Talking down the firm: Short-term market manipulation and optimal management compensation

Gerald T. Garvey[a], Simon Grant[b], Stephen P. King[b],[*]

[a]*Finance Division, Faculty of Commerce, University of British Columbia, British Columbia, Canada*
[b]*Economics Program, RSSS, The Australian National University, Canberra, Australia*

Abstract

This paper analyzes the optimal use of short- and long-term share prices in management incentive contracts. A key innovation of our model is that the short-term share price is determined even before the manager has made her effort choice and therefore cannot be informative in the standard principal-agent sense. We show that when traders on the short-term market have as much information as the manager does, the optimal contract fully insures the manager against short-term share price fluctuations. However, if the manager has private information that is relevant to the short-term share price and is fully insured then she will have an incentive to 'talk down the firm'—to manipulate the short-term share price and so raise perceptions of her value added. These results endogenize corporate managers' concern with short-term stock market fluctuations, and show how manipulation can occur even with optimal contracts.   © 1998 Elsevier Science B.V.

Keywords: Incentive contracts; Manipulation; Share price

JEL classification: G30

1. Introduction

The most compelling and general result from formal principal-agent theory is

[*]Corresponding author. Tel.: +61 6 2493881; fax: +61 6 2490182; e-mail: sking@coombs.anu.edu.au

that optimal contracts make use of any signal which is informative about the agent's action (Holmstrom, 1979). As Hart and Holmstrom (1987) point out, the relative simplicity of many incentive contracts is a puzzle for the theory. We address this puzzle in the specific context of publicly traded firms where the primary form of incentive compensation, especially in recent years, is a stock option plan (see for example Yermack, 1995). Since stock price movements are often short-lived or are otherwise unrelated to an executive's action, standard theory implies that option schemes should be indexed to filter out such extraneous events (see, Diamond and Verrechia, 1982 or Egginton et al., 1989 for formal demonstrations). The great bulk of actual option contracts, however, are granted with fixed exercise prices equal to the stock price at the date of the award and are not indexed to any exogenous variables (see Yermack, 1997 for the US case and Harcourt, 1987 for the case of the UK).

We develop a model which highlights the *potential* value of indexing an executive's compensation to remove the influence of short-term stock price movements, but shows why this value may be illusory. Our innovation is to allow for the possibility that the manager has private information about the firm's prospects. We first consider the case where the manager can simply announce her information to the market. We show that indexation is impossible in this case because the manager will 'talk down' her firm in the short term and so artificially raise perceptions of her long-term value added. The manager will tell the truth in equilibrium, but only because her incentive contract will effectively ignore short-term stock price information.

The result that the manager will not distort her announcements in equilibrium is a straightforward application of the revelation principle. Recent studies of actual price movements around stock option grants, however, indicate that some degree of 'talking-down' does in fact take place. Yermack (1997) finds that stock prices show abnormal *positive* returns in the three months after the CEO has been awarded an option grant even though the existence of the grant is not publicly announced until the three-month period has lapsed.[1] Similarly, Chauvin and Shenoy (1995) find a significant stock price *decrease* prior to executive stock option grants. CEO's benefit both from the pre-grant decrease and the post-grant rebound—the former by lowering the exercise price set for the option and the latter by raising the option value. We show that such behavior emerges under optimal contracts and rational expectations by all parties if there is a cost of talking-down the firm. Specifically, we adapt the framework of Stein (1989) in which the manager can shift cash-flows between periods in a manner which is

---

[1] Yermack (1997) finds no evidence that this price run-up reflects trading based on early leakages or inside information of the stock grants.

unobservable to the market but which is correctly anticipated in equilibrium.[2] The optimal contract permits some manipulation because the associated deadweight costs are traded off against the benefits of insuring the manager against short-term price movements. We also are able to confirm the intuitive result that there will generally be *more* 'talking-down' when the short-term share price is more variable or the manager is more risk-averse, because in these cases the benefits to insulating the manager from short-term stock price movements are greater.

A key feature of our model is that the short-term share price is established after contracting but before the manager makes her action choice. This timing contrasts with other models in the literature which set the manager's action choice before any share trading. Holmstrom and Tirole (1993) present a model where the short-term share price satisfies the Holmstrom (1979) informativeness criterion in that it tells shareholders something about the manager's action that they could not extract from final cash-flow realizations. The short-term share price then has a role in optimal managerial compensation. In contrast to our model, Holmstrom and Tirole only have share trading after the choice of managerial action. Their results also depend upon the presence of 'noise traders' in the stock market. Our model involves neither of these assumptions, but complements the Holmstrom and Tirole analysis by presenting an alternative role for the short-term share price. The alternative timing used in our model captures the effect of short-term information flows that can overwhelm any initial managerial decisions. For example, the exact costs associated with a project may only become known after the appointment of the manager but before her main contribution to the project. This cost information will be a primary determinant of the short-term share price. Similarly, if the manager takes over an on-going project, the main short-term determinants of firm value may be the realization of the activities of previous managers.[3]

Our results have implications for the debates on whether management incentives are sufficiently 'high-powered', (e.g., Jensen and Murphy, 1990; Haubrich, 1994) and the role of inside information on stock prices (e.g., Allen and Gale, 1992a; Benabou and Laroque, 1992), as well as for the substantial literature which examines the role of accounting and capital market measures of performance in

---

[2] Maggi and Rodriguez-Clare (1995) consider an adverse selection model where an agent can exert effort to distort a signal observed by the principal. They find that distortion may be optimal in equilibirum, but this result is driven by the desire of one 'type' of agent to mimic another. In contrast, optimal distortion in our model involves a trade-off with managerial risk aversion. See also Allen and Gale (1992b).

[3] In general both the framework used in our model and that presented in Holmstrom and Tirole (1993) will be relevant for managerial compensation. The two models capture different aspects of the short-term share price. Holmstrom and Tirole focus on the revelation of information over time after managerial action. Our focus is on the lag between contracting and the impact of managerial activities.

optimal contracts (see Lambert, 1993 for a recent summary). One implication is that the cost of motivating the manager to exert effort is strictly greater when the manager has relevant information to release to the market. Holding constant the marginal productivity of managerial effort, this favors low-powered incentive contracts.

2. Basic structure of the model

We adopt the following standard principal-agent assumptions. A risk-averse manager is hired by risk-neutral shareholders to take an action on their behalf. Competition between prospective managers ensures that the manager selected receives her reservation expected utility, denoted $\bar{U}$. The manager's action is denoted by a and is an element of the set A. The utility cost of any action a to the manager is given by $c(a)$. The manager's utility is additively separable in income and the cost of action with her preference scaling function for income denoted $U(I)$ with $U' > 0$, $U'' < 0$.

The firm's revenue gross of payments to the manager is denoted V and is assumed observable and verifiable. Revenues are a function of the manager's action and the realization of two random shocks, denoted s and z. The shock s is independently drawn from the cumulative density function $G(s)$ and is realized before the manager has chosen her action. The shock z is realized after the manager has chosen her action.

The realization of s is not directly verifiable. We assume, however, that there is an active market for claims on the firm's profit stream which is open after s is realized and before the manager's action is chosen. This stock market will produce a 'short-term share price' p which is verifiable. Since the price is revealed before the manager chooses her action, it cannot contain any useful information about her action in the standard principal-agent sense. Both V and p are observable and verifiable so that the manager's incentive contract can be conditioned on their realizations. We denote this contract by $m(p,V)$. We denote by $F(V|a,s)$ the distribution of revenues conditional on the manager's action a and the random shock s, where the effect of the shock z is subsumed by $F(\cdot)$.

While s is never verifiable, in Section 3 we first consider as a base case the situation where it is directly observed by the share market participants and is therefore 'automatically' incorporated in p which is verifiable. By way of contrast, in Section 4 and Section 5, s is always private information of the manager and she must be induced to announce its true realization to the market. Our key assumptions about observability and timing are summarized by Fig. 1.

In the case where all relevant information is public in the short-run, we show that the optimal managerial remuneration involves insuring the manager against short-term share price fluctuations which are both beyond her control and reveal nothing about the manager's action. For example, if we assume that gross revenue
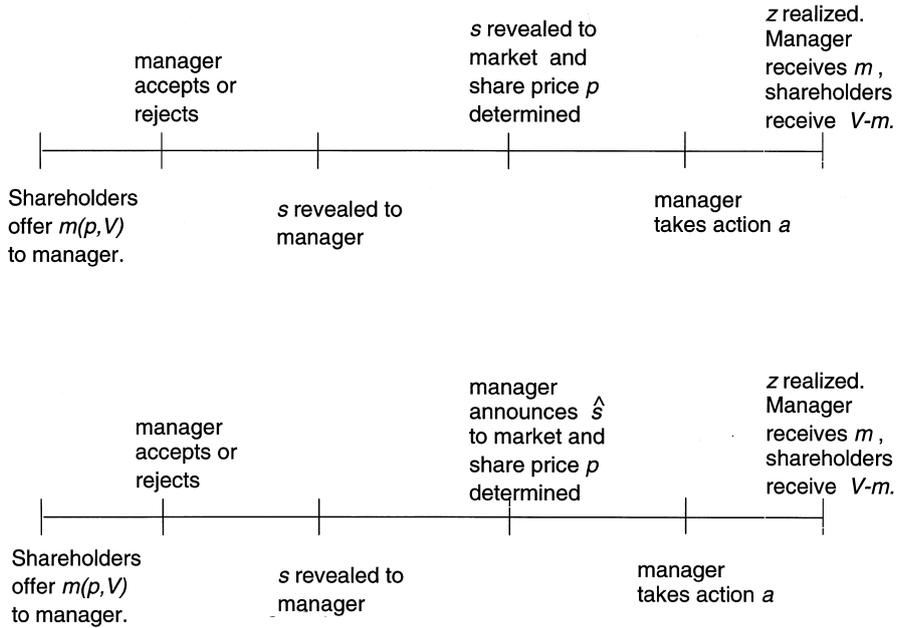
Fig. 1. (a) The order of moves when information is public. (b) The order of moves when information is private.

is additive, $V = s + a + z$, and restrict attention to the class of linear contracts, the optimal contract will vary managerial reward solely on the basis of long-term value added, $V - p$.

Section 4 considers the case where the manager possesses private information about s and there are no direct resource costs associated with the manager 'talking down' the firm. The optimal contract involves no manipulation of the public information by the manager in equilibrium. To avoid such manipulation we show that the manager must be 'punished' for announcing information that leads to a lower short-term share price. Of course, by the revelation principle, we can restrict attention to contracts where the manager always reveals her private information truthfully in equilibrium. However, the manager must be exposed to the fluctuations in the short-term share price under an optimal contract to ensure such revelation. For example, with additive revenue and linear contracts the optimal incentive scheme will expose the manager fully to short-term fluctuations by rewarding her solely on the basis of V.

Finally, in Section 5 we model manipulation of the private information by the manager as a costly activity that directly reduces the long-term value of the firm. For a specific model we show that manipulation occurs in equilibrium so long as

there is a positive risk-sharing benefit to insulating the manager from short-term stock price movements.

3. Fully observable information

In this section, we consider the unrealistic but expositionally useful case where corporate managers have no private information about the firm's short-term performance. To this end, we first assume that s is a publicly observed random variable and that there is a one-to-one relationship between s and p, given a payment schedule $m(p,V)$ and any beliefs by the market about the future actions of the manager. Thus, the share price p provides a perfect and verifiable signal of s. Shareholders choose the compensation scheme $m(p(s),V)$ to implement a desired action schedule $a(s)$ by solving the following standard principal-agent problem:

$$\max_{m(s,V)} \int_s \int_V [V - m(s,V)] \mathrm{d}F(V|a(s),s) \mathrm{d}G(s) \tag{1}$$

subject to the manager's participation constraint,

$$\int_s \int_V [U(m(s,V)) \mathrm{d}F(V|a(s),s) - c(a(s))] \mathrm{d}G(s) \geqslant \bar{U} \tag{2}$$

and the constraint that the manager choose $a(s)$ rather than any other a for all realizations of s

$$\forall s \int_V U(m(s,V)) \mathrm{d}F(V|a(s),s) - c(a(s)) \geqslant \int_V U(m(s,V)) \mathrm{d}F(V|\tilde{a},s) - c(\tilde{a})$$

$$\forall \tilde{a} \neq a(s) \tag{3}$$

Proposition 1 shows that when there is no private information, the shareholders fully index the manager's contract to neutralize short-term share price fluctuations. While the contractual payments and the managerial effort choice may depend upon p, the contract is identical to that which would have been set by the shareholders after the realization of s, satisfying the ex interim participation constraint for the manager that her expected utility given s must be at least her reservation utility $\bar{U}$. The manager's expected utility will not depend on the short-term share price, since her pay is determined only by returns accumulated after the short-term share price is determined.

Proposition 1: *The solution to the program given by* Eqs. (1)–(3) *is identical to the equivalent program set by the shareholders after s is realized and subject to ex interim participation.*

Proof: The program after the realization of s is given by:

$$\forall s \max_{m(s,V)} \int_V [V - m(s,V)]\mathrm{d}F(V|a(s),s) \tag{4}$$

subject to:

$$\forall s \int_V U(m(s,V))\mathrm{d}F(V|a(s),s) - c(a(s)) \geqslant \bar{U} \tag{5}$$

and

$$\forall s \int_V U(m(s,V))\mathrm{d}F(V|a(s),s) - c(a(s)) \geqslant \int_V U(m(s,V))\mathrm{d}F(V|\tilde{a},s) - c(\tilde{a}) \; \forall \tilde{a}$$

$$\neq a(s) \tag{6}$$

The proposition immediately follows, noting that the program after the realization of s is simply the point-wise optimization of the original program. ∎

In the absence of private information, the short-term share price is used to relieve the manager of the risk associated with s. It is so effective in this role that the manager is actually indifferent about the realization of s. The optimal incentive contract is indexed by the short-term share price and the manager is paid only according to 'abnormal' returns which are due to her action choice and the realization of the random variable z.

For example, suppose that $V = s + a + z$ and restrict attention to the class of linear contracts $m(p,V) = \alpha V - \beta p + \gamma$. As both the marginal value and marginal utility cost of effort are independent of s, the optimal action to be implemented by a managerial contract after s is revealed will not depend upon s. If we denote this (expected) action by a^e and assume (without loss of generality) that the expectation of z is zero then there is a one-to-one relationship between s and the short-term price under the optimal contract with $p + E[m(p,V)|s] = s + a^e$. But, by Proposition 1, s, and consequently p, will only be used to index the contract, so that the optimal linear contract will set $\beta = \alpha$.

Proposition 1 underscores the benefits from removing extraneous noise from managerial contracts. If the manager cannot influence short-term information flows then the optimal contract will insulate her from the risk associated with this information. The short-term share price has a natural insurance role. Proposition 1 has the counterfactual implication that CEO stock option contracts will be carefully indexed so that capital gains on the options will only be driven by long-term fundamentals. This result, we now show, alters drastically if the manager can directly affect the short-term share price. As we show in the remainder of this paper, in such a situation the manager's expected utility will, in general, depend upon the short-term share price p, even though this price is set prior to her action choice. Put simply, contracts which fully protect the manager

from short-term share price movements will lead the manager to manipulate her private information and 'talk down' the firm.

4. Private information

In this section we allow the manager to influence the share price in the most direct way possible; the manager privately observes the realization of s and announces some value of $\hat{s}$ prior to the market setting the short-term share price. All relevant information about p is private to the manager. If the shareholders wish to use the short-term share price as part of managerial compensation then, by the revelation principle, an optimal contract will induce truthful revelation of s by the manager. The informational asymmetries with which the shareholders must now contend are a short-term hidden information problem followed by a long-term hidden action problem.

As in Section 3 we assume that there is a one-to-one relationship between the true value of s and the price p. Thus, if 'truth telling' is the equilibrium strategy for the manager then the shareholders can infer s perfectly from p and can set the contract $m(p(s),V)$. The program for the optimal payment schedule to implement an action schedule $a(s)$ is thus given by Eqs. (1) and (2) together with the revised incentive compatibility constraint:

$$\forall s \int_V U(m(s,V))\mathrm{d}F(V|a(s),s) - c(a(s))$$

$$\geq \int_V U(m(\tilde{s},V))\mathrm{d}F(V|\tilde{a},s) - c(\tilde{a}) \; \forall \tilde{a} \text{ and } \tilde{s} \neq s \tag{7}$$

With Eq. (7), the optimal contract will be governed by two opposing forces. Managerial risk aversion leads to an optimal contract insuring the manager against variations in p. However, when the information that drives the short-term share price is private to the manager, the ex ante insurance possibilities are undermined by the ability of the manager to misrepresent her private information. While the manager and shareholders could both potentially gain from a contract which promises to insure the manager against fluctuations in s, the manager is the only one who knows the realization of s and is therefore able to 'pick' the value of p which best suits her. If m is indexed to p, the manager will always announce the value of s which results in the most favorable possible short-term share price.

Proposition 2: *Consider any two signals s' and s''. An optimal management payment scheme that satisfies Eq. (7) cannot have*

$$m(p(s''),V) \geq m(p(s'),V) \; \forall V$$

with strict inequality for some action a and some set of revenues $\mathcal{V}$ such that

$$\int_{V \in \mathscr{V}} dF(V|a,s') > 0$$

Proposition 2 follows trivially from Eq. (7). It implies that managerial payments cannot be monotonic in *s*. This rules out numerous contracts which would insure the manager from fluctuations in the short-run information flow. Returning to the example of linear contracts $m(p,V) = \alpha V - \beta p + \gamma$, the optimal contract under private information must set $\beta = 0$, rather than $\beta = \alpha$ as was the case under public information. The manager is completely exposed to the vagaries of short-term information flows even though these reflect factors beyond her control. The manager is effectively punished or rewarded for outcomes that may reflect either random events or the results of actions taken before her tenure.

The loss of insurance possibilities that arise because *s* is private information to the manager means that any non-trivial action schedule $a(s)$ will be strictly more expensive to implement in this case compared to a situation where *s* was public information. While the manager will receive different ex interim utility depending upon the realization of *s*, whether the manager is better off with a high or a low value of *s* will depend upon a number of features including the 'information rent' associated with the signal *s* and the optimal action schedule that the contract implements.

5. Costly manipulation

Section 4 clearly shows how private information can undermine indexation of incentive contracts. However, contrary to recent empirical results, 'talking-down' never occurs in equilibrium in this simple framework. In effect, by endowing the manager with private information about the firm's prospects, we have allowed her to manipulate short-run stock prices at zero direct cost. Incentive contracts must be radically altered to counteract this 'costless' manipulation.

In this section we consider a less extreme case where real resources must be expended in the process of misrepresenting the firm's short-term value. Extending Stein (1989), we assume that the manager can alter the firm's 'natural' timing of cash-flows at a strictly increasing cost. Specifically, she can affect actual short-term performance by deferring or accelerating future cash-flows.

To facilitate the analysis let us specialize the model from Section 2 as follows: *s* and *z* are assumed to be independent and normally distributed with zero means and variances σ_s^2 and σ_z^2, respectively. For an announcement $\hat{s}$ made to the market by the manager, let $d = s - \hat{s}$ denote the amount she effectively 'talks down' the firm by deferring cash-flows. We now assume that such manipulation of her private information reduces the long-term value of the firm by rd^2 so the marginal cost of manipulation is linearly increasing. The firm's (accumulated) gross revenue, *V*, including payments to the manager, is taken to be the sum of the manager's action

a, the realizations of the short-term shock s and the long-term shock z, less the 'talking-down' cost rd^2. That is:

$$V = s - rd^2 + a + z \qquad (8)$$

Following Holmstrom and Milgrom (1987) we restrict ourselves to contracts which are linear in the verifiable variables V and p:

$$m(V,p) = \alpha V - \beta p + \gamma \qquad (9)$$

Let $E[\cdot]$ denote the market's expectation operator given an announcement $\hat{s} = s - d$ by the manager, and given the market's expectations d^e and a^e for the manager's short-term manipulation of her private information and long-term action choice. $E[V]$ is thus equal to $\hat{s} + d^e - r(d^e)^2 + a^e = s - (d - d^e) - r(d^e)^2 + a^e$. Hence the (rational expectations) short-term share price for the firm may be expressed as:

$$p = E[V] - E[m(V,p)] = \frac{(1-\alpha)}{(1-\beta)} E[V] - \frac{\gamma}{(1-\beta)}$$

$$= \frac{(1-\alpha)}{(1-\beta)}[s - (d - d^e) - r(d^e)^2 + a^e] - \frac{\gamma}{(1-\beta)} \qquad (10)$$

Eq. (9) can now be re-expressed as:

$$m(V,p) = \frac{(\alpha - \beta)}{(1-\beta)} s + \frac{\beta(1-\alpha)}{(1-\beta)}[(d - d^e) + r(d^e)^2 - a^e] + \alpha[-rd^2 + a + z]$$

$$+ \frac{\gamma}{(1-\beta)}. \qquad (11)$$

We further assume that the manager's utility is exponential (that is, exhibits constant absolute risk aversion) in income with $U(Y) = -\exp(-\theta Y)$, her reservation certainty equivalent income is $\bar{Y}$ and that the certainty equivalent income cost of any action a is $a^2/(2\phi)$.

Given the linear compensation scheme and CARA utility function of the manager, it readily follows that the manager's manipulation choice d and action choice a are independent of s. To simplify the presentation these results are subsumed in the formulation of the shareholder's problem.

If we let $E_0[\cdot]$ denote the ex ante expectations operator, then the problem for the risk neutral shareholders is to write a contract that solves the following program:

$$\max_{\langle \alpha, \beta, \gamma, a*, d* \rangle} E_0[V - m(V,p)] = \frac{(1-\alpha)}{(1-\beta)}[a* - r(d*)^2] - \frac{\gamma}{(1-\beta)}$$

subject to:

- (Ex ante) Participation constraint

$$\frac{\beta(1-\alpha)}{(1-\beta)}[(d^*-d^e)+r(d^e)^2-a^e]+\alpha[-r(d^*)^2+a^*+z]$$

$$+\frac{\gamma}{(1-\beta)}-\frac{\theta}{2}\frac{(\alpha-\beta)^2}{(1-\beta)^2}\sigma_s^2-\frac{\theta}{2}\alpha^2\sigma_z^2-\frac{(a^*)^2}{2\phi}\geqslant\bar{Y} \tag{12}$$

- 'Talking Down the Firm' (TDF) constraint

$$d^*\in\underset{d}{\text{argmax}}\,\frac{(\alpha-\beta)}{(1-\beta)}s+\frac{\beta(1-\alpha)}{(1-\beta)}[(d-d^e)+r(d^e)^2-a^e]$$

$$+\alpha[-rd^2+a^*]+\frac{\gamma}{(1-\beta)}-\frac{\alpha^2\sigma_z^2\theta}{2}-\frac{(a^*)^2}{2\phi} \tag{13}$$

- (Ex interim) Incentive constraint

$$a^*\in\underset{a}{\text{argmax}}\,\frac{(\alpha-\beta)}{(1-\beta)}s+\frac{\beta(1-\alpha)}{(1-\beta)}[(d^*-d^e)+r(d^e)^2-a^e]$$

$$+\alpha[-rd^2+a]+\frac{\gamma}{(1-\beta)}-\frac{\alpha^2\sigma_z^2\theta}{2}-\frac{a^2}{2\phi} \tag{14}$$

- Rational expectations for the market

$$d^e=d^*\text{ and }a^e=a^* \tag{15}$$

From Eq. (15), and the first-order conditions for the TDF and incentive constraints we derive

$$d^*=\frac{\beta(1-\alpha)}{2r(1-\beta)\alpha}\text{ and }a^*=\alpha\phi. \tag{16}$$

Hence the equilibrium amount of manipulation depends on the extent to which the manager is rewarded for short-term relative to long-term price movements. Of course, both α and β are endogenous. Substituting Eq. (16) into the participation constraint to solve for $\gamma/(1-\beta)$ reduces the program to

$$\max_{\langle\alpha,\beta\rangle}E_0[V-m(V,p)]=[a^*-r(d^*)^2]-\frac{\theta}{2}\left[\left(\frac{\alpha-\beta}{1-\beta}\right)^2\sigma_s^2+\alpha^2\sigma_z^2\right]-\frac{a^2}{2\phi}$$

$$-\bar{Y}=\alpha\phi-\frac{1}{4r}\left[\frac{\beta(1-\alpha)}{(1-\beta)\alpha}\right]^2$$

$$-\frac{\theta}{2}\left[\left(\frac{\alpha-\beta}{1-\beta}\right)^2\sigma_s^2+\alpha^2\sigma_z^2\right]-\frac{\alpha^2\phi}{2}-\bar{Y}$$

This yields the first-order conditions for α and β:

$$\alpha{:}\phi + \frac{1}{2r}\left[\frac{\beta^2(1-\alpha)}{(1-\beta)^2\alpha}\right]\frac{1}{\alpha^2} - \theta\left[\left(\frac{\alpha-\beta}{(1-\beta)^2}\right)\sigma_s^2 + \alpha\sigma_z^2\right] - \alpha\phi = 0 \qquad (17)$$

$$\beta{:} -\frac{1}{2r}\left[\frac{\beta(1-\alpha)^2}{(1-\beta)\alpha^2}\right]\frac{1}{(1-\beta)^2} + \theta\left(\frac{\alpha-\beta}{1-\beta}\right)\frac{(1-\alpha)}{(1-\beta)^2}\sigma_s^2 = 0 \qquad (18)$$

Rearranging Eq. (18) we obtain

$$\beta = \frac{2r\theta\alpha^3\sigma_s^2}{1 - \alpha + 2r\theta\alpha^2\sigma_s^2} \text{ and using Eq. 17 we have } d^* = \frac{\theta\alpha^2\sigma_s^2}{1 + 2r\theta\alpha^2\sigma_s^2} \qquad (19)$$

Notice that for the case where manipulation is costless (i.e. $r = 0$) as Proposition 2 from Section 4 states, the optimal contract involves exposing the manager completely to the vagaries of short-term information flows, which in this situation corresponds to setting $\beta = 0$. It also immediately follows from Eq. (19) that there is no manipulation in the equilibrium associated with the optimal linear contract if either the manager is risk-neutral (i.e. $\theta = 0$) or the there is no noise associated with the short-term share price (i.e. $\sigma_s^2 = 0$).

More definitive comparative static results are elusive, for the simple reason that our expression for d^* in Eq. (19) contains the endogenous variable α. Changes in parameters such as σ_s^2 can invoke quite subtle changes on the optimal settings for the linear contract and the implied choices of effort and manipulation. However, in Appendix A we are able to show that the α that satisfies the first-order conditions Eqs. (17) and (18) is a non-zero solution of

$$\alpha(1-\alpha)\phi - \alpha^2\sigma_z^2 - \frac{\alpha^2\theta\sigma_s^2}{(1 + 2r\alpha^2\theta\sigma_s^2)^2} = 0 \qquad (20)$$

Differentiating the expression for d^* in Eq. (19) with respect to σ_s^2 we obtain

$$\frac{\mathrm{d}d^*}{d\sigma_s^2} = \frac{\theta\left(\dfrac{\mathrm{d}\alpha^2}{d\sigma_s^2}\sigma_s^2 + \alpha^2\right)}{(1 + 2r\alpha^2\theta\sigma_s^2)^2}$$

and so provided $(d\alpha^2/d\sigma_s^2)(\sigma_s^2/\alpha^2)$ is greater than -1 then $\mathrm{d}d^*/d\sigma_s^2$ is, as intuition would suggest, greater than zero. That is, an increase in short-term variability makes exposing the manager to the short-term share market relatively more expensive. This induces the shareholders to set a contract that insulates the manager more from short-term fluctuations, despite the fact that in so doing they encourage more 'talking down the firm' in equilibrium. In Appendix A, by differentiating Eq. (20) we are able to show that $(d\alpha^2/d\sigma_s^2)(\sigma_s^2/\alpha^2) > -1$ indeed holds for sufficiently high costs of effort (i.e. small ϕ).

6. Summary and conclusion

This paper has presented a model of short-term share prices and optimal management incentive contracts. When the short-term share price depends only on information possessed by corporate outsiders, we obtain the standard result from the principal-agent literature that such information is optimally used to index management compensation. The manager's pay is based on how well her firm performs in the longer-run, relative to the benchmark of the initial short-term share price. While such contracts are highly effective in isolating the manager's contribution from other determinants of the share price, they are not often observed. One reason, we show, is that indexed contracts are only viable when the short-term share price is truly exogenous to the firm. When the short-term share price is also sensitive to announcements or other actions taken by corporate insiders, it loses its integrity as an index. Managers can effectively reduce the price they must pay for their option rights by altering the information they release to the market. In this situation, the buy-in price must often be set regardless of the short-term share price, so that the manager receives windfall gains when this price is high and bears windfall losses when this price is low. So long as shareholders wish to provide her with any effort incentive at all, the manager will (optimally) be exposed to the short-term vagaries of the market for her firm's shares.

We consider two alternative ways in which the manager can influence the short-term share price. If the manager possesses private information which she can announce to the market, there will be no 'talking-down' in equilibrium because the incentive contract will be adjusted to ensure that she correctly reveals such information. When managers can take costly steps to alter the market's perceptions of the firm, optimal contracts do allow for a degree of equilibrium manipulation, consistent with recent empirical studies of stock price behavior around the time that executive options are granted. Our model predicts that there will be manipulation when the short-term price is volatile, and when the manager is relatively risk-averse.

In addition to empirically testing the above implications, our theoretical approach could usefully be extended in at least two directions. First, the manager might affect the short-term share price not only by announcing information, but also by trading the firm's shares in a market where order flow affects prices (e.g., Glosten and Milgrom, 1985; Seyhun, 1988). Second, it would be useful to incorporate the idea that indexation can also be affected by the firm's internal politics. Crystal (1991) takes the extreme position that corporate managers are able effectively to override the ex ante optimal contracts we analyze here by inducing the compensation committee of the firm's Board of Directors to re-price shares or options in the managers' favor. Our model has stressed the manager's 'external' influence activities directed at the short-term share market. A richer approach could also allow the manager to affect her compensation through internal influence activities as in, for example, Milgrom (1988).

Appendix A

Solving Eq. (16) for β yields:

$$\beta = \frac{2rd\alpha}{1 - \alpha(1 - 2rd\alpha)} \tag{21}$$

$$(1 - \beta) = \frac{1 - \alpha}{1 - \alpha(1 - 2rd\alpha)} \tag{22}$$

$$\frac{\alpha - \beta}{1 - \beta} = \alpha(1 - 2rd) \tag{23}$$

Substituting Eqs. (21)–(23) into Eqs. (17) and (18) to eliminate β, Eqs. (17) and (18) respectively become:

$$\phi + \frac{2rd^2}{\alpha(1 - \alpha)} - \theta\left[\alpha(1 - 2rd)\frac{1 - \alpha(1 - 2rd)}{1 - \alpha}\sigma_s^2 + \alpha\sigma_z^2\right] - \alpha\phi = 0 \tag{24}$$

$$-\frac{d}{\alpha} + \alpha\theta\sigma_s^2(1 - 2rd) = 0 \tag{25}$$

From Eq. (25) we obtain

$$d = \frac{\alpha^2\theta\sigma_s^2}{1 + 2r\alpha^2\theta\sigma_s^2} \text{ and } 1 - 2rd = \frac{1}{1 + 2r\alpha^2\theta\sigma_s^2} \tag{26}$$

Substituting Eq. (26) into Eq. (24) to eliminate d and rearranging yields

$$\alpha(1 - \alpha)\phi - \alpha^2\theta\sigma_z^2 - \frac{\alpha^2\theta\sigma_s^2}{(1 + 2r\alpha^2\theta\sigma_s^2)^2} = 0 \tag{27}$$

To differentiate Eq. (27) with respect to σ_s^2 it is convenient to set $s' := \sigma_s^2$, $z' := \sigma_z^2$ and $\gamma := \alpha^2$, so that Eq. (27) can now be expressed as:

$$\sqrt{\gamma}\phi - \gamma(\phi + z') = \theta\frac{\gamma s'}{(1 + 2r\gamma\theta s')^2} \tag{28}$$

Differentiating Eq. (28) with respect to s' we obtain

$$\frac{d\gamma}{ds'}\frac{s'}{\gamma}\left(\frac{\sqrt{\gamma}\phi - 2\gamma(\phi + \theta z')}{2\theta s'\gamma}\right)$$

$$= \frac{\left(\frac{d\gamma}{ds'}\frac{s'}{\gamma} + 1\right)(1 + 2r\gamma\theta s')(1 - 2r\gamma\theta s')}{(1 + 2r\gamma\theta s')^4} \Rightarrow \frac{d\gamma}{ds'}\frac{s'}{\gamma}$$

$$= \frac{(1 - 2r\gamma\theta s')2\gamma\theta s'}{(\sqrt{\gamma}\phi - 2\gamma(\phi + \theta z'))(1 + 2r\gamma\theta s')^3 - (1 - 2r\gamma\theta s')2\gamma\theta s'}$$

Substituting σ_s^2 for s', σ_z^2 for z' and α^2 for γ yields

$$\frac{\mathrm{d}\alpha^2}{\mathrm{d}\sigma_s^2}\frac{\sigma_s^2}{\alpha^2} = \frac{(1 - 2r\alpha^2\theta\sigma_s^2)2\alpha\theta\sigma_s^2}{(\phi - 2\alpha(\phi + \theta\sigma_z^2))(1 + 2r\alpha^2\theta\sigma_s^2)^3 - (1 - 2r\alpha^2\theta\sigma_s^2)2\alpha\theta\sigma_s^2} \quad (29)$$

From Eq. (29) it follows immediately that if ϕ is sufficiently small then $\phi - 2\alpha(\phi + \theta\sigma_z^2)$ is less than zero and hence $(\mathrm{d}\alpha^2/\mathrm{d}\sigma_s^2)(\sigma_s^2/\alpha^2)$ will be greater than -1.

References

Allen, F., Gale, D., 1992. Stock price manipulation. Review of Financial Studies 5, 503–529.

Allen, F., Gale, D., 1992. Measurement distortion and missing contingencies in optimal contracts. Economic Theory 2, 1–16.

Benabou, R., Laroque, G., 1992. Using privileged information to manipulate markets: Insiders, gurus and credibility. The Quarterly Journal of Economics 107, 921–958.

Chauvin, K., Shenoy, C., 1995. Stock price decreases prior to executive stock-option grants, working paper, School of Business, University of Kansas.

Crystal, G.S., 1991. In Search of Excess, W.W. Norton, New York.

Diamond, D., Verrechia, R., 1982. Optimal managerial contracts and equilibrium security prices. Journal of Finance 37, 275–288.

Egginton, D., Forker, J., Tippett, M., 1989. Share option rewards and managerial performance: An abnormal performance index model. Accounting and Business Research 19, 255–266.

Glosten, L., Milgrom, P.R., 1985. Bid, ask, and transaction prices in a specialist market with heterogeneously informed traders. Journal of Financial Economics 14, 71–100.

Harcourt, T., 1987. Charterhouse Top Management Remuneration, Monks Publications, London, UK.

Hart, O., B. Holmstrom, 1987. The theory of contracts, In: Bewley, T. (Ed.), Advances in Economic Theory, Yale University Press.

Haubrich, J.G., 1994. Risk-aversion, performance pay, and the principal-agent problem. Journal of Political Economy 102, 258–276.

Holmstrom, B.R., 1979. Moral hazard and observability. Bell Journal of Economics 10, 4–29.

Holmstrom, B., Milgrom, P., 1987. Aggregation and Linearity in the Provision of Intertemporal Incentives. Econometrica 55, 303–328.

Holmstrom, B.R., Tirole, J., 1993. Market liquidity and performance monitoring. Journal of Political Economy 101, 678–709.

Jensen, M.C., Murphy, K.J., 1990. Performance pay and top management incentives. Journal of Political Economy 98, 225–264.

Lambert, R.A., 1993. The use of accounting and security price measures of performance on managerial compensation contracts. Journal of Accounting and Economics 6, 101–123.

Maggi, G., Rodriguez-Clare, A., 1995. Costly distortion of information in agency problems. The RAND Journal of Economics 26, 675–689.

Milgrom, P.R., 1988. Employment contracts, influence activities, and efficient organizational design. Journal of Political Economy 96, 42–60.

Seyhun, H.N., 1988. The informational content of aggregate insider trading. Journal of Business 61, 1–24.

Stein, J., 1989. Efficient Capital Markets, Inefficient Firms: A Model of Myopic Corporate Behavior. Quarterly Journal of Economics 104, 655–669.

Yermack, D., 1995. Do corporations award stock options effectively?. Journal of Financial Economics 39, 237–269.
Yermack, D., 1997. Good timing: CEO stock option awards and company news announcements. Journal of Finance 52, 449–476.