The Growth of Performance-Based Managerial Pay: Implications for Corporate Finance, Regulatory Policy, and Corporate Governance

by

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Submitted to the Department of Economics
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy in Economics

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

June 1995

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Abstract

This thesis examines the implications of the principal-agent paradigm of shareholder-manager relations for a set of policy issues in corporate finance, economic regulation, and corporate governance. Chapter one examines the way in which the structure of stock-based managerial compensation affects corporate financial policy. A longstanding puzzle in corporate finance is the dramatic increase in stock repurchases by publicly-traded corporations over the last two decades. I present evidence in chapter one that the upsurge in repurchases resulted in part from increased reliance on stock options in executive compensation packages. Stock options encourage managers to substitute repurchases for dividends because repurchases (unlike dividends) do not dilute the per-share value of the firm. The potential savings for an average executive choosing the repurchase route are large – over $400,000 in 1993. Consistent with the stock option hypothesis, I find that firms that rely heavily on stock option-based compensation are significantly more likely to repurchase their stock than firms that rely less heavily on stock options.

Chapter two analyzes the interaction of principal-agent theory and economic regulation. While the principal-agent model has been widely applied to regulator-firm as well as shareholder-manager agency relationships, literatures on those relationships have grown up largely independent of one another and, as a result, do not yield predictions about situations in which intra-firm (shareholder-manager) and inter-firm (regulator-firm) agency problems intersect. Chapter two develops an integrated model of shareholder-manager and regulator-firm relations and analyzes the effects of regulation on the managerial contracts offered by firms. I find that regulation reduces the level and, in some cases, the performance-sensitivity of managerial pay, consistent with available empirical evidence.

Chapter three examines the distributive and efficiency consequences of "implicit" managerial compensation in a principal-agent setting. Examples of implicit compensation include profits from insider trading and profits from use of business opportunities of the firm. I show in chapter three that opportunities for implicit payments generally reduce shareholder wealth and produce inefficient outcomes. Existing institutions and legal rules that constrain such payments may reflect sensible responses to the consequences of implicit compensation.

2

To Amy Biehl, who never much liked economics (especially when it required speedily scrawling supply and demand diagrams during exams), but whose friendship, inspiration, and admonitions not to take things too seriously made all the difference.

Acknowledgements

Contents

Introduction

The last two decades have witnessed enormous growth in the use of performance-based pay for those in charge of our economy's largest enterprises. The use of incentives to motivate individuals in positions of authority is certainly not new; Julius Caesar was rewarding military successes with Roman dinari as early as 50 B.C. (McLaughlin 1991). More recent antecedents of today's performance-based compensation schemes include the bonus plans pioneered by General Motors in the early twentieth century (Liebtag 1991) and the second generation bonus plans that flourished after World War II. What *was* new, starting in the mid-1970s, was the reliance on economic measures (such as stock prices) rather than accounting measures of performance. By the early to mid-1980s, the vast majority of large companies had stock-based compensation of some sort (Bok 1993, 44).

The steady march to align managerial incentives with corporate performance was accompanied by parallel developments in economic theory. Models of principal-agent contracting under moral hazard were formally analyzed by Holmstrom (1979), Shavell (1979), and Grossman and Hart (1983), and principal-agent theory was applied to the shareholder-manager relationship by these authors and by Jensen and Meckling (1976) and Harris and Raviv (1978). More recently, work in economic theory has ex-

tended the principal-agent model in various ways, including incorporation of dynamic considerations (Rogerson 1985; Holmstrom and Milgrom 1987; Malcomson and Spinnewyn 1988; Fudenberg, Holmstrom, and Milgrom 1990) and renegotiation prospects (Fudenberg and Tirole 1990). The principal-agent model of shareholder-manager relationships has also been analyzed empirically and numerically (Jensen and Murphy 1990a; Jensen and Murphy 1990b; Garen 1994; Haubrich 1994).

The essays below seek to extend principal-agent analysis of shareholder-manager relationships in a different direction. These essays bring the principal-agent paradigm to a set of specific policy issues (in corporate finance, economic regulation, and corporate governance) and attempt to trace out the implications of the paradigm for those issues.

My approach reflects two principal points of departure from conventional principal-agent analysis. First, the conventional analysis pays virtually no attention to differences among different types of stock-based compensation. Even empirical work on executive compensation generally treats incentive pay as a monolithic category (Jensen and Murphy 1990a; Jensen and Murphy 1990b; Garen 1994). In practice, however, performance incentives come in widely varying shapes and sizes. The many forms of stock-based compensation include incentive stock options, non-qualified stock options, stock appreciation rights, restricted stock, and phantom stock. One goal of my work is to improve our understanding of the economic effects of different types of incentive pay.

To this end, chapter one below examines ways in which the structure of executives'

stock-based compensation affects corporate financial policy. A longstanding puzzle in corporate finance is the dramatic increase in stock repurchases by publicly-traded corporations over the course of the 1970s and 1980s (Bagwell and Shoven 1989; American Law Institute 1989, 7). Repurchases offer substantial tax advantages over dividends, the conventional mechanism for distributing corporate earnings, but those tax advantages pre-date the growth of repurchases by several decades. I present evidence in chapter one that the upsurge in repurchases resulted in part from increased reliance on stock options in executive compensation packages. Stock options encourage managers to substitute repurchases for dividends because repurchases (unlike dividends) do not dilute the per-share value of the firm. The potential savings for an average executive choosing the repurchase route are large – over $400,000 in 1993. Meanwhile, forms of stock-based compensation other than stock options create no incentive to substitute repurchases for dividends, as those forms of compensation accrue dividends and therefore retain their value when the dividend route is adopted. These other forms of stock-based compensation therefore provide a useful control against which the effects of stock options on repurchase behavior can be compared.

Examining the structure of stock-based compensation at publicly-traded corporations in 1993 (the first year in which firms were required to disclose complete stock option information in their proxy statements), I find that firms that relied heavily on stock option-based compensation were significantly more likely to repurchase their stock than firms that relied less heavily on stock options. I find no such effect for stock-based compensation that, unlike stock options, retains its value when the

dividend route is adopted. The contrast between stock options and other forms of stock-based compensation suggests that the effect of stock options on repurchases is not merely a reflection of an underlying relationship between repurchases and stock-based compensation or its determinants. The magnitude of the stock option effect in my sample suggests that increased use of stock options over the 1975-1993 period may have played a significant role in the increase in repurchase activity over that period.

Chapter one concludes with a discussion of ways in which firms can address the potentially distortionary effect of stock options on repurchase behavior. A particularly promising mechanism of "self help" for firms is providing for accrual of dividends on stock options. Several high dividend firms, such as NYNEX, have taken this step in recent years.

The second point of departure in my research involves examining contextualized applications of principal-agent analysis to shareholder-manager relationships. Chapters two and three below take the canonical principal-agent model to particular settings and expand the model to reflect the salient features of those settings. Contextualizing principal-agent theory in this way can improve our understanding of how incentive issues interact with other economic and institutional features of particular settings.

Chapter two analyzes how the principal-agent model interacts with a central feature of our economy: regulation. While agency theory has been widely applied to regulator-firm as well as shareholder-manager relationships, literatures on those re-

lationships have grown up largely independent of one another and, as a result, do not yield predictions about situations in which intra-firm (shareholder-manager) and inter-firm (regulator-firm) agency problems intersect. Chapter two develops an integrated model of shareholder-manager and regulator-firm agency relations and analyzes the effects of regulation on the managerial contracts offered by firms. I find that regulation (operating to reduce the variability of the firm's performance) reduces the level of managerial pay and, when managerial incentives are sufficiently high, the sensitivity of pay to firm performance. The characterization of regulation as a buffer against highly variable firm performance (as my analysis assumes) is consistent with the empirical evidence (Murphy 1987; Joskow, Rose, and Shepard 1993) and also coincides with the prescriptions of optimal regulation in simple settings (though not necessarily in general). My conclusion that regulation decreases the level and, in some cases, the performance-sensitivity of managerial pay is broadly consistent with empirical findings on the effects of regulation on compensation (Hendricks 1977; Carroll and Ciscel 1982; Murphy 1987; Joskow, Rose, and Shepard 1993).

Chapter three (which is based on a paper coauthored with Lucian Bebchuk) provides a second example of contextualizing the canonical principal-agent model. While the canonical model focuses on explicit salaries and performance-based rewards, real-world corporate managers may be paid in a variety of other ways. Many institutions and legal rules function to constrain such opportunities for implicit payment, which include taking business prospects of the firm and developing them for private advantage, selling assets to the firm or buying assets from it at non-arms' length prices,

and trading in the firm's stock on the basis of inside information (Clark 1986, 166-79, 191-94, 225-30, 293-340). As an a priori matter, however, such alternative forms of payment represent potentially efficient mechanisms for compensating managers (Scott 1980; Easterbrook and Fischel 1982; Carlton and Fischel 1983).

Chapter three investigates whether indirect forms of compensation are in fact desirable in the shareholder-manager setting. The basic conclusion is that opportunities for implicit payment tend to reduce shareholder wealth and produce inefficient outcomes. The reason is that substituting alternative forms of compensation for conventional pay arrangements has the effect of undoing or at least weakening the alignment of shareholders' and managers' interests. The distortions created by opportunities for implicit payment may be offset to some degree by countervailing benefits of such opportunities, as when business prospects of the firm have greater value in managers' hands than in the firm's (Easterbrook and Fischel 1982). However, such direct efficiency benefits must exceed a threshold (which I identify) if they are to outweigh the efficiency costs of implicit payments to managers. I show that the lower bound on the level to which the direct efficiency benefits must rise to outweigh the costs is an increasing function of the magnitude of the implicit payments managers receive.

From a policy standpoint, the efficiency costs of alternatives to conventional managerial pay may provide a justification for institutions and legal rules restricting the use of such forms of compensation. My analysis suggests that constraints on the taking of corporate opportunities, managerial self dealing, and insider trading may

12

enhance both shareholder wealth and the joint welfare of shareholders and managers. Empirical study might usefully address the tradeoff between the efficiency costs of alternative compensation mechanisms and their possible efficiency benefits.

The link in practice between managerial pay and market measures of shareholder value is by now almost ubiquitous (Buyniski 1991). Likewise, the canonical principal-agent model and its application to shareholder-manager relationships have come to be familiar features of economic theory and practice. The findings reported in the following chapters reflect an attempt to fill in the canonical model in particular ways and then trace out the implications for corporate finance, regulatory policy, and corporate governance.

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Chapter One

Unraveling the Puzzle of Stock Repurchases: The Role of Incentive Compensation in Buyback Decisions

Introduction

Twenty years ago, stock repurchases by publicly-traded corporations were a rarity. Today repurchases, which represent an alternative to conventional dividend distributions, total over $46 billion annually (table 1). What explains the dramatic upsurge in repurchase activity? Is it a temporary phenomenon or a permanent one? Should it be applauded or deplored?

These basic questions about repurchases have proven difficult to answer. The timing and pattern of the repurchase boom create a puzzle about its cause (Bagwell and Shoven 1989; American Law Institute 1989, 7). Distributing earnings to shareholders by buying back shares of stock (as in a repurchase) has for many decades yielded more favorable tax consequences than paying dividends, but repurchases became fashionable among publicly-traded corporations only relatively recently (American Law In-

stitute 1989, 36; table 1). Likewise, while some of the repurchase activity in the 1980s was undoubtedly takeover-related, repurchases survived the dry-up of the takeover market in the late 1980s.[1] Thus, neither taxes nor takeovers can fully explain the pattern of repurchase behavior we have observed.

This chapter suggests a new explanation for repurchases, based on the structure of executive compensation at repurchasing firms. The division of ownership and control in the typical large corporation creates an agency problem that incentive compensation, which has become extremely popular in the last fifteen years, is designed to mitigate. By giving top managers a stake in corporate profits, incentive compensation aligns their financial interests with those of shareholders. But incentive compensation may affect more than managerial incentives to maximize corporate profits; stock options – the most popular form of incentive compensation – may have the additional effect of encouraging managers to substitute repurchases for dividends. The reason is that repurchases, unlike dividends, do not dilute the per-share value of the firm; the flow of earnings out of corporate solution is matched by a proportionate reduction in the number of shares outstanding. As a consequence, stock options, which give holders the right to purchase stock at pre-specified prices, are worth more after a repurchase than after a dividend.[2]

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[1] Repurchase activity is much greater today than in the late 1970s and early 1980s, before the takeover market heated up. For example, in 1987 dollar terms, repurchases totaled $37 billion in 1993 but only $15 billion in 1983 and $3 billion in 1975 (table 1).

[2] Suppose, for example, that a firm worth $100, with 10 shares outstanding, wishes to distribute $10 either by a repurchase or by a dividend. The firm's shares are initially worth $10 each. If the firm opts for the dividend route, then it distributes $10 via a dividend payment. The value of the firm falls to $90 ($100 minus $10). Shares are then worth only $9 ($90 divided by 10).

The dollar amounts at stake for top managers are substantial – on the order of $420,000 per executive in an average share repurchase.[3] Likewise, the patterns of stock option holdings and repurchase activity over time seem to corroborate the relation between them suggested here; the surge in stock options' popularity in the 1980s coincided with the growth in repurchase activity by publicly-traded corporations (Bok 1993, 44; table 1). On the dividend side, commentators on executive compensation have noted the disincentive to pay dividends created by stock options (Buyniski 1991, 291).

If I am correct that stock options have played a role in the repurchase activity of publicly-traded corporations, then it should be the case that firms managed by executives with large numbers of stock options are most likely to repurchase their stock. The focus of this chapter is testing that prediction empirically. My findings provide substantial support for the stock option-based explanation of repurchase behavior: controlling for other factors, repurchases are significantly more likely to

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If, instead, the firm opts for the repurchase route, then it repurchases one share and is left with nine shares outstanding. The value of the firm again is $90, but shares are worth $10 each ($90 divided by nine), rather than $9. It follows that stock options will be worth more if the repurchase route is chosen than if the dividend route is chosen.

Of course, a repurchase would be no better than a dividend if either the number of stock options held by an executive or the exercise price associated with those options were adjusted in response to the repurchase decision. However, such adjustments appear not to occur (at least, none were apparent for any of a random set of firms that repurchased stock in 1993).

It is important to note that the reason that stock options – but not stock ownership – lead managers to prefer repurchases is that stock options do not give managers the right to share in dividends paid by the firm. Managers who own actual stock should not have any preference for repurchases, as they (like other shareholders) benefit from the payment of dividends.

[3]See section 4.2.

19

be undertaken when top managers have substantial stock option compensation than when they have little such compensation. The data also indicate that the relationship between repurchase behavior and stock options is not just a reflection of a more general link between repurchases and executive pay or its determinants; I find no relationship between repurchase behavior and restricted stock, an alternative form of stock-based compensation that (unlike stock options) accrues dividends and thus retains its value regardless of the dividend-repurchase choice. The magnitude of the stock option effect on repurchase decisions in my sample suggests that increased use of stock options over the 1975-1993 period may have played a significant role in the increase in repurchase activity over that period.

From a normative perspective, the stock option-based explanation of repurchase behavior suggests that firms sometimes undertake inefficient repurchases. Stock options create a wedge between the attractiveness of a repurchase from the standpoint of total corporate value and the attractiveness of a repurchase to managers. Managers may be led to choose the repurchase route to avoid diluting the value of their stock options, in spite of possible adverse effects on corporate value.

The important question for repurchase policy-makers is whether there are barriers to self-help by firms that rely on stock option-based compensation. One self-help mechanism would involve providing for accrual of dividends on stock options held by managers; if stock options accrued dividends, then options would no longer be differentially affected by the repurchase and dividend alternatives. A few high-dividend firms have recently taken precisely this step, as discussed in the final section of this

chapter.

Section 1 below outlines my model of the repurchase decision at publicly-traded corporations. Section 2 discusses the data sample used in the empirical analysis. Section 3 describes the estimation technique I employ, and section 4 reports my empirical results. Finally, section 5 discusses firms' prospects for self-help.

1 Modeling the Repurchase Decision

This section outlines my model of repurchase decision-making by publicly-traded corporations. (Appendix 1 describes the model in greater detail.) A firm chooses an amount $d \geq 0$ by which to increase its dividend and an amount $r \geq 0$ of stock to repurchase.[4] The choices of d and r are made by the firm's top managers. These managers' preferred course of action can be described in regression model terms as follows (see appendix 1):

$$
\left\{
\begin{array}{ll}
\text{dividend increase } (d > 0, r = 0) & \text{if } \beta_0 x + \epsilon_0 > \beta_j x + \epsilon_j, j \neq 0 \\
\text{repurchase } (d = 0, r > 0) & \text{if } \beta_1 x + \epsilon_1 > \beta_j x + \epsilon_j, j \neq 1 \\
\text{neither } (d = 0, r = 0) & \text{if } \beta_2 x + \epsilon_2 > \beta_j x + \epsilon_j, j \neq 2 \\
\text{both } (d > 0, r > 0) & \text{otherwise}
\end{array}
\right\} .
\tag{1}
$$

This is a multinomial logit model; the firm either increases its dividend, repurchases

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[4]The model focuses on dividend increases rather than the simple decision to pay a dividend because firms are very reluctant to eliminate or cut existing dividends (Lintner 1956). Even a dividend increase may not be a perfect substitute for a repurchase, as reverting to a previous dividend level in a subsequent year is probably more costly than failing to repeat a repurchase in the subsequent year (Bierman and West 1966; Wall Street Journal, July 2, 1993, at C1). On the other hand, firms that repurchase in one year are much more likely than others to repurchase in the next year (Bagwell and Shoven 1988), so a repurchase may well generate an expectation of future repurchases.

its stock, does neither of these two things ("retention"), or does both of them. β_0, β_1, β_2, and β_3 are coefficient vectors that measure the importance of the explanatory variables in x, and x is given by:

$$x = (\text{INSTITUTIONAL, CASHFLOW}, q, \text{DEBT-EQUITY, OPTIONS}). \tag{2}$$

(These variables are defined in appendix 2).

The model in (1) derives from optimizing behavior by corporate managers, as described in appendix 1.[5] The managers' choices are driven by the variables in (2). Taking the variables in turn, the institutional shareholding variable (INSTI-TUTIONAL) may affect managers' choice behavior due to the tax situations of many institutional shareholders, as described more fully in the next paragraph; the cash flow variable (CASHFLOW) may affect choice behavior due to the bearing of the firm's cash position on its ability to fund a higher level of distributions;[6] the Tobin's

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[5]An alternative to the regression model derived in appendix 1 is a nested logit model, in which managers first choose whether to make a distribution and then, if they choose to do so, choose the degree to which each mode of distribution (dividend increase and repurchase) will be utilized. The second set of specification checks reported in section 4.4 of this chapter seems to suggest, however, that use of the multinomial logit model is appropriate.

[6]The empirical corporate finance literature has documented the existence of a positive relationship between dividend and repurchase distributions and the firm's current and future earnings. Ofer and Siegel (1987) find that announcements of dividend increases lead analysts to revise their earnings forecasts upward; Dann, Masulis, and Mayers (1991) report that announcements of repurchase tender offers are correlated with positive earnings surprises; Hertzel and Jain (1991) find that announcements of repurchase tender offers lead analysts to revise their earnings forecasts upward; and Bartov (1991) shows that announcements of open market repurchases lead analysts to revise their earnings forecast upward and are correlated with positive earnings surprises.

Cash flow may bear differently on the market value effects of repurchases and dividend increases. For example, Bernheim and Wantz (1993) find that the share price response to payment of a dollar of dividends is positively related to the effective tax on dividends; the dividend payment conveys more information about earnings when the cost of making it

q variable (q) may affect managers' choices due to its implications for the relative value of investment funds within and without corporate solution;[7] the debt-equity ratio (DEBT-EQUITY) may affect these choices due to the possibility that repurchase and dividend distributions are motivated by firms' desires to adjust their debt-equity ratios;[8] and, finally, the stock options variable (OPTIONS) may affect managers' behavior due to the fact that, as discussed in the introduction, repurchases (as well as retentions, a point to which I return below) preserve the value of outstanding stock options, while dividend increases dilute that value.[9]

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is higher. The same reasoning suggests that a dividend increase is a more effective signal than a repurchase (which is almost always less costly tax-wise). Firms eager to signal high earnings may therefore prefer the dividend route.

[7]Jensen (1986) has argued that managers often make negative net present value investments for empire-building reasons. The relevant empirical evidence is conflicting, however. Lang and Litzenberger (1989) find larger positive share price responses to announcements of dividend increases for firms that are overinvesting (based on their Tobin's q values) than for firms that are not overinvesting, consistent with the Jensen story. However, Howe, He, and Kao (1992) find no such effect for repurchase announcements and announcements of "special" or "extraordinary" dividends. Bernheim and Wantz (1993) provide additional evidence against the Jensen story: if positive share price responses to distribution announcements reflect the value of wresting funds from managers' hands (as in the Jensen story), then the share price response to a dividend announcement should decrease (rather than increase, as they find) if the cost of paying a dividend rises.

[8]A repurchase or dividend distribution reduces the outstanding equity of the firm by the amount of the distribution and, thus, increases the debt-equity ratio. The Modigliani and Miller (1958) irrelevance theorem assets that financial structure is of no consequence for firm value, but that result does not hold once taxes and bankruptcy costs are introduced. In the standard model of optimal financial structure, in which tax advantages of debt are traded off against its bankruptcy costs, changes in the debt-equity ratio may well have consequences for the value of the firm.

As Bagwell and Shoven (1988) note, the underlying variable of interest is the difference between the firm's pre-distribution debt-equity ratio and the optimal debt-equity ratio. However, only the former ratio is observable. I include that ratio in my empirical analysis, but omitting it does not affect my results.

[9]The difference between repurchases and retentions, on the one hand, and dividend increases, on the other, may be mitigated to some degree by the existence of dividend reinvestment plans, which reduce the flow of earnings out of the corporation. Such plans, however, are far from universal.

The tax dimension of the dividend increase-repurchase-retention decision stems from the fact that the dividend and repurchase routes for distributing corporate earnings have significantly different tax implications. In the case of a dividend, a shareholder generally is taxed on the full amount distributed by the corporation (Internal Revenue Code (hereinafter I.R.C.) section 301).[10] In the case of a repurchase, in contrast, a participating shareholder generally is taxed only on the difference between the purchase price paid by the corporation and the shareholder's tax basis in the repurchased shares.[11] Relative to the dividend increase option, then, the repurchase

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In addition to the variables in (2), the presence or absence of a hostile takeover threat may also affect firms' repurchase behavior, as noted in the introduction. Takeover threats may affect repurchase behavior because a repurchase may serve as an effective takeover defense; those shareholders who are most likely to tender their shares to a hostile raider (because they attach a low value to the shares) are also most likely to sell their shares to the corporation in a repurchase. A repurchase is then a means by which managers can weed out shareholders who are not "loyal" to them (Bagwell 1991). The available empirical evidence suggests that, in fact, firms that repurchase their stock in the face of takeover threats often succeed in warding off those threats (Denis 1990).

There was no indication that any of the repurchasing firms in my data sample (which includes all publicly-traded corporations that announced repurchases during their 1993 fiscal years (as reported by the Wall Street Journal)) was the subject of a takeover attempt during the year. Thus, a model of the repurchase behavior of these firms can safely put takeover considerations to one side, as the model in the text does.

To the extent that recent events suggest that the hostile takeover market may be heating up again, a study of future repurchases might require explicit consideration of takeover-based motives for repurchase distributions.

[10]One exception to the general rule is the case of corporate shareholders, who are permitted to deduct 70 percent of dividends received (I.R.C. section 243). Another exception involves situations in which the firm does not have sufficient "earnings and profits" to cover the dividend, in which case the dividend is treated as a nontaxable return of capital (I.R.C. section 316).

[11]A shareholder's tax basis generally will be the amount that the shareholder paid for his or her shares or, if the shares were inherited, the fair market value of the shares at the time of the transfer. A repurchase will lead to capital gains treatment, as described in the text, as long as either the repurchase is not "dividend equivalent" within the meaning of section 302 of the I.R.C. or (a provision that is very unlikely to apply to repurchases by publicly-traded corporations) the repurchase is of the stock of a deceased shareholder, and certain other requirements specified by section 303 of the I.R.C. are met. Section 302

option will typically yield more favorable tax consequences for shareholders.

Tax considerations are likely to play a role in the choice between repurchase and dividend distributions. Repurchase decision-makers in publicly-traded corporations will not, however, know the exact magnitude of the tax benefit associated with a repurchase, as that magnitude depends on (among other things) the tax bases of participating shareholders, something about which managers generally will have no information.[12] Repurchase decision-makers may have a rough sense of the tax benefit

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(the key provision for repurchases by publicly-traded corporations) specifies three sets of circumstances under which a shareholder who has sold shares to the corporation receives capital gains treatment. First, the shareholder receives capital gains treatment if his or her proportionate share in the corporation after the repurchase transaction is less than 80 percent of his or her proportionate share of the corporation before the repurchase transaction and certain other conditions are met (I.R.C. section 302(b)(2)), or if the repurchase terminates the shareholder's interest in the corporation entirely (I.R.C. section 302(b)(3)). Second, the shareholder receives capital gains treatment if the distribution is in partial liquidation of the corporation (I.R.C. section 302(b)(4)). Finally, under section 302(b)(1)'s catch-all provision, a shareholder receives capital gains treatment if the distribution is "not essentially equivalent to a dividend." An example of a distribution that falls outside of this catch-all provision is a repurchase from the sole shareholder of a corporation; in such a case, because the firm has only one shareholder, the distribution necessarily is pro rata, just like a dividend (United States v. Davis, 397 U.S. 301 (1970)). However, in the context of publicly-traded corporations, which by definition have large numbers of dispersed shareholders, the likelihood that a repurchase distribution would turn out to be strictly pro-rata – especially if the shares were purchased by the corporation on the open market – seems extremely low. In fact, repurchases by publicly-traded firms apparently are routinely categorized as non-dividend-equivalent for tax purposes. Indeed, were this not the case, repurchases might be tax-disadvantageous relative to dividends, as they would in some cases lead to tax liability for non-participating shareholders under I.R.C. section 305, which provides that non-occasional dividend-equivalent repurchase distributions yield taxable stock dividends to non-participants.

[12] In the case of a closely-held corporation, in contrast, the repurchase decision makers ordinarily will be the primary shareholders in the conception and, therefore, will possess the information necessary to determine the magnitude of the tax benefit associated with a repurchase. Consistent with the informational differences between the publicly-traded corporation context and the closely-held corporation context, repurchases caught on earlier among closely-held corporations than among their publicly-traded counterparts. On closely-held corporations, see, for example, American Law Institute (1989, 7) ("The point [that repurchases are tax-advantaged relative to dividends] has long been perfectly well un-

of the repurchase route based on the proportion of taxable shareholders in the firm; for that reason, the model in (1) allows the dividend increase-repurchase-retention decision to depend on the percent of the firm's stock held by institutional investors, which are typically tax exempt.[13]

2   Data

Proxy statements filed with the SEC since 1993 contain fiscal-year-end stock option holdings (and other compensation information) for the five most highly-paid officers of the corporation, pursuant to new SEC rules requiring extensive disclosure of compensation arrangements. For repurchase behavior in 1993, the relevant figures are the 1992 fiscal-year-end ones, which are available under the new SEC rules for all firms whose 1992 fiscal years ended between December 31, 1992, and May 31, 1993. Financial information on these firms was obtained from Standard and Poor's Compustat database.[14] Information on institutional shareholding was obtained from Standard

derstood by shareholders and advisors to close corporations; tax planning for these entities has centered around [repurchases] . . . ."); on publicly-traded corporations, see table 1. The lag in publicly-traded corporations' repurchase activity may well also reflect an initial uncertainty on the part of those corporations about whether the Internal Revenue Service would treat large-scale repurchases as "dividend equivalent" for tax purposes (Poterba 1987).

[13]My data on institutional shareholding comes from Standard and Poor's Security Owners' Stock Guide. Unfortunately, that publication does not distinguish between taxable institutional investors and tax-exempt ones.

[14]To be consistent with the data definitions in the Compustat database, I define firms' 1992 fiscal years as years ending between June 30, 1992 and May 31, 1993. Thus, for example, if a firm's fiscal-year-end is June 30, then its 1992 fiscal year is July 1, 1991 through June 30, 1992. (The Compustat definition sometimes differs from the firm's usage; for example, some firms with spring fiscal-year-ends (such as March) refer to the fiscal year ending in the spring of 1993 as the 1993 fiscal year.)

and Poor's Security Owners' Stock Guide.

My basic sample consists of all domestic publicly-traded corporations with December 31 through May 31 fiscal-year-ends, total 1992 fiscal-year-end assets greater than $5 million, and at least 500 1992 fiscal-year-end shareholders of record.[15] The number of firms in this initial sample was 3078. Of these, 100 announced dividend increases during their 1993 fiscal years, 56 announced repurchases, and 27 announced both dividend increases and repurchases, all as reported by the Wall Street Journal. I limited the repurchase category to substantial, non-privately-negotiated repurchases; repurchases with the stated goal of buying out small shareholders or acquiring shares for pension plan or similar purposes, and negotiated repurchases involving a single large shareholder, were excluded.[16]

The size of the initial sample made it impracticable to obtain proxy statement information for each of the 3078 firms in the sample.[17] I thus chose a random subsample

of the 2895 firms announcing neither a dividend increase nor a repurchase. I account for the choice-based nature of my sample in the estimation process (see section 3). The choice-based sample contains the 183 firms announcing either dividend increases or repurchases and a total of 100 (randomly-drawn) firms that announced neither a dividend increase nor a repurchase. The total number of firms in the choice-based sample is 283.

Proxy statement information for 177 of the firms in this sample was obtained from Lexis/Nexis.[18] The necessary financial and institutional shareholding data were available for 144 of these 177 firms. My basic sample therefore contains 144 firms, of which 64 announced dividend increases, 28 announced repurchases, 21 announced both a dividend increase and a repurchase, and 31 announced neither a dividend increase nor a repurchase. Summary statistics for the basic sample are reported in table 2.

I also analyze a supplementary sample containing the firms in the basic sample plus additional firms in the retention category. The additional firms are ones for which proxy statement information was available from the Laser D SEC service (though not from Lexis/Nexis) and the necessary financial and institutional shareholding data were available from the Compustat database and the Security Owners' Stock Guide. Of the 57 retention firms for which proxy statement information was not available on Lexis/Nexis, proxy statements for 43 firms were available from the Laser D SEC

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information must be compiled from individual proxy statements.

[18]The 1993 proxy statements of the other 106 firms in the subsample were not available on Lexis/Nexis.

service. However, the necessary financial and institutional shareholding data were available for only 17 of those 43 firms. The supplementary sample therefore contains 161 firms, of which 64 announced dividend increases, 28 announced repurchases, 21 announced both a dividend increase and a repurchase, and 48 announced neither a dividend increase nor a repurchase. Summary statistics for the supplementary sample are reported in table 3.

3 Estimation

The likelihood function for a series of observations (here, firms) from a choice-based sample is:

$$\prod_{i=1}^{N} P_{j_i} Q_{j_i}^{-1} H_{j_i}$$

(Amemiya and Vuong 1987), where:

P_{j_i} = probability of the alternative j chosen by i, given x_i;

Q_{j_i} = probability across population of the alternative j chosen by i;

H_{j_i} = probability in sample of the alternative j chosen by i.

In the multinomial logit model, the probability of alternative j given x is given by (A9) (see appendix 1) and is a function of the coefficient vectors β_j ($j = 0..., J - 1$ for J alternatives). Consistent estimates of the β_j are obtained by maximizing:

$$\sum_{i=1}^{N} \ln \left(\frac{P_{j_i} Q_{j_i}^{-1} H_{j_i}}{\sum_{j=0}^{J-1} P_{j_i} Q_{j_i}^{-1} H_{j_i}} \right)$$

(Manski and McFadden 1981). Here, the probability of alternative j in the population is given by the proportion of all firms in the original sample (3078 firms) that chose alternative j, while the probability of alternative j in the sample is given by the proportion of firms in the ultimate sample (144 firms, or 161 firms if the supplementary sample is used) that chose alternative j.[19]

4 Results and Discussion

This section reports and discusses my empirical results. Sub-section 1 reports coefficient estimates for the model outlined in section 1. Sub-section 2 analyzes the connection between repurchase behavior and stock options holdings in greater detail. Sub-section 3 discusses and tests alternatives to the stock option-based explanation of repurchases proposed above. Finally, sub-section 4 reports the results of specification tests of the independence-of-alternatives assumption of the multinomial logit model.

4.1 Basic results

The top panel of table 4 reports coefficient estimates for section 1's model for the basic sample of 144 firms. The estimates in column 1 indicate the effects of the explanatory variables on the marginal benefit from a repurchase relative to the

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[19]As a check on the estimates produced by the choice-based sampling procedure, I reestimated a version of the model with only the dividend increase, repurchase, and dividend increase-and-repurchase options (specification (3-II) below) using the standard multinomial logit routine. The standard routine should produce consistent estimates in the model without the retention option because the sample is no longer choice-based. Consistent with this prediction, the estimates produced by the standard routine were identical to those reported in table 9a for specification (3-II).

effects of these variables on the marginal benefit from a dividend increase. The effects are relative to the dividend increase benchmark because the coefficient vector β_0 corresponding to the dividend increase alternative in section 1's model is normalized to zero (see appendix 1). Likewise, the coefficient estimates in column 2 indicate the effects of the explanatory variables on the marginal benefit from the retention alternative relative to the effects of these variables on the marginal benefit from a dividend increase; and the coefficient estimates in column 3 indicate the effects of the explanatory variables on the marginal benefit from the dividend increase-and-repurchase alternative relative to the effects of these variables on the marginal benefit from a dividend increase. The adjusted R^2 value for the overall model is 0.667.[20]

The estimated coefficient on the institutional shareholding variable is positive in each of the three equations and is significantly different from zero in the repurchase equation – a finding to which I return below.[21] The estimated coefficient on the cash flow variable is negative in the repurchase and retention equations and is significantly different from zero in the retention equation, implying that firms with low earnings are less likely to engage in repurchase and especially dividend distributions than firms with high earnings (a finding that is consistent with the literature described in note 6 above). The estimated coefficient on the cash flow variable in the dividend increase-and-repurchase equation is positive and significantly different from zero, suggesting a strong positive relationship between earnings levels and the decision to engage in

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[20]The adjusted R^2 is one minus the ratio of the maximized likelihood function to the likelihood function when all coefficients are restricted to zero (Greene 1991, 682).

[21]All tests of significance are at the five percent level.

both a dividend increase and a repurchase.

The estimated coefficient on the Tobin's q variable is not significantly different from zero in any of the equations, perhaps due to the difficulty of measuring Tobin's q precisely. Meanwhile, the estimated coefficient on the debt-equity ratio is negative and significantly different from zero in the repurchase equation, not significantly different from zero in the retention equation, and positive and significantly different from zero in the dividend increase-and-repurchase equation, implying that low debt firms tend to choose the repurchase alternative, medium debt firms the retention and dividend increase alternatives, and high debt firms the dividend increase-and-repurchase alternative.

The explanatory variable of greatest interest for my thesis is the stock options variable, which has a statistically significant positive effect in the repurchase and retention equations and a statistically insignificant effect in the dividend increase-and-repurchase equation. These findings support the stock option hypothesis of repurchase behavior outlined above. First, the stock option hypothesis predicts that managers with large stock option holdings will be more favorably inclined towards repurchases, which do not dilute the value of outstanding options, than dividend increases, which do have a dilutive effect. Second, the stock option hypothesis predicts that managers with large stock option holdings will also be more favorably inclined towards retentions, which likewise do not dilute the value of outstanding options, than dividend increases. Consistent with these predictions, the estimated coefficient on the stock options variable is positive and significantly different from zero in both

the repurchase equation and the retention equation. The estimated coefficients in the two equations are also of similar magnitude, as would be expected if the same economic effect underlies them. Also consistent with the stock option hypothesis, the total amount of retention of earnings by publicly-traded corporations, like the level of repurchase activity by these corporations, has increased over time, as has the use of stock options.[22]

The stock option hypothesis in turn suggests a parallel explanation for the finding that the institutional shareholding variable has a statistically significant positive effect in the repurchase equation (and also a positive effect, statistically significant at the 10 percent level, in the retention equation). Just as a move from the repurchase option or the retention option to the dividend increase option dilutes the value of managers' stock options and is thus unattractive to managers with large option holdings, such a move would reduce the compensation of institutional fund managers, who are typically compensated on the basis of the market value of their portfolios, and would thus be unattractive to these individuals.[23] The prediction – borne out by the empirical results – is that firms with many institutional investors will be more likely to engage in repurchases and retentions than dividend increases.

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[22]The increase in the use of stock options over time was noted in the introduction. In terms of retention activity, publicly-traded firms' annual distributions (repurchases plus dividends) totaled 5.05 percent of market value in 1975 but only 3.58 percent of market value in 1993 (see table 1).

[23]A move to the dividend increase option would reduce the market value of the institution's portfolio because it would cause a decrease in the share value of the firm. The disinclination towards dividend increases on the part of institutional fund managers should be mitigated to some degree by the existence of dividend reinvestment plans, but, as noted above, such plans are far from universal.

In terms of the overall predictive ability of the model, the specification reported in table 4 compares favorably (though not by a large margin) with the benchmark model in which the predicted alternative is the alternative with the largest frequency in the sample. In the 144 firm sample, the most frequently chosen alternative is the dividend increase option, chosen by 64 firms; the benchmark model thus predicts accurately in 64 of 144 cases, or 44.44 percent of the time. Meanwhile, in the model reported in table 4, a repurchase is predicted if the probability of a repurchase (a function of the estimated coefficients) is greater than the probabilities of the other alternatives, and the retention, dividend increase-and-repurchase, and dividend increase alternatives are predicted if analogous conditions hold. The predicted choices match up with the actual choices as follows:

		predicted				
		dividend increase	repurchase	both	neither	total
actual	dividend increase	61	0	0	3	64
	repurchase	19	7	0	2	28
	both	24	6	0	1	31
	neither	16	0	0	5	21
	total	120	13	0	11	144

The model is correct in 73 of the 144 cases, or 50.69 percent of the time. This success

rate compares favorably to that of the benchmark model (though only by a relatively small margin).

The top panel of table 5 reports coefficient estimates for section 1's model for the supplementary sample of 161 firms. The results are very similar to those reported in the top panel of table 4. The estimated coefficients on the stock options variable in the repurchase and retention equations are positive, significantly different from zero, and close in magnitude to the estimated coefficients obtained for the 144 firm sample. The only notable difference in the point estimates for the supplementary sample is in the estimated coefficient on the institutional shareholding variable in the retention equation, which falls from 1.373 to 0.563, but that coefficient is insignificantly different from zero in both samples. The results reported in table 4 therefore appear to be robust to inclusion of additional firms in the retention category.

4.2 The significance of the stock option effect

The present sub-section examines the connection between stock options and repurchases in greater detail. I first address the behavioral plausibility of the connection. I present a rough calculation of how much the average executive in a publicly-traded corporation that did a repurchase in 1993 would have stood to lose (stock option-wise) by substituting a dividend increase for the repurchase.

The average repurchase undertaken by a publicly-traded corporation in 1993 was a repurchase of 6.0 percent of the firm's outstanding share value.[24] If 6.0 percent of a

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[24]The 6.0 percent figure is the average of substantial (more than one half of one percent

firm's outstanding share value were instead paid out in the form of a dividend increase, then the firm's stock price would fall by 6.0 percent. The average stock price (at year-end 1992) of firms announcing repurchases in 1993 was $47.62 (see column 4 of table 2). So the stock price would fall by $2.86 (6.0 percent of $47.62) on average. The average number of stock options held by top mangers at firms announcing repurchases in 1993 was 147,000 (see column 4 of table 2). So the average amount that a top manager would have at stake in the choice between a repurchase and a dividend increase would be $420,420 ($2.86 per share multiplied by 147,000 shares).

The magnitude of the effect of the repurchase-dividend increase choice on managers' wealth suggests that stock options may be quite important in explaining managers' behavior. The estimated marginal effects reported in the bottom panel of table 4 confirm this suspicion. The estimated effect of a one unit increase (approximately one standard deviation – see table 6) in the stock options variable on the probability of a repurchase is 0.362. Meanwhile, the estimated effect of a one unit increase in the stock options variable on the probability of the dividend increase-and-repurchase

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of the firm's outstanding share value) repurchases, as reported by Compustat. The one half of one percent criterion is taken from Bagwell and Shoven (1988).

The Compustat repurchase data includes all repurchase transactions, large and small, and thus may include, for example, going-private transactions, for which dividend distributions are not substitutes. Unfortunately, other published data to which I have access focuses on repurchases of large firms only. Those repurchases probably tend to involve a smaller proportion of total outstanding share value than repurchases by smaller firms. Even if repurchase figures for only very large firms are used, however, the dollar amounts at stake for managers are large. The average repurchase by a firm in the Standard and Poor's 500-stock or Midcap 400-stock index in 1993 was 2.5 percent of the firm's outstanding share value, or 41.67 percent of the size of the average repurchase in the Compustat data (Wall Street Journal, May 2, 1994, at C1). The amount that top managers would stand to lose by substituting a dividend increase for a repurchase of this magnitude would therefore be 41.2 percent of the figure in the text, or $175,315.

alternative is -0.168; the net effect on the probability of observing a repurchase is thus 0.194 (0.362 - 0.168). The net figure implies that if the average number of stock options held by top executives increases 10 percent from its mean value of 124,000 (see column 2 of table 2) while the number of outstanding shares remains constant at the mean value (23,846,154) implied by the mean of stock options variable,[25] then the probability of observing a repurchase increases by one percentage point (0.194 * (136,400*100/23,846,154 - 0.520), or 0.010), which represents a 37 percent increase in the proportion of firms engaging in repurchases.[26] Likewise, if the average number of stock options increases by 50 percent (from 124,000) while the number of outstanding shares remains constant at the mean value of 23,846,154, then the probability of observing a repurchase increases by about five percentage points (0.194 * (186,000*100/23,846,154 - 0.520), or 0.051). Similar predictions follow from the estimated marginal effects reported in the bottom panel of table 5 for the 161 firm supplementary sample.

The economic significance of the stock option effect suggests that the increase in stock option usage over the last two decades may have played a significant role in the increase in repurchase activity over that period. For instances, if the average level of the stock options variable in 1993 represents a doubling of the 1975 figure, then the corresponding increase in the proportion of repurchasing firms would be

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[25]The mean value of shares outstanding implied by the mean of the stock options variable is the value s defined by $124,000/s = .00520$ (where .00520 is the mean of the (unscaled) stock options variable).

[26]The proportion of repurchasing firms in my original sample is 83/3078, or 0.027.

(using the above results for the 144 firm sample) 0.051 (0.194 * (0.520 - 0.260)). This is larger than the actual proportion (0.027) of repurchasing firms in my sample. Of course, many factors other than stock options undoubtedly changed as well over the 1975-1993 period; for instance, debt-equity ratios, which my results suggest are negatively related to repurchases, rose significantly over that period. Without an explicitly longitudinal analysis, it is not possible to ascertain the exact magnitude of the stock option effect on repurchase behavior over time. Nevertheless, my results suggest that increased use of stock options over 1975-1993 may have been an important consideration in the upsurge in repurchase activity over that period.

The relatively small magnitudes of the estimated marginal effects of the explanatory variables on the probability of the retention alternative (column 2 in the bottom panel of table 4) are somewhat puzzling. The explanation may be that the model simply does a better job explaining choices between different modes of distribution (repurchase, dividend increase-and-repurchase, and dividend increase) than it does explaining choices about whether to distribute earnings in the first place. The latter choices presumably depend on a much more complex set of factors than the former, and thus it is less likely that I have managed to capture all of the relevant variables. Consistent with this suggestion, the model does a dramatically better job predicting choices of the repurchase, dividend increase-and-repurchase, and dividend increase alternatives than it does predicting the retention alternative, as the prediction table above reveals. Whatever the explanation for the retention results, however, omitting the retention option from the model entirely (one of the specification checks reported

in sub-section 4.4 below) has very little effect on the estimated coefficients in the repurchase and dividend increase-and-repurchase equations.

4.3 Alternative explanations for the stock option effect

The results described thus far suggest that stock options play an important role in repurchase decisions, as suggested by the stock option hypothesis developed in this chapter. I now examine several alternative explanations for the empirical relationship between stock options and repurchases. I present evidence that this relationship does not reflect an underlying connection between repurchases and executive pay or its determinants; is not an artifact of a correlation between repurchases and stock undervaluation; and does not reflect underlying size or industry effects. I also discuss reasons why high levels of stock options are unlikely to have resulted from an explicit desire on the part of shareholders to encourage repurchase activity.

4.3.1 Repurchases and executive pay

One alternative explanation for the relationship between stock options and repurchases is that repurchase behavior is correlated with executive pay or its determinants in a more general way. If this alternative explanation is correct, then forms of compensation other than stock options should affect repurchases in much the way that stock options do. A particularly strong case for this prediction is restricted stock awards, which are similar to stock options in that both forms of compensation reward managers on the basis of stock price, but differ in that restricted stock gives the

holder the right to share in dividend payments that accrue before the vesting of the stock (Crystal 1991) and thus, in contrast to stock options, creates no preference for repurchases vis-a-vis dividend increases. Any underlying effect of compensation on repurchase behavior should be picked up both by stock options and by other forms of compensation, particularly restricted stock.

Columns 1 through 3 of table 8a report the results of a model that includes, in addition to the explanatory variables in section 1's model, the average dollar amount of restricted stock awards (RESTRICTEDSTOCK) and the average non-stock-based compensation (NONSTOCK). The estimated coefficients on the restricted stock and non-stock-based compensation variables in the repurchase equation are negative and significantly different from zero at the 10 percent (though not at the five percent) level. Meanwhile, the estimated coefficient on the stock options variable in the re-purchase equation is similar to the estimated coefficient in the original model (1.562 versus 1.870), and is significantly different from zero at just above the five percent level. Likewise, the estimated coefficient on the restricted stock variable in the re-tention equation is not significantly different from zero, the estimated coefficient on the non-stock-based compensation variable in that equation is negative and signifi-cantly different from zero, and the estimated coefficient on the stock options variable in the retention equation is similar to the estimated coefficient in the original model and is significantly different from zero. These results support the conclusion that the observed positive effect of the stock options variable in the repurchase and retention equations is not merely a reflection of a more general relationship between repurchases

or retentions and the structure or level of executive pay.[27]

4.3.2 Repurchases and stock undervaluation

A second alternative to the stock option hypothesis traces the relationship between stock options and repurchases to an underlying correlation of each of these variables with a depressed stock price. If a firm's stock price is depressed, then executives of the firm might tend both to have a large number of outstanding stock options (because exercising options has been unprofitable due to the low stock price) and to want to do a repurchase to "correct" the market's undervaluation of the firm's stock.[28] Thus, the stock option effect might actually be a stock undervaluation effect. This explanation predicts that adding a variable correlated with stock undervaluation to the empirical specification will reduce the effect of stock options on repurchases.

Columns 4 through 6 of table 8a report the results of section 1's model with a stock price trend variable (PRICETREND) added to the original set of explanatory variables. The price trend variable is the percent increase in the firm's stock price between the end of fiscal 1991 and the end of fiscal 1992. The estimated coefficient on this variable in the repurchase equation is negative and significantly different from

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[27]The significant negative effect of the non-stock-based compensation variable in the retention equation may reflect an underlying size effect; larger firms may be less likely, all else equal, to choose the retention option (as discussed below), and it is well-known that firm size is positively correlated with the level of compensation. I control explicitly for firm size in the specifications reported in table 8b.

[28]Repurchasing firms often state that they are motivated by such a desire. Note that, even if the stock is undervalued, a repurchase does not redound to the benefit of the shareholders as a group but rather effects a wealth transfer from selling shareholders to non-selling shareholders (Clark 1986, 629-630).

zero, consistent with the above discussion, but the estimated coefficient on the stock options variable in the repurchase equation is still positive, and is larger in magnitude, in the alternative specification than in the original model. This finding supports the conclusion that the stock options variable is not picking up a spurious stock price effect.[29]

4.3.3 Repurchases and other firm characteristics

The results reported in table 8a show that controlling for other forms of compensation and stock price trends has no effect on the repurchase-stock option connection. The first three columns of table 8b report a specification that attempts to control for additional explanatory variables that might correlate with firms' repurchase behavior. The specification adds a market value variable (SIZE) and three industry dummy variables to section 1's model. The estimated coefficient on the market value variable in the retention equation is negative and significantly different from zero, implying that larger firms are less likely to choose the retention option. The estimated coefficient on the communications industry dummy variable in the repurchase equation, and the estimated coefficient on the finance industry dummy variable in the retention equation, are negative and significantly different from zero, indicating that firms in the communications industry category tend not to choose the repurchase option and that firms in the finance industry category tend not to choose the retention option.

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[29]The price trend variable is obviously an imperfect measure of the underlying economic variable (undervaluation), but as long as it is correlated with that variable, including it would tend to decrease rather than increase the estimated coefficient on the stock options variable if the undervaluation explanation were correct.

The estimated coefficients on the stock options variable in the repurchase and retention equations continue to be positive, but they are about 25 percent smaller in magnitude than the estimated coefficients in the basic model, and only the retention equation estimate is significantly different from zero.

Columns 4 through 6 of table 8b report a final specification, which contains the entire set of additional explanatory variables discussed in this sub-section. The estimated coefficients on the stock options variable in the repurchase and retention equations in this specification are positive and significantly different from zero, as in the original model. In addition, the magnitude of the repurchase equation effect is very similar to the magnitude of that effect in the original model (the estimated coefficient is 1.719 in the alternative specification and 1.870 in the original model). In the retention equation, the estimated coefficient on the non-stock-based compensation variable is no longer significantly different from zero, suggesting that the size effect noted above is driving the effect of the non-stock-based compensation variable in the specification reported in columns 1 through 3 of table 8a.

The set of results reported in tables 8a and 8b indicates that controlling for additional variables not reflected in the original specification has little effect on the repurchase-stock option connection. The contrast between the estimated coefficients on the stock options and restricted stock variables in the repurchase equation (column 1 of table 8a or column 4 of table 8b), discussed above, bears particular emphasis. If the stock options coefficient reflected not a relationship between repurchases and stock options but rather an underlying connection between each of these things and

some (unobservable) third variable, then one might expect the restricted stock coefficient to pick up some of the same effect, since (as discussed above) restricted stock is similar to stock options in many respects. However, the sign of the restricted stock coefficient is opposite the sign of the stock options coefficient, implying that while firms that rely on stock option-based incentive compensation are disposed towards repurchases, firms that rely on restricted stock-based incentive compensation are not inclined in that direction. The contrast between stock options and restricted stock provides support for the claim that the repurchase-stock option connection observed in the data supports the stock option hypothesis developed in this chapter.

4.3.4 Repurchases and shareholder interests

A final issue raised by the suggested relation between the repurchase-stock option connection and the stock option hypothesis presented in this chapter is the possible connection between high option levels and an explicit desire on the part of shareholders to encourage repurchase activity. The introduction to this chapter suggested that stock options may create a wedge between the attractiveness of a repurchase from the standpoint of total corporate value and its attractiveness to managers, and that stock options may therefore induce managers to engage in inefficient repurchases. Perhaps, however, inducing managers to choose the repurchase route mitigates some other managerial disincentive to engage in a repurchase and thus enhances rather than reduces corporate value. If this is true, then high stock option levels at particular firms might reflect a deliberate attempt to encourage repurchase activity, not an

instance of exogenous variation in the type of compensation (stock options, restricted stock, non-stock-based compensation) paid to top managers.

Stock options encourage repurchases relative to the dividend increase alternative but not relative to the retention alternative, as noted above. The hypothesis just described therefore requires the existence of some factor that makes repurchases more attractive to shareholders than dividend increases. One such factor is taxes, but the data indicate that firms with few institutional investors, and, therefore, much to gain tax-wise from taking the repurchase route, are managed by executives with low, not high, levels of stock options.[30] A second factor that might make repurchases more attractive than dividend increases to certain shareholders – institutional ones – is the structure of fund managers' compensation, as discussed above. This factor (unlike the tax factor) is consistent with the data.

I am unaware of any direct evidence that institutional investors have sought to encourage repurchases through the awarding of stock options. While the effects of options on managers' payout incentives have been explicitly recognized (Buyniski 1991), the institutional investor argument requires two further logical steps (that the effects of stock options are appreciated at the time they are awarded, by those who campaign for them (the institutional investors), and that fund managers are motivated to push for repurchases due to the structure of their own compensation). Furthermore, the attractiveness of repurchases from institutional investors' (and other shareholders')

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[30]The raw (population-weighted) correlation between the institutional shareholding variable and the stock options variable is 0.120.

perspective is significantly reduced by the fact that a repurchase carries an important risk that is not present with a dividend increase. The risk is that managers may exploit inside information in making repurchase decisions, to the detriment of participating shareholders. If managers who own stock in the firm cause the firm to repurchase shares from outside investors at a price that does not reflect the true value of the shares, then they enrich themselves at the outside investors' expense. A dividend increase, in contrast, poses no such threat. The difference between repurchase and dividend distributions from the perspective of potential unfair treatment of sharehold- ers has for long been a theme in the corporate law treatment of repurchases.[31] The extra risk that shareholders face when a firm uses the repurchase route to distribute earnings makes it less likely that institutional investors or other shareholders inten- tionally engineer stock option-heavy compensation packages to encourage repurchase activity.

4.4   Specification checks

The alternative specifications reported in this sub-section test the independence- of-alternatives assumption of the multinomial logit model (Hausman and McFadden 1984; Greene 1990, 702). The specification checks involve omitting various subsets of the four choice possibilities encompassed by the original specification and examining whether the omissions produce changes in estimated coefficients.

Tables 9a and 9b report results from omitting each single alternative from the

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[31]See, for example, Clark (1986, 627, 634-36).

original model. In specifications (3-I) through (3-III), the repurchase, retention, and dividend increase-and-repurchase options, respectively, are omitted, while in specification (3-IV) the dividend increase option is omitted. The benchmark for comparison in specifications (3-I) through (3-III) is the original specification reported in table 4; the benchmark for comparison in specification (3-IV) is the original specification with the repurchase equation coefficients (rather than the dividend increase equation coefficients) normalized to zero (see columns 1 through 3 in table 9b).

Of the 48 estimated coefficients in the four alternative specifications, all but two, the estimated coefficients on the institutional shareholding variable and the constant in the repurchase equation in specification (3-II), differ from their counterpart estimates in the original model by less than their standard errors. The estimated coefficients on the institutional shareholding variable and the constant in the repurchase equation in specification (3-II) differ from their counterpart estimates in the original model by less than twice their standard errors.

Tables 10a and 10b report results from omitting pairs of alternatives from the original model. In specifications (2-I) through (2-III) the benchmark for comparison is the original specification reported in table 4; in specifications (2-IV) through (2-V) the benchmark for comparison is the specification reported in columns 1 through 3 in table 9b; and in specification (2-VI) the benchmark for comparison is the specification reported in columns 1 through 3 of table 10b, in which the retention equation coefficients (rather than the dividend increase or repurchase equation coefficients) are normalized to zero. Of the 36 estimated coefficients in the alternative specifications,

again all but two, the estimated coefficients on the institutional shareholding variable and the constant in the repurchase equation in specification (2-III), differ from their counterpart estimates in the original model by less than their standard errors. The estimated coefficients on the institutional shareholding variable and the constant in the repurchase equation in specification (2-III) – which like specification (3-II) omits the retention option – differ from their counterpart estimates in the original model by less than twice their standard errors.

The results reported in tables 9a, 9b, 10a, and 10b suggest that the original specification of the model is robust to the omission of various subsets of the four choice possibilities.[32] This robustness in turn suggests that the independence-of-alternatives assumption of the multinomial logit model is likely to be satisfied.

5 Prospects for Self-Help

The results reported in section 4 provide empirical support for the stock option hypothesis of publicly-traded corporations' repurchase behavior; controlling for other factors, firms in which managers have large stock option holdings are significantly more likely to choose the repurchase route than firms in which managers have small stock option holdings. From a normative perspective, the stock option hypothesis of repurchase behavior suggests that firms sometimes undertake inefficient repurchases;

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[32]A more precise test would involve testing the equality of all of the estimated coefficients in the original specification and the alternative specification simultaneously (Amemiya 1981).

if total corporate value would be higher, but the value of outstanding stock options notably lower, under the dividend route than the repurchase route, then the firm might take the latter route in spite of its adverse effect on corporate value. The important question for policy-makers is whether there are barriers to self-help by firms that rely on stock option-based compensation.

One potential self-help mechanism for such firms involves providing for accrual of dividends on stock options held by managers. As noted above, restricted stock, an alternative form of stock-based compensation, accrues dividends and therefore creates no need for managers to rely on the repurchase route (or the retention route) to avoid diluting the value of their compensation packages. If stock options likewise accrued dividends, then option values would no longer be differentially affected by the repurchase and dividend increase alternatives. In fact, several firms with high dividend stocks, such as NYNEX and a number of electric utilities, have apparently altered their stock option plans recently to provide for precisely this sort of accrual (Buyniski 1991).

Operationally, exercise of a stock option under a dividend accrual plan gives the holder the right not only to the difference between the market price of the stock and the exercise price of the option, but also to any dividends paid on the firm's stock since the time at which the option was granted.

An alternative mechanism for eliminating managers' incentive to substitute repurchases for dividend increases would involve a proportionate adjustment in either the number of options held by top managers, or the exercise prices associated with these

options, in response to a repurchase. Under this mechanism, a repurchase would have the same dilutive effect on the value of stock options as a dividend increase. The problem with this mechanism is that it would give managers a powerful incentive to retain rather than distribute earnings, as only the retention option would protect the value of outstanding options. The proportionate adjustment mechanism would thus aggravate preexisting problems of managerial empire-building (Jensen 1986), whereas the dividend accrual mechanism would preserve managers' incentive *   ... 'er earnings to shareholders' hands.

6   Conclusion

This chapter has presented a new explanation for the repurchase behavior of publicly-traded corporations. The stock option hypothesis of repurchase behavior reflects an appreciation of the importance of agency issues in explaining corporate decision-making. As described above, managers holding stock options have substantial personal wealth at stake in the choice between repurchase and dividend distributions. This chapter's empirical findings suggest that stock option concerns factor substantially in observed repurchase behavior; controlling for other observable factors, firms in which managers have large stock option holdings are significantly more likely to choose the repurchase route than firms in which managers have small stock option holdings.

Cross-sectional results such as those reported in this chapter cannot rule out the

possibility that the effect of stock options on repurchase behavior reflects unobserved firm effects of some sort. However, my findings are robust across a number of empirical specifications, including models that contain additional compensation variables and stock price, size, and industry dummy variables. The absence of a relationship between repurchases and restricted stock awards, which are similar to stock options in most respects but differ in the key respect that they are not diluted by dividend distributions (in contrast to stock options), seems to be fairly strong evidence for the stock option hypothesis presented in this chapter.

The stock option-based explanation of repurchases fits well with the pattern of repurchase activity over time and may thus usefully supplement the tax and takeover explanations of repurchase behavior. The magnitude of the stock option effect in my sample suggests that increased use of stock options over the 1975-1993 period may have played a significant role in the increase in repurchase activity over that period.

Appendix 1

This appendix develops a simple model of repurchase decisions at publicly-traded corporations. I show how optimizing behavior by managers gives rise to the decision rule in equation (1) in the text.

A publicly-traded corporation with N_0 shares outstanding and stock price p_0 chooses an amount $d \geq 0$ by which to increase its dividend and an amount $r \geq 0$ of stock to repurchase at price p_r. The choice is made by the firm's top managers, who hold q_T stock options with exercise prices p_q, $q = 1, ..., q_T$. The total amount distributed is at most L. The distributions occur in period 1. In period 2 the managers exercise their stock options and realize an aggregate gain of:

$$\sum_{q=1}^{q_T} \max\langle p_1 - p_q, 0 \rangle, \tag{A1}$$

where p_1 is the price of the firm's stock at the end of period 1 (after the dividend and repurchase distributions). I assume that $(p_1 - p_q)$ is nonnegative for all q, an assumption that may be justified on the basis of the frequency with which out-of-the-money options are repriced in managers' favor.[a] With $(p_1 - p_q)$ nonnegative for all q,

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[a] An out-of-the-money option is an option with an exercise price above the market price of the firm's stock. In my data sample (described in section 2 above), virtually all firms' top managers had option packages with positive values. (Unfortunately, option value information is available only for each top manager's option package as a whole; proxy statements do not report how many of the individual options in an executive's portfolio have negative values.) This may well reflect in large part the propensity of corporate boards to reduce exercise prices in situations in which the market price has fallen below the exercise price ($p_q > p_1$ in the terms of the model in the text). If $(p_1 - p_q)$ were allowed to be negative in my model, then the managers' period 2 stock option gain would be the (nondifferentiable) expression in (A1) rather than the (differentiable) expression in (A2), which would greatly complicate the managers' optimization problem.

(A1) reduces to:

$$\sum_{q=1}^{qT}(p_1 - p_q).\qquad\qquad(A2)$$

Managers are assumed to choose d and r to maximize a weighted average of the value of the distributions to shareholders, the firm's market value after the distributions, and the value of managers' stock options:

$$\Pi = \lambda_1(\pi_d d + \pi_r r) + \lambda_2[N_0 p_0 + \Phi_d d + \Phi_r r - d - r] + (1 - \lambda_1 - \lambda_2)\sum_{q=1}^{qT}(p_1 - p_q),\quad(A3)$$

where π_d is the value to shareholders of amounts distributed via dividends, π_r is the value to shareholders of amounts distributed via repurchases, Φ_d is the percent increase (possibly negative) in the firm's value associated with distribution of one percent of its initial value in a dividend increase, Φ_r is the percent increase in the firm's value associated with repurchase of one percent of its outstanding stock, and λ_1 and λ_2 are parameters corresponding to the weights attached to the value of the distributions to shareholders and the firm's market value after the distributions.[b] p_1 is given by:

$$p_1 = \frac{N_0 p_0 + \Phi_d d + \Phi_r r - d - r}{N_0 - (r/p_r)}\qquad\qquad(A4)$$

(the total market value of the firm after the repurchase and dividend distributions

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[b]Stein (1989) is an example of a model in which the managers' objective function is a weighted average of shareholder value and manager value components (in his case, the discounted expected earnings of the firm and the firm's current stock price).

divided by the number of shares outstanding after those distributions).

The actual act of repurchasing shares (following the announcement of the repurchase) should not affect the firm's stock price; the act of repurchasing conveys no new information about the firm. Therefore, the repurchase price should equal the price of the firm's stock after the repurchase and dividend distributions: $p_r = p_1$. Substituting into (A4) and rearranging:

$$p_1 = \frac{N_0 p_0 + \Phi_d d + \Phi_r r - d}{N_0}.$$

Differentiating (A3) with respect to d and r:

$$\frac{\partial \Pi}{\partial d} = \lambda_1 \pi_d + \lambda_2 (\Phi_d - 1) + (1 - \lambda_1 - \lambda_2) q_T \left(\frac{\Phi_d - 1}{N_0} \right); \qquad (A5)$$

$$\frac{\partial \Pi}{\partial r} = \lambda_1 \pi_r + \lambda_2 (\Phi_r - 1) + (1 - \lambda_1 - \lambda_2) q_T \left(\frac{\Phi_r}{N_0} \right). \qquad (A6)$$

These derivatives reflect the marginal benefits from dividend and repurchase distributions respectively. Because the derivatives do not vary with d and r, the solution to the problem of maximizing (A3) subject to $d \geq 0$, $r \geq 0$, and $d + r \leq L$ may be written:

$$\left\{ \begin{array}{ll} d = L, r = 0 & \text{if } \partial\Pi/\partial d > \partial\Pi/\partial r \text{ and } \partial\Pi/\partial d \geq 0 \\ d = 0, r = L & \text{if } \partial\Pi/\partial r > \partial\Pi/\partial d \text{ and } \partial\Pi/\partial r \geq 0 \\ d = 0, r = 0) & \text{if } \partial\Pi/\partial d < 0 \text{ and } \partial\Pi/\partial r < 0 \\ d = L/2, r = L/2 & \text{otherwise} \end{array} \right\}. \qquad (A7)$$

(A7) assumes (without loss of generality) that if the marginal benefits of the dividend increase and repurchase routes are equal and nonnegative, then the firm will divide the

54

total amount L to be distributed equally between the two routes ($d = L/2, r = L/2$). Meanwhile, $d = L, r = 0$ means the firm does a dividend increase; $d = 0, r = L$ means the firm does a repurchase; and $d = 0, r = 0$ means the firm does neither (retention).

The derivatives $\partial \Pi / \partial d$ and $\partial \Pi / \partial r$ are functions of π_d, π_r, Φ_d, Φ_r, and q_T/N_0. The first two of these variables, the value to shareholders of amounts distributed via dividends (π_d) and the value to them of amounts distributed via repurchases (π_r), are influenced primarily by the tax consequences attending the distributions, as discussed in the text. I therefore allow π_d and π_r to depend on the percent of the firm's stock held by institutional investors, which are often are tax exempt. This is the variable called INSTITUTIONAL. Meanwhile, I model the variables Φ_d (the percent increase in corporate value associated with distribution of one percent of corporate value in a dividend increase) and Φ_r (the percent increase in corporate value associated with repurchase of one percent of the firm's outstanding stock) as functions of the firm's current cash flow (CASHFLOW), its Tobin's q (q), and its debt-equity ratio (DEBT-EQUITY), for the reasons described in the text. Finally, q_T/N_0 is simply the variable called OPTIONS. The vector of explanatory variables implied by (A5) and (A6) is therefore:

(INSTITUTIONAL, CASHFLOW, q, DEBT-EQUITY,

OPTIONS*CASHFLOW, OPTIONS*q, OPTIONS*DEBT-EQUITY, OPTIONS).

The three interaction terms reflect the fact that, in the world of the model, the effect of stock options on repurchase behavior depends not only on the number of options

held by managers (the direct effect) but also on the levels of the cash flow, Tobin's q, and debt-equity variables. (The value of stock options depends in part on the price of the firm's stock after the repurchase and dividend distributions (p_1), and that price in turn depends on the cash flow, Tobin's q, and debt-equity variables.) Indirect effects of changes in the stock options variable, operating through the cash flow, Tobin's q, and debt-equity variables, lack the intuitive appeal of the direct effect, however.

My empirical analysis therefore focuses on the direct effect, implying the following vector of explanatory variables:

$$x = (\text{INSTITUTIONAL, CASHFLOW, } q, \text{ DEBT-EQUITY, OPTIONS}).$$

The derivatives $\partial\Pi/\partial d$ and $\partial\Pi/\partial r$ may be written as $\delta_0 x$ and $\delta_1 x$ for parameter vectors δ_0 and δ_1. Letting $\delta_2 = 0$ and $\delta_3 = \mu\delta_0 + (1-\mu)\delta_1$, where μ and $(1-\mu)$ are weights, and introducing disturbance terms ϵ_0, ϵ_1, ϵ_2, and ϵ_3, (A7) may be written:

$$\left\{ \begin{array}{ll} \text{dividend increase } (d = L, r = 0) & \text{if } \delta_0 x + \epsilon_0 > \delta_j x + \epsilon_j, j \neq 0 \\ \text{repurchase } (d = 0, r = L) & \text{if } \delta_1 x + \epsilon_1 > \delta_j x + \epsilon_j, j \neq 1 \\ \text{neither } (d = 0, r = 0) & \text{if } \delta_2 x + \epsilon_2 > \delta_j x + \epsilon_j, j \neq 2 \\ \text{both } (d = L/2, r = L/2) & \text{otherwise} \end{array} \right\}.$$

Equivalently, where $\beta_0 = 0$, $\beta_1 = \delta_1 - \delta_0$, $\beta_2 = -\delta_0$, and $\beta_3 = (1-\mu)(\delta_1 - \delta_0)$:

$$\left\{ \begin{array}{ll} \text{dividend increase} & \text{if } \beta_0 x + \epsilon_0 > \beta_j x + \epsilon_j, j \neq 0 \\ \text{repurchase} & \text{if } \beta_1 x + \epsilon_1 > \beta_j x + \epsilon_j, j \neq 1 \\ \text{neither} & \text{if } \beta_2 x + \epsilon_2 > \beta_j x + \epsilon_j, j \neq 2 \\ \text{both} & \text{otherwise} \end{array} \right\}. \tag{A8}$$

With ϵ_j independently and identically distributed with extreme value distribution

56

$Pr(\epsilon_j \leq \epsilon) = exp\{exp\{\epsilon\}\}$, (A8) gives rise to the multinomial logit model (McFadden 1974), in which the probability of alternative j, $j = 0, 1, 2, 3$, is:

$$P_j = \frac{exp\{\beta_j' x\}}{\sum_{i=0}^{3} exp\{\beta_i' x\}}.$$ \hfill (A9)

This is the model in equation (1) in the text.

Appendix 2

This appendix defines the variables used in the empirical analysis and identifies the sources of the data for these variables. The omitted industry dummy variable is equal to one if the firm's primary 2-digit SIC is between 20 and 39.

variable	definition
INSTITUTIONAL	proportion of shares held by institutional investors

(Source: Standard and Poor's Security Owners' Stock Guide)

CASHFLOW

$$\frac{\text{fiscal 1992 operating income before depreciation}}{\text{total assets at 1992 fiscal-year-end}}$$

(Source: Compustat)

q

(Constructed as in Hayashi (1982), using fiscal 1992 book value of debt, carrying value of preferred stock, and book value of inventory and property, plant, and equipment)

(Source: Compustat)

DEBT/EQUITY

$$\frac{\text{book value of debt}}{\text{market value of equity}}$$

(Source: Compustat)

OPTIONS/SHARES

$$\frac{\text{average number of stock options (exercisable and unexercisable) held by five most highly-paid executives at 1992 fiscal-year-end}}{\text{number of shares outstanding at 1992 fiscal-year-end}}$$

(Source: proxy statements obtained from Lexis/Nexis and Laser D SEC)

variable	definition
NONSTOCK	average non-stock-based compensation paid to five most highly paid executives in fiscal 1992

(Source: proxy statements obtained from Lexis/Nexis)

RESTRICTEDSTOCK	average dollar amount of restricted stock granted to five most highly-paid executives over fiscal 1990 to fiscal 1992

(Source: proxy statements obtained from Lexis/Nexis)

PRICETREND

$$\frac{(\text{stock price at 1992 fiscal-year-end} - \text{stock price at 1991 fiscal-year-end})}{\text{stock price at 1991 fiscal-year-end}}$$

(Source: Compustat)

SIZE

stock price at 1992 fiscal-year-end *
number of shares outstanding at 1992 fiscal-year-end

(Source: Compustat)

COMMUNICATIONS	dummy variable equal to 1 if primary 2-digit SIC is between 10 and 14 or between 40 and 49.

(Source: proxy statements obtained from Lexis/Nexis)

TRADE/SERVICES	dummy variable equal to 1 if primary 2-digit SIC is between 50 and 59 or between 70 and 89.

(Source: proxy statements obtained from Lexis/Nexis)

FINANCE	dummy variable equal to 1 if primary 2-digit SIC is between 60 and 67.

(Source: proxy statements obtained from Lexis/Nexis)

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Table 1: Repurchases, Dividends, and Acquisitions of Publicly-traded Corporations 1975-1993

year	billions of current dollars			billions of 1987 dollars		
	repurchases	dividends	acquisitions	repurchases	dividends	acquisitions
1975	1.575	38.414	1.815	3.201	78.077	3.689
1976	2.669	45.303	3.188	5.103	86.621	6.096
1977	4.857	53.865	4.446	8.689	96.360	7.953
1978	5.664	59.996	7.607	9.393	99.496	12.615
1979	6.797	69.135	20.125	10.377	105.550	30.725
1980	8.315	76.129	21.991	11.597	106.177	30.671
1981	8.278	88.965	37.562	10.492	112.757	47.607
1982	12.873	97.098	32.440	15.362	115.869	38.711
1983	12.984	106.023	30.282	14.890	121.586	34.727
1984	35.346	111.983	72.272	38.842	123.058	79.420
1985	53.885	113.331	107.899	57.082	120.054	114.230
1986	55.567	127.018	109.753	57.345	131.082	113.264
1987	69.463	141.254	118.965	69.463	141.254	118.965
1988	63.720	153.843	131.668	61.328	148.068	126.726
1989	69.255	161.081	143.110	63.829	141.791	131.899
1990	53.105	170.066	93.730	46.871	150.102	82.727
1991	34.385	167.650	54.856	29.214	142.438	46.607
1992	42.817	172.043	60.587	35.357	142.071	50.031
1993	46.561	171.024	72.613	37.489	137.700	58.465
				(repurchases/ stock market value) x 10^2	(dividends/ stock market value) x 10^2	(acquisitions/ stock market value) x 10^2
1975				0.199	4.849	0.229
1993				0.766	2.815	1.195

Sources: Compustat; 1994 Economic Report of the President.

Table 2: Summary Statistics for Basic Sample

Means and (in parenthesis) standard deviations of explanatory variables

	whole sample (N=144)	popula-tion (imputed from sample)*	dividend increase sample (N=64)	repurch. sample (N=28)	retention sample (N=31)	dividend increase/ repurch. sample (N=21)
INSTITUTIONAL	0.511 (0.376)	0.557 (0.701)	0.450 (0.191)	0.581 (0.139)	0.560 (0.734)	0.529 (0.202)
CASHFLOW x 10	1.427 (1.075)	1.092 (0.656)	1.021 (0.841)	1.556 (0.992)	1.066 (0.633)	2.115 (1.830)
q x 10^{-1}	0.624 (0.854)	0.410 (0.473)	0.654 (0.911)	0.553 (0.547)	0.394 (0.449)	0.968 (1.296)
DEBT/EQUITY	0.979 (2.404)	0.911 (1.294)	1.021 (2.459)	0.276 (0.460)	0.911 (1.243)	1.887 (4.253)
OPTIONS/SHARES x 10^2	0.296 (0.505)	0.520 (0.900)	0.185 (0.157)	0.387 (0.417)	0.537 (0.943)	0.106 (0.123)
RESTRICTEDSTOCK x 10^{-6}	0.398 (1.478)	0.230 (0.575)	0.582 (2.082)	0.083 (0.152)	0.218 (0.526)	0.525 (1.093)
NONSTOCK x 10^{-6}	0.829 (0.700)	0.397 (0.231)	0.945 (0.596)	0.740 (0.569)	0.363 (0.204)	1.280 (1.131)
PRICETREND	0.190 (0.383)	0.193 (0.560)	0.272 (0.351)	0.052 (0.215)	0.193 (0.577)	0.120 (0.219)
SIZE x 10^{-10}	0.571 (1.144)	0.186 (0.355)	0.782 (1.473)	0.276 (0.340)	0.157 (0.309)	0.933 (1.244)
COMMUNICATIONS	0.188 (0.392)	0.193 (0.401)	0.234 (0.427)	0.036 (0.189)	0.290 (0.461)	0.095 (0.301)
TRADE/SERVICES	0.146 (0.354)	0.129 (0.341)	0.109 (0.315)	0.250 (0.441)	0.194 (0.402)	0.048 (0.218)
FINANCE	0.229 (0.422)	0.286 (0.458)	0.297 (0.460)	0.107 (0.315)	0.129 (0.341)	0.333 (0.483)
price of stock at 1992 fiscal-year-end x 10^{-2}		0.223 (0.175)		0.476 (0.920)		
avg. options at 1992 fiscal-year-end x 10^{-6}		0.124 (0.175)		0.147 (0.159)		

*The population means and standard deviations are weighted averages of the means and standard deviations from the four choice sub-samples (columns 3 through 6 of the table), where the weights reflect the representation of the choices in the overall population (100/3078 for the dividend increase choice, 56/3078 for the repurchase choice, 2895/3078 for the retention choice, and 27/3078 for the dividend increase-and-repurchase choice).

Table 3: Summary Statistics for Sample with Supplementary Retention Firms

Means and (in parenthesis) standard deviations of explanatory variables

	whole sample (N = 161)	population (imputed from sample)[a]	retention sample (N = 48)	retention sample-- supple- mentary firms (N = 17)	retention sample-- firms in basic sample (N = 31)
INSTITUTIONAL	0.490 (0.367)	0.475 (0.586)	0.473 (0.611)	0.313 (0.215)	0.560 (0.734)
CASHFLOW x 10	1.368 (1.187)	1.026 (1.192)	0.996 (1.202)	0.868 (1.862)	1.066 (0.633)
q x 10^{-1}	0.587 (0.818)	0.369 (0.415)	0.350 (0.387)	0.270 (0.224)	0.394 (0.449)
DEBT/EQUITY	0.954 (2.299)	0.856 (1.230)	0.852 (1.175)	0.745 (1.067)	0.911 (1.243)
OPTIONS/SHARES x 10^2	0.320 (0.558)	0.515 (0.874)	0.533 (0.915)	0.524 (0.890)	0.537 (0.943)
price of stock at 1992 fiscal-year-end x 10^{-2}		0.203 (0.163)			
avg. options at 1992 fiscal-year-end x 10^{-6}		0.118 (0.177)			

[a]The population means and standard deviations are computed in the same manner as in table 3.

Table 4: Coefficient Estimates and Estimated Marginal Effects -- Basic Model/Basic Sample

Choice-based sampling multinomial logit estimation; standard errors in parenthesis; estimated marginal effects computed at imputed population means of explanatory variables.

	coefficient estimates		
	repurch. equation	retention equation	dividend increase/ repurch. equation
INSTITUTIONAL	2.529 (0.961)	1.373 (0.773)	0.386 (0.916)
CASHFLOW x 10	-0.306 (0.312)	-0.971 (0.379)	0.738 (0.281)
q x 10^{-1}	0.012 (0.349)	-1.021 (0.529)	0.222 (0.223)
DEBT/EQUITY	-1.498 (0.566)	-0.143 (0.156)	0.182 (0.083)
OPTIONS/SHARES x 10^2	1.870 (0.668)	2.334 (0.646)	-1.500 (1.490)
CONSTANT	-1.718 (0.690)	-4.380 (0.657)	-2.476 (0.671)
maximized likelihood	-155.653		
adjusted R^2	0.667		
	estimated marginal effects		
	probability of repurchase	probability of retention	probability of dividend increase/ repurchase
INSTITUTIONAL	0.443 (0.192)	0.009 (0.008)	-0.024 (0.172)
CASHFLOW x 10	-0.068 (0.058)	-0.011 (0.006)	0.069 (0.136)
q x 10^{-1}	0.000 (0.062)	-0.012 (0.007)	0.019 (0.070)
DEBT/EQUITY	-0.273 (0.080)	0.002 (0.002)	0.048 (0.035)
OPTIONS/SHARES x 10^2	0.362 (0.172)	0.024 (0.010)	-0.168 (0.020)

Table 5: Coefficient Estimates and Estimated Marginal Effects -- Basic Model/Sample with Supplementary Retention Firms

Choice-based sampling multinomial logit estimation; standard errors in parenthesis; estimated marginal effects computed at imputed population means of explanatory variables.

	coefficient estimates		
	repurch. equation	retention equation	dividend increase/ repurch. equation
INSTITUTIONAL	2.227 (0.801)	0.565 (0.613)	0.198 (0.723)
CASHFLOW x 10	-0.202 (0.246)	-0.566 (0.253)	0.716 (0.243)
q x 10^{-1}	-0.010 (0.348)	-1.165 (0.458)	0.226 (0.218)
DEBT/EQUITY	-1.413 (0.466)	-0.088 (0.102)	0.187 (0.080)
OPTIONS/SHARES x 10^2	1.704 (0.667)	2.100 (0.610)	-1.756 (1.819)
CONSTANT	-1.692 (0.599)	-3.488 (0.489)	-2.323 (0.540)
maximized likelihood	-177.457		
adjusted R^2	0.580		

	estimated marginal effects		
	probability of repurchase	probability of retention	probability of dividend increase/ repurchase
INSTITUTIONAL	0.364 (0.125)	0.002 (0.014)	-0.024 (0.156)
CASHFLOW x 10	-0.042 (0.041)	-0.015 (0.007)	0.057 (0.104)
q x 10^{-1}	0.001 (0.057)	-0.031 (0.013)	0.019 (0.049)
DEBT/EQUITY	-0.237 (0.052)	0.005 (0.004)	0.037 (0.034)
OPTIONS/SHARES x 10^2	0.300 (0.156)	0.050 (0.018)	-0.161 (0.019)

Table 6: Estimated Effects of One Standard Deviation Increases in Explanatory Variables -- Basic Model/ Basic Sample

	population standard deviation	probability of repur-chase	probability of retention	probability of dividend increase/ repurchase	probability of dividend increase
INSTITUTIONAL	0.701	0.311	0.006	-0.017	-0.300
CASHFLOW x 10	0.656	-0.045	-0.008	0.045	0.007
q x 10^{-1}	0.473	0.000	-0.006	0.009	-0.003
DEBT/EQUITY	1.294	-0.354	0.003	0.062	0.289
OPTIONS/SHARES x 10^2	0.900	0.326	0.022	-0.151	-0.197

Table 7: Estimated Effects of One Standard Deviation Increases in Explanatory Variables -- Basic Model/ Sample with Supplementary Retention Firms

	population standard deviation	probability of repur-chase	probability of retention	probability of dividend increase/ repurchase	probability of dividend increase
INSTITUTIONAL	0.586	0.213	0.001	-0.014	-0.200
CASHFLOW x 10	1.192	-0.050	-0.018	0.068	0.001
q x 10^{-1}	0.415	0.001	-0.013	0.008	0.005
DEBT/EQUITY	1.230	-0.292	0.007	0.046	0.240
OPTIONS/SHARES x 10^2	0.874	0.263	0.043	-0.141	-0.165

Table 8a: Coefficient Estimates -- Alternative Specifications (I) and (II)/ Basic Sample

Choice-based sampling multinomial logit estimates; standard errors in parenthesis

	(I)			(II)		
	repurch. equation	retention equation	dividend increase/ repurch. equation	repurch. equation	retention equation	dividend increase/ repurch. equation
INSTITUTIONAL	3.819 (1.235)	2.934 (1.235)	1.233 (1.306)	2.023 (1.018)	0.959 (0.827)	0.184 (0.950)
CASHFLOW x 10	-0.393 (0.335)	-0.828 (0.427)	0.850 (0.291)	-0.472 (0.331)	-1.060 (0.373)	0.684 (0.275)
q x 10^{-1}	0.211 (0.328)	-0.183 (0.443)	0.285 (0.233)	0.155 (0.396)	-0.807 (0.455)	0.242 (0.229)
DEBT/EQUITY	-1.593 (0.684)	-0.123 (0.307)	0.150 (0.098)	-1.481 (0.513)	-0.178 (0.149)	0.160 (0.080)
OPTIONS/SHARES x 10^2	1.562 (0.785)	1.750 (0.783)	-1.641 (1.754)	2.631 (0.848)	2.883 (0.834)	-1.081 (1.703)
RESTRICTEDSTOCK x 10^{-6}	-2.154 (1.163)	0.463 (0.352)	-0.243 (0.288)			
NONSTOCK x 10^{-6}	-1.011 (0.532)	-5.858 (1.412)	0.559 (0.377)			
PRICETREND				-2.692 (0.898)	-1.632 (0.737)	-0.836 (0.974)
CONSTANT	-1.105 (0.842)	-2.409 (0.913)	-3.519 (0.903)	-1.061 (0.701)	-3.902 (0.682)	-2.197 (0.717)
MAXIMIZED LIKELIHOOD	-133.812			-150.469		
ADJUSTED R^2	0.714			0.678		

Table 8b: Coefficient Estimates -- Alternative Specifications (III) and (IV)/ Basic Sample

Choice-based sampling multinomial logit estimates;
standard errors in parenthesis

	(III)			(IV)		
	repurch. equation	retention equation	dividend increase/ repurch. equation	repurch. equation	retention equation	dividend increase/ repurch. equation
INSTITUTIONAL	3.217 (1.059)	1.688 (0.919)	0.641 (1.077)	4.042 (1.281)	2.044 (1.174)	0.960 (1.215)
CASHFLOW x 10	-0.733 (0.409)	-1.390 (0.494)	0.725 (0.316)	-0.496 (0.394)	-0.794 (0.403)	0.885 (0.342)
q x 10^{-1}	0.307 (0.370)	-0.035 (0.466)	0.098 (0.292)	0.496 (0.457)	-0.153 (0.487)	0.377 (0.254)
DEBT/EQUITY	-1.160 (0.534)	-0.144 (0.212)	0.145 (0.088)	-1.758 (0.619)	-0.187 (0.312)	0.149 (0.114)
OPTIONS/SHARES x 10^2	1.241 (0.804)	1.719 (0.793)	-1.355 (1.774)	1.719 (0.792)	1.606 (0.748)	-0.979 (0.967)
RESTRICTEDSTOCK x 10^{-6}				-1.427 (0.744)	0.054 (0.397)	0.154 (0.199)
NONSTOCK x 10^{-6}				-4.064 (1.147)	-1.419 (0.769)	-1.172 (0.888)
PRICETREND				-3.434 (1.545)	0.433 (0.509)	-0.257 (0.264)
SIZE x 10^{-10}	-1.051 (0.604)	-2.009 (0.984)	0.054 (0.190)	0.013 (0.732)	-6.735 (1.472)	0.660 (0.394)
COMMUNICATIONS	-2.640 (1.202)	0.194 (0.605)	-0.642 (0.865)	-1.003 (0.686)	-0.468 (0.651)	0.591 (0.643)
TRADE/SERVICES	-0.259 (0.673)	-0.139 (0.783)	-0.810 (1.125)	-0.578 (0.746)	0.083 (0.812)	0.189 (0.699)
FINANCE	-1.772 (0.944)	-2.007 (0.953)	0.451 (0.927)	-1.705 (0.749)	0.497 (0.647)	-0.300 (0.756)
CONSTANT	-0.361 (0.803)	-3.341 (0.844)	-2.467 (0.986)	-0.205 (0.890)	-1.192 (0.950)	-3.612 (0.939)
MAXIMIZED LIKELIHOOD	-141.852			-121.758		
ADJUSTED R	0.697			0.739		

Table 9a: Coefficient Estimates -- Three-Choice Models (3-I) through (3-III)/ Basic Sample

Choice-based sampling multinomial logit estimation;
standard errors in parenthesis

	(3-I): repurchase omitted		(3-II): retention omitted	
	retention equation	dividend increase/ repurchase equation	repurchase equation	dividend increase/ repurchase equation
INSTITUTIONAL	1.045 (0.683)	0.134 (0.726)	4.689 (1.428)	1.569 (1.296)
CASHFLOW x 10	-1.280 (0.456)	0.783 (0.288)	-0.226 (0.346)	0.728 (0.284)
q x 10^{-1}	-1.488 (0.658)	0.222 (0.216)	0.144 (0.366)	0.213 (0.221)
DEBT/EQUITY	-0.166 (0.144)	0.184 (0.089)	-1.257 (0.649)	0.185 (0.084)
OPTIONS/SHARES x 10^2	2.612 (0.842)	-1.647 (1.735)	2.772 (1.017)	-1.597 (1.853)
CONSTANT	-3.715 (0.712)	-2.401 (0.663)	-3.428 (1.013)	-3.021 (0.806)

		(3-III): dividend increase/ repurchase omitted		
		repurchase equation	retention equation	
INSTITUTIONAL		2.449 (0.927)	1.186 (0.719)	
CASHFLOW x 10		-0.267 (0.314)	-0.935 (0.370)	
q x 10^{-1}		0.012 (0.355)	-0.958 (0.532)	
DEBT/EQUITY		-1.533 (0.521)	-0.167 (0.148)	
OPTIONS/SHARES x 10^2		1.840 (0.696)	2.320 (0 693)	
CONSTANT		-1.700 (0.677)	-4.343 (0.634)	

Table 9b: Coefficient Estimates -- Three-Choice Model (3-IV)/
Basic Sample

Choice-based sampling multinomial logit estimation;
standard errors in parenthesis

| | four alternative model with repurchase equation coefficients normalized to zero | | | repurchase equation coeffficients normalized to zero | |
| | | | | (3-IV): dividend increase omitted | |
	dividend increase equation	retention equation	dividend increase/ repurch. equation	retention equation	dividend increase/ repurch. equation
INSTITUTIONAL	-2.528 (0.989)	-1.155 (0.852)	-2.141 (1.051)	-0.830 (0.760)	-2.120 (1.108)
CASHFLOW x 10	0.305 (0.307)	-0.665 (0.379)	1.043 (0.355)	-0.723 (0.438)	1.041 (0.395)
q x 10^{-1}	-0.012 (0.324)	-1.033 (0.575)	0.210 (0.346)	-0.933 (0.528)	0.186 (0.450)
DEBT/EQUITY	1.498 (0.519)	1.355 (0.522)	1.680 (0.519)	1.195 (0.524)	1.545 (0.544)
OPTIONS/SHARES x 10^2	-1.870 (0.729)	0.469 (0.400)	-3.368 (1.715)	0.365 (0.372)	-2.718 (1.654)
CONSTANT	1.718 (0.684)	-2.663 (0.754)	-0.758 (0.814)	-2.685 (0.741)	-0.822 (0.793)

Table 10a: Coefficient Estimates -- Two-Choice Models (2-I) through (2-V)/ Basic Sample

Choice-based sampling multinomial logit estimation;
standard errors in parenthesis

	dividend increase equation coefficients normalized to zero			repurchase equation coefficients normalized to zero	
	(2-I): repurch., retention omitted	(2-II): repurch., dividend increase/ repurch. omitted	(2-III): retention, dividend increase/ repurch. omitted	(2-IV): retention, dividend increase omitted	(2-V): dividend increase/ repurch., dividend increase omitted
	dividend increase/ repurch. equation	retention equation	repurch. equation	dividend increase/ repurch. equation	retention equation
INSTITUTIONAL	1.549 (1.434)	0.894 (0.575)	4.882 (1.599)	-3.482 (2.918)	-0.891 (0.851)
CASHFLOW x 10	0.745 (0.289)	-1.227 (0.431)	-0.134 (0.378)	0.946 (0.471)	-0.643 (0.442)
q x 10^{-1}	0.183 (0.226)	-1.383 (0.607)	0.204 (0.359)	0.062 (0.462)	-0.790 (0.606)
DEBT/EQUITY	0.192 (0.088)	-0.182 (0.166)	-1.226 (0.637)	1.227 (1.078)	1.177 (0.535)
OPTIONS/SHARES x 10^2	-2.312 (2.029)	2.554 (0.827)	2.873 (1.061)	-3.194 (1.752)	0.362 (0.381)
CONSTANT	-2.897 (0.882)	-3.730 (0.668)	-3.720 (1.114)	0.483 (1.704)	-2.821 (0.794)

Table 10b: Coefficient Estimates -- Two-Choice Model (2-VI)/ Basic Sample

Choice-based sampling multinomial logit estimation;
standard errors in parenthesis

	four alternative model with retention equation coefficients normalized to zero			retention equation coefficients normalized to zero		
				(2-VI): repurch., dividend increase omitted		
	dividend increase equation	repurch. equation	dividend increase/ repurch. equation		dividend increase/ repurch. equation	
INSTITUTIONAL	-1.373 (0.752)	1.154 (0.858)	-0.987 (0.776)		-1.427 (0.896)	
CASHFLOW x 10	0.971 (0.379)	0.665 (0.382)	1.708 (0.424)		2.450 (0.796)	
q x 10^{-1}	1.020 (0.520)	1.033 (0.567)	1.242 (0.549)		1.791 (1.014)	
DEBT/EQUITY	0.143 (0.164)	-1.355 (0.522)	0.325 (0.167)		0.404 (0.228)	
OPTIONS/SHARES x 10^2	-2.339 (0.438)	-0.469 (0.373)	-3.837 (1.625)		-2.822 (1.515)	
CONSTANT	4.380 (0.651)	2.663 (0.749)	1.904 (0.810)		0.672 (1.232)	

Chapter Two

Managerial Contracts
at Regulated Firms

Introduction

Empirical studies of how top managers are compensated at regulated firms suggest

that regulation has important and systematic effects on managerial pay; pay is lower

and less sensitive to firm performance at regulated firms than at unregulated ones.

(Hendricks 1977; Carroll and Ciscel 1982; Murphy 1987; Joskow, Rose, and Shepard

1993.) Less well understood, however, is what shape managerial contracts at regulated

firms *should* take according to the principal-agent paradigm that has been widely

applied to both shareholder-manager and regulator-firm relationships. Literatures on

those relationships have grown up largely independent of one another and, as a result,

do not yield predictions about situations in which intra-firm (shareholder-manager)

and inter-firm (regulator-firm) agency problems intersect.

This chapter presents an integrated model of shareholder-manager and regulator-

firm agency relations. It begins with the classical economic paradigm for managerial

compensation at unregulated firms: principal-agent contracting under moral hazard.

(Jensen and Meckling 1976; Holmstrom 1979; Shavell 1979; Grossman and Hart 1983; Arrow 1985; Fudenberg and Tirole 1990; Jensen and Murphy 1990.) In that standard paradigm, the shareholders (the principal) put the manager (the agent) on a profit-sharing incentive contract to induce the manager to maximize profits. I introduce regulation into the standard paradigm and compare the resulting managerial contract with the contract predicted by the standard paradigm. I find that regulation (operating to reduce the variability of the firm's performance) reduces the level of managerial pay, consistent with the empirical evidence. I also find that regulation lowers the performance-sensitivity of managerial pay, consistent with the empirical evidence, when managerial effort is sufficiently high. The characterization of regulation as a buffer against highly variable firm performance is consistent with the empirical evidence (Murphy 1987; Joskow, Rose, and Shepard 1993) and also coincides with the prescriptions of optimal regulation in simple settings (though not necessarily in general).

The effects of regulation on managerial pay in my model reflect the fact that regulation changes the objective function of the regulated firm and, as a result, changes the shape of the managerial contract that the firm wishes to offer. With less variable firm performance under regulation, the returns to inducing high managerial effort are lower, as less is at stake for the firm. The effort level that shareholders wish to induce is therefore lower in the presence of regulation than in its absence. Managerial compensation is lower on average as a result; managers from whom less is demanded are paid less generously. Managerial pay is also less variable under regulation, as

managers need not be rewarded as much for good firm performance to induce the (lower) desired level of effort. However, because firm performance is also less variable in regulated settings, the ultimate effect of regulation on the performance-sensitivity of pay may differ from its effect on the variability of pay. The direction of the performance-sensitivity effect turns on the relative magnitudes of the pay variability and performance variability effects, a comparison that either is ambiguous or (when managerial effort is sufficiently high) favors the former effect. The dominance of the pay variability effect when managerial effort is sufficiently high implies that regulation is certain to reduce the performance-sensitivity of pay in that circumstance.

Differences in managerial pay in the regulated and unregulated settings may also reflect factors other than the change in the regulated firm's objective function. Political constraints may lead to systematic departures from optimal contracting (Jensen and Murphy 1990), and such constraints are likely to be stronger for regulated firms, whose behavior is regularly subjected to public scrutiny, than for unregulated ones (Joskow, Rose, and Shepard 1993; Joskow, Rose, and Wolfram 1994). Whereas distributional and other political considerations that shape the regulatory process make themselves felt through changes in the objective function of the regulated firm (see section 2.1 below), political constraints act as direct barriers to optimizing behavior by firms. The effects of regulation on the level and structure of managerial pay may reflect some combination of the change in the regulated firm's objective function and the change in the governing political constraints.

Section 1 of this chapter describes the basic features of my model. Section 2 char-

acterizes optimal managerial contracts in the unregulated and regulated settings and provides a series of comparative results that hold for any regulatory regime that reduces the variability of the regulated firm's performance. Section 3 characterizes the optimal regulatory regime for a simple version of section 1's model and identifies sufficient conditions for optimal regulation to reduce the variability of firm performance in that setting. Finally, section 4 concludes.[1]

1   Model

A single-product firm faces demand $D(p)$, with $D' \leq 0$, and marginal cost c. Marginal cost is observable and verifiable and is a stochastic function of the effort exerted by the manager who runs the firm. The manager's effort level, $e \in [\underline{e}, \bar{e}]$, is unobservable and, thus, subject to moral hazard. Following Grossman and Hart

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[1]The contracting model developed in this chapter differs from the model in Laffont and Tirole (1993, ch. 17) in that it starts from the classical moral hazard paradigm (risk-averse agent, unobservable action, stochastic outcome), whereas Laffont and Tirole's model combines moral hazard and adverse selection but assumes no risk aversion and no uncertainty. Introducing risk aversion and uncertainty gives rise to the incentives-risk tradeoff on which the classical moral hazard paradigm focuses and, therefore, permits me to compare the managerial contract offered by the regulated firm with the benchmark contract predicted by the classical paradigm.

Pint (1991), like Laffont and Tirole, examines a setting in which both shareholder-manager and regulator-firm agency relations are present but does not address how regulation alters the managerial contract predicted by the classical principal-agent paradigm. (Pint's model focuses on how regulation affects capital/labor ratios and pricing conditions.) Demski and Sappington (1987) allow for agency problems between regulators and *their* principals, legislatures, but the analysis of agency issues higher up in the hierarchy differs from the analysis of agency issues at the level of the firm; the focus in the former case is the informational advantage of the regulator vis-a-vis the legislature, but shareholders (the middle party in the regulator-shareholder-manager hierarchy) ordinarily would not be expected to enjoy such an advantage vis-a-vis the regulator.

(1983), the manager has reservation utility $\mathcal{U}$ and objective function:

$$U(c, I(c)) = \int_c [K(e)V(I(c)) + G(e)]f(c,e)dc,$$

where K satisfies $K > 0$, V satisfies $V' > 0$ and $V'' < 0$, $I(c)$ is the manager's compensation as a function of c, and $f(c,e)$ is the density of c as a function of e.[2]

I examine two environments in the model. The first is the "market environment," in which the firm is unregulated and charges a price $p(c)$ to consumers when its marginal cost is c. If the firm is a monopolist, then $p(c)$ is the price that maximizes $D(p)(p - c)$. If the firm is a price-taker, then $p(c)$ is the competitive price (and $D(p)$ may be interpreted as the maximum quantity that the firm is able to produce). In either case, the model in the market environment reduces to the standard model of principal-agent contracting under moral hazard (see section 2.1). I assume that $p(c)$ is such that the firm's profit increases (or, at least, does not decrease) when its marginal cost falls.[3]

The second environment examined below is the "regulatory environment," in which the firm is subject to economic regulation. Following Schmalensee (1989), I assume that the regulator imposes a limit $\hat{p}(c)$ on what the firm may charge its customers when its marginal cost is c and that (for each c) $\hat{p}(c)$ must yield nonnegative profits for the firm $(D(\hat{p})(\hat{p} - c) \geq 0)$.[4] The regulator's objective function takes

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[2] I also assume that the further technical assumptions in assumption A1 of Grossman and Hart (1983) are satisfied.

[3] This assumption is always satisfied with monopoly pricing.

[4] Schmalensee also considers the case in which the firm's profit must be nonnegative only on average. See footnote 14 below for a discussion of that case.

the standard form of a weighted average of consumer surplus and the firm's profit (Laffont and Tirole 1986, 1993; Schmalensee 1989):

$$\int_c \int_{\hat{p}(c)}^{P(0)} D(\tilde{p}) f(c,e) d\tilde{p} dc + (1-\lambda) \int_c \left\{ D(\hat{p}(c))[\hat{p}(c) - c] - I(c) \right\} f(c,e) dc, \quad (1)$$

where $P \equiv D^{-1}$ and $\lambda \in (0,1)$. The manager's utility does not enter into the regulator's objective function because that utility is always equal to the reservation value $\mathcal{U}$ under an optimal managerial contract (see section 2.1). $\lambda > 0$ in (1) reflects the regulator's distributional preference for consumers over producers.

After the regulator has chosen $\hat{p}(c)$, the firm sets its managerial compensation scheme $I(c)$. I model the managerial contract phase as subsequent to the regulatory design phase because regulatory arrangements tend to be of greater longevity than managerial incentive schemes (which are generally reset each year).

To simplify analysis and exposition (and facilitate the definition of the performance-sensitivity of managerial pay (see section 2.2)), I assume below that the cost c takes on one of two possible values, c_1 and $c_2 > c_1$. I also make the standard assumption that the densities $\Pi_1(e) \equiv f(c_1, e)$ and $\Pi_2(e) \equiv f(c_2, e)$ satisfy the monotone likelihood ratio property (MLRP): $\Pi_1'(e)/\Pi_1(e) > \Pi_2'(e)/\Pi_2(e)$ for all e. Differentiating both sides of the identity $\Pi_1(e) + \Pi_2(e) = 1$ with respect to e yields $\Pi_1'(e) + \Pi_2'(e) = 0$; together with MLRP, this identity implies that the probability of the better outcome ($c = c_1$) is increasing in e, or $\Pi_1'(e) > 0$. The values $\bar{e}$ and $\underline{e}$ are then defined by $\Pi_1(\bar{e}) = 1$ and $\Pi_2(\underline{e}) = 1$.

For any e, the shareholders' choice of an optimal managerial incentive scheme involves minimizing expected compensation payments subject to incentive compatibility and participation constraints for the manager:

$$\min_{I_1, I_2} \langle \Pi_1(e)I_1 + \Pi_2(e)I_2 \rangle$$

$$\text{s.t. } e \in \arg\max_{e'} \langle U(e', I_1, I_2) \rangle, \tag{2}$$

$$U(e, I_1, I_2) \geq \mathcal{U}.$$

Let $I_1^*(e)$ and $I_2^*(e)$ denote the solutions to this problem as functions of e. Also, define $AC(e) = \Pi_1(e)I_1^*(c) + \Pi_2(e)I_2^*(e)$; $AC(e)$ is the expected compensation paid to the manager under the optimal incentive scheme for inducing e. I assume that $AC(e)$ is a continuous function of e.[5]

2 Optimal Managerial Contracts

This section characterizes optimal managerial contracts in the market and regulatory environments. Given $I_1^*(e)$ and $I_2^*(e)$ defined above, an optimal managerial contract is fully characterized by an optimal effort level e. I compare the optimal effort levels in the market and regulatory environments and then use that comparison to examine the relationship between the levels of managerial pay, and degrees of performance-sensitivity of managerial pay, in the two settings. I find that regula-

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[5]Sufficient conditions for the continuity of $AC(e)$ are that K, V, and G are continuous and that the incentive compatibility constraint in (2) can be replaced by the first-order condition $\partial U / \partial e = 0$.

tion (operating to reduce the variability of the firm's performance) lowers the level of managerial pay, consistent with the empirical evidence. I also find, focusing on the original version of the moral hazard problem studied by Holmstrom (1979) and Shavell (1979), that regulation lowers the performance-sensitivity of managerial pay, consistent with the empirical evidence, when managerial effort is sufficiently high.

2.1 Contract Design

In the market environment, the optimal effort level e is the value that maximizes shareholder wealth over $[\underline{e}, \overline{e}]$:

$$\max_{e} \; \langle \Pi_1(e)[D(p_1)(p_1 - c_1)] + \Pi_2(e)[D(p_2)(p_2 - c_2)] - AC(e) \rangle \tag{3}$$

$$\text{s.t.} \;\; e \in [\underline{e}, \overline{e}].$$

The objective function in (3) is the difference between the firm's expected profit and the expected compensation paid to the manager. The problem may be written without reference to the choice of prices p_1 and p_2 (even if the firm is a price-setting monopolist rather than a price-taking competitor) because the choice of prices is independent of the choice of e.[6] Let $P_i \equiv D(p_i)(p_i - c_i)$, $i = 1, 2$, and let e^* denote a solution to the problem in (3).

In the regulatory environment, the firm chooses its managerial contract optimally given the price limits $\hat{p}_1$ and $\hat{p}_2$ chosen by the regulator. The regulator is thus able to

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[6]If the firm is a monopolist, p_i ($i = 1, 2$) is defined by the condition $\Pi_i(e)[D'(p_i)(p_i - c_i) + D(p_i)] = 0$, which (after dividing by $\Pi_i(e)$), is simply the standard monopoly pricing condition.

influence the choice of a managerial contract through its choice of $\hat{p}_1$ and $\hat{p}_2$. However, the contract that the manager ultimately confronts must be one that maximizes the joint surplus of the regulated firm and the manager given $(\hat{p}_1, \hat{p}_2)$; if a (nominal) managerial contract failed to maximize that surplus (because, say, the regulator had mandated a specific contract that was not optimal for the firm-manager unit), then the firm and the manager would have an incentive to "undo" the effects of the nominal contract by means of a secret side contract between them.[7] The optimal managerial contract in the regulatory environment maximizes shareholder wealth (now a function of $(\hat{p}_1, \hat{p}_2)$) over $[\underline{e}, \bar{e}]$:

$$\max_e \ \langle \Pi_1(e)[D(\hat{p}_1)(\hat{p}_1 - c_1)] + \Pi_2(e)[D(\hat{p}_2)(\hat{p}_2 - c_2)] - AC(e) \rangle \qquad (4)$$

$$\text{s.t. } e \in [\underline{e}, \bar{e}].$$

The problem in (4) is identical to the contract design problem in the market environment except that $\hat{p}_1$ and $\hat{p}_2$ replace p_1 and p_2 in the shareholders' objective function. Let $\hat{P}_i \equiv D(\hat{p}_i)(\hat{p}_i - c_i)$, $i = 1, 2$, and let $\hat{e}^*$ denote a solution to this problem.

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[7]The regulator could prevent the legal enforcement of such a contract (Jolls 1993), but an implicit side contract between the firm and the manager would be sustainable under a variety of circumstances. In particular, such a contract would be sustainable if the horizon were uncertain or infinite or the firm-manager relationship were characterized by private information and the horizon not too short (Fudenberg and Tirole 1991, 367-391). A remaining question is whether the conditions that make implicit contracting between the firm and the manager possible also imply that the firm would want *not* to side-contract with the manager in return for a side payment from the regulator. The problem with such an arrangement is that earlier regulators have no means of committing later regulators to make good on side payments, which could not be paid out to the firm until it had a cost history sufficiently long to allow a regulator to infer (from the firm's performance) that it had not been engaging in side-contracting with the manager.

The objective functions in (3) and (4) may be rewritten as $\Pi_1(e)\Delta P + P_2 - AC(e)$

and $\Pi_1(e)\Delta\hat{P} + \hat{P}_2 - AC(e)$ respectively, where $\Delta P \equiv P_1 = P_2$ and $\Delta\hat{P} \equiv \hat{P}_1 - \hat{P}_2$.

Then, by revealed preference:

$$\Pi_1(e^*)\Delta P + P_2 - AC(e^*) \geq \Pi_1(\hat{e}^*)\Delta P + P_2 - AC(\hat{e}^*),$$

$$\Pi_1(\hat{e}^*)\Delta\hat{P} + \hat{P}_2 - AC(\hat{e}^*) \geq \Pi_1(e^*)\Delta\hat{P} + \hat{P}_2 - AC(e^*).$$

Adding:

$$[\Pi_1(e^*) - \Pi_1(\hat{e}^*)](\Delta P - \Delta\hat{P}) \geq 0. \tag{5}$$

The inequality in (5) relates the difference in optimal managerial effort in the market and regulatory environments $\dagger$ the difference between ΔP and $\Delta\hat{P}$. In turn, the difference between ΔP and $\Delta\hat{P}$ reflects the difference between the variability of firm performance in the market environment and the variability of firm performance in the regulatory environment. The difference between ΔP and $\Delta\hat{P}$ therefore reflects the effect of regulation on the objective function of the firm. T: s, the inequality in (5) links differences in optimal managerial contracts in the unregulated and regulated settings to the corresponding changes in the objective function of the regulated firm.

2.2 Comparisons

I now compare optimal managerial contracts in the market and regulatory environments. I examine, first, the comparison between the levels of managerial pay in the two environments and, second, the relative performance-sensitivity of pay in

these settings. My results hold for any regulatory regime that reduces the variability of the firm's performance: $\Delta\hat{P} < \Delta P$.

This characterization of regulation is consistent with empirical findings on the effect of regulation on firm returns. For example, Joskow, Rose, and Shepard (1993) find that annual stock market return variance was about 25 percent less for regulated firms than for unregulated firms over the 1970 to 1990 period, and that annual accounting return variance was about 10 percent less in the regulated sector than in the unregulated sector over that period.[8] While the variance of firm performance is not identical to the variability of firm performance, the two measures are related; for example, in section 1's model, if firm performance is either $\hat{P}_1$ or $\hat{P}_2$, then the variance of firm performance is $\Pi_1(e)\Pi_2(e)(\Delta\hat{P})^2$, while the variability of firm performance is $\Delta\hat{P}$.

Other empirical findings on the variance of firm performance under regulation also indicate lower variance than in unregulated settings. For instance, Murphy (1987) finds that five year stock market return variance was more than 50 percent less for regulated firms than for unregulated firms over the 1964-1983 period.

By (5), $\Delta\hat{P} < \Delta P$ implies that e^*, the optimal managerial effort in the market environment, is at least as high as $\hat{e}^*$, the optimal managerial effort in the regulatory en-

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[8]In the case of stock market return, the mean values in the regulated and unregulated sectors were almost identical, so direct comparison of the variance values seems clearly appropriate. In the case of accounting return, the regulated sector mean was lower than the unregulated sector mean, and the mean-scaled variance was actually slightly higher in the regulated sector than in the unregulated sector. However, the trend in executive compensation packages has been towards stock-based compensation (McLaughlin 1991), and, therefore, the key measure is stock market return variance as opposed to accounting return variance.

vironment. Meanwhile, as long as e^* and $\hat{e}^*$ are interior solutions, they must satisfy the necessary first-order conditions $\Pi_1'(e^*)\Delta P - AC'(e^*) = 0$ and $\Pi_1'(\hat{e}^*)\Delta P - AC'(\hat{e}^*) = 0$ (see (3) and (4)).[9] So if $e^* \geq \hat{e}^*$ holds with equality, then:

$$\Pi_1'(e^*)\Delta P - AC'(e^*) = \Pi_1'(e^*)\Delta \hat{P} - AC'(e^*),$$

which contradicts $\Delta \hat{P} < \Delta P$. It follows that $\Delta \hat{P} < \Delta P$ implies $e^* > \hat{e}^*$ (optimal managerial effort is higher in the market environment than in the regulatory environment).

The difference between optimal managerial effort in the market and regulatory environments reflects the difference in the returns to effort in the two settings. Because regulation reduces the variability of firm performance ($\Delta \hat{P} < \Delta P$), it reduces the benefit of inducing a higher level of managerial effort. The optimal effort level is therefore lower in the regulatory environment than in the market environment.

The relationship between e^* and $\hat{e}^*$ generates comparisons between the levels of managerial pay and the degrees of performance-sensitivity of pay in the market and regulatory environments. The following sub-sections examine these two dimensions of comparison in turn.

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[9]Section 2.2.2 gives sufficient conditions for interior solutions in the version of the moral hazard problem studied by Holmstrom (1979) and Shavell (1979).

2.2.1 Level of Managerial Pay

Proposition 1: The optimal managerial contract in the regulatory environment provides lower expected compensation than the optimal managerial contract in the market environment.

Proof: Expected compensation under an optimal managerial contract is given by $AC(\hat{e}^*)$ in the regulatory environment and by $AC(e^*)$ in the market environment. Suppose $AC(\hat{e}^*) \geq AC(e^*)$; then, since $\Pi_1'(e) > 0$, increasing managerial effort from $\hat{e}^*$ to e^* would unambiguously increase the value of the objective function in (4). But this would contradict the optimality of $\hat{e}^*$.　　　　■

Intuitively, the lower level of effort under an optimal managerial contract in the regulatory environment must translate to lower expected compensation. If expected compensation were higher in the regulatory environment, then the shareholders of the regulated firm would prefer to switch to the market environment maximand e^*, as such a switch would increase the firm's expected profit $(\Pi_1(e)\Delta\hat{P} + \hat{P}_2)$ while reducing expected compensation payments $(AC(e))$. Only if expected compensation is lower in the regulatory environment than in the market environment can the maximand $\hat{e}^*$ be optimal for the shareholders of the regulated firm.

The conclusion that compensation is lower on average in the regulatory environment is consistent with empirical findings on the level of managerial pay at regulated and unregulated firms. For instance, Joskow, Rose, and Shepard (1993) find that chief executive officers (CEOs) of regulated firms earned significantly less than their counterparts in unregulated industries over the period from 1970 to 1990, with dis-

counts ranging from 60 to 70 percent for regulated electric utilities to 25 percent for natural gas pipelines. Likewise, Murphy (1987) finds that CEOs of regulated utilities earned between 41 and 53 percent less than CEOs in unregulated industries over the 1964-1983 period, while Carroll and Ciscel (1982) find that CEOs of regulated utilities earned approximately 30 percent less than CEOs in unregulated industries over the period from 1970 to 1976. Carroll and Ciscel also find that CEOs of transportation companies, which faced various forms of minimum price controls over the 1970-1976 period, earned approximately 40 percent less than CEOs in unregulated industries over that period [10]

The empirical evidence indicates that chief executives at regulated firms earn substantially less on average than similarly situated individuals in unregulated industries. Proposition 1 above reveals that this pattern is predicted by optimal contracting between regulated firms and their managers. Whenever regulation reduces the variability of the firm's performance (as appears to be true empirically), it reduces the benefit associated with inducing high managerial effort. Lower effort in turn translates to lower expected compensation.

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[10] All of the studies described in the text control for firm size (measured by sales), and the two more recent studies (by Joskow, Rose, and Shepard and by Murphy) also control for such additional variables as CEO tenure, CEO age, whether the CEO founded the company, whether the CEO was an outside hire or an internal promotion, the number of employees at the firm, the value of the firm's assets, the firm's accounting or stock market return, and the percent of the firm's stock owned by the CEO.

2.2.2 Performance-Sensitivity of Managerial Pay

I now examine the effect of regulation on the performance-sensitivity of managerial pay. In a two-outcome model (such as the model of section 1), the incentive contracts offered to managers are necessarily linear, as they specify only two compensation levels; thus, the performance-sensitivity of pay (defined as the derivative of managerial pay with respect to firm performance) is simply the difference in managerial pay between the low and high cost states divided by the difference in the firm's performance between the two states.

The difference in managerial pay between the low and high cost states is $\Delta I^*(e^*)$ in the market environment and $\Delta I^*(\hat{e}^*)$ in the regulatory environment, where $\Delta I^*(e) \equiv I_1^*(e) - I_2^*(e)$. Meanwhile, firm performance may be defined either as profit gross of managerial pay (ΔP in the market environment; $\Delta \hat{P}$ in the regulatory environment) or as profit net of managerial pay ($\Delta P - \Delta I^*(e^*)$ in the market environment; $\Delta \hat{P} - \Delta I^*(\hat{e}^*)$ in the regulatory environment). Regulation reduces the performance-sensitivity of pay in the former case if and only if:

$$\frac{\Delta I^*(\hat{e}^*)}{\Delta \hat{P}} < \frac{\Delta I^*(e^*)}{\Delta P}, \tag{6}$$

and it reduces the performance-sensitivity of pay in the latter case if and only if:

$$\frac{\Delta I^*(\hat{e}^*)}{\Delta \hat{P} - \Delta I^*(\hat{e}^*)} < \frac{\Delta I^*(e^*)}{\Delta P - \Delta I^*(e^*)}. \tag{7}$$

To evaluate whether the inequalities in (6) and (7) hold, I place some additional structure on the model of section 1. I focus on the version of the moral hazard

problem originally analyzed by Holmstrom (1979) and Shavell (1979), in which the agent's utility $\tilde{U}(e, I)$ takes the form $V(I) - \tilde{G}(e)$ (in terms of section 1's model, $K(e) = 1$ and $G(e) = -\tilde{G}(e)$). I assume that $\tilde{G}$ satisfies $\tilde{G}' \geq 0$, and I impose the following technical conditions, which ensure interior solutions to the contract design problems in the market and regulatory environments:

$$\tilde{G}'(\underline{e}) = 0; \tag{8}$$

$$\Delta P \leq H(\mathcal{U} + \tilde{G}(\bar{e})) - H(\mathcal{U} + \tilde{G}(\bar{e}) - \tilde{G}'(\bar{e})), \tag{9}$$

where $H \equiv V^{-1}$. I also assume that the following inequality holds for all e:

$$\Pi_1''(e)\tilde{G}'(e) - \Pi_1'(e)\tilde{G}''(e) < 0. \tag{10}$$

The condition in (10) ensures that the manager's utility maximization problem is concave, which in turn permits one to replace the incentive compatibility constraint in (2) with the first-order condition $\partial U/\partial e = 0$.

The first-order condition $\partial U/\partial e = 0$ in the Holmstrom-Shavell version of section 1's model is:

$$\Pi_1'(e)[V(I_1) - V(I_2)] - \tilde{G}'(e) = 0. \tag{11}$$

Meanwhile, by the argument in Grossman and Hart (1983), the participation constraint in (2) must bind at a solution to the contract design problem, implying:

$$\Pi_1(e)V(I_1) + \Pi_2(e)V(I_2) - \tilde{G}(e) = \mathcal{U}. \tag{12}$$

Combining (11) and (12):

$$V(I_1) = \mathcal{U} + \tilde{G}(e) + \frac{\Pi_2(e)\tilde{G}'(e)}{\Pi_1'(e)},$$

$$V(I_2) = \mathcal{U} + \tilde{G}(e) + \frac{-\Pi_1(e)\tilde{G}'(e)}{\Pi_1'(e)}.$$

These expressions specify the values of I_1 and I_2 that satisfy the constraints in (2) for a given value of e. It follows that, for any e, the solution $(I_1^*(e), I_2^*(e))$ to (2) is defined by:

$$I_1^*(e) = H\left(\mathcal{U} + \tilde{G}(e) + \frac{\Pi_2(e)\tilde{G}'(e)}{\Pi_1'(e)}\right), \tag{13}$$

$$I_2^*(e) = H\left(\mathcal{U} + \tilde{G}(e) + \frac{-\Pi_1(e)\tilde{G}'(e)}{\Pi_1'(e)}\right). \tag{14}$$

By (13) and (14), $I_1^*(e) \geq I_2^*(e)$ for any e, implying that the manager is rewarded when the firm's costs are low. Meanwhile, differentiating (13) and (14) and canceling terms:

$$\frac{\partial I_1^*}{\partial e} = H'(V(I_1^*))\left[\frac{\Pi_2(e)}{[\Pi_1'(e)]^2}\right][\Pi_1'(e)\tilde{G}''(e) - \Pi_1''(e)\tilde{G}'(e)] \geq 0, \tag{15}$$

$$\frac{\partial I_2^*}{\partial e} = -H'(V(I_2^*))\left[\frac{\Pi_1(e)}{[\Pi_1'(e)]^2}\right][\Pi_1'(e)\tilde{G}''(e) - \Pi_1''(e)\tilde{G}'(e)] \leq 0. \tag{16}$$

Thus, inducing higher levels of effort requires increasing the manager's pay in the low cost state and reducing the manager's pay in the high cost state. The move from the optimal effort level in the market environment (e^*) to the optimal effort level in the regulatory environment ($\hat{e}^*$) therefore reduces the variability of managerial pay: $\Delta I^*(\hat{e}^*) < \Delta I^*(e^*)$.

The reduction in the variability of managerial pay under regulation does not necessarily imply lower sensitivity of pay to performance, as the variability of firm performance also falls with regulation. The relative magnitude of the two competing effects may be examined using the first-order conditions that define the optimal managerial effort levels in the market and regulatory environments. The derivatives of the objective functions in the contract design problems in the market and regulatory environments are:

$$\Pi_1'(e)[\Delta P - \Delta I^*(e)] - \Pi_1(e)\left[\frac{\partial I_1^*}{\partial e}\right] - \Pi_2(e)\left[\frac{\partial I_2^*}{\partial e}\right],$$

$$\Pi_1'(e)[\Delta \hat{P} - \Delta I^*(e)] - \Pi_1(e)\left[\frac{\partial I_1^*}{\partial e}\right] - \Pi_2(e)\left[\frac{\partial I_2^*}{\partial e}\right].$$

The first of these derivatives is positive at $e = \underline{e}$, as $I_1^*(\underline{e}) = I_2^*(\underline{e})$, $\Pi_1(\underline{e}) = 0$, and $\partial I_2^*(e)/\partial e|_{e=\underline{e}} = 0$. It follows that the constraint $e \geq \underline{e}$ in the market environment contract design problem must be slack. Meanwhile, each of the above derivatives is negative at $e = \bar{e}$, by (9) and $\Delta \hat{P} < \Delta P$, so the constraint $e \leq \bar{e}$ in both the market environment contract design problem and the regulatory environment contract design problem must be slack.

Since $e \in (\underline{e}, \bar{e})$ in the market environment contract design problem, a maximand e^* must satisfy the necessary first-order condition:

$$\Pi_1'(e^*)[\Delta P - \Delta I^*(e^*)] - \Pi_1(\varepsilon^*)\left[\frac{\partial I_1^*}{\partial e}\right] - \Pi_2(e^*)\left[\frac{\partial I_2^*}{\partial e}\right] = 0. \tag{17}$$

This necessary condition may be satisfied by more than one value of e; the maximand

e^* is the value (assumed unique) among those satisfying (17) that maximizes the objective function in (3) over $(\underline{e}, \bar{e})$. Meanwhile, in the regulatory environment, a maximand $\hat{e}^*$ satisfies an analogous first-order condition unless $\Delta \hat{P}$ is negative and sufficiently large in absolute magnitude that the solution to (4) is a corner solution with $\hat{e}^* = \underline{e}$. As long as optimal managerial effort in the regulatory environment is greater than $\underline{e}$, the value $\hat{e}^*$ will satisfy a first order condition analogous to (17).

Proposition 2: Assume that $\tilde{U}(e, I) = V(I) - \tilde{G}(e)$ with $\tilde{G}' \geq 0$ and that (8) - (10) hold. Then the performance-sensitivity of pay under the optimal managerial contract is lower in the regulatory environment than in the market environment if the manager's effort under the optimal managerial contract in the regulatory environment is sufficiently high.

Proof: Under the stated condition on optimal managerial effort in the regulatory environment, $\hat{e}^*$ must satisfy the necessary first-order condition:

$$\Pi_1'(\hat{e}^*)[\Delta \hat{P} - \Delta I^*(\hat{e}^*)] - \Pi_1(\hat{e}^*)\left[\frac{\partial I_1^*}{\partial e}\right] - \Pi_2(\hat{e}^*)\left[\frac{\partial I_2^*}{\partial e}\right] = 0. \tag{18}$$

In turn, (17) and (18) permit one to express the performance-sensitivity inequalities in (6) and (7) in terms of $\hat{e}^*$ and e^*:

$$\frac{\Delta I^*(\hat{e}^*)}{\Delta I^*(\hat{e}^*) + W(\hat{e}^*)} < \frac{\Delta I^*(e^*)}{\Delta I^*(e^*) + W(e^*)}, \tag{19}$$

$$\frac{\Delta I^*(\hat{e}^*)}{W(\hat{e}^*)} < \frac{\Delta I^*(e^*)}{W(e^*)}, \tag{20}$$

where:

$$W(e) = \left[\frac{1}{\Pi_1'(e)}\right]\left\{\Pi_1(e)\left[\frac{\partial I_1^*}{\partial e}\right] + \Pi_2(e)\left[\frac{\partial I_2^*}{\partial e}\right]\right\}. \qquad (21)$$

In (19), $\Delta I^*(e) + W(e)$ is substituted for the variability of the firm's gross profit (ΔP or $\Delta \hat{P}$); likewise, in (20), $W(e)$ is substituted for the variability of the firm's gross profit ($\Delta P - \Delta I^*(e)$ or $\Delta \hat{P} - \Delta I^*(\hat{e}^*)$).

Cross-multiplying, (19) is:

$$\Delta I^*(\hat{e}^*)[\Delta I^*(e^*) + W(e^*)] < \Delta I^*(e^*)[\Delta I^*(\hat{e}^*) + W(\hat{e}^*)].$$

Subtracting $\Delta I^*(\hat{e}^*)\Delta I^*(e^*)$ from both sides and then dividing yields (20). Thus, whether firm performance is defined as profit gross of managerial pay, as in (6) and (19), or as profit net of managerial pay, as in (7) and (20), regulation reduces the performance-sensitivity of pay if and only if the inequality in (20) holds.

As noted above, $\Delta I^*(e)$ is an increasing function of e (implying $\Delta I^*(\hat{e}^*) < \Delta I^*(e^*)$). Meanwhile, rewriting (21) using (15) and (16):

$$W(e) = \frac{\Pi_1(e)\Pi_2(e)}{[\Pi_1'(e)]^3}\left[\frac{1}{V'(I_1^*)} - \frac{1}{V'(I_2^*)}\right][\Pi_1'(e)\tilde{G}'''(e) - \Pi_1''(e)\tilde{G}'(e)]. \qquad (22)$$

Differentiating:

$$\frac{\partial W}{\partial e} = \left[\frac{\Pi_2(e) - \Pi_1(e)}{[\Pi_1'(e)]^2}\right]\left[\frac{1}{V_1'} - \frac{1}{V_2'}\right]\mathcal{K}(e) + \left[\frac{-2\Pi_1(e)\Pi_2(e)\Pi_1''(e)}{[\Pi_1'(e)]^5}\right]\left[\frac{1}{V_1'} - \frac{1}{V_2'}\right]\mathcal{K}(e)$$

$$+\frac{\Pi_1(e)\Pi_2(e)}{[\Pi_1'(e)]^3}\left\{\left[\frac{-V_1''I_1'(e)}{(V_1')^2} + \frac{V_2''I_2'(e)}{(V_2')^2}\right]\mathcal{K}(e)\right.$$

$$\left. + \left[\frac{1}{V_1'} - \frac{1}{V_2'}\right][\Pi_1'(e)\tilde{G}''''(e) - \Pi_1'''(e)\tilde{G}'(e)]\right\}, \qquad (23)$$

94

where $V'_i = V'(I^*_i(e))$ and $V''_i = V''(I^*_i(e))$, $i = 1, 2$, and where:

$$\mathcal{K}(e) = \Pi'_1(e)\tilde{G}''(e) - \Pi''_1(e)\tilde{G}'(e).$$

Let $\mathcal{V}(e)$ denote the sum of the second and third of the three terms in (23); as e goes to $\bar{e}$, $\mathcal{V}(e)$ goes to zero, and $\partial \mathcal{W}/\partial e$ goes to:

$$\frac{-\Pi_1(\bar{e})}{[\Pi'_1(\bar{e})]^2} \left[\frac{1}{V'_1} - \frac{1}{V'_2} \right] \mathcal{K}(\bar{e}). \tag{24}$$

Since $I^*_1(\bar{e}) > I^*_2(\bar{e})$ and V is concave, $(V'_1)^{-1} - (V'_2)^{-1}$ is positive. It follows that the expression in (24) is negative. So $\mathcal{W}(e)$ is at least weakly decreasing in e over some nonempty range $(\tilde{e}, \bar{e})$. Therefore, for $\hat{e}^*$ in that range, moving from $\hat{e}^*$ to the market environment maximand e^* decreases $\mathcal{W}(e)$ (at least weakly), while increasing $\Delta I^*(e)$. It follows that (20) holds for $\hat{e}^*$ sufficiently large. ∎

Proposition 2 may be understood as follows. The difference in managerial pay between the low and high cost states $(\Delta I^*(e))$ must rise when e increases from $\hat{e}^*$ to e^*, as the manager can only be induced to exert more effort if the reward associated with realization of the low cost outcome (the probability of which increases with e) rises. So the variability of managerial pay is lower in the regulatory environment than in the market environment. Meanwhile, the difference in the firm's profit gross of managerial pay between the low and high cost states is also lower in the regulatory environment than in the market environment (as $\Delta \hat{P} < \Delta P$), while the difference in the firm's profit net of managerial pay between the low and high cost states may be either higher or lower under regulation, depending on the relative magnitudes of

95

$\Delta P - \Delta \hat{P}$ and $\Delta I^*(e^*) - \Delta I^*(\hat{e}^*)$. Thus, while the numerator $(\Delta I^*(e))$ of performance-sensitivity is lower in the regulatory environment than in the market environment, the denominator may be either lower or higher, and whether performance-sensitivity falls then depends on the relative rates of change of the variability of managerial pay and the variability of firm performance.

By the first-order conditions in (17) and (18), the rate of change in the variability of firm performance is given by the rate of change in $\Delta I^*(e) + \mathcal{W}(e)$. It follows that whether $\Delta I^*(e)$ falls more with a move from e^* to $\hat{e}^*$ than does the variability of firm performance depends on whether $\Delta I^*(e)$ decreases at a greater rate than $\mathcal{W}(e)$ when e is reduced. $\Delta I^*(e)$ depends directly on $I_1^*(e)$ and $I_2^*(e)$ and, as noted above, always falls with a reduction in e. Meanwhile, $\mathcal{W}(e)$, which is a weighted average of $\partial I_1^* / \partial e$ and $\partial I_2^* / \partial e$, is a second-order term that depends on the product $\Pi_1(e)\Pi_2(e)$. It therefore goes to zero as e goes to $\bar{e}$. It turns out also to approach zero from above (as shown in the proof of proposition 2), so for e sufficiently near $\bar{e}$, increases in e reduce $\mathcal{W}(e)$. Thus, for $\hat{e}^*$ (and, hence, e^*) sufficiently high, moving from the market environment to the regulatory environment (which reduces e) increases $\mathcal{W}(e)$, while decreasing $\Delta I^*(e)$. It follows that the performance-sensitivity of managerial pay falls with the move to the regulatory environment.

Lower performance-sensitivity of pay in the regulatory environment is consistent with the empirical findings of Murphy (1987) and Joskow, Rose, and Shepard (1993). Those authors find that, controlling for the firm and CEO characteristics described in subsection 2.2.1, the pay of CEOs at regulated firms is significantly less sensitive

to firm performance than is the pay of CEOs in unregulated industries. Proposition 2 indicates that this pattern of differential performance-sensitivity is predicted by optimal contracting when the level of effort under an optimal managerial contract in the regulatory environment is sufficiently high.

It should be emphasized that the effect of regulation on the performance-sensitivity of managerial pay is ambiguous when the condition on $\hat{e}^*$ stated in proposition 2 does not hold. If, for instance, $\hat{e}^*$ is less than $\breve{e}$ defined by $\Pi_1(\breve{e}) = \frac{1}{2}$, and e^* is also less than this value, then $\mathcal{W}(e)$ may fall along with $\Delta I^*(e)$ when e is reduced (see (23)). In this case, while (20) may hold, it need not; either the numerator or the denominator of the ratio $\Delta I^*(e)/\mathcal{W}(e)$ may fall at a greater rate with a move from the market environment maximand e^* to the regulatory environment maximand $\hat{e}^*$.

3 Optimal Regulation

The results described in section 2 reveal that regulation reduces the level of managerial pay and, for sufficiently high managerial effort, the performance-sensitivity of pay in situations in which the effect of regulation is to reduce the variability of the firm's performance ($\Delta \hat{P} < \Delta P$). As noted above, this characterization of regulation is consistent with the empirical evidence on how regulation affects firms' returns in practice. The present section considers whether this characterization is consistent with optimal regulation in a simplified version of section 1's model. The model in-

97

volves unit demand (consumers purchase either one unit of the good or nothing)[11] and managerial utility $V(I) - \tilde{G}(e)$, where V and $\tilde{G}$ satisfy the conditions specified in section 2.2.2. I also assume that $\tilde{G}'''$ is nonnegative and that Π_1'' and Π_1''' are nonpositive; an example of $(\tilde{G}, \Pi_1)$ satisfying these assumptions is $\tilde{G}$ quadratic ($\tilde{G}(e) = ke^2$ with $k > 0$) and $\Pi_1(e)$ linear ($\Pi_1(e) = a + be$ for $b > 0$). I refer to these assumptions on $\tilde{G}$ and Π_1 collectively as A1. Finally, I assume that (17) (the necessary first-order condition for a market environment maximand e^*) defines a unique value of e on $[\underline{e}, \bar{e}]$. A sufficient condition for a unique solution to (17) on $[\underline{e}, \bar{e}]$ is that the left-hand side of that expression is monotonic over $[\underline{e}, \bar{e}]$.[12]

In the simplified model considered in this section, optimal regulation satisfies $\Delta \hat{P} < \Delta P$ under fairly modest conditions. It should be emphasized, however, that the analysis below depends upon unit demand; with variable demand, lower price levels under regulation would increase the profitability of marginal cost reductions, and that effect might push the variability of firm performance under regulation above the variability of performance in the market environment.

With unit demand, an unregulated monopolist sets $p_1 = p_2 = v$, where v is

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[11]Laffont and Tirole (1993, chs. 1, 17) analyze optimal regulatory regimes with unit demand.

[12]The derivative of the left-hand side of (17) (with $e^* = e$) with respect to e is:

$$\Pi_1''(e)[\Delta P - \Delta \Gamma^*(e) - \mathcal{W}(e)] - \Pi_1'(e)\left[\frac{\partial \Delta \Gamma^*}{\partial e} + \frac{\partial \mathcal{W}}{\partial e}\right].$$

The former term in this expression is nonpositive at $e = \underline{e}$, as $\Pi_1'' \leq 0$ by assumption and $\Delta \Gamma^*(\underline{e}) = \mathcal{W}(\underline{e}) = 0$ by (13), (14), and (21). Meanwhile, at $e = \underline{e}$ the second term in the above expression is equal to $-\Pi_1'(\underline{e})(\partial \Gamma_1^*/\partial e) < 0$, as $\partial \Gamma_1^*/\partial e = \partial \mathcal{W}/\partial e = 0$ at $e = \underline{e}$. It follows that the left-hand side of (17) is decreasing in e at $e = \underline{e}$. Thus, monotonicity of that expression on $[\underline{e}, \bar{e}]$ implies that the expression is decreasing over $[\underline{e}, \bar{e}]$, which in turn ensures a unique solution e^* to (17).

consumers' valuation of the good, while an unregulated price-taker charges $p_1 = p_2 = \bar{p}$, where $\bar{p}$ is the competitive price.[13] It follows that ΔP is equal to $c_2 - c_1 \equiv \Delta c$. The derivative of the objective function in the market environment contract design problem is then:

$$\Pi_1'(e)[\Delta c - \Delta I^*(e) - \mathcal{W}(e)] \equiv Z(e), \tag{25}$$

and the market environment maximand e^* is defined by $Z(e^*) = 0$.

In the regulatory environment, prices are set by the regulator, as described in section 1, and $\Delta \hat{P}$ is equal to $\Delta \hat{p} + \Delta c$, where $\Delta \hat{p} \equiv \hat{p}_1 - \hat{p}_2$ for regulatory prices $\hat{p}_1$ and $\hat{p}_2$. The derivative of the objective function in the regulatory environment contract design problem is:

$$\Pi_1'(e)[\Delta \hat{p} + \Delta c - \Delta I^*(e) - \mathcal{W}(e)] \equiv \hat{Z}(e). \tag{26}$$

Consumer surplus is $v - \hat{p}_i$, and firm profit $\hat{p}_i - c_i - I_i^*(\hat{e}^*)$, when cost is c_i $(i = 1, 2)$, so the regulatory design problem is:

$$\max_{\hat{p}_1, \hat{p}_2} \ \langle v - \Pi_1(\hat{e}^*) \{\lambda \hat{p}_1 - (1 - \lambda)[c_1 + I_1^*(\hat{e}^*)]\} - \Pi_2(\hat{e}^*) \{\lambda \hat{p}_2 - (1 - \lambda)[c_2 + I_2^*(\hat{e}^*)]\}\rangle$$

$$\text{s.t. } \hat{p}_1 - c_1 - I_1^*(\hat{e}^*) \geq 0, \tag{27}$$

$$\hat{p}_2 - c_2 - I_2^*(\hat{e}^*) \geq 0.$$

Letting ν_1 and ν_2 denote the respective multipliers on the break-even constraints for the firm, a solution $(\hat{p}_1^*, \hat{p}_2^*, \nu_1^*, \nu_2^*)$ to the problem in (27) must satisfy the following

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[13]$\bar{p}$ is assumed not to depend on c, which should be interpreted as a firm-specific cost.

conditions:

$$\Pi_1(\hat{e}^*)\left\{-\lambda - (1-\lambda)\left[\frac{\partial I_1^*}{\partial e}\frac{\partial \hat{e}^*}{\partial \hat{p}_1}\right]\right\} + \Pi_2(\hat{e}^*)\left\{-(l-\lambda)\left[\frac{\partial I_2^*}{\partial e}\frac{\partial \hat{e}^*}{\partial \hat{p}_1}\right]\right\}$$

$$+\Pi_1'(\hat{e}^*)\left\{-\Delta\hat{p}^* + (1-\lambda)[\Delta\hat{p}^* + \Delta c - \Delta I^*(\hat{e}^*)]\right\}\left[\frac{\partial \hat{e}^*}{\partial \hat{p}_1}\right]$$

$$+\nu_1^*\left[1 - \frac{\partial I_1^*}{\partial e}\frac{\partial \hat{e}^*}{\partial \hat{p}_1}\right] - \nu_2^*\left[\frac{\partial I_2^*}{\partial e}\frac{\partial \hat{e}^*}{\partial \hat{p}_1}\right] = 0, \tag{28}$$

$$\Pi_1(\hat{e}^*)\left\{-(1-\lambda)\left[\frac{\partial I_1^*}{\partial e}\frac{\partial \hat{e}^*}{\partial \hat{p}_2}\right]\right\} + \Pi_2(\hat{e}^*)\left\{-\lambda - (l-\lambda)\left[\frac{\partial I_2^*}{\partial e}\frac{\partial \hat{e}^*}{\partial \hat{p}_2}\right]\right\}$$

$$+\Pi_1'(\hat{e}^*)\left\{-\Delta\hat{p}^* + (1-\lambda)[\Delta\hat{p}^* + \Delta c - \Delta I^*(\hat{e}^*)]\right\}\left[\frac{\partial \hat{e}^*}{\partial \hat{p}_2}\right]$$

$$-\nu_1^*\left[\frac{\partial I_1^*}{\partial e}\frac{\partial \hat{e}^*}{\partial \hat{p}_2}\right] + \nu_2^*\left[1 - \frac{\partial I_2^*}{\partial e}\frac{\partial \hat{e}^*}{\partial \hat{p}_2}\right] = 0, \tag{29}$$

$$\hat{p}_1^* - c_1 - I_1^*(\hat{e}^*) \geq 0, = 0 \text{ if } \nu_1^* > 0, \tag{30}$$

$$\hat{p}_2^* - c_2 - I_2^*(\hat{e}^*) \geq 0, = 0 \text{ if } \nu_2^* > 0. \tag{31}$$

The complexity of these expressions results from the fact that the regulator's choice

of $\hat{p}_1$ and $\hat{p}_2$ must take into account their effect on the cost probabilities $\Pi_1(\hat{e}^*)$ and

$\Pi_2(\hat{e}^*)$ and the managerial contract $(I_1^*(\hat{e}^*), I_2^*(\hat{e}^*))$ offered by the firm. Using (21)

and (26) to substitute in (28) and (29):

$$\Pi_1(\hat{e}^*)(-\lambda) + \left[-\Pi_1'(\hat{e}^*)\Delta\hat{p}^* + (1-\lambda)\hat{Z}(\hat{e}^*)\right]\left[\frac{\partial\hat{e}^*}{\partial\hat{p}_1}\right]$$

$$+ \nu_1^*\left[1 - \frac{\partial I_1^*}{\partial e}\frac{\partial\hat{e}^*}{\partial\hat{p}_1}\right] - \nu_2^*\left[\frac{\partial I_2^*}{\partial e}\frac{\partial\hat{e}^*}{\partial\hat{p}_1}\right] = 0. \tag{32}$$

$$\Pi_2(\hat{e}^*)(-\lambda) + \left[-\Pi_1'(\hat{e}^*)\Delta\hat{p}^* + (1-\lambda)\hat{Z}(\hat{e}^*)\right]\left[\frac{\partial\hat{e}^*}{\partial\hat{p}_2}\right]$$

$$- \nu_1^*\left[\frac{\partial I_1^*}{\partial e}\frac{\partial\hat{e}^*}{\partial\hat{p}_2}\right] + \nu_2^*\left[1 - \frac{\partial I_2^*}{\partial e}\frac{\partial\hat{e}^*}{\partial\hat{p}_2}\right] = 0. \tag{33}$$

The conditions defining a solution to the regulatory design problem may be simplified considerably by application of the envelope theorem if the regulatory environment maximand $\hat{e}^*$ is interior ($\hat{e}^* \in (\underline{e}, \bar{e})$). Whether $\hat{e}^*$ is interior depends on the levels of $\hat{p}_1^*$ and $\hat{p}_2^*$ chosen by the regulator. I show that $(\hat{p}_1^*, \hat{p}_2^*)$ must be such that the break-even constraint for the firm is slack in the low cost state and binding in the high cost state. I then show that the interiority of $\hat{e}^*$ follows from this.

Suppose first that neither of the break-even constraints for the firm is binding; then lowering both $\hat{p}_1^*$ and $\hat{p}_2^*$ by the same amount, which has no effect on $\hat{Z}(e)$ (see (26)) and, hence, no effect on the regulatory environment maximand $\hat{e}^*$, would increase the value of the objective function in (27) without violating either constraint, a contradiction. So at least one of the break-even constraints must bind. Also, the constraint for the low cost state ($\hat{p}_1^* - c_1 - I_1^*(\hat{e}^*) \geq 0$) cannot be binding. For suppose that it is. Then $\Delta\hat{p}^* + \Delta c - \Delta I^*(\hat{e}^*) \leq 0$ (combining the two constraints). It follows (from (26)) that $\hat{e}^*$ must equal $\underline{e}$. Suppose first that $\hat{Z}(\hat{e}^*)$ is negative at $\hat{e}^* = \underline{e}$, so

that $\partial\hat{e}^*/\partial\hat{p}_1 = 0$. Then (32) is $\nu_1^* = 0$, a contradiction. Suppose now that $\hat{Z}(\hat{e}^*)$ is

equal to zero at $\hat{e}^* = \underline{e}$. Then, by the implicit function theorem, $\partial\hat{e}^*/\partial\hat{p}_1$ is given by

$-\Pi_1'(\hat{e}^*)[\hat{Z}'(\hat{e}^*)]^{-1}$, and (32) simplifies to:

$$\frac{[\Pi_1'(\hat{e}'')]^2\Delta\hat{p}^*}{\hat{Z}'(\hat{e}^*)} + \nu_1^* \left\{ 1 + \left[\frac{\partial I_1^*}{\partial e}\right]\left[\frac{\Pi_1'(\hat{e}^*)}{\hat{Z}'(\hat{e}^*)}\right]\right\} = 0. \tag{34}$$

Differentiating $\hat{Z}(\hat{e}^*)$:

$$\hat{Z}'(\hat{e}^*) = \Pi_1''(\hat{e}^*)\left[\frac{\hat{Z}(\hat{e}^*)}{\Pi_1'(\hat{e}^*)}\right] - \Pi_1'(\hat{e}^*)\left[\frac{\partial\Delta I^*}{\partial e} + \frac{\partial W}{\partial e}\right]. \tag{35}$$

The first term on the right-hand side of (35) is zero (as $\hat{Z}(\hat{e}^*) = 0$). Meanwhile,

at $\hat{e}^* = \underline{e}$, $\partial\Delta I^*/\partial e = \partial I_1^*/\partial e$ and $\partial W/\partial e = 0$ (see (16) and (23)), so $\hat{Z}'(\hat{e}^*) =$

$-\Pi_1(\hat{e}^*)(\partial I_1^*/\partial e)$ (< 0). Thus, (34) with $\hat{e}^* = \underline{e}$ is $\Pi_1'(\hat{e}^*)\Delta\hat{p}^*[\partial I_1^*/\partial e]^{-1} = 0$, which

in turn requires $\hat{p}_1^* = \hat{p}_2^*$. But $\hat{p}_1^* = \hat{p}_2^*$ implies $\Delta\hat{p}^* + \Delta c - \Delta I^*(\hat{e}^*) > 0$ at $\hat{e}^* = \underline{e}$,

which obviously contradicts $\Delta\hat{p}^* + \Delta c - \Delta I^*(\hat{e}^*) \leq 0$.

The two break-even constraints thus imply $\Delta\hat{p}^* + \Delta c - \Delta I^*(\hat{e}^*) > 0$. It follows

that $\hat{Z}(\hat{e}^*)$ is positive at $\hat{e}^* = \underline{e}$, implying $\hat{e}^* > \underline{e}$. Also, $\hat{Z}(\hat{e}^*)$ must be negative at

$\hat{e}^* = \overline{e}$; $\hat{Z}(\overline{e}) \geq 0$ implies $\hat{e}^* = \overline{e}$ and $\partial\hat{e}^*/\partial\hat{p}_1 = 0$, which in turn imply (by (32))

$-\lambda = 0$, a contradiction. It follows that $\hat{e}^*$ is interior and is defined by $\hat{Z}(\hat{e}^*) = 0$.

Substituting for $\hat{Z}(\hat{e}^*)$ in (32) and (33) eliminates one term in each of these ex-

pressions. Meanwhile, the interiority of $\hat{e}^*$ also implies $\partial\hat{e}^*/\partial\hat{p}_1 = -\Pi_1'(\hat{e}^*)[\hat{Z}'(\hat{e}^*)]^{-1}$

and $\partial\hat{e}^*/\partial\hat{p}_2 = \Pi_1'(\hat{e}^*)[\hat{Z}'(\hat{e}^*)]^{-1}$. Then, adding (32) and (33):

$$[\Pi_1(\hat{e}^*) + \Pi_2(\hat{e}^*)](-\lambda) + \nu_2^* = 0.$$

So $\nu_2^* = \lambda$. (32) is then:

$$\Pi_1(\hat{e}^*)(-\lambda) + \frac{[\Pi_1'(\hat{e}^*)]^2\Delta\hat{p}^*}{\hat{Z}(\hat{e}^*)} + \lambda\left[\frac{\partial I_2^*}{\partial e}\right]\left[\frac{\Pi_1'(\hat{e}^*)}{\hat{Z}'(\hat{e}^*)}\right] = 0. \qquad (36)$$

Triples $(\hat{p}_1^*, \hat{p}_2^*, \hat{e}^*)$ are therefore defined by (31) with equality, $\hat{Z}(\hat{e}^*) = 0$, and (36).

Proposition 3: Assume unit demand and $\tilde{U}(e, I) = V(I) - \tilde{G}(e)$ with $\tilde{G}' \geq 0$. Also assume that (8) - (10) and A1 hold and that (17) defines a unique value e^*. Then sufficient conditions for $\Delta\hat{P} < \Delta P$ under an optimal regulatory pricing scheme are $\Pi_1(e^*) < \frac{2}{3}$ (where e^* is the market environment maximand defined by (17)) and λ sufficiently small.

Proof: By (5), $\Delta\hat{P} \leq \Delta P$ if $\hat{e}^* < e^*$. If $\Delta\hat{P} = \Delta P$ (rather than $\Delta\hat{P} < \Delta P$), then the contract design problems in the market and regulatory environments are identical, which in turn implies $\hat{e}^* = e^*$ (as e^* uniquely solves the contract design problem in the market environment). $\Delta\hat{P} = \Delta P$ therefore yields a contradiction with $\hat{e}^* < e^*$. So $\hat{e}^* < e^*$ implies $\Delta\hat{P} < \Delta P$. The proof therefore proceeds by showing that $\hat{e}^* < e^*$ holds under the stated conditions.

Solving $\hat{Z}(\hat{e}^*) = 0$ for $\Delta\hat{p}^*$ and substituting in (36):

$$\Pi_1(\hat{e}^*)(-\lambda) - \frac{[\Pi_1'(\hat{e}^*)]^2[\Delta c - \Delta I^*(\hat{e}^*) - \mathcal{W}(\hat{e}^*)]}{\hat{Z}'(\hat{e}^*)} + \lambda\left[\frac{\partial I_2^*}{\partial e}\right]\left[\frac{\Pi_1'(\hat{e}^*)}{\hat{Z}'(\hat{e}^*)}\right] = 0. \qquad (37)$$

Substituting $Z(\hat{e}^*)$ for $\Delta c - \Delta I^*(\hat{e}^*) - \mathcal{W}(\hat{e}^*)$ and then dividing both sides of (37) by

$\Pi'_1(\hat{e}^*)[\hat{Z}'(\hat{e}^*)]^{-1}$ and rearranging:

$$\lambda \left[\frac{-\Pi_1(\hat{e}^*)\hat{Z}'(\hat{e}^*)}{\Pi'_1(\hat{e}^*)} + \frac{\partial I_2^*}{\partial e} \right] - Z(\hat{e}^*) = 0. \tag{38}$$

Substituting for $\hat{Z}'(\hat{e}^*)$, the bracketed term is:

$$\Pi_1(\hat{e}^*) \left[\frac{\partial \Delta I^*}{\partial e} + \frac{\partial W}{\partial e} \right] + \frac{\partial I_2^*}{\partial e}.$$

Rewriting:

$$\Pi_1(\hat{e}^*)\frac{\partial I_1^*}{\partial e} + \Pi_2(\hat{e}^*)\frac{\partial I_2^*}{\partial e} + \Pi_1(\hat{e}^*)\frac{\partial W}{\partial e}.$$

Substituting for $\partial I_1^*/\partial e$, $\partial I_2^*/\partial e$, and $\partial W/\partial e$:

$$\frac{\Pi_1(\hat{e}^*)\Pi_2(\hat{e}^*)}{[\Pi'_1(\hat{e}^*)]^2} \left[\frac{1}{V'_1} - \frac{1}{V'_2} \right] \mathcal{K}(\hat{e}^*) + \Pi_1(\hat{e}^*) \left\{ \frac{\Pi_2(\hat{e}^*) - \Pi_1(\hat{e}^*)}{[\Pi'_1(\hat{e}^*)]^2} \left[\frac{1}{V'_1} - \frac{1}{V'_2} \right] \mathcal{K}(\hat{e}^*) + \mathcal{V}(\hat{e}^*) \right\}.$$

Combining terms:

$$\Pi_1(\hat{e}^*) \left\{ \frac{2\Pi_2(\hat{e}^*) - \Pi_1(\hat{e}^*)}{[\Pi'_1(\hat{e}^*)]^2} \left[\frac{1}{V'_1} - \frac{1}{V'_2} \right] \mathcal{K}(\hat{e}^*) + \mathcal{V}(\hat{e}^*) \right\}. \tag{39}$$

$\mathcal{V}(e)$ is nonnegative for all e by A1, and $\mathcal{K}(e)$ is positive for all e by (10). So (39) is positive if $2\Pi_2(\hat{e}^*) - \Pi_1(\hat{e}^*)$ is positive. It follows that the first term on the left-hand side of (38) is positive if $2\Pi_2(\hat{e}^*) - \Pi_1(\hat{e}^*)$ is positive.

At e^*, $2\Pi_2(e) - \Pi_1(e) > 0$ (as $\Pi_1(e^*) < \frac{2}{3}$ by assumption). Meanwhile, $Z(e^*) = 0$ (by definition). It follows that $\hat{e}^* = e^*$ cannot solve (38).

As e is reduced from e^*, $Z(e)$ must turn positive (as $Z(e)$ must be negatively sloped at e^*). So $-Z(e)$ must turn negative. Meanwhile, $2\Pi_2(e) - \Pi_1(e) > 0$ at every

$e < e^*$ (as $\Pi_1(e) < \Pi_1(e^*) < \frac{2}{3}$). It follows that there exists a solution $\hat{e}^* < e^*$ to (38) for λ sufficiently small.

In contrast, with λ sufficiently small, $\hat{e}^* > e^*$ cannot solve (38). To begin, at any $e > e^*$, $Z(e)$ must be negative (as $Z(e) = 0$ only at e^*, and $Z'(e^*) < 0$). So $-Z(e)$ must be positive. Meanwhile, as e is increased above e^* to $\tilde{e}$ defined by $\Pi_1(\tilde{e}) = \frac{2}{3}$, $2\Pi_2(e) - \Pi_1(e)$ remains nonnegative. It follows that $\hat{e}^* \in (e^*, \tilde{e}]$ cannot solve (38). At $e > \tilde{e}$, $2\Pi_2(e) - \Pi_1(e)$ may turn negative, but $-Z(e) > 0$ on $[\tilde{e}, \bar{e}]$ implies that there exists $\bar{\lambda} > 0$ such that the left-hand side of (38) evaluated at $\hat{e}^* = e \in (\tilde{e}, \bar{e}]$ is strictly positive for all $\lambda < \bar{\lambda}$. So, for λ sufficiently small, $\hat{e}^* > \tilde{e}$ also cannot solve (38). ■

Proposition 3 may be understood as reflecting the conventional efficiency-rent extraction tradeoff under optimal regulation (Laffont and Tirole 1986, 1993). On the one hand, efficiency requires that the firm be allowed to keep the full surplus associated with lower costs (so that it has an incentive to reduce costs). This effect implies $\Delta \hat{P} = \Delta P = \Delta c$ under optimal regulation. On the other hand, rent extraction requires that the firm retain no surplus even when its costs are low ($p_1 - c_1 - I_1^*(\hat{e}^*) = p_2 - c_2 - I_2^*(\hat{e}^*) = 0$), and this effect implies a value of $\Delta \hat{P}$ much smaller than Δc. The optimal regulatory scheme trades off these competing considerations and (at least under the conditions stated in proposition 3) ends up at some intermediate point involving $\Delta \hat{P} < \Delta P$. Thus, in the particular setting examined in this section, optimal regulation satisfies the characterization of regulation employed in section 2

above.[14]

[14]As previously noted, an alternative to the model of regulation considered in this section is a model in which the regulated firm is required to break even only on average: $\Pi_1(e)[\hat{p}_1 - c_1 - I_1^*(e)] + \Pi_2(e)[\hat{p}_2 - c_2 - I_2^*(e)] \geq 0$ rather than (as above) $\hat{p}_1 - c_1 - I_1^*(e) \geq 0$ and $\hat{p}_2 - c_2 - I_2^*(e) \geq 0$. The requirement that the regulated firm break even only on average implies that the firm can be forced to continue operating even when it is losing money and would prefer to shut down – a strong obligation to serve. (Perhaps a more reasonable assumption would be that the firm, if it wishes to cease operations temporarily or permanently, can be forced to rent or sell its assets to the state, thereby assuring continued service.)

If the regulator faces an average break-even constraint (with associated multiplier ν) rather than individual break-even constraints, then a solution $(\hat{p}_1^*, \hat{p}_2^*, \nu^*)$ to the regulatory design problem must satisfy:

$$\Pi_1(\hat{e}^*)[-(\lambda - \nu^*)] + \Pi_1'(\hat{e}^*)\{-\Delta\hat{p}^* + (1 - \lambda + \nu^*)[\Delta\hat{p}^* + \Delta c - \Delta I^*(\hat{e}^*) - \mathcal{W}(\hat{e}^*)]\} \left[\frac{\partial\hat{e}^*}{\partial\hat{p}_1}\right] = 0,$$

$$\Pi_2(\hat{e}^*)[-(\lambda - \nu^*)] + \Pi_1'(\hat{e}^*)\{-\Delta\hat{p}^* + (1 - \lambda + \nu^*)[\Delta\hat{p}^* + \Delta c - \Delta I^*(\hat{e}^*) - \mathcal{W}(\hat{e}^*)]\} \left[\frac{\partial\hat{e}^*}{\partial\hat{p}_2}\right] = 0,$$

$$\Pi_1(\hat{e}^*)[\hat{p}_1 - c_1 - I_1^*(\hat{e}^*)] + \Pi_2(\hat{e}^*)[\hat{p}_2 - c_2 - I_2^*(\hat{e}^*)] \geq 0, = 0 \text{ if } \nu^* > 0.$$

Using $d\hat{e}^*/d\hat{p}_1 = -\Pi_1'(\hat{e}^*)[\hat{Z}'(\hat{e}^*)]^{-1}$ and $d\hat{e}^*/d\hat{p}_2 = \Pi_1'(\hat{e}^*)[\hat{Z}'(\hat{e}^*)]^{-1}$ (assuming an interior value of $\hat{e}^*$), the first and second equations sum to:

$$\Pi_1(\hat{e}^*)[-(\lambda - \nu^*)] + \Pi_2(\hat{e}^*)[-(\lambda - \nu^*)] = 0.$$

So $\lambda = \nu^*$, which in turn implies (using the first equation) $Z(\hat{e}^*) = 0$. So $\hat{e}^* = e^*$. It follows that $\hat{p}_1^* = \hat{p}_2^*$ (pure fixed-price regulation). Intuitively, lowering $\hat{p}_1$ and lowering $\hat{p}_2$ are perfect substitutes in terms of rent extraction, so the regulator need not distort cost-cutting incentives to extract rent.

The pure fixed-price regulation result with an average break-even constraint is not surprising. In Laffont and Tirole's model of regulation, for example, if the firm is subject to an average break-even constraint rather than individual constraints for each firm "type" ($\beta \in \underline{\beta}, \overline{\beta}$), then there is no conflict between efficiency and rent extraction, and the optimal regulatory scheme preserves full incentives for cost reduction while extracting all of the firm's rent. (The objective function in Laffont and Tirole's model with an average break-even constraint (which necessarily binds at the optimum) is $v[\underline{C} + \Psi(\underline{\beta} - \underline{C})] + (1 - v)[\overline{C} + \Psi(\overline{\beta} - \overline{C})]$ (where v is the ex ante probability of type $\underline{\beta}$, C is the firm's cost, Ψ is the effort cost function, and $\beta - C$ is the firm's effort). Maximizing this objective function subject to incentive compatibility constraints for the firm yields first-order conditions $\Psi'(\beta - C) = 1$ for $(\beta, C) \in \{(\underline{\beta}, \underline{C}), (\overline{\beta}, \overline{C})\}$, and these conditions imply first-best efficiency.) Schmalensee (1989) allows for some averaging in the break-even determination, but he still requires that each individual "type" of firm break even, as in Laffont and Tirole's model. Thus, models

4 Conclusion

Existing literatures on shareholder-manager and regulator-firm relationships treat those relationships in isolation from one another and therefore do not generate testable predictions about the effect of regulation on managerial pay. This chapter has attempted to generate such predictions against the backdrop of a growing empirical literature on the compensation of top executives at regulated firms. The results described above are generally consistent with the available empirical evidence; regulation (operating to reduce the variability of firm performance) reduces the level of managerial pay, consistent with the empirical evidence, and may also reduce the performance-sensitivity of pay, as is true empirically. The characterization of regulation as a buffer against highly variable firm performance is consistent with the empirical evidence of the effects of regulation on performance and also plausibly coincides with the prescriptions of optimal regulation in a unit demand setting.

The results described in this chapter suggest that optimal contracting by regulated firms and their managers may help to explain observed patterns of compensation at such firms. As noted at the start of the chapter, however, regulation is likely to influence managerial pay not only through its effects on the objective function of the regulated firm, but also through special political constraints attending the regulatory process. Observed differences in the compensation of managers at regulated firms probably do not reflect either of these regulatory influences in isolation but rather

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that generate the efficiency-rent extraction tradeoff on which the optimal regulation literature has focused require individualized (to a greater or lesser degree) break-even constraints. The model in this chapter tracks that approach.

some combination of the two.

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Chapter Three

Managerial Contracts and
Implicit Managerial Compensation

Introduction

The agents to whom shareholders delegate the day-to-day management of the typical large corporation have a variety of opportunities to transfer wealth from shareholders to themselves. These agents may take business opportunities presented to the firm and turn them to their own advantage; they may engage in classic self dealing, selling assets to the firm or buying assets from it at non-arms'-length prices; they may trade in the firm's stock on the basis of inside information; or they may provide themselves with various perks not germane to their job responsibilities. Each of these actions increases the effective level of managerial pay above the level implied by managers' explicit compensation. The various forms of implicit managerial compensation are therefore substitutes for conventional means of paying managers.[1]

Many institutions and legal rules function to constrain opportunities for implicit

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[1]Some managers may, for reputational or other reasons, decline to take advantage of opportunities for implicit payment. This chapter assumes, however, that at least some individuals will in at least some circumstances choose to avail themselves of such opportunities.

payments to managers. For example, state and federal rules of corporate and securities law regulate the taking of corporate opportunities, transactions between corporations and their managers, insider trading, and the provision of perks and other benefits to managers (Clark 1986, 166-79, 191-94, 225-30, 293-340). These restraints on implicit managerial compensation reflect the view that such compensation effects a wealth transfer from shareholders to managers and should therefore be discouraged.

As an a priori matter, however, implicit payments to managers represent a potentially efficient form of managerial compensation (Scott 1980; Easterbrook and Fischel 1982; Carlton and Fischel 1983). Such payments do not necessarily reflect transfers of wealth from shareholders to managers, as shareholders may choose to adjust the managerial contract to account for other sources of managerial pay. Opportunities for implicit payment in the shareholder-manager context may therefore leave shareholder wealth and the joint welfare of shareholders and managers either unchanged or, if alternative forms of managerial compensation are efficient, enhanced. Institutions and rules limiting reliance on implicit compensation for managers are then either irrelevant (because they have no effect on managerial pay or shareholder wealth) or harmful (because they prevent shareholders and managers from utilizing efficient compensation mechanisms).

One objection to the argument that implicit payments to managers represent a potentially efficient form of compensation is that, contrary to the assumption of the canonical principal-agent model, the level of managerial pay is not set by an actor seeking to maximize shareholder wealth. Realistically, the board of directors of the

typical large corporation may often be torn between the interests of shareholders and those of managers, at whose pleasure the directors serve. It may be implausible, therefore, to assume that the board will push for reductions in managers' explicit compensation in response to their ability to profit indirectly from the association with the firm (Brudney 1985). If the directors are reluctant to pursue an aggressive strategy of driving down managerial pay, then opportunities for implicit payment can obviously have the effect of enriching managers at shareholders' expense. From this perspective, the imposition of restrictions on implicit managerial compensation may be entirely sensible.

This chapter offers a different objection to the argument about the potential efficiency of implicit payments to managers. My criticism of that argument focuses on its implicit assumption that managers' explicit compensation can be costlessly adjusted in response to their ability to profit indirectly from their association with the firm. I show that even within a conventional principal-agent model in which the managerial contract is chosen to maximize shareholder wealth, opportunities for implicit payment tend to reduce shareholder wealth and produce inefficient outcomes. My conclusion is that implicit managerial compensation generally should be expected to have both distributive and efficiency consequences. The institutions and rules that operate to constrain the use of such compensation are therefore not a matter of indifference, nor are they (necessarily) inefficient.

Intuitively, opportunities for implicit payment reduce shareholder wealth and produce inefficient outcomes (notwithstanding shareholders' ability to adjust managerial

compensation in response) whenever such adjustments impose costs of their own, as they typically do. Managerial pay in a principal-agent model is structured to encourage managers to act in ways that enhance shareholder wealth; reducing managers' pay will therefore tend to weaken the alignment of shareholders' and managers' interests. Less alignment of shareholders' and managers' interests means less value-creation by the firm and, thus, a reduction in shareholder wealth. Likewise, the need to adjust managerial compensation in response to opportunities for implicit payment produces a less efficient managerial contract than the contract that would obtain with no implicit payment.

The distortions created by opportunities for indirect payments to managers may be offset to some degree by countervailing benefits of such payments. Permitting managers to take business opportunities of the firm and turn them to their own use, for example, will involve direct efficiency benefits if the value of such opportunities is much greater in the managers' hands than in the hands of the firm (Easterbrook and Fischel 1982, 706-707). This chapter provide a lower bound on the level to which such direct efficiency benefits must rise to outweigh the efficiency costs I identify. I also show that this lower bound is an increasing function of the amount of the firm's profit diverted through indirect forms of managerial compensation.

Section 1 below describes the basic features of my model. Section 2 characterizes optimal managerial contracts with and without implicit managerial compensation and then provides a series of comparative results for the case in which implicit payments to managers have no direct efficiency benefits. Section 3 extends the analysis to the

114

case in which implicit managerial compensation has direct efficiency benefits. Finally, section 4 discusses conclusions and policy implications.

1 Model

The starting point for my model is the classical principal-agent framework, in which the profit p earned by the principal (the shareholders of the firm) is a function of the level of effort exerted by the manager who runs the firm (Jensen and Meckling 1976; Holmstrom 1979; Shavell 1979; Grossman and Hart 1983; Arrow 1985; Fudenberg and Tirole 1990; Jensen and Murphy 1990). The manager's effort level $e \in [\underline{e}, \bar{e}]$ is unobservable and, thus, subject to moral hazard. The manager has utility of income V, cost of effort $\tilde{G}$, and reservation utility $\mathcal{U}$. V satisfies $V' > 0$ and $V'' < 0$. $\tilde{G}$ satisfies $\tilde{G}' \geq 0$ and $\tilde{G}'' > 0$.

My addition to the standard principal-agent framework is the prospect of implicit managerial compensation. The manager in my model not only influences the likelihood that the firm realizes a high profit level but also may enjoy some control over how much of the firm's profit actually finds its way into shareholders' hands. I assume that with probability $\theta \in (0,1)$ the manager has the opportunity to divert an amount $X > 0$ of the firm's profit, reducing shareholder wealth by an amount βX $(\beta > 0)$.[2] I assume that θ is less than one because implicit managerial compensation typically takes the form of large windfalls that materialize occasionally, as opposed to

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[2]The cost to shareholders of the manager's diversion of profit could be written as $Y (> 0)$ rather than βX without changing the nature of the results described below.

steady, certain streams of income (Scott 1980). The difference between the manager's expected gain θX from diverting profits from the firm and the expected cost $\theta \beta X$ to shareholders of this behavior may be interpreted as the direct efficiency benefit (if $\beta < 1$) or cost (if $\beta > 1$) of opportunities for implicit payment. The shareholders' objective function is the difference between the firm's expected profit and the manager's explicit and implicit compensation. The manager's objective function is:

$$U(e, I(p)) = \int_p [\theta V(I(p) + X) + (1 - \theta)V(I(p)) - \tilde{G}(e)] f(p, e) dp,$$

where $I(p)$ is the manager's compensation as a function of p and $f(p, e)$ is the density of p as a function of e.

To simplify analysis and exposition, I assume that the firm's profit p is either p_1 or p_2, with $\Delta p \equiv p_1 - p_2 > 0$, and that, for $i = 1, 2$, the density $\Pi_i(e) \equiv f(p_i, e)$ is linear in e. The linearity assumption ensures the validity of the first order condition approach to the contract design problem (Grossman and Hart 1983) but is not necessary for my results. I also impose the following technical conditions, which rule out corner solutions to the contract design problem considered below:

$$\tilde{G}'(\underline{e}) = 0; \tag{1}$$

$$\Delta p \leq I_1^* - I_2^*, \tag{2}$$

where I_1^* and I_2^* are defined by:

$$\theta V(I_1^* + X) + (1 - \theta)V(I_1^*) - \Pi_2(e)\tilde{G}'(e) - \tilde{G}(e) - \mathcal{U} = 0; \tag{3}$$

116

$$\theta V(I_2^* + X) + (1 - \theta)V(I_2^*) + \Pi_1(e)\tilde{G}'(e) - \tilde{G}(e) - \mathcal{U} = 0. \tag{4}$$

(These expressions are derived below.)

Differentiating both sides of the identity $\Pi_1(e) + \Pi_2(e) = 1$ with respect to e yields $\Pi_1' + \Pi_2' = 0$; without loss of generality I normalize the absolute value of the two slopes to one. I also make the standard assumption that the densities satisfy the monotone likelihood ratio property (MLRP): $\Pi_1'/\Pi_1(e) > \Pi_2'/\Pi_2(e)$ for all e. MLRP and $\Pi_1' + \Pi_2' = 0$ together imply that the probability of the better outcome ($p = p_1$) is increasing in e, or $\Pi_1' > 0$. The values $\bar{e}$ and $\underline{e}$ are then defined by $\Pi_1(\bar{e}) = 1$ and $\Pi_2(\underline{e}) = 1$.

2 Optimal Managerial Contracts

This section characterizes optimal managerial contracts in the model outlined above; it then uses these results to compare settings with and without opportunities for implicit payment under the assumption that implicit payments have no direct efficiency benefits ($X \leq \beta X$, or $\beta \geq 1$). Section 3 generalizes the analysis to the case in which implicit managerial compensation produces direct efficiency benefits ($\beta > 1$).

2.1 Contract Design

The contract design problem in section 1's model is the standard problem of maximizing shareholder wealth subject to incentive compatibility and participation

constraints for the manager:

$$\max_{e, I_1, I_2} \ \langle \Pi_1(e)(p_1 - I_1) + \Pi_2(e)(p_2 - I_2) - \theta \beta X \rangle$$

$$\text{s.t.} \ \ e \in \arg\max_{e'} \ \langle U(e', I_1, I_2) \rangle; \tag{5}$$

$$U(e, I_1, I_2) \geq \mathcal{U};$$

$$e \in [\underline{e}, \overline{e}].$$

The first constraint in (5) may be replaced by the associated first order condition $\partial U / \partial e = 0$, as the linearity of the probabilities and the convexity of $\tilde{G}$ ensure that the first order condition is sufficient for a solution to the manager's optimization problem. Meanwhile, by the argument in Grossman and Hart (1983), the second constraint in (5) must bind at a solution to the contract design problem. The two constraints therefore define I_1 and I_2 in terms of e as follows:

$$\frac{\partial U}{\partial e} = \theta V(I_1 + X) + (1 - \theta)V(I_1) - \theta V(I_2 + X) - (1 - \theta)V(I_2) - \tilde{G}'(e) = 0, \tag{6}$$

$$U(e, I_1, I_2) = \Pi_1(e)[\theta V(I_1 + X) + (1 - \theta)V(I_1)]$$

$$+ \Pi_2(e)[\theta V(I_2 + X) + (1 - \theta)V(I_2)] - \tilde{G}(e) = \mathcal{U}. \tag{7}$$

Combining (6) and (7) yields (3) and (4) with $I_1^* = I_1$ and $I_2^* = I_2$. Substituting for I_1 and I_2 in (5) therefore yields (for I_1^* and I_2^* defined by (3) and (4)):

$$\max_{e} \; \langle \Pi_1(e)(p_1 - I_1^*) + \Pi_2(e)(p_2 - I_2^*) - \beta\theta X \rangle \tag{8}$$

$$\text{s.t.} \;\; e \in [\underline{e}, \bar{e}].$$

The derivative with respect to e of the objective function in the modified problem in (8) is:

$$\Delta p - \Delta I^* - \Pi_1(e)\frac{\partial I_1^*}{\partial e} - \Pi_2(e)\frac{\partial I_2^*}{\partial e}, \tag{9}$$

where $\Delta I^* \equiv I_1^* - I_2^*$. Differentiating I_1^* and I_2^*:

$$\frac{\partial I_1^*}{\partial e} = \frac{\Pi_2(e)\tilde{G}'''(e)}{\theta V'(I_1 + X) + (1 - \theta)V'(I_1)}; \tag{10}$$

$$\frac{\partial I_2^*}{\partial e} = \frac{-\Pi_1(e)\tilde{G}'''(e)}{\theta V'(I_2 + X) + (1 - \theta)V'(I_2)}. \tag{11}$$

The derivative in (9) is positive at $e = \underline{e}$, as $I_1^*(\underline{e}) = I_2^*(\underline{e})$, $\Pi_1(\underline{e}) = 0$, and $\partial I_2^*/\partial e|_{e=\underline{e}} = 0$. Also, the derivative in (9) is negative at $e = \bar{e}$ by (2). It follows that a maximand e^* of the objective function in (8) over $[\underline{e}, \bar{e}]$ must satisfy the necessary first-order condition:

$$\Delta p - \Delta I^* - \Pi_1(e^*)\frac{\partial I_1^*}{\partial e} - \Pi_2(e^*)\frac{\partial I_2^*}{\partial e} \equiv Z(e^*, X) = 0. \tag{12}$$

This necessary condition may be satisfied by more than one value of e; the maximand e^* is the value (assumed unique) among those satisfying (12) that maximizes the objective function in (8) over $[\underline{e}, \bar{e}]$.

2.2 Comparisons

This sub-section compares settings without and with opportunities for implicit payment under the assumption that implicit payments have no direct efficiency benefits ($\beta \geq 1$). I first examine the comparison between the levels of shareholder wealth and shareholder-manager welfare in the two environments. I then explore the relative generosity of explicit managerial compensation in these settings.

2.2.1 Shareholder wealth and shareholder-manager welfare

My first result concerns the effect on shareholder wealth and the joint welfare of shareholders and managers of moving from an environment without opportunities for implicit payment (the "no implicit pay environment") to an environment with such opportunities (the "implicit pay environment"). Such a move corresponds in my model to an increase in X from zero to a value greater than zero. I find that an increase in X reduces both shareholder value and the welfare of the shareholder-manager unit.

Proposition 1: Both shareholder wealth and the joint welfare of shareholders and managers are lower under an optimal managerial contract in the implicit payment environment than under an optimal managerial contract in the no implicit payment environment.

Proof: A move from the no implicit payment environment ($X = 0$) to the implicit payment environment ($X > 0$) necessarily reduces shareholder wealth under an optimal managerial contract if shareholder wealth under such a contract is decreasing in

$X > 0$, as I now show to be the case. The derivative with respect to X of shareholder wealth under an optimal managerial contract is (applying the envelope theorem):

$$- \Pi_1(e^*) \left[\frac{\partial I_1^*}{\partial X} \right] - \Pi_2(e^*) \left[\frac{\partial I_2^*}{\partial X} \right] - \theta \beta. \tag{13}$$

Differentiating:

$$\frac{\partial I_i^*}{\partial X} = \frac{-\theta V'(I_i + X)}{V_i'}, i = 1, 2, \tag{14}$$

where $V_i' = \theta V'(I_i^* + X) + (1 - \theta) V'(I_i^*)$, $i = 1, 2$. The right-hand side of (14) is strictly greater than $-\theta$ for $i = 1, 2$ (as $V'(I_i) > V'(I_i + X)$, $i = 1, 2$, for $X > 0$). Thus, the sum of the first two terms in (13) is strictly less than θ. It therefore follows from $\beta \geq 1$ that the expression in (13) is negative or, equivalently, that shareholder wealth is decreasing in X (> 0).

Since the manager is held to the reservation utility level $\mathcal{U}$ in both the no implicit payment environment and the implicit payment environment, it follows from the reduction in shareholder wealth with a move from $X = 0$ to $X > 0$ that the welfare of the shareholder-manager unit also falls. ■

Proposition 1 indicates that a move from the no implicit payment environment to the implicit payment environment reduces both shareholder wealth and the welfare of the shareholder-manager unit. Contrary to the suggestion that any reduction in shareholder wealth would be matched by a corresponding increase in the manager's welfare (a distributional effect that conceivably could be "undone" ex ante), the reduction in shareholder wealth does not yield any increase in managerial utility. The

move to the implicit payment environment is therefore both harmful to shareholder wealth and inefficient.

I next report a comparative statics result that relates the magnitude of the reductions in shareholder wealth and the welfare of the shareholder-manager unit to the magnitude of the firm's profit that the manager is able to divert in the implicit payment environment. My conclusion is that the adverse effects of implicit payments are magnified by increases in the amount of profit that the manager may divert.

Proposition 2: The reductions in shareholder wealth and the joint welfare of shareholders and managers with a move from the no implicit pay environment to the implicit pay environment are increasing functions of the amount of the firm's profit that the manager may divert in the latter environment.

Proof: The result for shareholder wealth follows directly from the fact that shareholder wealth is monotonically decreasing in $X > 0$. The result for the welfare of the shareholder-manager unit then follows from the fact that the manager's utility is always at its reservation level.　　　　　　　　　　　　　　　　　　　　■

By proposition 2, the distributive effects and inefficiency associated with a move from the no implicit pay environment to the implicit pay environment are magnified by increases in the amount of the firm's profit that the manager may divert. Shareholder wealth is monotonically decreasing in the amount of profit that the manager is able to divert, while the manager's utility remains at its reservation level; thus, the greater is the profit that the manager may divert, the greater are the losses in both shareholder wealth and the joint welfare of shareholders and managers with a move to the implicit

payment environment.

2.2.2 Level of explicit managerial compensation

My next two results examine the effects of opportunities for implicit payment on the shape of the optimal managerial contract. The goal is to explore the precise way in which implicit managerial compensation affects the level of the manager's explicit compensation. It is clear from proposition 1 that explicit compensation does not adjust by enough to offset the cost of implicit payments to shareholders; the remaining question is the degree to which explicit compensation does adjust, if at all.

An optimal managerial contract in the model of section 1 is fully characterized by the optimal effort level e^* (as (3) and (4) define I_1^* and I_2^* as functions of e). Thus, comparisons of the no implicit payment environment and the implicit payment environment turn on the relationship between the optimal effort levels in each of the two environments. Differentiating:

$$\frac{\partial e^*}{\partial X} = \frac{-\partial Z/\partial X}{\partial Z/\partial e}.$$

(15)

The denominator of the right-hand side of the expression in (15) is negative, as $Z(e, X)$ is zero at the maximand e^* and must be decreasing in e at that point. The sign of $\partial e^*/\partial X$ is therefore given by the sign of $\partial Z/\partial X$. Substituting for $\partial I_1^*/\partial e$ and $\partial I_2^*/\partial e$ in the expression for $Z(e, X)$ in (12):

$$Z(e, X) = \Delta p - \Delta I^* - \Pi_1(e)\Pi_2(e)\tilde{G}''(e) \left(\frac{1}{V_1'} - \frac{1}{V_2'} \right).$$

123

Differentiating:

$$\frac{\partial Z}{\partial X} = - \left[\frac{\partial I_1^*}{\partial X} - \frac{\partial I_2^*}{\partial X} \right]$$

$$-\Pi_1(e)\Pi_2(e)\tilde{G}''(e) \left\{ \frac{-\theta V''(I_1^* + X)\left[\partial I_1^*/\partial X + 1\right]}{(V_1')^2} \right.$$

$$+ \frac{-(1-\theta)V''(I_1^*)\partial I_1^*/\partial X}{(V_1')^2} - \frac{-\theta V''(I_2^* + X)\left[\partial I_2^*/\partial X + 1\right]}{(V_2')^2}$$

$$\left. - \frac{-(1-\theta)V''(I_2^*)\partial I_2^*/\partial X}{(V_2')^2} \right\}. \qquad (16)$$

Substituting for $\partial I_1^*/\partial X$ and $\partial I_2^*/\partial X$ and then canceling terms:

$$\frac{\partial Z}{\partial X} = \theta \left[\frac{V'(I_1^* + X)}{V_1'} - \frac{V'(I_2^* + X)}{V_2'} \right]$$

$$+ \Pi_1(e)\Pi_2(e)\tilde{G}''(e)\theta(1-\theta)\left[\mathcal{Y}_1(I_1^*) - \mathcal{Y}_2(I_2^*)\right], \qquad (17)$$

where:

$$\mathcal{Y}_i(I_i) = \frac{V''(I_i + X)V'(I_i) + V''(I_i)V'(I_i + X)}{(V_i')^3}, i = 1, 2,$$

for $V_i'' = \theta V''(I_i + X) + (1-\theta)V''(I_i)$, $i = 1, 2$. Differentiating and cancelling terms:

$$\frac{\partial}{\partial I_i}\left(\frac{V'(I_i + X)}{V_i'}\right) = \frac{(1-\theta)V'(I_i)V''(I_i + X) - V'(I_i + X)(1-\theta)V''(I_i)}{(V_i')^2}; \qquad (18)$$

124

$$\frac{\partial y_i}{\partial I_i} = \big\{ [-(V_i')^3(V'''(I_i)V'(I_i + X) + V'''(I_i + X)V'(I_i))]$$

$$+ [3(V''(I_i)V'(I_i + X) + V''(I_i + X)V'(I_i))(V_i')^2 V_i''] \big\} / (V_i')^6 , \quad (19)$$

$i = 1, 2.$

Proposition 3: The level of effort under an optimal managerial contract in the implicit payment environment is less than the level of effort under an optimal managerial contract in the no implicit payment environment as long as V''' is sufficiently small in absolute terms.

Proof: I show that e^* is monotonically decreasing in $X > 0$, from which it follows that a move from $X = 0$ (the no implicit payment environment) to a value of X greater than zero reduces managerial effort.

The sign of $\partial e^*/\partial X$ is given by the sign of $\partial Z/\partial X$. A sufficient condition for $\partial Z/\partial X < 0$ is that each of the terms in square brackets in (17) is negative. As noted above, $I_1^* > I_2^*$; thus, those terms will be negative if the derivatives in (18) and (19) are negative for any I_i. In turn, those derivatives will be negative if their numerators are negative.

The concavity of V implies $V'(I_i) > V'(I_i + X)$ for any I_i, from which it follows that the numerator of (18) is negative as long as V''' is sufficiently small. Meanwhile, the sign of the numerator of (19) is determined by the sign of the second term in square brackets as long as V''' is sufficiently small in absolute terms. In turn, since

$(V_i')^2 > 0$ and $V_i'' < 0$, the sign of the second term in square brackets is given by the sign of:

$$V''(I_i)V'(I_i + X) - V''(I_i + X)V'(I_i),$$

which is the numerator of (18). Therefore, the numerator of (19) is negative for V''' sufficiently small. ∎

Thus, under the condition stated in proposition 3, a move from the no implicit payment environment to the implicit payment environment reduces managerial effort. The proof establishes that, under the stated condition, managerial effort under an optimal managerial contract is monotonically decreasing in $X > 0$; it follows directly that the reduction in the level of effort under an optimal managerial contract with a move from the no implicit payment environment to the implicit payment environment is an increasing function of the amount of the firm's profit that the manager may divert in the latter environment. Expressed slightly differently, the comparative statics result is that the distortion in the manager's effort level is greater, the larger is the share of the firm's profit that the manager may divert in the implicit payment environment. The condition on V''' stated in proposition 3 (that V''' is sufficiently small in absolute terms) will be satisfied when, for example, V is quadratic ($V(I) = a + bI^2$).

The reason for examining the effect on optimal managerial effort of a move from the no implicit payment environment to the implicit payment environment is that this effect in turn establishes how the move influences the level of explicit compensation paid to the manager. As noted above, proposition 1 establishes that explicit

compensation does not adjust by enough to offset the cost of implicit compensation to shareholders; the remaining question is whether it adjusts at all and, if so, in what direction.

Proposition 4: Under the condition stated in proposition 3, the expected compensation provided by the optimal managerial contract in the implicit payment environment is less than the expected compensation provided by the optimal managerial contract in the no implicit payment environment.

Proof: The manager's expected compensation under an optimal managerial contract is $\Pi_1(e^*)I_1^* + \Pi_2(e^*)I_2^*$. The derivative of this expression with respect to X is:

$$\Delta I^* \frac{\partial e^*}{\partial X} + \Pi_1(e^*) \left[\frac{\partial I_1^*}{\partial e} \frac{\partial e^*}{\partial X} + \frac{\partial \hat{I}_1}{\partial X} \right] + \Pi_2(e^*) \left[\frac{\partial I_2^*}{\partial e} \frac{\partial e^*}{\partial X} + \frac{\partial \hat{I}_2}{\partial X} \right].$$

Substituting for $\partial I_1^*/\partial e$ and $\partial I_2^*/\partial e$ and rearranging:

$$\Delta I^* \frac{\partial e^*}{\partial X} + \Pi_1(e^*)\Pi_2(e^*) \left[\frac{1}{V_1'} - \frac{1}{V_2'} \right] \frac{\partial e^*}{\partial X} + \Pi_1(e^*) \frac{\partial \hat{I}_1}{\partial X} + \Pi_2(e^*) \frac{\partial \hat{I}_2}{\partial X}. \qquad (20)$$

The first term is nonpositive, as $I_1^* \geq I_2^*$ and $\partial e^*/\partial X < 0$. The second term is also nonpositive, by the concavity of V and the sign of $\partial e^*/\partial X$. Finally, the third and fourth terms are negative by (14). It follows that the manager's expected compensation under an optimal managerial contract is decreasing in X and, hence, falls when X rises from zero to a positive value. ∎

Proposition 4 indicates that the manager's explicit compensation is adjusted downward in response to opportunities for implicit payment. Again, however, the adjustment is insufficient to offset the cost of the implicit compensation to sharehold-

ers. Meanwhile, the manager is no better off in the implicit payment environment than in the no implicit payment environment, as managerial utility is always at the reservation level $\mathcal{U}$. It therefore follows that the welfare of the shareholder-manager unit is lower in the former environment than in the latter.

3 Efficiency Benefits from Implicit Payments

The analysis in section 2 assumes that implicit managerial compensation has no direct efficiency benefits (βX, the direct cost of such compensation to shareholders, is greater than or equal to X, the direct benefit of such compensation to the manager). This section relaxes that assumption, allowing for the possibility that βX is less than X. The value of $(1 - \beta)$ then measures the magnitude of the direct efficiency benefits from implicit compensation. My first result gives a lower bound on the level to which such direct efficiency benefits must rise to outweigh the efficiency costs of implicit compensation identified above.

Proposition 5: Both shareholder wealth and the joint welfare of the shareholders and the manager are lower under an optimal managerial contract in the implicit payment environment than under such a contract in the no implicit payment environment as long as $(1 - \beta)$ is less than:

$$1 - \left[\Pi_1(e) \frac{\theta V'(I_1 + X)}{V_1'} + \Pi_2(e) \frac{\theta V'(I_2 + X)}{V_2'} \right]. \tag{21}$$

Proof: If $(1 - \beta)$ is less than the expression in (21), then the derivative with respect

128

to X of shareholder wealth under an optimal managerial contract (see (13)) is negative. Shareholder wealth therefore falls with a move from the no implicit payment environment ($X = 0$) to the implicit payment environment ($X > 0$). In turn, since managerial utility is always at its reservation level, the move must also reduce the welfare of the shareholder-manager unit.

My next result concerns the comparative statics properties of the lower bound in (21). Specifically, I examine how that bound changes with changes in the amount of the firm's profit that the manager may divert in the implicit payment environment.

Proposition 6: The lower bound in (21) on the level to which the direct efficiency benefits of implicit payments must rise to outweigh the efficiency costs they impose is an increasing function of the amount of the firm's profit that the manager may divert in the implicit payment environment.

Proof: Differentiating and then canceling terms:

$$\frac{\partial}{\partial X}\left(\frac{\theta V''(I_i + X)}{V_i'}\right) = \frac{(1 - \theta)V'(I_i)\theta V''(I_i + X)}{(V_i')^2}, i = 1, 2. \tag{22}$$

The expression on the right-hand side of (22) is negative, from which it follows that the lower bound in (21) is increasing in X.

Thus, even in settings in which implicit payments have direct efficiency benefits, opportunities for implicit payment may reduce shareholder wealth and the joint welfare of shareholders and managers. The direct efficiency benefits from implicit payments must rise to at least the lower bound in (21) for a move to the implicit payment environment to increase shareholder wealth and the welfare of the shareholder-

manager unit.

4 Conclusions and Policy Implications

This chapter has explored the distributive and efficiency effects of opportunities for implicit compensation of managers. As an a priori matter, implicit payments represent a potentially efficient form of managerial compensation. Contrary to the view underlying many institutions and legal rules restricting the use of implicit compensation, such compensation does not necessarily reflect a wealth transfer from shareholders to managers, as shareholders may choose to adjust the managerial contract to account for other sources of managerial pay. As shown above, however, though explicit compensation is generally adjusted in response to implicit payment opportunities in a principal-agent setting, this is not enough to keep shareholder wealth and the welfare of the shareholder-manager unit at the same level as in the absence of implicit payment opportunities. To the contrary, a move from the no implicit payment environment to the implicit payment environment in a canonical principal-agent model reduces both shareholder wealth and the joint welfare of shareholders and managers.

The a priori argument about the potential efficiency of implicit managerial compensation ignores the cost of adjusting managers' explicit compensation in response to opportunities for implicit payment. In the traditional principal-agent framework, such adjustments are costly because they weaken the alignment of shareholders' and

managers' interests. Implicit managerial compensation may in some cases entail direct efficiency benefits that (wholly or partially) offset the cost of adjusting explicit compensation, and the analysis above provides a lower bound on the level to which the direct efficiency benefits in such cases must rise to outweigh the efficiency costs of implicit compensation.

This chapter's analysis of implicit managerial compensation implies that existing institutions and legal rules that limit the use of such compensation are not a matter of indifference, nor are they (necessarily) inefficient. To the contrary, these institutions and legal rules may be sensible responses to the distributive and efficiency consequences of opportunities for implicit payment. The case in favor of restrictive institutions and legal rules is strongest for types of implicit compensation, such as insider trading, that are unlikely to involve direct efficiency benefits of the sort postulated by Easterbrook and Fischel (1982), and in all likelihood involve direct efficiency costs that exacerbate the adverse efficiency effects emphasized in this chapter.

Of course, the argument that existing institutions and legal rules may be justified on distributive and efficiency grounds posits a market failure at some level; otherwise, the parties should be expected to agree on their own to prohibit implicit payments. The need for external regulation is most plausibly traced to the difficulty of specifying complete contractual arrangements governing the treatment of implicit payments and the mechanisms for enforcing restrictions on such payments. Just as "fiduciary duties" in corporation law are said to be standard-form terms included in every shareholder-manager contract to save the parties the costs of anticipating precisely "when and how

their interests may diverge" (Easterbrook and Fischel 1982), so too may institutions

and legal rules restricting implicit managerial compensation be standard-form terms

that economize on transaction costs. To pursue the analogy with fiduciary duties a

bit further, many of the institutions and legal rules restricting implicit compensation

parallel fiduciary duties in the additional sense that these institutions and legal rules

replace "prior supervision with deterrence, much as the criminal law uses penalties for

bank robbery rather than pat-down searches of everyone entering banks" (Easterbrook

and Fischel 1982).

The transaction cost perspective cannot, however, justify the mandatory nature

of some of the existing restrictions on implicit managerial compensation. Legal rules

against insider trading, for example, are not just default terms for contracting parties

but, rather, are legally imposed prohibitions that parties are not free to undo.

The desirability of mandatory contract terms in the shareholder-manager rela-

tionship has been the subject of a longstanding debate among scholars of corporation

law. Some commentators take the view that most or all of the externally-supplied

contract terms in the shareholder-manager relationship should be default terms (East-

erbrook and Fischel 1982; Carlton and Fischel 1983; Easterbrook and Fischel 1991).

Other commentators argue that various sorts of information failures on shareholders'

part justify mandatory contract terms in certain contexts (Bebchuk 1989a; Bebchuk

1989b).[3]

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[3]The debate over mandatory contract terms in the shareholder-manager relationship was
the subject of a symposium issue of the *Columbia Law Review* in June of 1989.

In the context of implicit payments to managers, regulatory institutions and legal rules may need to be mandatory due to the difficulties that shareholders would often face in trying to anticipate all of the indirect means by which corporate profits might be diverted. Even if, due to proxy statement disclosure requirements and media reports, shareholders are reasonably well informed about the level and structure of managers' explicit compensation, they may be much less able to appreciate and respond to the diverse forms of indirect managerial compensation. If this is true, then mandatory contract terms governing implicit payments to managers may be appropriate.

The analysis of implicit managerial compensation presented in this chapter raises a number of interesting empirical issues that bear further investigation. For example, if firms vary in the degree to which they contract around non-mandatory restrictions on implicit compensation, it would be useful to know whether and to what degree managers' explicit compensation is adjusted in response. Likewise, in the case of mandatory restrictions on implicit compensation, do firms ever adopt contract terms that are more restrictive than the externally imposed terms, and, if so, is explicit compensation adjusted in response? Empirical work could also usefully explore the relationship between limits on implicit compensation and the long term performance of the firm.

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