010***	1.496***		
	(0.033)	(0.382)	(0.000)	(0.004)		
G-index	−0.002	−0.002	0.030*	0.037*	−0.001	−0.000
	(0.621)	(0.566)	(0.072)	(0.066)	(0.553)	(0.680)
Delaware inc.	0.001	0.006	−0.075	−0.116	0.003	0.003
	(0.972)	(0.844)	(0.439)	(0.308)	(0.484)	(0.520)
Inst. ownership	0.000	0.000	−0.000	−0.002	0.000	0.000
	(0.911)	(0.689)	(0.993)	(0.722)	(0.765)	(0.631)
Blockholders	0.011	0.007	0.008	−0.002	−0.001	−0.001
	(0.377)	(0.586)	(0.859)	(0.974)	(0.802)	(0.797)
Median SGA/sales	0.074	−0.010	0.094	0.120	0.032	0.019
	(0.669)	(0.954)	(0.884)	(0.864)	(0.372)	(0.598)
Managers' stock	−0.006***	−0.005*	0.000	−0.002	−0.000	0.000
	(0.002)	(0.056)	(0.985)	(0.803)	(0.413)	(0.443)
Dividend size increase	−0.013	0.017	0.176*	0.223	0.016	0.008
	(0.593)	(0.542)	(0.054)	(0.201)	(0.250)	(0.637)
Outstanding incentives		0.173***		−0.066		−0.004
		(0.009)		(0.514)		(0.444)
Dividend size increase × Outstanding incentives		−0.035		−0.005		0.013
		(0.174)		(0.864)		(0.397)
Observations	840	838	843	843	913	903
Adjusted-R^2	0.137	0.211	0.216	0.233		

III. D. Determinants of Option Exercises

To determine how employees react to increases in their compensation risk, I test whether repurchases prompt the early exercise of stock options. Bettis, Bizjak, and Lemmon (2005) use the number of years before options expire for the exercised options to measure early stock option exercise. Since I do not have the time to maturity for the exercised options, I proxy for early exercise with total stock option exercises. Using this proxy introduces the possibility of measurement error in the dependent variable. Under a reasonable assumption

that the measurement error is uncorrelated with the dependent variables, the estimated coefficients should still be consistent. However, the standard errors of the error term should be larger, making it more difficult to find any statistical relationship.

Since share repurchases are often followed by higher stock prices (e.g., Ikenberry, Lakonishok, and Vermaelen (2000)), which can trigger early exercise by risk-averse employees (Huddart and Lang (1996)), it becomes important to control for price behavior. Thus, I include the firm's stock returns prior to and during the year of option exercise, as well as the market-to-strike ratio and market-to strike ratio squared of outstanding options. Since a high dividend yield may warrant early exercise, I also control for it. Firms with different corporate governance may have different restrictions on the exercise of stock options by employees, such as blackout periods (Bettis, Coles, and Lemmon (2000)). To address this issue, I include in the exercise model the same set of governance variables as in the grant model. To incorporate the feedback between option grants and exercises, I model them as a system of simultaneous equations, identifying the system by exclusion restrictions. In the first stage I use all of the exogenous explanatory variables from the exercise and grant models.

The results for stock option exercises are displayed in Table V. Option exercises tend to increase with stock repurchases, consistent with the diversification motive of managers and employees. The coefficient on the interaction between repurchases and stock return volatility is positive and statistically significant. The effect is economically sizable, with a one-standard deviation increase in repurchases leading to an increase in stock option exercises by managers of approximately 30% and by employees of 19%.[26] The regressions on cross-terms between repurchases and outstanding incentives yield similar results (columns 2 and 5). Moreover, there appears to be no significant change in the volume of traded (non-employee) call options for repurchasing firms (Option Metrics), and options volume is unrelated to the repurchased amount. I also check whether more option exercises follow dividend increases and do not find such evidence (columns 3 and 6).

The positive link between stock option exercises and repurchases cannot be easily explained by a signalling hypothesis, since I control for stock returns and the market-to-strike ratio of options. Moreover, managers may want to hold onto their options and stock if they believe their stock is largely undervalued. Managers may also face board pressure not to exercise their options as a way of signalling optimism to the market.

E. Determinants of Employee Turnover

Since the expected utility of employees decreases with repurchases, I expect larger repurchases to be associated with larger employee turnover. I use the

[26] For example, for managers the calculation is $(\beta_{rep} + \beta_{rep*vol}\overline{Vol})\frac{\sigma(rep)}{\overline{Exercises}} = (-0.005 + 0.023 \cdot 0.44)(7.67/0.14) = 0.30$.

Table V

Option Exercises in Repurchasing and Dividend-Increasing Firms

The model is the simultaneous equations model, estimated by 2SLS. The dependent variable in columns 1 and 2 and 4 and 5 is the number of options granted in the year following the repurchase announcement to managers and employees, respectively, multiplied by option delta, scaled by outstanding shares. The dependent variable in columns 3 and 6 is the number of options granted in the year following a dividend increase to managers and employees, respectively, multiplied by option delta, scaled by outstanding shares. All variables are described in Appendix B. Also included are 11 industry and 6-year dummies. The *p*-values are in parentheses. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	Exercised Options (Managers)			Exercised Options (Employees)		
Market-to-strike ratio	0.210***	0.207**	0.040***	0.650***	0.619***	−0.021
	(0.000)	(0.000)	(0.004)	(0.000)	(0.000)	(0.852)
Market-to-strike ratio^2	−0.015**	−0.014*	−0.001***	−0.098***	−0.090***	−0.002
	(0.047)	(0.064)	(0.001)	(0.000)	(0.000)	(0.324)
Dividend yield	0.014	0.017	−0.008	0.020	0.015	0.039
	(0.358)	(0.250)	(0.342)	(0.668)	(0.718)	(0.443)
Volatility	−0.174	−0.054	−0.257	−1.766***	−1.302***	−2.391*
	(0.218)	(0.654)	(0.408)	(0.000)	(0.001)	(0.096)
Past returns	0.010**	0.127***	0.016	0.908***	0.970***	0.368
	(0.011)	(0.002)	(0.595)	(0.000)	(0.000)	(0.113)
Contemporaneous returns	0.047	0.036	−0.043	−0.082	−0.088	0.034
	(0.149)	(0.255)	(0.078)	(0.403)	(0.334)	(0.759)
Granted options (simultaneous)	0.250***	0.127	0.246***	0.369***	0.313***	0.825***
	(0.000)	(0.176)	(0.003)	(0.000)	(0.000)	(0.002)
G-index	−0.015***	−0.013**	0.002	−0.011	−0.011	−0.026*
	(0.009)	(0.027)	(0.600)	(0.510)	(0.494)	(0.093)
Delaware inc.	−0.028	−0.024	0.042***	−0.080	−0.060	0.086
	(0.376)	(0.429)	(0.006)	(0.377)	(0.476)	(0.263)
Inst. ownership	0.001	0.000	0.001	0.001	0.001	0.001
	(0.538)	(0.943)	(0.129)	(0.773)	(0.616)	(0.660)
Blockholders	−0.022*	−0.021*	−0.013	0.021	0.013	−0.008
	(0.089)	(0.084)	(0.105)	(0.575)	(0.700)	(0.829)
Median SGA/sales	−0.128	−0.090	−0.163	−1.259**	−1.183**	−0.131
	(0.429)	(0.558)	(0.145)	(0.017)	(0.016)	(0.815)
Managers' stock	−0.001	−0.001	0.003***	−0.001	−0.002	−0.001
	(0.623)	(0.667)	(0.003)	(0.882)	(0.731)	(0.667)
Repurchases	−0.005	−0.004		−0.004	0.008	
	(0.321)	(0.158)		(0.789)	(0.284)	
Repurchases × Volatility	0.024**			0.079**		
	(0.031)			(0.014)		
Outstanding incentives		0.067*			0.016	
		(0.080)			(0.522)	
Repurchases × Out. incentives		0.004***			0.002***	
		(0.005)			(0.002)	
Dividend size increase			−0.032			−0.372*
			(0.475)			(0.066)
Dividend size increase × Volatility			0.079			0.643
			(0.453)			(0.190)
Observations	1,131	1,128	840	1,151	1,151	843
Adjusted-R^2	0.106	0.180	0.056	0.270	0.360	0.178

number of forfeited options during the year of and the year after the announcement, deflated by the number of outstanding options as a measure of employee turnover. While this measure has been previously used by Carter and Lynch (2004), a note of caution is due here since firms often group expired options with forfeited options, and it is possible that some of the variation in my turnover variable is driven by variation in the cancellation rate. For repurchasing firms, I expect employee turnover to increase with pay-performance sensitivity, and with the interaction of this variable with the firm's riskiness. I measure the firm's riskiness by the coefficient of variation of earnings (item 18) over the past 5 years. Results are similar if the stock volatility, or the change in volatility around the repurchase announcement, is used instead of cash flow volatility.

I control for stock returns, market-to-book equity, the volatility of stock returns, and firm size. In addition, I control for the ratio of cash from operations to assets, hypothesizing that companies with larger cash flows treat their employees better and have lower turnover. Since employee turnover may be a sign of restructuring at the firm, I include three controls that proxy for the possibility of restructuring. The first variable is one if the firm reduces its R&D in the year of and the year after the repurchase announcement, zero if there is no change in R&D, and negative one otherwise. The second variable is constructed in the same manner, but for capital expenditures. Finally, since Denis and Kruse (2000) find that restructuring often follows poor performance, I include the change in return on assets. Since employee turnover cannot be negative, I conduct Tobit regressions with censoring at zero to avoid bias in coefficients.

Results for employee turnover are displayed in Table VI. Employee turnover is positively and significantly related to the fraction of repurchased equity (columns 1 and 2) and to employees' pay-performance sensitivity (columns 3 and 4). Moreover, the interaction of pay-performance sensitivity with cash flow volatility increases employee turnover and is statistically significant (columns 3 and 4). These results are important as they provide clear evidence of the increased risk exposure for employees. The effect of repurchases on turnover is of relatively modest economic importance, which is reasonable given the significant relocation costs of changing jobs. A one-standard deviation increase in the announced size of a repurchase program increases annual employee turnover by approximately 6.9%.

To determine directly whether risk borne by employees increases after repurchases, I perform a *t*-test for the difference in means of volatility. I find that the total volatility of stock returns increases from 0.45 over the year prior to a repurchase announcement to 0.47 over the year following the repurchase announcement (*t*-stat of 2.39). Systematic risk decreases, consistent with the findings of Grullon and Michaely (2004). In particular, the market beta decreases from its average of 0.88 to 0.83 (*t*-stat of 2.31).[27] Thus, the increase

[27] Knopf, Nam, and Thornton (2002) find that when the sensitivity of managers' portfolios to the stock price increases, firms tend to hedge more. The decrease in systematic risk following large repurchases could be consistent with managerial hedging.

Table VI

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 options outstanding (%). All variables are described in Appendix B. Also included are 11 industry and 6-year dummies. Columns 1–4 give full sample results, and columns 5 and 6 give results for the subsamples in which beta increased more or less than the sample median, respectively. The first entry is the marginal effect; the second is the maximum likelihood *p*-value. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Log of assets	−0.410**	−0.474**	−0.672***	−0.715***	−0.440*	−0.384
	(0.033)	(0.013)	(0.001)	(0.001)	(0.072)	(0.196)
Market-to-book	0.020	0.023	0.015	0.017	0.020	−0.015
	(0.473)	(0.419)	(0.594)	(0.543)	(0.459)	(0.852)
Operating cash/ assets	−0.090***	−0.094***	−0.099***	−0.103***	−0.079**	−0.093**
	(0.002)	(0.001)	(0.001)	(0.001)	(0.028)	(0.040)
Volatility	14.426***	14.616***	9.520***	9.811***	12.265***	17.847***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Past returns	−1.437**	−1.644***	−1.764***	−1.887***	0.010	−3.045***
	(0.019)	(0.009)	(0.005)	(0.003)	(0.989)	(0.003)
Contemporaneous returns	−1.230**	−1.273**	−0.710	−0.748	−0.987	−1.575*
	(0.026)	(0.022)	(0.216)	(0.193)	(0.172)	(0.061)
Immobility	−0.066	−0.071	0.065	0.060	0.051	−0.187
	(0.666)	(0.643)	(0.676)	(0.701)	(0.785)	(0.440)
Change in ROA	−0.074**	−0.078**	−0.111***	−0.115***	−0.097**	−0.058
	(0.022)	(0.015)	(0.001)	(0.001)	(0.017)	(0.261)
Indicator of decrease in CAPEX	0.935***	0.940***	0.998***	1.009***	1.017***	0.864**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.035)
Indicator of decrease in RD	1.405***	1.383***	1.026**	1.026**	1.321***	1.490**
	(0.000)	(0.001)	(0.014)	(0.014)	(0.008)	(0.016)
Percent sought	0.113***		0.094**		0.103*	0.118*
	(0.010)		(0.033)		(0.065)	(0.082)
Repurchases		0.084**		0.058*		
		(0.015)		(0.096)		
Employees' out. incentives			0.199***	0.189***		
			(0.006)	(0.008)		
CF volatility			−0.091	−0.094		
			(0.348)	(0.333)		
CF volatility × employees' out. incentives			0.065***	0.065***		
			(0.000)	(0.000)		
Mobility × percent sought			0.002***			
			(0.001)			
Mobility × repurchases				0.004***		
				(0.002)		
Observations	1,233	1,236	1,132	1,135	616	617

in total volatility is driven by an idiosyncratic component: idiosyncratic risk (measured by the volatility of the residuals from the market model) increases from 0.42 to 0.44 (*t*-stat of 3.23).

From a theoretical perspective, employees should not be affected by changes in market risk since, in principle, they can hedge systematic risk by trading

on the secondary market (Jin (2002)). In contrast, employees cannot hedge idiosyncratic risk. Employees are often prohibited from selling short company stock and are inherently undiversified, with their human and physical capital (e.g., pension plans) invested disproportionately in their company. My findings that employee turnover increases with repurchases reinforce the idea that employees primarily react to changes in idiosyncratic risk. In addition, turnover is positively related to the announced size of the repurchase program in firms in which the beta increased more than the sample median around the repurchase announcement, as well as for firms in which the beta decreased (columns 5 and 6). These results suggest that even for firms that observe decreased systematic risk, the total risk borne by employees increases with repurchases.

A possible concern related to employee turnover results is that turnover may respond not to repurchases per se, rather to some fundamental changes in firm operations. 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. This argument could be extended to firms laying off employees to liquidate unprofitable lines of business. To examine whether employee turnover is voluntary, I test whether turnover responds more to repurchases when the mobility of employees is high. I proxy for the immobility of employees using a Herfindahl index of job concentration, constructed similarly to that used in Massa, Rehman, and Vermaelen (2007). I find that the positive link between turnover and repurchases appears to be stronger for more mobile employees (columns 3 and 4). The results are also largely unaffected if I directly control for asset sales and sales growth.

F. Determinants of Employee Compensation

I now test the prediction of the model that rational employees demand higher compensation in repurchasing firms when they sign their contracts. Following Hanka (1998), I use total labor expense (item 42) prior to the repurchase announcement scaled by assets as a proxy for total employee compensation. Since the disclosure of labor expenses is voluntary, with only about 10% of firms reporting, my sample size is small. However, it is unlikely that the results are biased by sample selection since it is unlikely that the reporting decision affects the relation between wages and repurchases. Given the small sample size, I also examine management compensation and present results of regressions of total manager compensation and fixed managers' salaries on a proxy for expected repurchases. As my proxy for expected repurchases, I use the fraction of equity the firm plans to repurchase. I expect that the compensation of managers and employees increases in the size of anticipated repurchases and with the interaction between anticipated repurchases and stock return volatility.

I use a set of control variables similar to that in my option and equity grants model. I include firm size, stock return volatility, stock returns, and corporate governance variables. Several papers stress the importance of corporate governance in setting managers' pay. For example, Bertrand and Mullainathan (2001) document that managers in poorly governed firms are more often

rewarded for luck; Hartzell and Starks (2003) find that the presence of institutional shareholders is associated with lower executive compensation, and Borokhovich, Brunarski, and Parrino (1997) show that the adoption of antitakeover provisions increases CEOs' compensation. I include industry and year dummies to control for industry and time differences in the demand for managerial and employee talent. The standard errors are robust to clustering at the firm level.

The results are shown in Table VII. Columns 1, 3, and 5 show that higher future repurchases are associated with larger total employee compensation, as well as with larger total compensation and fixed salaries of the top five managers. The effect is statistically significant at the 1% level and is economically sizable. A one-standard deviation increase in the size of an announced repurchase program increases total manager compensation by roughly 10% and increases employee compensation by approximately 17%. Although a high payout may proxy for managerial skill, I do not find a similar relation between dividends and manager or employee compensation. Moreover, columns 2, 4, and 6 show that an increase in compensation by repurchasing firms is especially pronounced in firms with highly volatile returns, confirming the prediction that employees demand higher wages to compensate for an increase in risk. As expected, manager compensation is less sensitive to repurchases than employees' compensation since managers have more decision-making power in the firm and are unlikely to buy back shares if they believe doing so would harm their welfare.[28]

G. Logistic Regressions of Payout Choice

Much of the payout literature focuses on the choice between dividends and share repurchases as the two major forms of returning cash to investors. For example, Grullon and Michaely (2002) find that over the last decade firms financed their share repurchases with funds that otherwise would have been used to increase dividends. Since repurchases increase the pay-performance sensitivity of employee contracts but dividends do not, I examine whether the probability of initiating a share repurchase is positively related to employees' pay-performance sensitivity. The dependent variable is equal to one if the firm makes a repurchase announcement and zero if the firm declares a dividend increase. The model is estimated by a logit regression with industry and year dummies; the standard errors are adjusted for clustering. Because the model is nonlinear, the marginal effects and standard errors of the interaction terms are computed as in Ai and Norton (2003).

I control for other factors that may affect payout choice. I include firm size since large established firms may prefer to increase dividends. To proxy for the firm's need to counteract the dilution created by exercised stock options,

[28] The untabulated results for total manager compensation indicate that firms in which managers have a lot of leeway in making payout decisions, measured by the governance index, compensate their managers less for repurchasing stock.

Table VII
Compensation and Share Repurchases

This table presents the regression results of total managers' compensation, employee compensation, and managers' salary on repurchases and control variables. The dependent variable in columns 1 and 2 (5 and 6) is the total compensation (combined fixed salary) of the top five managers prior to the repurchase announcement, scaled by market equity (%); the dependent variable in columns 3 and 4 is the firm's total labor expense (item 42), scaled by market equity (%). All variables are described in Appendix B. Also included are 11 industry and 6-year dummies. The *p*-values based on robust standard errors (clustered at the firm level) are in parentheses. Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	Total Managers' Compensation		Total Employee Compensation		Managers' Salary	
Log of assets	0.034	0.027	−0.207***	−0.207***	−0.087***	−0.087***
	(0.269)	(0.361)	(0.000)	(0.000)	(0.000)	(0.000)
Volatility	1.209**	−0.017	0.998***	0.243	0.091	−0.080
	(0.018)	(0.968)	(0.000)	(0.260)	(0.138)	(0.254)
Past returns	0.362***	0.365***	−0.200***	−0.213***	−0.088***	−0.091***
	(0.009)	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)
Contemporaneous returns	0.429*	0.424*	0.185***	0.165***	0.074***	0.070***
	(0.077)	(0.067)	(0.002)	(0.005)	(0.000)	(0.000)
G-index	0.007	0.015	0.019**	0.019**	0.004	0.004
	(0.592)	(0.307)	(0.032)	(0.028)	(0.250)	(0.244)
Delaware inc.	0.099	0.071	0.116**	0.117**	0.011	0.012
	(0.290)	(0.433)	(0.016)	(0.014)	(0.477)	(0.462)
Inst. ownership	−0.009***	−0.008***	−0.004***	−0.004***	−0.003***	−0.003***
	(0.006)	(0.006)	(0.004)	(0.004)	(0.000)	(0.000)
Blockholders	0.124***	0.127***	0.056***	0.056***	0.027***	0.027***
	(0.007)	(0.005)	(0.003)	(0.003)	(0.000)	(0.000)
Median SGA/sales	−0.012	−0.077	−0.137	−0.130	−0.204**	−0.203**
	(0.981)	(0.880)	(0.657)	(0.668)	(0.018)	(0.018)
Managers' stock	0.001	0.003	0.000	0.000	0.001	0.001
	(0.838)	(0.642)	(0.913)	(0.905)	(0.507)	(0.498)
Percent sought	0.015***	−0.035*	0.014***	−0.035***	0.005***	−0.006*
	(0.007)	(0.054)	(0.001)	(0.000)	(0.000)	(0.081)
Volatility × Percent sought		0.140***		0.110***		0.025***
		(0.009)		(0.000)		(0.002)
Observations	130	130	1,212	1,212	1,212	1,212
Adjusted-R^2	0.405	0.432	0.320	0.338	0.437	0.444

I include the number of exercised options in the previous fiscal year normalized by the number of the firm's outstanding shares. Since managers often buy back stock following price declines, I include the stock price runup in the 40 days prior to a payout change and Tobin's Q. I expect that the larger the runup or Tobin's Q the lower the probability that a firm will initiate a share repurchase. In addition, I include corporate governance variables since firms with different governance or investor clientele may prefer different payout methods.[29]

[29] Grinstein and Michaely (2005) show that while institutions prefer firms that repurchase shares, higher institutional ownership does not cause firms to alter their payout method.

Table VIII

Determinants of Repurchases vs. Dividend Increases

The table shows the results of a logit estimation of the determinants of whether a firm repurchases shares or increases dividends. The dependent variable is equal to one if a firm announces share repurchase program. All variables are described in Appendix B. Also included are 11 industry and 6-year dummies. The first number is the marginal effect, and the second is *p*-value based on robust standard errors adjusted for clustering at the firm level. The marginal effects and standard errors of the interaction terms are computed as in Ai and Norton (2003). Significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	(1)	(2)	(3)
Log of assets	−0.027***	−0.028***	−0.027***
	(0.003)	(0.002)	(0.004)
Exercised options	0.034***	0.030**	0.030**
	(0.010)	(0.020)	(0.020)
Stock price runup	−0.552***	−0.526***	−0.547***
	(0.000)	(0.000)	(0.000)
Tobin's Q	−0.029***	−0.039***	−0.055***
	(0.003)	(0.001)	(0.000)
G-index	−0.014***	−0.014***	−0.014***
	(0.005)	(0.006)	(0.005)
Delaware inc.	0.095***	0.092***	0.094***
	(0.000)	(0.001)	(0.000)
Inst. ownership	−0.001	−0.001	−0.001
	(0.334)	(0.416)	(0.302)
Blockholders	0.037***	0.037***	0.037***
	(0.000)	(0.001)	(0.000)
Median SGA/sales	−0.041	−0.038	−0.013
	(0.849)	(0.826)	(0.942)
Managers' stock	−0.002	−0.002	−0.002
	(0.202)	(0.251)	(0.189)
Employees' outstanding incentives	0.047***	0.037***	0.038***
	(0.000)	(0.000)	(0.000)
Employees' exercisable incentives	−0.025***	−0.025***	−0.025***
	(0.004)	(0.004)	(0.004)
RD/assets		−0.313	
		(0.591)	
High incentives		0.031	−0.023
		(0.551)	(0.649)
RD/ assets × High incentives		1.913**	
		(0.044)	
Tobin's Q × High incentives			0.042**
			(0.043)
Observations	1,963	1,963	1,963
Pseudo-R^2	0.234	0.240	0.238

The empirical results are presented in Table VIII. The probability that a firm will repurchase stock is positively related to employees' outstanding incentives and negatively related to employees' exercisable incentives (column 1). A one-standard deviation increase in incentives from *outstanding* employee options is associated with a 19% increase in probability of initiating a repurchase, while

a one-standard deviation increase in incentives from *exercisable* employee options reduces this probability by 6%. Moreover, the propensity to buy back stock has a stronger relation to employees' outstanding incentives for human capital–intensive firms. This observation follows from the positive coefficients on the interaction between the high incentives dummy and R&D expenses, and the interaction between the high incentives dummy and Tobin's Q (columns 2 and 3). Interestingly, I also find that firms with more blockholders have a larger propensity to initiate share repurchases—a result consistent with the observation that the blockholders have an incentive to expropriate employees, just as management does.

IV. Conclusion

In this paper, I analyze the effect of share repurchases on employee compensation contracts. I show that since repurchases increase pay-performance sensitivity, a firm's announcement that it will repurchase stock is associated with positive stock returns. Managers are more likely to engage in such opportunistic stock buybacks when employees collectively hold a large stake in the firm.

I derive empirical implications for a firm's payout choice, stock option grants and exercises, employee turnover, total compensation, and announcement returns, and test them using data on firms that increase payouts during the period 1996 to 2002. I document that the incentive effect of stock buybacks has large explanatory power for various patterns around share repurchases. In particular, it explains the abnormal returns around share repurchase announcements and is consistent with the common practice of repurchasing stock to counteract the dilution from stock options.

The empirical evidence presented in the paper indicates that despite a decrease in systematic risk following share repurchases, the volatility of stock returns increases around such events. To diversify away additional risk created by repurchases, employees exercise more stock options. Moreover, both managers and employees demand higher compensation when they expect stock buybacks to increase their compensation risk. Corporate boards seem to recognize the positive effect of repurchases on incentives and thus make fewer new stock option grants following stock buybacks.

Recently, Helwege, Pirinsky, and Stulz (2007) document that both the numerator and denominator can drive changes in managerial stock ownership. Given their findings, it would be interesting to study whether other corporate events that significantly affect the number of outstanding shares, such as mergers and new equity issues, have similar effects on pay-performance sensitivity and risk as do the repurchases studied in this paper.

Appendix A: Proofs of Propositions

Proof of Proposition 1: I first establish that optimal employee effort increases with pay-performance sensitivity and then show that pay-performance

sensitivity, θ_R, increases with the repurchase amount, R. Since $U' > 0$, the maximization (2) results in the following first order candition for optimal effort:

$$\theta_R p'\left(e_R^*\right) - c'\left(e_R^*\right) = 0. \tag{A1}$$

The problem is well defined, and the second order condition is satisfied. Denoting by $f(\theta_R, e_R) = \theta_R p'(e_R) - c'(e_R)$ and totally differentiating this condition yields

$$\frac{de_R^*}{d\theta_R} = -\frac{\frac{\partial f(\theta_R, e_R)}{\partial \theta_R}}{\frac{\partial f(\theta_R, e_R)}{\partial e}} = \frac{p'\left(e_R^*\right)}{c''\left(e_R^*\right) - \theta_R p''\left(e_R^*\right)}. \tag{A2}$$

Since $p' > 0, p'' < 0$, and $c'' > 0$, the optimal effort increases with sensitivity, θ_R.

Once a repurchase is announced, the equity value reflects the increased employee effort, that is, $E = \bar{X} + p(e_R)$. Equity after repurchase is smaller by the distributed amount R, that is, $E' = E - R$. The no-arbitrage condition requires that shareholders be indifferent to tendering or holding on to their shares, implying that a non-tendering holder of stake θ receives a stake θ_R after repurchase:

$$\theta_R = \theta \frac{E}{E'}. \tag{A3}$$

Condition (A3) defines the pay-performance sensitivity of the employee subsequent to a buyback. To show that pay-performance sensitivity increases with the repurchase R, rewrite (A3) as

$$\theta_R = \theta + \frac{\theta R}{\bar{X} + p(e_R) - R}. \tag{A4}$$

It can be seen from (A4) that $\theta_R > \theta$ and θ_R increase with the repurchase amount R. Q.E.D.

Proof of Proposition 2: The price reaction at the announcement of repurchase R is

$$\Delta P = p(e_R(\theta_R(R))) - E_R[p(e_R(\theta_R(\tilde{R})))]. \tag{A5}$$

Differentiating ΔP with respect to R and noting that $p' > 0$, $\frac{de_R}{d\theta_R} > 0$, and $\frac{\partial \theta_R}{\partial R} > 0$ establishes that ΔP increases with R. $\Delta P > 0$ for a larger-than-expected buyback, that is, when $R > R_T$, where $p(R_T) = E_R[p(\tilde{R})]$. To show that ΔP increases with θ, write

$$\Delta P = p(e_R(\theta_R)) - p\left(e_{R_T}\left(\theta_{R_T}\right)\right). \tag{A6}$$

When $R > R_T$ the quantity $\theta_R - \theta_{R_T}$ is positive, and I only need to show that $\theta_R - \theta_{R_T}$ increases with θ. Using (A4),

$$\theta_R - \theta_{R_T} = \theta\left(\frac{R}{\bar{X} + p\left(e_R\right) - R} - \frac{R_T}{\bar{X} + p\left(e_{R_T}\right) - R_T}\right). \tag{A7}$$

Since the expression in parentheses is positive for $R > R_T$, the price reaction increases with initial pay-performance sensitivity θ. Q.E.D.

Proof of Proposition 3: From the optimality of effort in the absence of repurchases, it follows that for any $e \neq e^*$ the following relation holds:

$$EU(w + \theta(\bar{X} + p(e^*) + \tilde{u}) - c(e^*)) > EU(w + \theta(\bar{X} + p(e) + \tilde{u}) - c(e)). \quad \text{(A8)}$$

Since utility is monotonically increasing, this implies that

$$\theta p(e^*) - c(e^*) \geq \theta p(e) - c(e). \quad \text{(A9)}$$

Absent repurchases, employee wealth net of the cost of effort is

$$W = w + \theta(\bar{X} + p(e^*) + \tilde{u}) - c(e^*). \quad \text{(A10)}$$

If there is a share repurchase, then employee wealth net of the cost of effort is

$$W_R = w + \theta_R(\bar{X} + p(e_R) - R + \tilde{u}) - c(e_R). \quad \text{(A11)}$$

Substituting the condition for fair repurchase (A4) into expression (A11) gives

$$\begin{aligned} W_R &= w + \theta(\bar{X} + p(e_R)) + \theta_R\tilde{u} - c(e_R) \\ &\leq w + \theta(\bar{X} + p(e^*)) + \theta_R\tilde{u} - c(e^*) = W + (\theta_R - \theta)\tilde{u} \end{aligned}, \quad \text{(A12)}$$

where the inequality follows from (A9). The last term shows higher risk exposure. Since the gap between $\theta p(e^*) - c(e^*)$ and $\theta p(e_R) - c(e_R)$ increases with R, the utility loss increases with R. Note that $\theta_R - \theta$ grows in θ (Proof of Proposition 2) and the mean-preserving term grows in σ, so that the utility loss also increases with θ and σ. Q.E.D.

Proof of Proposition 4: Managers buy back shares if the repurchase increases their expected utility. Denoting managers' wealth net of the cost of effort without repurchases by W_M and with repurchase by W_{MR}

$$W_M = w_M + \theta_M(\bar{X} + p_M(e_M) + p_E(e_E) + \tilde{u}) - c_M(e_M), \quad \text{(A13)}$$

$$W_{MR} = w + \theta_{MR}(\bar{X} + p_M(e_{MR}) + p_E(e_{ER}) - R + \tilde{u}) - c_M(e_{MR}), \quad \text{(A14)}$$

$$\begin{aligned} W_{MR} - W_M = &\underbrace{\theta_M \cdot p_M(e_{MR}) - c_M(e_{MR}) - \theta_M \cdot p_M(e_M) + c_M(e_M)}_{+\underbrace{(\theta_{MR} - \theta_M)\tilde{u}} + \underbrace{\theta_M(p_E(e_{ER}) - p_E(e_E))}} \end{aligned}. \quad \text{(A15)}$$

The first term measures the change in managerial wealth due to the change in managerial effort. The second term shows the increase in risk. The last term measures the return to a manager from additional employee productivity. $EU(W_{MR}) > EU(W_M)$ when the first two terms are small (i.e., there is small risk

aversion, $e_{MR} \approx e_M$) and the third term is large. Since the difference in e_{ER} and e_E increases with θ_E, the third term increases with θ_E. Thus, the probability that a repurchase will be initiated also increases with θ_E. Q.E.D.

Appendix B: Variable Definitions

Repurchases	Dollars spent on repurchases (item 115) in the year of and the year after the repurchase announcement, reduced by decreases in preferred stock (item 130), divided by the market value of equity at the beginning of the announcement year (%).
Percent sought	Target fraction the firm plans to repurchase as listed in the repurchase announcement (SDC).
CAR	Cumulative abnormal stock return over the (−1, +1) announcement window, calculated using the market model with the value-weighted CRSP index (%).
Cash flow/assets	After-tax cash flow that was not distributed to security holders, deflated by book assets; calculated as in Lehn and Poulsen (1989).
Op. cash/ assets	Cash from operations (item 308) to book assets at the beginning of the announcement year (%).
Dividend yield	Common dividends prior to payout change (item 21), scaled by the market value of equity (%).
Market-to-book	Market-to-book value of equity (item 24 ∗ item 25/item 60).
Stock price runup	CAR from day 43 to day 4 prior to the date of payout change, calculated with the market model.
RD/assets	R&D (item 46) deflated by book assets (item 6) (%).
Volatility	*SD* of log returns over the 36 months prior to the payout change.
Leverage deviation	Difference between actual and predicted leverage. The predicted value is from a Tobit model estimated on Compustat firms over 1996 to 2002, where the dependent variable is market leverage and the explanatory variables are size, PPE/assets, RD/sales, SGA/sales, year, and industry dummies.
Indicator of decrease in RD	Equal to one if the average RD expense in the year of and the year after repurchase announcement is greater than RD expense in the prior year; equal to zero if there is no change; and negative one otherwise.
Indicator of decrease in CAPEX	Equal to one if the average CAPEX in the year of and the year after the repurchase announcement is greater than CAPEX in the prior year; equal to zero if there is no change; and negative one otherwise.
Change in ROA	The difference between average earnings (item 13) in the year of and the year after the repurchase announcement and earnings in the prior year, deflated by book assets (item 6) in the prior year.
Tobin's *Q*	Book value of assets (item 6) minus book value of equity (item 60), plus market value of equity (item 24 ∗ item 25), all divided by book assets.
CF volatility	The coefficient of variation of income (item 18) over the past 5 years prior to payout change.
G-index	Defined as in Gompers, Ishii, and Metrick (2003).
Delaware inc.	Equal to one if the firm is incorporated in Delaware; equal to zero otherwise.
Inst. ownership	Fraction of equity owned by institutions (CDA Spectrum) (%). Whenever the data prior to an announcement are missing, I use the data after the announcement (not more than 3 years from the announcement date).

(*continued*)

Appendix B—*Continued*

Blockholders	Number of investors owning at least 5% of the firm's equity (CDA Spectrum).
Med. SGA/sales	Median ratio of selling expenses to sales in each Fama–French (1997) industry.
Managers' stock	Number of shares of stock owned by the top five managers prior to the payout change (*SHROWN*), divided by the number of outstanding shares (%).
Exercised options	Number of options exercised by all employees in the fiscal year prior to the payout change, divided by the number of outstanding shares (%). The variable is winsorized at 1% tails.
Market-to-strike	MTS ratio for outstanding options at the beginning of the exercise year.
Managers' outstanding incentives	Number of outstanding options held by the top five managers (*UEXNUMEX* + *UEXNUMUN*) prior to the announcement, multipied by the delta of outstanding options divided by the number of outstanding shares (%).
Employees' outstanding incentives	Number of outstanding options prior to the payout change (10K) times the delta of outstanding options, divided by the number of outstanding shares (%), all minus managers' outstanding incentives. The variable is winsorized at 1% tails.
High incentives	Equal to one if employees' outstanding incentives are above sample median; equal to zero otherwise.
Managers' exercisable incentives	Number of exercisable options of the top five managers (*UEXNUMEX*) prior to the payout change times the delta of exercisable options, divided by the number of outstanding shares (%).
Employees' exercisable incentives	Number of exercisable options prior to the payout change (10K) times the delta of exercisable options, divided by the number of outstanding shares, all minus managers' exercisable incentives (%). The variable is winsorized at 1% tails.
Exercised options (managers)	Number of stock options exercised by top five managers in the year following the repurchase announcement (*SOPTEXSH*) times the delta of options exercised, divided by the number of outstanding shares (%).
Exercised options (employees)	Number of stock options exercised (10K) in the year following the repurchase announcement times the delta of options exercised, divided by the number of outstanding shares, all minus exercised options (managers) (%). The variable is winsorized at 1% tails.
Granted options (managers)	Number of stock options granted to the top five managers in the year following the repurchase announcement (*SOPTGRNT*), times the delta of options granted, divided by the number of outstanding shares (%).
Granted options (employees)	Number of options granted (10K) in the year following the repurchase announcement times the delta of options granted, divided by the number of outstanding shares, all minus granted options (managers) (%). The variable is winsorized at 1% tails.
Granted stock (managers)	Value of restricted stock options granted to the top five managers in the year following the repurchase announcement (*RSTKGRNT*), divided by the market value of equity (%).
Total managers' compensation	Total compensation for the top five managers in the year prior to the payout change (*TDC1*), divided by the market value of equity.

(*continued*)

Appendix B—*Continued*

Total employee compensation	Total labor expense (item 42) prior to the payout change, divided by the market value of equity.
Manager salary	Dollar value of base salary of the top five managers in the year prior to the payout change (*SALARY*), divided by the market value of equity.
Employee turnover	Number of options forfeited during the year of and year after the announcement (10K), deflated by the number of options outstanding at the year-end prior to the announcement (%).
Immobility	Herfindahl index of the number of employees, calculated as a ratio of the number of employees squared to the sum of squares of the number of employees working at all firms within the industry. Mobility is the inverse of immobility.
Dividend size increase	The declared quarterly dividend minus the dividend in the previous quarter, all divided by the previous quarter dividend (%).
Asset sales	Change in book value of assets, less capital expenditures, plus depreciation, as a fraction of beginning-of-year book value of assets.

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