Long-Term Incentives to Underperform in the Short Term

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Abstract

A firm's manager may choose to underperform in the short-term in order to boost subsequent pay: the apparent value of subsequent incentive compensation is diminished, requiring more overall pay to meet the manager's outside option. A greater weight on short-term compensation can counteract these incentives, provided liquidity constraints do not bind. Shifting to more long-term compensation, such as restricted stock and vesting conditions, generally worsens illiquidity and incentive compatibility problems. An extension considers reporting: managers have an incentive to under-report the firm's value, which can be remedied by granting short-term stock-based compensation.

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1 Introduction

An extensive literature explores the optimal contours of performance-based pay and the proper mix of long-term and short-term incentives – a problem that has immense practical and regulatory implications. This literature has focused on incentive compatibility, and has generally found that long-term instruments (such as restricted or delayed vesting compensation) are preferable to short-term ones: they combat opportunism (such as misreporting), reduce excessive risk, and align the interests of managers with shareholders. The contribution of this paper, in contrast, is to show that short-term incentives are necessary to combat intentional underperformance in the short term: managers can increase the value of their future compensation by making the firm appear to be of lower value than it actually is. Driving this dynamic are participation constraints that hold in each period, as opposed to holding in expectation over the aggregate tenure. Further, under such assumptions, this paper shows that the effect of certain long-term compensation instruments, such as restriction and delayed vesting, can be significantly negative.

The motivation for this paper arises out of the financial crisis of 2007-8 and, more particularly, the reform efforts that have followed. Short-termism is the bugbear of the post-financial crisis capital markets. Among other things, it is claimed that short-term incentives lead managers to "hide bad news [and] inflate earnings" (Coffee 2006), assume too much risk (Bebchuk & Fried 2010), abandon profitable long term projects (Edmans, Fang & Lewellen 2013), and promote trendy, "castle-in-the-air" projects in their place (Bolton, Scheinkman & Wong 2006). One underlying cause of short-termism may be that performance-based incentives are flawed and counterproductive; for in-

stance, according to Bebchuk (2009), the "broad freedom to cash out equity incentives has contributed substantially to creating short-term distortions" and help bring about the recent financial crisis.

Accordingly, reform efforts have pushed companies to utilize long-term compensation, such as restricted stock, in order to discourage managerial myopia. Bebchuk & Fried (2010) and Bhagat & Romano (2009), for instance, have advocated for long-term compensation reforms (mandatory for important financial institutions, advisable for other firms). Such proposals have gained significant traction. The SEC (Gallagher 2015) and Treasury (Geithner 2009) have pushed for longer-term incentives. The Dodd Frank Act of 2010 requires clawbacks, enhanced disclosure about compensation and compensation risks, mandatory compensation practices for certain institutions, and also directs regulatory institutions to promulgate consonant regulations. Corporate governance norms have internalized long-termism; for instance, the influential proxy adviser, Institutional Shareholder Services, incorporates the degree of long-term compensation into its governance scores.[1] More reforms appear to be coming down the pike: as part of her 2016 presidential campaign, for instance, Hillary Clinton has promised "a number of ideas designed to tackle... overly short-term focus on corporate strategy," with (yet unspecified) reforms addressing shareholder activism, capital gains rates, and executive compensation.[2]

This does, however, beg the question of whether shareholders might have

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[1] See Institutional Shaerholder Services, ISS Governance Quickscore 2.0: Overview and Updates, January 2014

[2] Laura Meckler and John D. McKinnon, Clinton to Push Revamp of Capital-Gains Tax Rates, The Wall Street Journal, July 20, 2015

benign motives for granting short term compensation, as well as the further question of whether reforms that mandate or subsidize long-term compensation will be helpful. This paper addresses those questions. The principal finding is that even non-myopic shareholders will put a heavier weight on short-term compensation in order to promote optimal managerial effort (and, in an extension, optimal reporting), and that reforms designed to undo that weighting likely have negative effects.

In the model developed in this paper, three factors drive short-term weighting: learning about firm type, unobservable effort, and binding participation constraints in each period. The manager's effort in each of two periods influences the likelihood of high cash flows. Because the shareholder does not observe effort but the manager does, the shareholder's forecast of firm type and value in period 2 departs from that of the manager. Hence, the manager can bias downward the shareholder's forecast by exerting less effort than expected in period 1. Where the shareholder's forecast is lower, the expected value of incentive compensation (modeled as a share of the period's cash flows) paid to the manager in period 2 will be lower. This requires the shareholder to pay a greater amount of wage compensation in period 2 in order to meet the manager's reservation wage to ensure the manager's participation. Overall, then, the manager has an incentive to shirk in the first period in order to boost her compensation in the second period. In effect, the manager has long-term incentives to "take a dive" in the short term. Similarly, the manager has long-term incentives to under-report value in the short-term, even if such misreporting is destructive to some degree.

Anticipating this result, the shareholder must award greater short-term performance-based compensation in order to ensure optimal effort; short-term

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compensation will therefore be more heavily weighted than it otherwise would be. While a first-best outcome is still achievable without liquidity constraints (such as the ability to pay the manager a negative salary), liquidity constraints may cause rents to the manager in some cases and a lack of otherwise-efficient production in others.

Attempting to undo this dynamic through commonly proposed reforms, such as restricted stock and delayed vesting, generally makes things worse. Restricted stock (i.e., any grant of period 1 cashflows must be bundled with some degree of period 2 cashflows) does reduce the shirking incentive but exacerbates the liquidity problems: either the manager's rents will be greater or a greater range of economic production is forestalled. Delayed vesting actually destroys incentives: to the extent early cash flows are high, these reduce the manager's subsequent pay, rendering her indifferent to first period outcomes.

An extension of the basic model shows that the same "taking a dive" dynamic applies to reporting. By making the firm appear to be worth less via a low report in the short term, the manager ensures a higher overall value of his subsequent compensation. The shareholder can remedy this problem by awarding more short-term stock compensation (which requires forcing the manager to sell it in the short-term).

1.1   Relation to prior literature

This paper follows the literature on optimal contracting and executive compensation. In the optimal contracting literature, provided that shareholders

control the firm and have broad freedom and ability to write contracts, there is generally little role for government intervention. Contract theory has described quite detailed optimal pay arrangements – for example, the dynamic savings accounts developed in Edmans, Gabaix, Sadzik, and Sannikov (2012), in which compensation is history-dependent, requires rebalancing and gradual vesting, and must account for factors such as the executive's ability to save.

Managerial power and myopia

It has been observed, however, that executive compensation schemes typically depart from what the optimal contracting literature prescribes. According to the "managerial power" theory, these departures arise because executives have hijacked the firm and set their own pay policies; executives tend to choose, among other things, short-termist pay which allows them to profit easily from short-term strategies or manipulations of stock price (Bebchuk, Fried & Walker 2002; Bebchuk & Fried 2004, 2005, 2010). Certain reforms, such as say on pay, enhanced compensation disclosure, or certain mandated pay arrangements, follow directly from the managerial power theory.

While the managerial power theory lays blame at the feet of executives, others suggest that shareholders themselves are myopic and incentivize managers accordingly. Such views have had some traction among regulators and politicians, such as SEC Commissioner Gallagher (2015) and presidential candidate Hillary Clinton, who view short-term, activist investment funds as a detriment to modern capital markets. Recent academic work has also questioned the role of shareholders. Bolton, Scheinkman & Wong (2006) present a heterogeneous expectations, behavioral model in which present shareholders favor the development of "castle-in-the-air" projects (such as dot-coms in the late 1990s)

which can be sold to a greater fool in the short-term; shareholders incentivize managers accordingly. Spindler (2011) presents a rational expectations model of shareholder choice of disclosure, showing that current shareholders, because they are collectively net sellers, favor disclosures that falsely inflate the market value of the firm's securities; this preference increases as the shareholder's propensity to sell in the short-term increases. Spindler (2015) shows that even non-myopic shareholders may choose compensation that causes misreporting if it also compels effort, and that fines on the firm can optimally deter such misreporting. Predictably, irrational expectations models lend themselves to regulation of substantive compensation terms, as in Bolton, Scheinkman & Wong (2006), while rational expectations models militate toward fines, as in Spindler (2011, 2015).

A significant literature demonstrates conditions under which managers may engage in myopic behavior or the effects that such myopia may have. Bebchuk (2005) notes "perverse incentives... to produce short-term stock price increases instead of long term value" that arise from "broad freedom to unload options and shares." Goldman & Slezak (2006) demonstrate that equity incentives tend to jointly compel misreporting and effort; fines placed on the manager can therefore be welfare improving because they deter misreporting but not effort. Alternatively, Bebchuk & Fershtman (1991) describe managers' insider trading as producing incentives to decrease firm value, a result that is not dissimilar to the one presented in the instant paper. Manso (2010) presents a model of uncertain returns in which short term, performance-based compensation (such as termination for poor performance) may in fact deter investment in innovative, uncertain technologies. Empirically, Edmans, Fang & Lewellen (2014) document a relation between managers' current equity sales

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and reduced long term investments in R&D. Burns & Kedia (2006) find that restricting CEO stock sales correlates with a decrease in misreporting. Finally, while not necessarily myopic behavior, the accounting literature conjectures that managers may take "big baths," artificially shading earnings lower at certain times, in order to obtain favorable benchmarking or for other strategic reasons (Elliott & Shaw 1988, Kirschenheiter & Melumad 2000).

In the policy sphere, Bebchuk & Fried (2010) have proposed requiring certain important firms to restrict their executives' stock for a period of years, while Bhagat & Romano (2009) propose restricting executives' stock until after retirement, a reform that they consider desirable for all publicly-traded firms. As noted in Spindler (2012), such recommendations have been popular with lawmakers: regulatory agencies, acting under the Dodd Frank Act, have recommended or mandated long term compensation for some types of firms, required clawbacks for certain others, and instituted enhanced disclosures regarding risks posed by compensation policies for publicly traded firms.

Benign short-term incentives

The financial economics literature has pushed back to some degree against the managerial power hypothesis. While observed pay arrangements may depart significantly from what orthodox contract theory would predict, new economic theories have developed to explain some of these departures. Edmans & Gabaix (2009) provide a survey of recent work along these lines, cataloging theories developed that account for, among other things, failures to index, awarding of severance pay, rewarding for luck, granting inside debt, and utilizing altogether less incentive compensation than might otherwise be predicted.

On the specific topic of the proper role of short-term incentives, there is an emerging literature that supports their use, which the instant paper joins. Several theories revolve around managerial risk-aversion (perhaps unsurprising since inherent managerial conservatism motivates much of the pay-for-performance literature in the first place – Jensen & Murphy (1990), for instance, famously asserted that most CEOs are paid like, and therefore act like, "bureaucrats"). Brisley (2006) finds that allowing more options to be exercised upon rises in stock price improves the incentives of managers to undertake positive-NPV, but risky, projects. Bhattacharyya & Cohn (2010) find a similar result, with the caveat that leveraged firm's shareholders have incentives to award too much short-term compensation to encourage excessive risk-taking. Chaigneau (2015) shows that vesting over time allows for "temporal diversification" of random shocks; mandatory minimum vesting periods are therefore harmful. Similarly, Peng & Roell (2013) demonstrate a trade-off between earnings manipulation and managerial risk aversion; the latter militates toward short-term compensation, as it is subject to fewer random shocks.

Several papers also model more fundamental reasons for the persistence of short-term compensation, which do not rely on managerial risk-aversion. Bizjak, Brickley & Coles (1993) develop a model in which high informational asymmetry leads to more long-term compensation; low asymmetry firms, such as mature companies, do better relying on short-term compensation. Acharya, John & Sundaram (2000) find that the optimal resetting of stock option exercise prices (which is done to maintain subsequent incentive compatibility in the face of a stock price drop) reduces early-period incentive compatibility (short-term compensation, however, is not modeled as a possibility). Laux

(2010) shows that allowing early stock option exercises leads to beneficial project-abandonment decisions. Laux (2012) shows that short term results may provide information on managerial quality, leading to better hiring and firing decisions. Spindler (2011c, 2012) addresses several recent compensation reform proposals and the distortions of incentives that they may create. Spindler (2015) shows that where short-term results signal managerial effort, non-myopic shareholders may choose short-term compensation, even though it causes harmful misreporting, due to its relative cost-effectiveness.

The paper most similar to the instant one is Acharya, John & Sundaram (2000), which addresses the optimality of resetting stock options. They derive an equilibrium in which shareholders will choose to be able to reset options (which are based upon the terminal value of the firm) upon interim drops in stock price in order to maintain long-term incentive compatibility: deeply "underwater" options may fail to compel effort because exceeding the exercise price may not be sufficiently attainable. This resetting comes at a cost, since executives know that they will, to an extent, be insured against bad outcomes; hence, more up-front incentive compensation is required in order to guarantee early-period incentive compatibility.

The instant paper does, however, depart significantly from Acharya, John & Sundaram (2000). This paper focuses on the role of short-term compensation, not considered in Acharya et al (all compensation there is long-term, in that it does not take into account interim price movements). The dynamic at play in the instant paper involves the participation constraint (also not considered in Acharya et al.), not the incentive compatibility constraint, which drives the option resetting result. Acharya et al. also does not consider learning about firm type (there is no unobserved type); in the instant paper, unobserved type

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gives managers an incentive cause the firm to perform poorly (or to create the appearance thereof) in the short-term.

Renegotiability and Participation Constraints

The model developed in the instant paper utilizes renegotiation of the manager's contract in light of learning about the firm and the manager's outside option. This assumption of binding participation (or individual rationality) constraints in each period follows in the spirit of Oyer (2004), who finds that lower-than-expected levels of performance based compensation may be optimal due to the effect of the "often overlooked participation constraint": managers' compensation must satisfy the reservation wage, which depends on economy-wide boom and bust cycles, rather than individual firm performance. Rajgopal, Shevlin & Zamora (2006) find empirical support for the hypothesis that participation constraints do actually bind from period to period. This assumption is also similar to that made in the renegotiation-proofness literature (Bolton & Dewatripont 2005 provide a survey), which allows renegotiation of contracts after an initial round of performance.

The state of the law suggests that executive compensation is subject to some degree of ongoing renegotiation. Under modern agency law, agents and principals are free to sever the agency relationship at any time. Liquidated damages for breach of a term employment agreement may be difficult or impossible to enforce. Non-compete agreements are subject to significant limitations. Lobel (2013) notes that competition to attract and retain talent is intense in the modern economy, and that attempts to impose contractual constraints on employees are often ineffective. As discussed in Acharya, John & Sundaram (2000), some degree of interim renegotiation of executive compensation ap-

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pears to be the norm.

Further, in part due to the success of the managerial power theory, firms are encouraged under modern corporate and securities law to scrutinize the effectiveness and amount of executive compensation on a continuous basis. Boards cannot abdicate their duty to oversee managerial pay. Long-term, hands-off contracts may raise the possibility of managerial windfalls, and subject the firm and board to criticism and even lawsuits. Public firms are subject to ever-increasing compensation disclosure requirements (including a duty to report risks related to disclosure) as well as shareholder "say on pay." Such factors suggest that the ability to enter into binding, long-term employment contracts is substantially limited.

2 The model

The shareholder and manager of a firm play a game in which the shareholder awards the manager equity-based compensation in order to induce the manager to exert costly effort. Each party is risk-neutral.

The are periods, $t = 1, 2$. The firm realizes cash flows of x_1 and x_2, random variables, at the ends of periods 1 and 2, respectively. Cash flows may be either high or low in each period $(x_t \in \{X_t, 0\}, X_t > 0)$ Firms may be either high or low type, $i \in \{H, L\}$, with $\Pr(H) = h, \Pr(L) = 1 - h$. High type firms having a greater likelihood of realizing high cash flows: $\Pr(X_t|H) > \Pr(X_t|L)$. More concretely, the production technology depends jointly on managerial effort and the firm's type: $\Pr(X_t|H) = \frac{a_H + e_t}{2}$ and $\Pr(X_i|L) = \frac{a_L + e_t}{2}$, with $e_t, a_H, a_L \in [0, 1]$ The terms a_H and a_L are exogenous parameters corresponding to firm

type, $a_H > a_L$, while e_t is the manager's choice of effort in period t. For simplicity, it is assumed that $a_H = 1$ and $a_L = 0$. The cost to the manager of exerting effort is $c_t(e_t) = C_t e_t$, where C_t is a constant.

The course of play is as follows. At the start, the firm's type, H or L, is randomly determined by nature; neither the shareholder nor the manager observe type. At the beginning of period $t = 1$, the shareholder awards to the manager a compensation contract w_1 consisting of performance-based compensation s_1 and a flat wage ω_1. The performance-based compensation takes the form of a grant of some fraction s_1 of the firm's cash flows. (Alternative forms of equity-based compensation, such as restricted stock, are considered in the extensions section.)

The manager has a reservation utility $\bar{w}$ in each period, and because the manager is free to leave, and the shareholder is free to fire him, the reservation wage must be satisfied in each period, conditional on the history. Termination of the manager leads to replacement with an identical manager. The manager privately chooses his effort e_1, which costs him $c(e_1) = C_1 e_1$. Maximal effort is assumed to be socially efficient: $\forall e_t, \frac{\delta E[x_t]}{\delta e_t} > \frac{\delta c(e_t)}{\delta e_t}$, as is production for any firm: $\frac{a_L + e_t}{2} X_t - c(e_t) - \bar{w} \geq 0$, $\forall\ e_t$. Time 1 cashflows x_1 are then realized, $x_1 \in \{X_1, 0\}$, and observed by the shareholder and manager.

In period $t = 2$, the shareholder, having observed x_1, revises her estimate of the firm's type. The shareholder then chooses w_2, which as before includes some level of equity-based award and salary, s_2 and ω_2, again subject to the constraint of satisfying the manager's reservation utility $\bar{w}$. The manager then chooses second-period effort e_2 at a private cost of $C_2 e_2$. Final cash flows x_2 are realized, and the game concludes.

3 Solving for the first-best outcome: unrestricted shares of cash-flows

3.1 Baseline: one shot game or precommitment

In the game where the manager and shareholder can precommit to a wage contract, or in the one shot version of the game, one can show that the contract $s_t = 2\frac{C_t}{X_t}, \omega_t = \bar{w} + C_t - s_t E[x_t]$ encourages optimal effort.

The manager's IC constraint in each period is $\max_{e_t} \omega_t + s_t E[x_t] - C_t e_t$. Substituting in the production function yields $\max_{e_t} s_t \frac{E[a_i]+e_t}{2} X_t - C e_t$, which is linear in e_t. This yields a corner solution of $e_t^* = 1$ if $s_t \geq 2\frac{C_t}{X_t}$, otherwise $e_t^* = 0$. If the IC constraint binds, $s_t^* = 2\frac{C_t}{X_t}$. The wage that then minimizes the cost of the compensation contract is given by the individual rationality (IR) constraint, which is $\omega_t^* = \bar{w} + C_t - s_t^* E[x_t]$.

In the two period game where the manager can precommit to a contract over both periods, the shareholder offers the contract $w_t^* = (s_t^*, \omega_t^*)$ for $t = 1, 2$. While $E[w_t^*] + C_t e_t^* = \bar{w}$, in the case that $x_1 = 0$, $E[w_2^*|x_1] + C_t e_t^* < \bar{w}$, that is, the expected value of the second period compensation contract is less than the manager's reservation wage. If given the choice to leave the firm, the manager would do so. Conversely, where $x_1 = X_1$, the expected value of the compensation contract would exceed the manager's reservation wage, and the shareholder could gain from adjusting down the wage to cause the IR2 constraint to bind.

Consider next the case where the manager cannot precommit to a second period compensation scheme that does not pay his reservation wage in all states of the world.

What would happen if the shareholder naively offered the precommitment contract (the "naive" contract) in each period? In the event that $x_1 = 0$, the manager would depart the firm, and no other manager would be willing to take on the job unless the shareholder relented. If the shareholder will renegotiate w_2 in the event of poor first-period performance, the manager can be induced to remain at the firm. However, there is an effect on first period incentives: the manager actually gets paid more salary in period 2 in the event of first period failure. (An analogous argument applies to period 1 success: the renegotiation results in a reduced salary due to the increased value of the incentive compensation.) Hence, if the manager can somehow fool the shareholder into believing the firm is of worse type than it really is, the manager would receive higher overall pay. Mechanisms to mislead the shareholder could include misreporting (discussed in an extension) or, as discussed in this section, by undertaking less effort, which is unobservable. By "taking a dive" in period 1, the manager can secure a higher level of pay in period 2.

This section formally considers that dynamic and solves for the equilibrium contract that guarantees efficient effort in each period. The specific incentive mechanism assumed here is a share of the firm's cashflows, s_t, in each period. As demonstrated, higher first period incentive compensation is required

than the naive contract would assign. In the extensions section, longer-term compensation measures, such as restricted stock and non-vesting stock, are considered.

3.2.1   Manager's choice of effort at $t = 2$

The manager chooses his effort at time $t = 2$ to maximize the value of his compensation contracts w_1 and w_2.

$$\text{IC2: } e_2^* = \arg\max s_2 E[x_2] - c(e_2)$$

Because $c(e_2)$ and $E[x_2]$ are each a linear function of e_2, the argmax is a corner solution, $e_2^* \in \{0, 1\}$. The condition for the manager to exert effort is $s_2 \frac{E[a_i]+1}{2} X_2 - C \geq s_2 \frac{E[a_i]+0}{2} X_2 \Leftrightarrow s_2 \geq 2\frac{C_2}{X_2}$.

The manager must also consider whether to participate at all in period 2, regardless of effort. He only does so if his second period incentive rationality constraint (IR2) is met:

$$\text{IR2: } s_2 E[x_2 | x_1, e_1, e_2^*] - Ce_2^* + \omega_2 \geq \bar{w}$$

. The manager's expectation of firm type depends on his choice of e_1 and the first period cashflows x_1, following Bayes' Law, $\Pr(H|X_1) = \frac{\Pr(X_1|H)\Pr(H)}{\Pr(X_1)}$ where $\Pr(H) = h$, $\Pr(X_t|H) = \frac{a_H + e_1}{2}$, and $\Pr(X_1) = \Pr(X_1|H)\Pr(H) + \Pr(X_1|L)\Pr(L)$. This yields Bayesian updates based on e_1 and x_1:

$$\Pr(a_H|X_1) = \frac{(1+e_1)h}{h+e_1}$$

$$\Pr(a_L|X_1) = \frac{e_1(1-h)}{h+e_1}$$

$$E[a_i|X_1] = \frac{(1+e_1)h}{h+e_1}$$

$$\Pr(a_H|0) = \frac{h\left(2-(1+e_1)\right)}{2-h-e_1}$$

$$\Pr(a_L|0) = \frac{(1-h)\left(2-e_1\right)}{2-h-e_1}$$

$$E[a_i|0] = \frac{h\left(2-(1+e_1)\right)}{2-h-e_1}$$

More compactly, $E[a_i|x_1] = 1_{X_1}\frac{(1+e_1)h}{h+e_1} + 1_0\frac{h(2-(1+e_1))}{2-h-e_1}$, where 1_j an indicator function equal to 1 if $x_1 = j$. The manager's IR2 constraint is then:

$$\text{IR2:}\ s_2\frac{1_{X_1}\frac{(1+e_1)h}{h+e_1} + 1_0\frac{h(2-(1+e_1))}{2-h-e_1} + e_2^*}{2}X_2 - C_2e_2^* + \omega_2 \geq \bar{w}$$

3.2.2 Shareholder's inference and share award at $t = 2$

At time $t = 2$, the shareholder determines the compensation contract w_2 according to the following objective function: $\max_{\omega_2,s_2,e_2}(1-s_2)\,\hat{E}[x_2|x_1] - \omega$ subject to the IC2 and IR2 constraints.

The shareholder chooses w to satisfy the manager's second period incentive compatibility (IC2) constraint for efficient effort.

$$\text{IC2:}\ e_2^* = 1$$

To satisfy the IR2 and IC2 constraints, the shareholder must form an esti-

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mate of second period cashflows based on first period performance, denoted $\hat{E}[x_2|x_1]$. Similar to the manager's update, $\hat{E}[x_2|x_1] = \frac{\hat{E}[a_i|x_1]+e_2^*}{2}X_2$, where $\hat{E}[a_i|X_1] = \frac{(1+\hat{e}_1)h}{h+\hat{e}_1}$ and $\hat{E}[a_i|0] = \frac{h(2-(1+\hat{e}_1))}{2-h-\hat{e}_1}$. The terms $\hat{E}[\cdot]$ and $\hat{e}_1$ denote that the shareholder's forecast of a_i and x_2 is based on what effort e_1 the shareholder believes the manager to have exerted in period 1.

IC2 will determine the relative weightings of salary ω_2 and performance-based compensation s_2. The shareholder's view (relying upon her estimate $\hat{e}_1$ of e_1) of the IC2 function is:

$$\text{IC2}: \ e_2^* = \arg\max s_2\hat{E}[x_2|x_1] - c(e_2)$$
$$= \arg\max s_2 \frac{1_{X_1}\frac{(1+\hat{e}_1)h}{h+\hat{e}_1} + 1_0\frac{h(2-(1+\hat{e}_1))}{2-h-\hat{e}_1} + e_2^*}{2}X_2 - c(e_2)$$

Removing terms that are not functions of the maximand, this is equivalent to:

$$\text{IC2}: e_2^* = \arg\max s_2 X_2 \frac{e_2}{2} - Ce_2$$

Because the manager's payoff is linear in e_2, he will choose $e_2 = 0$ where $\frac{1}{2}s_2 X_2 < C$ and $e_2 = 1$ where $\frac{1}{2}s_2 X_2 \geq C$. Rearranging terms, the IC2 condition pins down the minimum share to be offered to obtain effort:

$$\text{IC2}: \ s_2^* \geq 2\frac{C}{X_2}$$

The manager's IR2 constraint is:

$$\text{IR2}: \ \omega_2 + s_2\hat{E}[x_2] - c(e_2) \geq \bar{w}$$

Because effort and participation are assumed to always be efficient, both the IC2 and IR2 conditions will be satisfied in equilibrium. Further, IR2 and IC2 may both bind because, absent liquidity constraints (an assumption to

be relaxed later) the shareholder can first use IC2 to determine the minimum share award s_2 and then adjust the flat wage ω_2 up or down as necessary to make IR2 bind.

Combining IC2 and IR2 yields the salary ω_2^* :

$$\omega_2^* = \bar{w} + C_2 - 2\frac{C_2}{X_2}\hat{E}[x_2|x_1]$$

The above condition shows that the smaller is the expected value of the firm at the end of period $t = 1$ (i.e., the smaller is $\hat{E}[x_2|x_1]$), the larger is the manager's salary compensation ω_2. If the manager could, ceteris paribus, induce the shareholder to have a negatively biased forecast, he would do so.

3.2.3   The manager's choice of effort at $t = 1$

At time $t = 1$, the manager must make his initial choice of effort. The manager chooses period 1 effort e_1 to maximize the overall sum of his compensation in periods $t = 1, 2$. The choice of period 1 effort affects the expected value of period 2 compensation because the success or failure of the firm (which depends partly upon effort) will affect the shareholder's perception of firm value and hence the compensation package that the shareholder will award the manager. The manager's IC1 constraint may be written as (taking account of expressions for $E[x_1], \omega_2$, and s_2 and removing terms not functions of e_1):

$$\text{IC1} : \max_{e_1} w_1 + w_2 = \max_{e_1} E[\omega_1 + s_1 x_1 + \omega_2 + s_2 x_2 - Ce_1 - Ce_2] \qquad (1)$$

$$= \max_{e_1} s_1 \frac{e_1}{2} X_1 - 2\frac{C_2}{X_2} E\left[\hat{E}[x_2|x_1]\right] - Ce_1 \qquad (2)$$

$$= \max_{e_1} \frac{1}{2} s_1 e_1 X_1 - \frac{C_2}{X_2} e_1 \left(\hat{E}[x_2|X_1] - \hat{E}[x_2|0]\right) - Ce_1$$

The manager's objective function is linear in e_1, which results in a corner solution: $e_1^* = 1$ if $\frac{1}{2}s_1X_1 \geq \frac{C}{X_2}(\hat{E}[x_2|X_1] - \hat{E}[x_2|0]) + C$, and $e_1^* = 0$ otherwise. Under the assumption that effort is efficient,

$$s_1^* = 2\frac{C_2}{X_1X_2}(\hat{E}[x_2|X_1] - \hat{E}[x_2|0]) + 2\frac{C_1}{X_1}$$

The manager's period 1 individual rationality constraint must also be met, which is given by

$$\text{IR1: } \omega_1^* = Ce_1^* - s_1E[x_1] + \bar{w}$$

3.2.4 The shareholder's compensation decision in period t=1

At the beginning of the game, the shareholder must decide what compensation to offer the manager in the first period. The shareholder chooses the compensation contract to maximize the value of the firm's first period cash flows, x_1, net of compensation paid.

$$\max_{\omega_1, s_1} E[x_1] - \omega_1 - s_1E[x_1]$$

subject to

$$e_1^* = \arg\max \frac{1}{2}s_1e_1X_1 - \frac{C_2}{X_2}e_1(\hat{E}[x_2|X_1] - \hat{E}[x_2|0]) - Ce_1 = 1 \qquad \text{(IC1)}$$

$$\omega_1 + s_1E[x_1] - Ce_1^* \geq \bar{w} \qquad \text{(IR1)}$$

The shareholder achieves the optimum compensation contract w_1^* by choosing the minimum s_1 such that $\frac{1}{2}s_1(X_1 + \kappa X_2) \geq \left(2\frac{C}{X_2} - s_1\kappa\right)\frac{1}{2}(\hat{E}[x_2|X_1] - \hat{E}[x_2|0]) + C$, which satisfies the IC1 constraint, and then either raising or lowering ω_1 until $\omega_1 + s_1E[x_1] - Ce_1^* = \bar{w}$, which satisfies the IR1 constraint.

Summing up, the equilibrium solution to the game is:

$$e_1^* = e_2^* = 1$$
$$\omega_1^* = \bar{w} + C_1 - \left(2\frac{C_2}{X_1 X_2} \Delta\hat{E} + 2\frac{C_1}{X_1} \right) E\left[x_1 \right]$$
$$s_1^* = 2\frac{C_2}{X_1 X_2} \Delta\hat{E} + 2\frac{C_1}{X_1}$$
$$\omega_2^* = \bar{w} + C_2 - 2\frac{C_2}{X_2} \hat{E}[x_2 | x_1]$$
$$s_2^* = 2\frac{C_2}{X_2}$$

where $\Delta\hat{E} \equiv \hat{E}\left[x_2 | X_1 \right] - \hat{E}\left[x_2 | 0 \right]$.

Notable results include the following:

More short-term compensation. The solution to this game requires more short-term compensation than the naive case. The naive first period share award is $s_1 = 2\frac{C_1}{X_1}$, whereas the equilibrium solution here is $s_1^* = 2\frac{C_2}{X_1 X_2}\Delta\hat{E} + 2\frac{C_1}{X_1}$. The additional term, $2\frac{C_2}{X_1 X_2}\Delta\hat{E}$, derives from the fact that a lower perceived value of the firm lowers the perceived value of the manager's second period incentive compensation, which requires more salary to be paid.

Comparing the weighting on short-term versus long-term compensation, there is relatively more short-term compensation awarded than long-term compensation, all other things being equal. That is, if $C_1 = C_2 = C$ and $X_1 = X_2 = X$, period 1 share compensation exceeds period 2 share compensation by $2\frac{C}{X^2}\Delta\hat{E}$.

Role of non-observable effort. The non-observability of effort is required for this result to obtain. If effort is observable, the manager has no incentive to make the firm appear to be worth less because there is no possibility of

misleading the shareholder. One can see this from the manager's first period incentive compatibility condition in Eq.(1). The manager chooses e_1 to maximize $\frac{1}{2}s_1e_1X_1 + 2\frac{C}{X_2}E\left(E[x_2] - \hat{E}[x_2|x_1]\right) - Ce_1$, where $\hat{E}[x_2|x_1]$ is the shareholder's forecast of second period cashflows given first period cashflows without observing e_1, and $E[\hat{E}[x_2|x_1]]$ is the manager's forecast of the shareholder's forecast. However, if the shareholder observes effort e_1, the shareholder's forecast of x_2 given x_1 is the same as the manager's: $\hat{E}[x_2|x_1] = E[x_2|x_1]$. By the law of iterated expectations, $E[E[x_2|x_1]] = E[x_2]$, and the two expectations cancel out. The optimal contract in such a case is the same as the naive one, $s_t^* = 2\frac{C_t}{X_t}$.

First-best outcomes and liquidity constraints. Despite the heavier weighting on short-term equity compensation, this outcome is not necessarily harmful to shareholders. If there are no liquidity constraints on the manager, then to the extent that share compensation needs to be raised to support incentive compatibility, the salary can be reduced commensurately, such that the net expected value of compensation is, in equilibrium, the same as the reservation wage. In such an environment, efficient effort is always exerted. However, liquidity constraints can impact shareholder welfare: if the wage ω has a lower bound of $\bar{\omega} > \omega_1^*$, then there are instances in which the first-best compensation package is not feasible due to the dynamic described here. In such a case, the shareholder would have to choose whether to pay the manager more, with the manager receiving an information rent in period 1, or the shareholder would have to forego effort and production.

4 Extension: long-term compensation mandates

This section presents extensions of the main model to analyze certain proposed compensation reforms intended to provide management with longer-term horizons. The question examined is, if regulators mandate or subsidize additional long-term compensation, how does that affect the negative incentives described in Section 3?

The first extension models restricted stock, and the second considers delayed vesting. The effect of restricted stock is to exacerbate illiquidity problems: a greater range of first-best contracts becomes infeasible than in the non-restricted case. Delayed vesting can actually negate early-period incentives to undertake effort.

4.1 Restricted, fully vested compensation

Consider the case where regulatory mandates require a certain proportion of the manager's performance-based compensation to be long term compensation.[3] Such a mandate can be modeled as requiring a proportion κ of any first period grant to consist of both first and second period cash-flows x_1 and x_2. The first period compensation contract is then of the form $w_1 = \omega_1 + s_1 \left(E[x_1] + \kappa E[x_2] \right)$. It is assumed that all grants vest immediately (non-vesting is considered in the Section 4.2).

Decisions at $t = 2$. The shareholder's inference of firm type $\hat{E}[x_2|x_1]$ proceeds as in the basic model, and again the shareholder's objective function

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[3] Such mandates arise under the Dodd Frank Act, for instance.

is $\max_{\omega_2,s_2,e_2} (1 - s_2) \hat{E}[x_2|x_1] - \omega_2$.

The manager's IC2 constraint takes into account restricted stock: $e_2^* = \arg\max (s_1\kappa + s_2) \hat{E}[x_2|x_1] - c_2(e_2)$, which yields the second period share award: $s_2^* = 2\frac{C_2}{X_2} - s_1\kappa$.

Restricted stock also factors into the manager's IR2 constraint and pins down the period two wage: $\omega_2^* = \bar{w} + Ce_2 - \left(2\frac{C_2}{X_2} - s_1\kappa\right) \hat{E}[x_2|x_1, e_2]$.

It is apparent that the restricted award $s_1\kappa$ reduces, share for share, the share that must be awarded to induce incentive compatibility in period 2, and reduces by $s_1\kappa\hat{E}[x_2|x_1, e_2]$ the number of dollars that must be paid as salary to satisfy the manager's participation constraint.

Decisions at $t = 1$.

At time $t = 1$, the shareholder's problem is

$$\max_{s_1,\omega_1,e_1} (1 - s_1) E[x_1] + (1 - s_1\kappa - s_2) E[x_2] - \omega_1 - E[\omega_2] \text{ subject to IC1}$$

and IR1.

From the IC1 constraint, the manager chooses effort to solve the following problem:

$$\max_{e_1} s_1 \frac{E[a_i|x_1]+e_1}{2} X_1 + \underbrace{\bar{w} + C_2 e_2^* - \left(2\frac{C_2}{X_2} - s_1\kappa\right) E[\hat{E}[x_2|x_1]] + \left(2\frac{C}{X_2} - s_1\kappa\right) E[x_2]}_{\omega_2^*} -$$

$$Ce_1$$

Expanding the expectations yields:

$$\max_{e_1} s_1 \frac{E[a_i|x_1]+e_1}{2} X_1 - \left(2\frac{C_2}{X_2} - s_1\kappa\right) \left(\frac{E[a_i|X_1]+e_1}{2} \hat{E}[x_2|X_1] + \left(1 - \frac{E[a_i|X_1]+e_1}{2}\right) \hat{E}[x_2|0]\right)$$

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$$+ \left(2\frac{C_2}{X_2} - s_1\kappa \right) E[x_2] - Ce_1$$

After eliminating non-e_1 terms:

$$\max_{e_1} \tfrac{1}{2}s_1e_1X_1 - \tfrac{1}{2}\left(2\frac{C_2}{X_2} - s_1\kappa\right) e_1 \left(\hat{E}[x_2|X_1] - \hat{E}[x_2|0]\right) - Ce_1$$

The objective is linear in e_1, yielding a corner solution of $e_1 = 1$ if $\frac{1}{2}s_1X_1 - \frac{1}{2}\left(2\frac{C_2}{X_2} - s_1\kappa\right)\Delta\hat{E} - C_1 \geq 0$, and $e_1 = 0$ otherwise.

It is notable that restricted stock $s_1\kappa$ does reduce the manager's incentive to slack in order to make the firm appear less valuable. This is because: (i) the total amount of incentive compensation in period 2 is pegged at $2\frac{C_2}{X_2} = s_1\kappa + s_2$, (ii) the closer to zero is s_2, the less effect incentive compensation has on the wage ω_2, and (iii) therefore the shareholder's biased forecast $\hat{E}[x_2|x_1]$ also has less effect as s_2 approaches zero. So, for example, in the case where $s_1\kappa = 2\frac{C_2}{X_2}$, second period incentive compensation is $s_2 = 0$, and the net effect of the shareholder's biased forecast on the manager's compensation is zero.

The manager's first period individual rationality constraint (IR1) takes into account the value of the restricted stock because it vests immediately.

IR1: $\omega_1 + s_1E[x_1] + s_1\kappa E[x_2] - Ce_1 \geq \bar{w}.$

Summary and comparison to naive case and non-restricted case. Summing up, we have the following equilibrium solution (with the subscript R denoting the share restriction condition):

$$s_{1R}^* = \frac{2C_2 \Delta \hat{E} + 2C_1 X_2}{X_2 \left(\kappa \Delta \hat{E} + X_1 \right)}$$

$$\omega_{1R}^* = \bar{w} + C_1 - s_{1R}^* E[x_1] - s_{1R}^* \kappa E[x_2]$$

$$s_{2R}^* = 2\frac{C_2}{X_2} - s_{1R}^* \kappa$$

$$\omega_{2R}^* = \bar{w} + C - \left(2\frac{C_2}{X_2} - s_{1R}^* \kappa \right) \hat{E}[x_2 | x_1, e_2]$$

$$e_{1R}^* = e_{2R}^* = 1$$

Notable results include the following:

Greater weight on short-term compensation. As in the basic model, the proportion of short-term compensation awarded will generally exceed what the naive incentive compensation contract would award. Consider the naive share award with restricted stock: $s_1 = 2\frac{C_1}{X_1}, s_2 = 2\frac{C_2}{X_2} - 2\frac{C_1}{X_1}\kappa$. To begin, note that, in equilibrium, $\Delta \hat{E} \in \left[0, \frac{1}{2} X_t \right]$ over the domain $h \in [0,1]$. Substituting in $\Delta \hat{E} = yX$, $y \in [0, 1/2]$, $s_{1R}^* = \frac{2C_2 y + 2C_1}{\kappa y X_2 + X_1}$. This exceeds the naive first period award if $\frac{C_2}{X_2} \geq \frac{C_1}{X_1}\kappa$; in other words, so long as second period naive award s_2 would be positive. (This is likely the case in reality: negative value implies that the shareholder would be granting negative share compensation in period 2, which requires an increase in the salary ω_2 commensurate with the shareholder's forecast of value; in such a case, the manager has incentives to inflate the apparent value of the firm.) Hence, even with restricted stock, it is necessary for the shareholder to weight short-term compensation more heavily than the naive incentive award would imply. This is easy to see, for instance, if $C_1 = 0$. Following the naive case, it would appear that no incentive compensation is necessary to compel first period effort ($s_1 = 0$), and any positive award would be "excessive" short term compensation; however, in reality, the manager would choose zero effort due to the effect on second

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period salary. Therefore, a larger award, of $s_{1R}^* = \frac{2C_2\Delta\hat{E}}{X_2(\kappa\Delta\hat{E}+X_1)}$, is necessary to ensure incentive compatibility.

Restricted stock reduces slacking, but exacerbates illiquidity. While restricted stock can reduce the incentive to slack in period 1, it also exacerbates potential illiquidity problems. As noted above, as the restriction constraint is greater (κ increasing), more of the second-period incentive compensation is taken up with restricted stock. So, for instance, if restricted stock grants are sufficiently large that $s_{1R}\kappa = 2\frac{C_2}{X_2}$, no further grant of stock will take place in period 2 ($s_2 = 0$), and the second period wage does not take equity grants into account ($\omega_{2R}^* = \bar{w} + C$). Effectively, the shareholder's misestimation affects equally both the manager's stock incentives $s_{1R}\kappa\hat{E}[x_2|x_1]$ and reservation utility $\bar{w} + s_{1R}\kappa\hat{E}[x_2|x_1]$.

The tradeoff, however, is that the shareholder has given the manager, free and clear, a substantial amount of incentive compensation that is not contingent on period 2 participation. This requires the payment of additional salary ω_{2R} to ensure the manager's period 2 participation. Absent illiquidity concerns, this can be made up for by lowering the period 1 salary ω_{1R} commensurately. Where the manager's liquidity is limited, such that ω_{1R} is bounded from below by $\bar{\omega}$, then the shareholder is faced with the choice of either compensating the manager in excess of the reservation wage $\bar{w}$ (with the excess being a rent to the manager) or else foregoing otherwise efficient production.

To see that the illiquidity problem is of greater severity in the restricted case than in the unrestricted case, consider a comparison of ω_1^* and ω_{1R}^*. The illiquidity problem in period 1 is always worse if the following inequality is

true:

$$\omega_{1R}^* = \bar{w} + C_1 - s_{1R}^* E\left[x_1\right] - s_{1R}^* \kappa E[x_2] \leq \ \omega_1^* = \bar{w} + C_1 - s_1^* E\left[x_1\right]$$

Substituting in for s_1^*, s_{1R}^*, and $\Delta \hat{E} = yX_2$, $y \in [0, 1/2]$, the above expression reduces to $\frac{X_1}{E[x_1]} \geq y\frac{X_2}{E[x_2]}$, which must always be true because $y \in [0, \frac{1}{2}]$. Thus, to the extent that there is a lower bound on the wage compensation that the manager can receive in any period, restricted stock exacerbates illiquidity problems.

4.2 Delayed-vesting, restricted stock

To take another commonly compensation mechanism, suppose the manager's grant of stock in period 1 is contingent on her continued employment with the firm in period 2. That is, the stock does not vest if the manager departs the firm in period 2. As shown below, this has significant negative incentive effects.

Manager's decision at $t = 2$. The IC2 constraint is unchanged from the restricted vesting case: for $e_2 = 1$, $s_1\kappa + s_2 \geq 2\frac{C}{X_2}$. IR2 is, however, different since the manager forfeits her first period restricted stock if she leaves:
$s_1x_1 + \left(s_1\kappa + s_2\right) E[x_2|x_1, e_2] - C_2 e_2^* + \omega_2 \geq \bar{w}.$

Shareholder's decision at $t = 2$. As before, the shareholder has to draw an inference regarding x_2, denoted as $\hat{E}[x_2|x_1]$, in the same way as in the basic model. The manager's IC2 constraint provides the choice of stock compensation: $s_2^* = 2\frac{C_2}{X_2} - s_1\kappa$. From the IR2 constraint, $\omega_2^* = \bar{w} + C_2 -$

$$s_1 x_1 - (s_1 \kappa + s_2) \, \hat{E}[x_2 | x_1, e_2].$$

Manager's decision at $t = 1$.

Because the expected value of the non-vesting stock will lower the period 2 wage, the manager's IC1 condition takes this into account. The manager's problem is:

$$\max_{e_1} s_1 E[x_1] + \underbrace{\bar{w} + C - s_1 E[x_1] - (s_1 \kappa + s_2) \, E[\hat{E}[x_2 | x_1]]}_{\omega_2^*} + s_2 E[x_2] - C e_1 - C e_2$$

This is equivalent to

$$\max_{e_1} \bar{w} + C - (s_1 \kappa + s_2) \, E[\hat{E}[x_2 | x_1]] + s_2 E[x_2] - C e_1 - C e_2.$$

The $s_1 E[x_1]$ term cancel out because the manager's first period returns will reduce wage compensation in the second period, dollar for dollar.

Removing terms not a function of e_1, IC1 is:

$$\max_{e_1} -\frac{2C}{X_2} e_1 \Delta \hat{E} - C e_1$$

This is a negative function of e_1, and hence the manager always chooses $e_1 = 0$. This indicates that vesting conditional on retention is a poor means of inducing effort: the manager foresees that non-vesting bonus compensation based on period 1 returns will simply reduce, dollar for dollar, the compensation the manager receives in period 2. [4]

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[4] Supposing that there is some additional component of period 1 incentive compensation that does vest in period 1 (denoted as α_1) returns the problem back to that of the basic model studied above, where the manager's problem is $\max_{e_1} \alpha_1 \frac{e_1}{2} X_1 - \frac{2C}{X_2} \frac{e_1}{2} \Delta \hat{E} - C e_1$, with a solution of $\alpha_1^* = 2 \frac{C}{X_1 X_2} \Delta \hat{E} + 2 \frac{C}{X_1}$. The first period salary is

The shareholder's decision at $t = 1$. Because of the failure of non-vesting performance-based compensation to compel effort, the shareholder chooses $s_1^* = 0$, $\omega_1^* = \bar{w}$.

Summary and discussion. In equilibrium, with all first period performance based compensation being non-vesting, the following results obtain (the subscript N denotes the non-vesting model).

$$
\begin{aligned}
&e_{1N}^* = 0, \;\; e_{2N}^* = 1 \\
&\omega_{1N}^* = \bar{w}, \;\; s_{1N}^* = 0 \\
&\omega_{2N}^* = \bar{w} + C - s_{1N}^* x_1 - \left(s_{1N}^* \kappa + s_2\right) \hat{E}[x_2|x_1, e_2] \\
&s_{2N}^* = 2\frac{C}{X_2} - s_{1N}^* \kappa
\end{aligned}
$$

Obviously, this alternative is highly inefficient: first period effort is always zero. This occurs because high period 1 payoffs reduce the manager's wage in period 2. The manager, therefore, is indifferent to period 1 outcomes. This suggests that delayed vesting can be harmful to firm value where pre-commitment is not otherwise possible. If, as in this model, delayed vesting is conditioned on retention (or some other outcome that requires retention, such as period 2 performance), early-period incentives are seriously impaired, rather than improved.

5 Extension: reporting

This section demonstrates that the insights of the model extend readily to the reporting context. An extension of the basic model shows that managers

$\omega_1^* = \bar{w} + C - \left(2\frac{C}{X_1 X_2}\Delta\hat{E} + 2\frac{C}{X_1}\right) E[x_1]$, all as in the basic model, with the same conclusions.

have incentives to report falsely low value of the firm. An award of short-term stock (i.e., stock that must be sold in the short-term) can rectify this problem.

The extension is as follows. Suppose that cash flows are realized as before in period 1. However, the manager also can observe the firm's type in period 1, and the manager makes a period 1 report of the firm's type, $R \in \{a_H, a_L\}$. In order to simplify the analysis to focus solely on reporting instead of effort, suppose that effort does not factor in to period 1 production: period 1 production is given by $\frac{a_i}{2}$, while period 2 production is $\frac{a_i + e_2}{2}$. A false report causes harm to the firm (this could be due to misallocation of resources, among other reasons): the probability of success in period 2 is reduced by $\theta \in \left(0, \frac{1}{2}\right)$, a publicly-known parameter, such that the expected value of period 2 cashflows is $\left(\frac{a_i + e_2}{2} - \theta\right) X_2$, which, in a slight abuse of notation, will be written as $E[x_2] - \theta X_2$.

Naive contract. Under the naive precommitment contract, $s_2 = 2\frac{C_2}{X_2}$, $\omega_2 = \bar{w} + C_2 - 2\frac{C_2}{X_2} E[x_2]$, $s_1 = 0$, $\omega_1 = \bar{w}$. However, where precommitment is not possible but the shareholder still utlizes the naive contract in period 1, the manager's second period wage will have to adjust to take into account firm preformance: $\omega_2 = \bar{w} + C_2 - 2\frac{C_2}{X_2} \hat{E}[x_2 | x_1, R]$. This means that the manager's second period compensation will be lower when he issues a high report ($R = a_H$) than when he provides a low one ($R = a_L$). Formally, assuming the manager observes a high value of the firm, under the naive contract the manager chooses to not defect from separation when

$$E[w_1 + w_2 | a_H, R = a_H] < E[w_1 + w_2 | a_H, R = a_L]$$

. Expanding those terms yields:

$$E\left[\bar{w} + s_2 E\left[x_2\right] - 2\frac{C_2}{X_2}\hat{E}[x_2]|a_H, R = a_H\right]$$
$$\geq E\left[\bar{w} + s_2\left(E\left[x_2\right] - \theta X_2\right) - 2\frac{C_2}{X_2}\hat{E}[x_2]|a_H, R = a_L\right]$$
$$\Leftrightarrow 1 \leq 2\theta$$

This condition is never true, and hence under the naive contract, the manager chooses never to pursue a pure separation strategy. That is, at least some of the time, the manager will choose to falsely report a low value of the firm.

Optimal contract. Consider next the possibility that the shareholder rewards the manager based on the share's stock price at the end of period 1. Letting s_1 be the shares so issued, the separation condition is:

$$E\left[s_1\hat{E}\left[x_2\right] + s_2 E\left[x_2\right] - 2\frac{C_2}{X_2}\hat{E}[x_2]|a_H, R = a_H\right]$$
$$\geq E\left[s_1\hat{E}\left[x_2\right] + s_2\left(E\left[x_2\right] - \theta X_2\right) - 2\frac{C_2}{X_2}\hat{E}[x_2]|a_H, R = a_L\right]$$

Replacing terms,

$$s_1 X_2 + s_2 X_2 - 2\frac{C_2}{X_2}X_2 \geq \frac{1}{2}s_1 X_2 + s_2\left(X_2 - \theta X_2\right) - \frac{C_2}{X_2}X_2$$
$$s_1^* \geq 2\frac{C_2}{X_2}\left(1 - 2\theta\right)$$

Thus, a sufficient award of stock – that must be sold at the end of period 1 – can properly incentivize truthful reporting.

Note that awarding additional long-term compensation will do nothing to induce truthful reporting in period 1: $E[x_2]$ is not a function of reporting. Further, even awarding the manager stock in period 1 is not sufficient: the

manager would choose not to sell it for its artificially depressed value in period 1, and instead would hold it until termination of the game.

6   Conclusion

The model presented in this paper shows that, given widely applicable assumptions of unobservable effort, learning about firm type, and renegotiation, managers have incentives to cause the firm to perform poorly in the short-term. By making the firm appear worse, the perceived value of the manager's subsequent incentive compensation appears lower, which requires more salary compensation to meet the manager's outside option. The manager may make the firm appear worse by exerting sub-optimal effort or, as shown in an extension, by under-reporting the firm's value.

Shareholders can counter these incentives by providing a greater amount of short-term performance-based compensation. Provided that liquidity constraints are not too severe, shareholders can still arrive at first-best outcomes.

Certain proposed compensation reforms, designed to weight long-term incentives more heavily, are likely to be counterproductive. While some reforms, such as restricted stock, may reduce incentives to slack/misreport, they do so at the cost of exacerbating illiquidity problems, precluding a wider range of first-best outcomes. Other reforms, such as deferred vesting based on participation, can render incentive compatibility problems worse.

7 Appendix A: Short-term stock

The basic model employs shares of cash flows as its instrument of incentive compensation. However, a commonly utilized instrument is paying the manager in stock, the price of which incorporates both current and expected future cash flows. For completeness, that alternative is modeled here. The basic results remain the same.

Because first period compensation has no effect on the manager's second period earnings, the second period compensation is the same as in the base case: $s_2^* = 2\frac{C_2}{X_2}, \omega_2^* = \bar{w} + C_2 - 2\frac{C_2}{X_2}\hat{E}[x_2|x_1]$. The first period compensation s_1 takes into account not just cashflows $E[x_1]$ but also the market's forecast of next period's returns $\hat{E}[x_2|x_1]$, i.e., the stock price. IC1 becomes $\max_{e_1} s_1\left(E[x_1] + E[\hat{E}[x_2|x_1]]\right) - 2\frac{C_2}{X_2}E[\hat{E}[x_2|x_1]] - C_1e_1$, which, rewritten in terms of e_1, is $\max_{e_1} \frac{1}{2}s_1e_1\left(X_1 + \Delta\hat{E}\right) - \frac{C_2}{X_2}e_1\Delta\hat{E} - C_1e_1$. Solving for the optimal s_1 and substituting $\Delta\hat{E} = yX_2$,

$$s_1^* = 2\frac{C_1}{\left(X_1+\Delta\hat{E}\right)} + 2\frac{C_2}{X_2\left(X_1+\Delta\hat{E}\right)}\Delta\hat{E} = 2\frac{C_1+yC_2}{X_1+yX_2}.$$

In contrast, the naive or precommitted case is given by the following: $s_2 = 2\frac{C_2}{X_2}$, $\omega_2 = \bar{w} + C_2 - 2\frac{C_2}{X_2}E[x_2]$, i.e., the period two wage takes into account only the unconditional value of the firm. IC1 takes into account stock price, but not the effect on period 2 wages: $\max_{e_1} s_1\left(E[x_1] + E[\hat{E}[x_2|x_1]]\right) - C_1e_1 = \max_{e_1} \frac{1}{2}s_1e_1\left(X_1 + \Delta\hat{E}\right) - C_1e_1$, which yields $s_1 = 2\frac{C_1}{X_1+yX_2}$, such that $\omega_1 = \bar{w} + C_1 - 2\frac{C_1}{X_1+yX_2}E[x_1]$.

As in all the other cases, s_1 is greater in the optimal, equilibrium case than in the naive case: $2\frac{C_1+yC_2}{X_1+yX_2} > 2\frac{C_1}{X_1+yX_2}$. Thus, even where the manager is paid based on stock price, which provides some incentive to inflate value, the equilibrium solution where precommitment is impossible would lead the

manager to exert suboptimal effort where he is paid naively.

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