OPTIMAL COMPENSATION CONTRACTS WITH PAY-FOR-PERFORMANCE AND TERMINATION INCENTIVES

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Abstract

This paper studies optimal compensation contracts in the presence of both pay-for-performance and termination incentives. While these incentives have been studied independently, this paper's model is the first to incorporate both. The primary result is that pay-for-performance and the threat of termination are substitute incentive devices; holding effort constant, optimal pay-for-performance incentives are increasing in the cost of termination. Our test of this result compares compensation contracts of managers of real estate investment trusts and general partners of real estate limited partnerships. REIT managers' wealth changes by $25.30 per $1,000 change in REIT value. Compensation for general partners, who are more costly to fire than REIT managers, changes by $253.57 per $1,000 change in partnership value.

One of the most common characteristics of employment agreements in the U.S. is that firms have the right to fire employees for poor performance. Recent news in the business press suggests that firms are increasingly willing to exercise this right. A 1994 survey by the American Management Association (AMA) reports that in 1992 and 1993 over 20% of the 463 AMA member companies dismissed a professional or managerial employee within the first three months of employment. The *Wall Street Journal* and other business publications regularly carry reports of firms firing upper-level managers in the wake of poor performance. And while chief executive officers (CEOs) used to be for the most part spared from the ranks of those who lost their jobs, events over the last few years suggest a less secure future even for chief executives. Since January of 1993, angry boards have dismissed CEOs at IBM, Eastman Kodak, Apple Computer, Westinghouse Electric, American Express, Eli Lilly, Scott Paper, Borden, Sunbeam, KMart, and Morris-Knudsen. Given this apparent willingness by firms to fire workers, it is somewhat surprising that the literature on optimal incentive compensation has focused almost exclusively on incentives provided by pay-for-performance schemes, while largely ignoring the incentive that comes from a firm's ability to fire workers.[1] In this paper, we develop a compensation model that incorporates both pay-for-performance and termination incentives.

We derive a Nash equilibrium in contract parameters, where the worker chooses the optimal effort taking the parameters of the contract as given, and the firm chooses the parameters of the contract taking the worker's choice of optimal effort (i.e., the worker's response to the parameters of the contract) as given. The implications of the model and this equilibrium contract are intuitively appealing. The basic result of the model is that the pay-for-performance incentive and the termination incentive are substitute incentive

[1]Two notable exceptions are Shapiro and Stiglitz (1984) and Stiglitz and Weiss (1983).

devices; holding effort constant, optimal compensation schemes contain increasingly more intense pay-for-performance incentives as the cost of firing increases and the termination incentive weakens.

The empirical test of the model compares the compensation of managers of real estate investment trusts (REITs) to the compensation of general partners of real estate limited partnerships (RELPs). This data provides a strong test of the model because while REIT managers and RELP general partners perform very similar jobs, the difference in organizational forms is such that REIT managers are less costly to fire than general partners. Because of this difference in firing cost, the model predicts that the compensation contracts of REIT managers will have weaker pay-for-performance incentives than the compensation contracts of general partners (i.e., general partner compensation will be much more closely tied to performance). The empirical evidence from this test is consistent with the prediction of the model. REIT manager compensation changes by $25.30 for every $1,000 change in the value of the REIT, while general partner compensation changes by $253.57 per $1,000 change in the dollar return to limited partners.

This paper adds to the previous research on compensation in two ways. First, while the termination and pay-for-performance incentives have been studied independently, this is the first model in the literature to incorporate both of these incentives.[2] Second, this paper is the first to empirically estimate and compare compensation schemes across organizational forms, and thus sheds light on the characteristics of organizational forms that affect optimal compensation contracts.

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[2]Termination incentives are modeled in Stiglitz and Weiss (1983) and Shapiro and Stiglitz (1984). Pay-for-performance incentives have been studied in great detail by many researchers (see e.g., Holmstrom (1979), Shavell (1979), Harris and Raviv (1979), Grossman and Hart (1983), Gibbons and Murphy (1992)).

The rest of the paper is organized as follows. Section I discusses variations in firing costs and the effect of firing costs on the termination incentive. Section II contains the theoretical analysis and the development of the model. Section III presents the empirical analysis and results. Section IV concludes the paper.

I. Firing Costs and the Termination Incentive

While pay-for-performance incentives such as profit-sharing and commissions on sales work by providing a reward for good performance, the termination incentive is basically a threat. The firm threatens to fire workers who perform poorly, and assuming that workers do not want to be fired, the threat of termination gives workers an incentive to perform well. Like any threat, the effectiveness of the termination incentive depends on its credibility. If workers do not believe that the firm will actually fire them in the event of poor performance, then the threat of termination has no incentive power. One reason that workers might not believe that the firm will carry out the termination threat is that workers (and firms) know that termination is costly. In firing a worker, firms incur procedural costs, which include creating any necessary documentation to substantiate the firing decision,[3] severance payments, replacement costs such as search and training costs for new workers, and possible disruptions in the production process. As these costs increase, the credibility of the termination threat, and thus the effectiveness of the termination incentive, is diminished.

Because of the effect of firing costs on the strength of the termination incentive, differences in firing costs create differences in optimal compensation schemes. Firing costs vary across workers for a number of reasons. The firing process can be more costly

[3]Documentation and adherence to procedure is important in today's litigious society. Based on a 1992 sample from California, a wrongful termination suit costs an average of $80,000 to defend. (*Forbes*, 10/26/92)

for some workers than it is for others due to differences in employment contracts and termination procedures. For example, real estate investment companies have typically organized as either limited partnerships or real estate investment trusts (REITs). Both of these real estate investment vehicles are designed to give individual investors the opportunity to invest in professionally managed real estate assets, but differences in the employment contracts given to the management teams create significant differences in the cost of firing the managers. REITs are organized much like regular corporations. The trustees of a REIT (equivalent to a board of directors) are elected by shareholders, and REIT managers (the CEOs of self-advised REITs and the advisors of advisory REITs) are retained subject to annual review by the trustees. Limited partnerships, on the other hand, have no analogous structure for oversight and removal of general partners. Although most partnership agreements give the limited partners the right to remove and replace a general partner with a majority vote of limited partners, this right is usually conditional on the partnership receiving an opinion of counsel as to the legality of such an action. There is also the possibility that the limited partners may lose their limited liability status if they attempt to remove the general partner.[4]

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[4]The prospectus and partnership agreement for JMB Income Properties Ltd. IX, a 1984 real estate limited partnership, contains a fairly typical warning regarding any attempt by limited partners to remove the general partner:

> The Partnership Agreement provides certain rights for a majority in interest of the Limited Partners to remove and replace General Partners....There is uncertainty under present law as to whether the exercise of these rights under certain circumstances could cause the Limited Partners to be deemed to be general partners of the Partnership under applicable laws, with a resulting loss of limited liability. If the Limited Partners were deemed to be general partners of the Partnership, they would be generally liable for Partnership obligations and such obligations could be satisfied out of their personal assets.
>
> In order to minimize the risk of general liability, the exercise by the Limited Partners of the foregoing rights is subject under the Partnership

A potentially significant component of termination costs that differs greatly across workers is severance pay. Many non-managerial employees receive little or no severance pay. Mid-level managerial employees may get both a severance payment of six months' to one year's salary and outplacement assistance. In contrast, the typical CEO severance agreement provides a payment of three to five times the annual salary.[5] Severance pay, or at least something akin to it, is also an issue in professional partnerships such as those in law and accounting. Professional partnership agreements typically contain a buyout provision whereby the remaining partners have to buy out the ownership share of partners who either voluntarily leave the partnership or are forced out by the other partners.[6] Because of this buy-out provision, partners with significant ownership shares can be very expensive to remove.

Replacement costs, such as search and training costs, and possible disruptions in the production process are significant components of the overall cost of firing, and these costs certainly vary across workers. While it may be less expensive to replace workers in low-skill jobs because the supply of low-skill workers is high and the training requirements for low-skill jobs are minimal, workers with specialized skills can be very costly to replace due to the relatively low supply of high-skill workers in the labor market. Firing costs may also vary across low- and high-skill workers due to the degree

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> Agreement to the prior receipt of an opinion of counsel to the effect that the exercise of such rights will not adversely affect the limited liability status of the Limited Partners....It should be noted that due to present and possible future uncertainties in this area of partnership law, it may be difficult or impossible to obtain an opinion of counsel to the effect that the Limited Partners may exercise certain of their rights without jeopardizing their status as Limited Partners.

[5]Coopers and Lybrand 1992 survey of severance pay policies.

[6]In addition to the cost of buying out an expelled partner, the partnership will usually face a legal battle. An article in *Accountancy* (June, 1993) notes that,"...experience shows that the recipients do not accept expulsion notices placidly, and a dispute inevitably ensues."

to which the production process is disrupted when a worker is fired. A firm may be able to quickly replace a low-skill worker and avoid any major disruption in the production process, while firing a worker with specialized skills that are vital to the firm's production process may cause a costly break in production.

Because of the wide variation in firing costs across workers, the results of this research are relevant to a wide variety of employment situations, and are also consistent with a number of observable compensation schemes. In the case of professional partnerships such as those in law and accounting, new hires are usually paid a salary while partners are paid based on a combination of individual and firm performance. Given that new hires are certainly less costly to fire than partners, this compensation arrangement is consistent with the idea that workers who are very costly to fire will have a much larger portion of their pay based on performance. The fact that we observe more performance pay for upper-level managers, who often have specialized firm-specific skills, than for lower-level support staff is also consistent with the conclusion of this paper. This paper also provides insight for firms as they deal with the difficult problem of designing optimal compensation schemes. For example, if a potential CEO (or manager) wanted to include a large severance package in his or her compensation contract, this paper suggests that the firm would be wise to offer such a contractual severance package only in exchange for tying more of the CEO's compensation to performance.

II. The Model

We restrict the analysis to compensation contracts that consist of a fixed payment (e.g., salary) and a performance component that is linear in firm profits (or some other measure of performance). With this restriction, the optimal contract that we derive is optimal in the class of contracts that fit this simple form. Although this restriction limits the generality of the results, contracts that fit this simple form are widespread in actual employment situations. Holmstrom and Milgrom (1987) note the widespread use of linear contracts, and argue that the popularity of linear incentive schemes is attributable to both their simplicity and the fact that they are effective in a wide range of real-world environments. Linear contracts also have an advantage over more complicated, non-linear incentive schemes because they keep the strength of the performance incentive constant over the entire range of performance measurement outcomes.

The analysis is conducted using a two-period model as this is the simplest way to capture the intertemporal incentive effect of a firm's ability to fire workers. In a more general framework, the first period of this setting represents any period in which the termination incentive is present. We assume that both firms and workers incur transaction costs (such as search and negotiation costs) whenever they go into the labor market, so it is optimal for both to negotiate multi-period contracts.[7] To focus the analysis exclusively on incentive issues without the additional complication of adverse selection considerations, we make the following two assumptions: (1) all available workers are identical in any given period, and (2) the attributes of the labor pool that affect workers' profit potential evolve stochastically, so there is the possibility that a firm can benefit from firing and replacing a worker with a "better" worker at some point in the future.[8]

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[7]These labor market transaction costs are also a major component of the firm's cost of firing and a major source of the worker's incentive to avoid being fired.

[8]These assumptions have been employed in previous research. For example, the assumption that workers are identical is used in Stiglitz and Weiss (1983) and Shapiro and Stiglitz (1984), and the assumption that worker attributes evolve stochastically is used in Acharya (1992). The evolution of worker attributes could come about from new workers entering the labor market over time.

At the beginning of the first period, the firm and the worker agree on a compensation contract consisting of a fixed salary, a, plus a percentage b $(0 \leq b \leq 1)$ of firm (or project) profits, π, so that compensation in each period is given by $w_t = a + b\pi_t$. The parameters of the compensation contract (namely the salary and profit-share percentage) remain the same over both periods.[9] Profit in each period is given by $\pi_t = \lambda e_t + \tilde{z}_t$ where λ is a positive constant, e_t is the effort supplied by the worker in period t, and $\tilde{z}_t$ is an i.i.d. normally distributed random variable with mean zero and variance σ_z^2. We assume that the worker incurs a cost of effort $c(e_t) > 0$, given by $c(e_t) = \exp(e_t)$, and that the worker's utility function $u(\cdot)$ (with $u'(\cdot) > 0$ and $u''(\cdot) < 0$) defined over net wages $(w_t - c(e_t))$ exhibits constant absolute risk aversion with $r < 1$ as the coefficient of absolute risk aversion.

The risk-neutral firm maximizes the expected value of profit less compensation. From the firm's perspective, the worker's effort is a normally-distributed random variable, with mean μ_e and variance σ_e^2. Effort is uncorrelated with the random variable $\tilde{z}_t$, but is positively autocorrelated with a correlation coefficient of $\rho_{e_t, e_{t+1}}$>0. This implies that profit is also correlated across periods, with a correlation coefficient of $\rho_{\pi_t, \pi_{t+1}} = \frac{\lambda^2 \sigma_e^2}{\sigma_z^2 + \lambda^2 \sigma_e^2} \rho_{e_t, e_{t+1}}$>0.

To focus the analysis on the characteristics of the optimal contract at any level of effort, we assume that the firm knows the level of effort that it wants the worker to provide (i.e., the firm knows the optimal level of effort that will maximize the expected value of profit less compensation), but the firm faces an incentive problem because the worker is averse to effort and effort is unobservable.[10] The only thing that the firm can

[9]Without full-negotiation each period, constant contract parameters over time are necessary to avoid the problems of the ratchet-effect described in Weitzman (1980).
[10]If effort were observable, compensation contracts would simply specify the level of

observe is the level of profits, π, and effort cannot be deduced from the realization of profits because the exact value of the random variable $\tilde{z}_t$ is also unobservable. Although the firm cannot directly observe the worker's choice of effort, we assume that the firm does know how the parameters of the contract affect the worker's choice of effort. In designing the worker's compensation, the firm's objective is to set the parameters of the compensation contract, a and b, so that the worker will supply the optimal amount of effort at minimum cost to the firm, subject to the constraint that the compensation contract provides the worker with at least his or her reservation level of utility.

Because profit is the only observable measure of the worker's effort, the firm bases its firing decision on realized first period profit and fires the worker if first period profit is below some critical value π^c. The cost to fire the worker is denoted by γ, and both the firm and the worker know the values of π^c and γ. The firm fires the worker if the expected benefit outweighs the cost. The expected benefit of firing and replacing the current worker is the difference between the expected profit the firm will realize with a new worker and the expected profit given the current worker. Since we assume that effort, and thus profit, is positively correlated over time, this expected benefit of replacing the current worker with a new worker increases for lower levels of realized first-period profit. The firm must incur the cost of firing, so the net benefit of firing the worker is the expected increase in profit less the cost of firing.

In setting the firing rule, the firm wants to set π^c so that realized first period profit less than π^c signals a positive expected net benefit from firing the worker. For workers who are very costly to fire, the expected net benefit is positive only when the expected benefit of firing is very high. Because lower levels of realized profit correspond

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effort to be supplied and there would be no incentive problem. The incentive problem faced by the firm is a moral hazard problem because the worker's choice of effort is a hidden action.

to a higher expected benefit of firing, π^c for high-cost-to-fire workers is lower than π^c for low-cost-to-fire workers.[11] Section A of the appendix formalizes this intuition by deriving an explicit expression for optimal π^c and showing its dependence on γ. It also shows that the probability of being fired, $P(e_1,\gamma)$, is given by

$$P(e_1,\gamma) = F\left[\frac{\frac{1}{\rho}(\lambda(\mu_e^N - (1-\rho)\mu_e^I) - \gamma) - \lambda e_1}{\sigma_z}\right], \tag{1}$$

where F is the standard normal cumulative density function, μ_e^N and μ_e^I are the expected effort for a new worker and the incumbent worker, respectively, and ρ equals $\rho_{\pi_t,\pi_{t+1}}$. As (1) shows, the probability that the worker will be fired is a function of both the worker's first-period effort and the cost to fire the worker. The probability of being fired is decreasing in first-period effort because first-period profit is increasing in effort, and the probability of being fired is decreasing in the cost of firing because the critical value π^c is decreasing in the cost of firing.

A. The Worker's Problem

Given the parameters of the compensation contract, a and b, the worker's problem is to choose first-period effort e_1 to maximize the two-period expected utility. Because maximizing the certainty equivalent is more tractable than maximizing expected utility, the worker's problem is set in terms of the certainty equivalent, and the worker chooses e_1 to solve the following problem at the beginning of the first period:

$$\underset{e_1}{Max}\ \left[a + b\lambda e_1 - \exp(e_1) - \tfrac{1}{2} rb^2\sigma_z^2\right] + \left(1 - P(e_1,\gamma)\right)\left[a + b\lambda e_2^* - \exp(e_2^*) - \tfrac{1}{2} rb^2\sigma_z^2\right]^{12} \tag{2}$$

[11]This effect of firing costs on the critical value of profit simply reflects the idea that workers who are very costly to fire have to perform very poorly in order to justify the expense of firing them.

[12]With normally distributed random variables and constant absolute risk aversion, the certainty equivalent is the expected outcome less one-half the variance times the

The worker's objective function (2) shows that the worker's choice of effort affects both the value of the first-period certainty equivalent (the first term in square brackets) and the probability of keeping the job into the second period (the $\left(1 - P(e_1, \gamma)\right)$ term) and collecting the second-period certainty equivalent (the second term in square brackets). Maximizing (2) with respect to e_1 gives the worker's first order condition for effort in the first period, which is implicitly defined by

$$b\lambda - \exp(e_1^*) - \left.\frac{\partial P}{\partial e_1}\right|_{e^1 = e_1^*} \left[a + b\lambda e_2^* - \exp(e_2^*) - \tfrac{1}{2} r b^2 \sigma^2\right] = 0 . \qquad (3)$$

Using the definition of $P(e_1, \gamma)$ in (1), the partial derivative in (3) is given by

$$\left.\frac{\partial P}{\partial e_1}\right|_{e^1 = e_1^*} = f\left(\frac{\frac{1}{\rho}(\lambda(\mu_e^N - (1-\rho)\mu_e^I) - \gamma) - \lambda e_1^*}{\sigma_z} \right)\left(-\frac{\lambda}{\sigma_z}\right), \qquad (4)$$

where f is the standard normal probability density function.

The worker's optimal first-period effort function (3) can be further simplified by solving for e_2^*, the worker's optimal second-period effort. To choose e_2^*, the worker maximizes just the second-period certainty equivalent (as we are assuming that the

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coefficient of absolute risk aversion. In the worker's problem, the certainty equivalent in each period is the expected wage minus the cost of effort, minus one-half the variance of the wage times the coefficient of absolute risk aversion, r. The effort level in the second-period certainty equivalent expression is denoted e_2^* because the worker knows that if she gets to the second period she will choose his or her optimal level of effort. We are not including a discount rate for second period expected wealth in order to keep the number of variables in the model to a minimum, but all the results of the model hold with any reasonable discount rate.

employment contract covers only two periods) by solving the following problem:

$$\underset{e_2}{Max} \quad a + b\lambda e_2 - \exp(e_2) - \tfrac{1}{2}\, rb^2\sigma_z^2 . \tag{5}$$

Solving (5) gives the worker's first order condition for second-period effort

$$e_2^* = \ln(b\lambda), \tag{6}$$

and substituting this expression into (3) gives optimal first-period effort as being defined by

$$b\lambda - \exp(e_1^*) - \left.\frac{\partial P}{\partial e_1}\right|_{e^1 = e_1^*} \left[a + b\lambda(\ln(b\lambda) - 1) - \tfrac{1}{2} rb^2\sigma_z^2\right] = 0 . \tag{7}$$

Since no closed-form expression for e_1^* is possible, we show in Figure 1 numerical solutions to (7) for example parameter values. The Figure illustrates the comparative statics we formally derive below. Specifically, (1) Optimal effort increases as the profit-share component of pay, *b*, increases, (2) As the cost of firing increases, optimal effort decreases, and (3) As the profit-share component, and therefore e_1^* become large, the probability of being fired decreases and e_1^* approaches $\ln(\lambda b)$, the optimal effort in the absence of the termination incentive (as in equation (6)).

[INSERT FIGURE 1 HERE]

Equation (7) shows that both the profit-share and termination incentives affect the worker's choice of first period effort. Implicitly differentiating (7) provides us with the partial derivative of effort with respect to the profit-share component, b,

$$\frac{\partial e_1^*}{\partial b} = \frac{\lambda - \left.\frac{\partial P}{\partial e_1}\right|_{e_1 = e_1^*} [\lambda \ln(b\lambda) - rb\sigma_z^2]}{\exp(e_1^*) + \left.\frac{\partial^2 P}{\partial e_1^2}\right|_{e_1 = e_1^*} [a + b\lambda(\ln(b\lambda) - 1) - \tfrac{1}{2} rb^2 \sigma_z^2]} > 0 \tag{8}$$

[13]

and the partial derivative of effort with respect to the cost of firing, γ,

$$\frac{\partial e_1^*}{\partial \gamma} = \frac{\left.\frac{\partial^2 P}{\partial e_1 \partial \gamma}\right|_{e_1 = e_1^*} [a + b\lambda(\ln(b\lambda) - 1) - \tfrac{1}{2} rb^2 \sigma_z^2]}{-\exp(e_1^*) - \left.\frac{\partial^2 P}{\partial e_1^2}\right|_{e_1 = e_1^*} [a + b\lambda(\ln(b\lambda) - 1) - \tfrac{1}{2} rb^2 \sigma_z^2]} < 0 \, . \tag{9}$$

These comparative statics indicate that optimal contracts contain more pay-for-performance incentives as the cost of firing increases. Because effort is decreasing in the cost of firing and increasing in the profit-share component, for any level of effort that the firm wants to induce from the worker, the firm must use more intense pay-for-performance incentives as the cost of firing increases.

Finally, the first order condition (7) shows that the fixed-salary component of the compensation scheme also affects the worker's choice of effort, and this effect is directly attributable to the termination incentive. An increase in the salary makes second-period employment with the firm more valuable, and this gives the worker an incentive to

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[13]The signs in (8) and (9) hold for what we consider to be reasonable parameter values. One sufficient condition for both of these signs is that $\lambda \ln(b\lambda) > rb\sigma_z^2$, $\mu_e^I = \mu_e^N$, $\mu_e^I < e_1^*$, and the second-period certainty equivalent is positive.

increase first-period effort in order to increase the probability of keeping the job into the second period. So while the level of current-period salary does not affect the choice of current-period effort, the level of future salary does have an incentive effect when the firm has the ability to make future employment contingent on current-period performance.

B. The Firm's Problem

The firm knows that the worker will choose effort to maximize his or her own expected utility, and the firm's problem is to choose the parameters of the compensation contract to induce the optimal level of effort from the firm's point of view, given the known responses of the worker (i.e., equations (2) - (9)).[14] In order to get the worker to accept the job, the compensation contract must also give the worker at least his or her reservation level of utility. Let k denote the optimal level of effort from the firm's point of view, and let $\overline{w}$ denote the worker's reservation utility in certainty equivalent terms. Given the worker's first order condition for choosing effort (7) and the expression for the worker's two-period certainty equivalent (2), the optimal contract must satisfy the following two equations

$$b\lambda - \exp(k) - \left.\frac{\partial P}{\partial e_1}\right|_{e^1=k} \left[a + b\lambda(\ln(b\lambda) - 1) - \tfrac{1}{2} r b^2 \sigma_z^2\right] = 0 \qquad (10)$$

[14]In this simplified two-period setting, the firm's goal is to choose the parameters of the contract to induce the level of effort that maximizes first-period profits less wages. The effort constraint only applies to the first period because the goal of our analysis is to show the effect of the termination incentive on optimal contracts, and the termination incentive is only present in the first period of our simple two-period model.

$$\left[a + b\lambda k - \exp(k) - \tfrac{1}{2} rb^2\sigma_z^2\right] +$$
$$\left(1 - P(e_1,\gamma)\big|_{e_1=k}\right)\left[a + b\lambda(\ln(b\lambda) - 1) - \tfrac{1}{2} rb^2\sigma_z^2\right] = \overline{w}, \qquad (11)$$

where the participation constraint (11) is binding to ensure a minimum-cost contract for the firm. Because the fixed salary a and the profit-share b affect both the effort constraint (10) and the participation constraint (11), solving the optimal contract from these equations involves solving for one of the contract parameters in terms of the other and substituting through the constraints to get final expressions for a and b in terms of the underlying parameters of the model.

Although closed-form solutions for a and b are not possible given this general setup of the problem,[15] equations (12) and (13) define the optimal contract parameters for any level of effort that the firm wants to induce from the worker:

$$a^* = (b^*\lambda - \exp(k))\left|\frac{\partial P}{\partial e_1}\bigg|_{e_1=k}\right|^{-1} - b^*\lambda(\ln(b^*\lambda) - 1) + \tfrac{1}{2} rb^{*2}\sigma_z^2 \qquad (12)$$

$$b^*\lambda\left[\left|\frac{\partial P}{\partial e_1}\bigg|_{e_1=k}\right|^{-1}(2 - P(e_1,\gamma)\big|_{e_1=k}) + k + 1 - \ln(b^*\lambda)\right] -$$
$$\exp(k)\left[\left(\frac{\partial P}{\partial e_1}\bigg|_{e_1=k}\right)^{-1}(2 - P(e_1,\gamma)\big|_{e_1=k}) + 1\right] - \overline{w} = 0 \qquad . \qquad (13)$$

[15]Section B of the appendix solves the worker's and firm's problems using an exogenous probability function that allows for closed-form solutions. The numerical solutions for the model presented here exhibit the same qualitative characteristics as the closed-form expressions in the appendix.

Our central interest here is the effect of termination costs on the optimal level of pay-for-performance incentives. Figure 2 presents the results of numerical solutions for $b*$ given assumed values.

[INSERT FIGURE 2 HERE]

The numerical solutions again show that the optimal level of the pay-for-performance incentive is increasing in the cost of firing. The intuition is the same as that shown in the worker's problem: as the cost of firing increases and the termination incentive becomes less effective, the firm must use more intense pay-for-performance incentives to induce the worker to provide the optimal level of effort. Although not presented graphically, the simulation also shows that the optimal level of the fixed salary, $a*$, decreases in the cost of firing. This result comes from the fact that as the pay-for-performance incentive (the profit-share) increases in the cost of firing, the worker expects to earn more as a result of the profit-share component and the fixed salary amount decreases to keep the total wages paid equal to the reservation wage, $\overline{w}$.

Figure 2 also demonstrates that $b*$ is decreasing in σ_z^2. As the signal becomes more noisy, the performance component is less cost-effective as a means of inducing the optimal effort. Thus, as σ_z^2 increases, the firm relies more on safe salary and less on incentive pay.

III. Empirical Evidence

The main implication of the model is that workers who are more costly to fire will have compensation contracts with more intense pay-for-performance incentives. Given this straightforward implication, the optimal test of the model would involve calculating and comparing the pay-performance sensitivity across workers who differ only in the cost of firing. To approximate this best case, we compare the pay-performance sensitivity of managers of real estate investment trusts (REITs) to the pay-performance sensitivity of general partners of real estate limited partnerships. Both REITs and real estate limited partnerships are designed to provide investors with an opportunity to make equity investments in professionally managed real estate assets, and it is reasonable to assume that the managers of these investment vehicles perform very similar jobs. This data provides a strong test of the model because although both REITs and limited partnerships operate very similar assets, the difference in organizational form between REITs and limited partnerships is such that general partners are more costly to fire than REIT managers.[16]

A. Data and Sample Construction

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[16]While the idea that general partners are more costly to fire than REIT managers (or corporate managers in general) is difficult to prove, available evidence certainly supports this idea. Olson (1991), looks at the options available to limited partners if they decide to remove the general partner, and concludes that while it is possible to remove a general partner, "The task of removing and replacing a general partner of a RELP [real estate limited partnership] can be extremely time-consuming and expensive". Generally speaking, limited partners can remove a general partner by (1) getting a majority (sometimes a super-majority) of limited partners to vote for removal of the general partner, or (2) successfully suing to remove a general partner for breach of fiduciary duty. Both of these options are expensive. Coordinating many limited partners to cast a vote for removal can be a very expensive process, and legal recourse is invariably expensive. In contrast, REIT managers (either the advisors of advisory REITs or executives of self-managed REITs) work under agreements that give the trustees (or board of directors) the power to terminate the manager's employment at any time. McIntosh et. al (1994), in a sample of 55 NYSE REITs, document 53 forced departures of top management in the period 1971-1990. Olson (1991) documents five instances of general partners being removed, where all five included court battles. In searching the LEXIS/NEXIS database, we could find only four additional reported removals of general partners from real estate limited partnerships, and again all of these included some form of judicial intervention.

The data consists of REIT manager compensation and returns, and real estate limited partnership contracts in the period 1988-1994. This sample period was chosen in order to hold the tax treatment constant across the two organizational forms. Prior to the Tax Reform Act of 1986 (TRA-1986), REITs and limited partnerships were very different investments. The latter were marketed mainly as tax shelters because limited partners were allowed to deduct passive real estate losses from wage income on their personal tax returns. In contrast, while neither REITs nor limited partnerships paid taxes at the firm level, REITs were not allowed to pass losses on the underlying real estate through to their shareholders. Both REITs and limited partnerships distribute gains to their investors (shareholders and limited partners, respectively) which are taxed at the personal level, and neither entity is allowed to pass losses from the underlying real estate assets through to their investors.

To construct the REIT sample, we used the *1992 REIT Sourcebook* to compile a list of 76 equity REITs that traded on either the New York or American Stock Exchanges, or on the National Association of Securities Dealers Automated Quotation (NASDAQ) system. Because the empirical tests use first-differences in compensation (and we therefore need data from consecutive years), we checked the Center for Research in Security Prices (CRSP) tapes to see which of these 76 REITs had at least four consecutive fiscal years of return data. Fifty-nine of the 76 REITs passed this consecutive-returns test. Of this 59, proxy statements for at least three consecutive fiscal years were available for 37 REITs. We excluded any years in which there was a change in management, and the final sample consists of 189 firm-years (an average of about five years for each of the REITs in the sample) in which we have complete data on compensation, share ownership, and returns.

REITs are organized as either advisor REITs or self-advised REITs. In advisor REITs, the management team consists of a separate advisor company where the managers are not employees of the REIT. The advisor provides management services to the REIT and is compensated according to an advisory contract that is typically one year in length and is renewed at the discretion of the REIT's board of directors. For the 13 advisor REITs in our sample, we collect the total amount paid by the REIT to the advisor for advisory services during the year and the amount of REIT stock owned by the advisor.

Self-advised REITs are organized like typical corporations where all of the managers are employees of the REIT. For the 18 self-advised REITs in our sample, we collect total compensation in terms of salary, bonus, stock awards, option awards, and firm contributions to retirement plans for the CEO of the REIT. We also collect the amount of REIT stock owned by the CEO. For the six REITs that switched from advisor to self-advised, we collect both types of data.

[INSERT TABLE I HERE]

To gauge the completeness of our sample, Table I presents summary statistics on three groups: all 76 equity REITs from the *1992 REIT Sourcebook*, an adjusted total that excludes 26 REITs from two sponsors,[17] and our sample of 37. Table I shows that the adjusted total of 50 REITs consists of 30 (60%) self-advised REITs and 20 (40%) advisor REITs, where our sample consists of 18 (49%) self-advised REITs, 13 (35%) advisor REITs, and 6 (16%) REITs that switched from advisor to self-advised in the sample period. A more accurate measure of our sample, based on the total compensation-years,

[17]The 26 excluded REITs consist of 20 REITs sponsored by Public Storage and 6 REITs sponsored by Meridian Company. There are no multiple REITs by the same sponsor in either the remaining 50 we define as the total possible sample, or our sample of 37.

shows that our sample consists of 126 (67%) self-advised compensation-years and 63 (34%) advisor compensation-years. The size measurements, based on total equity market capitalization, show that the total possible sample has a mean market capitalization of $107.3 million and a median market capitalization of $56.0 million, where our sample has a mean market capitalization of $125.5 million and a median market capitalization of $67.8 million. In terms of total size, our sample represents 86% of the market capitalization of the total possible sample. The comparisons presented in Table I indicate that our sample is representative of the total possible sample of equity REITs listed in the *1992 REIT Sourcebook*.[18]

The limited partnership sample was obtained from Robert A. Stanger & Co., an investment advisory firm that specializes in partnership investing. The 69 partnerships in the sample represent all of the public equity real estate limited partnerships in the Stanger database that successfully closed in the sample period 1988-1994.[19] For each partnership, the Stanger data shows the value of the property at the time of closing, the total investment by limited partners, the leverage of the partnership, the front-end fees, and the sharing rule used to split both operating and terminal cash flows between the general and the limited partners. The partnership sample is heavily weighted towards the early years of the sample period (55 of the partnerships have a closing date in either 1988 (40) or 1989 (15)), reflecting the diminishing popularity of real estate limited partnerships. In terms of size, the partnerships are, on average, smaller than the REITs in our sample, with an average value at closing of $48.3 million and a median value at closing of $33.2 million. Regarding the completeness of the partnership sample, Robert Stanger & Co.

[18]Our sample represents 74% of the total possible (adjusted) REITs and 54% of the possible compensation years.

[19]Regarding duplication of general partners in the partnership sample, four of the partnerships are run by one general partner, and that is the highest number by one general partner in the sample.

claims that their database contains all public real estate limited partnerships. While we have no reason to doubt this claim, we have no way to judge the completeness of the partnership sample because we know of no other available database of real estate limited partnerships for the sample period.

B. Calculation of the Pay-Performance Sensitivity

We define the pay-performance sensitivity as the dollar change in REIT manager (general partner) wealth corresponding to a one-thousand dollar change in shareholder (limited partner) wealth. As the manager considers expending effort in order to make money for the shareholders, this sensitivity measure shows how much the manager receives for every one-thousand dollars that the shareholders receive as a result of the manager's effort.[20] This is the most commonly used measure of pay-performance sensitivity (Jensen and Murphy (1990), Gibbons and Murphy (1992), Murphy (1985), (1986)).

C. Pay-Performance Sensitivity for REIT Managers (CEOs and Advisors)

REIT managers receive compensation in a number of ways. The compensation package in each year typically includes salary and bonus, stock and option awards, and firm contributions to the manager's retirement plan. The manager's wealth is also affected by changes in the value of the firm's stock owned by the manager and changes in the value of previously granted options. In an attempt to isolate the source(s) (if any) of pay-performance sensitivity, we investigate the sensitivity of the component parts of the

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[20]Of course, managerial effort is not the only input to the firm's production function. However, if shareholder wealth is increasing in managerial effort, then shareholders have an incentive to make managerial compensation sensitive to changes in shareholder wealth.

compensation package as well as the sensitivity of the total wealth changes from both compensation and ownership. Very large one-time awards affect the results of the regressions. Our sample has a few bonuses and stock options awards in excess of $1 million, more than twice the mean compensation in the self-advised REIT sample. These extreme observations can unduly affect the regression coefficients. Consequently, in all of the regressions, we throw out the three highest and the three lowest observations of the dependent variable in order to mitigate the effect of extreme observations on the estimation of the regression coefficients.[21] We also control for inflation by stating all variables in 1988 dollars.[22] We check all of the regressors for multicollinearity using the condition index (Belsley et. al. (1980)), which is never high enough to indicate a serious problem. We also test the regressions for heteroscedasticity using the general test in White (1980), and where it is found, robust t-statistics are presented (again, following White (1980)).[23]

Because salary and bonus are arguably the most visible forms of compensation, we start the analysis by measuring the sensitivity of salary and bonus to changes in shareholder wealth. Since many of the advisors' "salaries" are based on a formula (e.g., percent of assets), this definition of compensation is only meaningful for the self-advised REITs. Thus, the advisor REITs are excluded from the sample used to estimate this specification. Because proxy statements are not always clear regarding which period's performance the bonus is based on, we include changes in shareholder wealth from both year *t* and year *t-1*.

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[21]Throwing out the four or five largest and smallest observations produced essentially unchanged results.

[22]Except for more significant intercept terms, the results are qualitatively similar if the regressions are run in nominal dollars.

[23]As the tables note, heteroscedasticity was only an issue for column four of Table II.

Previous research has suggested that firm size can affect the sensitivity of compensation to performance (Murphy (1985)). Murphy (1985), working with a much larger sample than we have, addresses the size issue by estimating a different intercept term for each manager. Because we only have an average of five years of data on each of the REIT managers in our sample, we are not able to estimate separate intercepts for each manager. To address the size issue in our analysis, we include size as a separate independent variable.

The manager's stock ownership in the REIT ties manager wealth changes directly to shareholder wealth changes irrespective of the change in salary and bonus. If there is some optimal total sensitivity of manager wealth changes to the performance of the REIT, then compensation committees might adjust the sensitivity of salary and bonus downward for managers that own a large number of shares. To investigate this possibility, we include a term that measures the percentage of the firm owned by the manager.

[INSERT TABLE II HERE]

Table II reports the results from the regression

$$\begin{aligned}\Delta(\mathit{Manager\ pay})_t = a\ &+ b_1\,\Delta(\mathit{Shareholder\ wealth})_t \\ &+ b_2\,\Delta(\mathit{Shareholder\ wealth})_{t-1} + b_3\,\mathit{Size}_t \\ &+ b_4\,(\mathit{Management\ percent\ ownership}_t),\end{aligned} \tag{14}$$

where $\Delta(\mathit{Manager\ pay})$ is defined in four different ways: (1) the change in salary and bonus, (2) the change in the sum of salary, bonus and the present value of the change in salary, (3) the change in total pay, where total pay is salary plus bonus plus stock awards plus option awards plus all other pay plus the present value of the change in salary, and

(4) total pay plus the change in the value of stock and options owned by management.[24] $\Delta(shareholder\,wealth)$ is a dollar measure of shareholder return calculated as the value of the REIT at the beginning of the year (shares outstanding x price per share) multiplied by the return for the year (where the data is from the CRSP tapes). Size is defined as shares outstanding times price per share at the end of the year. Management percent ownership is defined as the percentage of shares outstanding owned by the manager.

The first column has the results for the regression when the manager's pay is defined as salary plus bonus. The results of the regression show that changes in REIT manager salary and bonus are related to changes in shareholder wealth. The coefficient on the contemporaneous change in shareholder wealth is significant and equal to 0.000366, and the coefficient on the previous year's change in shareholder wealth is insignificantly different from zero. The contemporaneous change coefficient is interpreted as evidence that REIT managers receive increases (decreases) in salary and bonus of approximately $0.37 per $1,000 increase (decrease) in shareholder wealth. This estimate is larger in magnitude but certainly similar in spirit (i.e., economic significance) to the $0.0135 per thousand estimate found by Jensen and Murphy (1990) with their sample of CEOs of Fortune 500 companies.[25]

Jensen and Murphy (1990) suggest that because changes in salary are usually permanent, and therefore the manager will enjoy any changes in salary for as long as he or she works for the firm, a more accurate measure of the wealth change from salary revisions includes the present value of changes in salary. Following Jensen and Murphy, we estimate an upper bound on this effect by assuming that the manager will work for the

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[24]The first and fourth of these definitions are identical to those used previously in the literature, notably by Jensen and Murphy (1990). Thus, our final measure of pay sensitivity can be compared to theirs.

[25]The coefficient on the contemporaneous change in shareholder wealth does not change materially when size and the management ownership variable are omitted.

REIT until age 70 and we calculate the present value of salary revisions using the risk-free rate as the discount rate.[26] The second column in Table II presents the results from the same regression used in the analysis of salary and bonus, where the dependent variable in the regressions is now the change in the sum of salary, bonus and the present value of the change in salary. The results show that with this measure of manager wealth change, REIT managers receive an increase (decrease) in wealth of approximately $1.14 per thousand dollar increase (decrease) in shareholder wealth. Again, the coefficient on the contemporaneous change in shareholder wealth is significant while the coefficient on the previous year's change in shareholder wealth is insignificant. The jump in the sensitivity estimate to over $1 per $1,000 also implies that much of the sensitivity in the first regression is attributable to changes in salary and not just changes in bonus.

While salary and bonus is the most visible component of compensation, it is certainly an incomplete measure of the total compensation the manager receives. For a more accurate measure of the sensitivity of the manager's compensation, the basic regression equations are re-estimated with a measure of total compensation as the dependent variable. Total Pay is defined as the value of salary, bonus, stock awards, option awards, and all other pay (typically retirement contributions), plus the present value of the change in salary, and represents all changes in manager wealth that are under the year-to-year control of the REIT compensation committee. The advisors of advisor REITs do not receive compensation in the form of stock and option awards, so Total Pay for the advisors is defined as the total annual advisory fee paid to the advisor.

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[26]We calculate this measure only for the self-advised REITs. If the CEO has eight or more years to age 70 (i.e., if the CEO is age 62 or younger), we use the 10-year Treasury-bond rate. If the CEO has between three and seven years to age 70, we use the 5-year Treasury rate, and we use the 1-year Treasury rate if the CEO has one or two years to age 70. If the CEO is 70 or older, we assume that the CEO is in the last year of employment with the REIT.

The stock awards are valued using the price at the end of the fiscal year, and the options are valued using a version of the Black-Scholes (1973) Option Pricing Model adjusted for continuously paid dividends (first developed by Merton (1973) and used by Murphy (1985), Jensen and Murphy (1990)).[27] The third column of Table II reports results from the regressions with changes in Total Pay as the dependent variable. For this regression, we allow for different slopes between the self-advised and advisor REITs by including interaction terms between each regressor and a dummy that equals one for advisor REITs and zero for self-advised REITs. The regression shows that managers of self-advised REITs receive an increase (decrease) in total compensation of approximately $1.09 per thousand dollar increase (decrease) in REIT shareholder wealth.[28]

The results to this point have included only changes in pay-related wealth and have not included the changes in manager wealth attributable to the manager's ownership stake in the REIT. For managers with material ownership stakes, the changes in the value of the stock and options that the manager owns can be much larger than the changes in pay-related wealth. The average value of management stock holding in our sample is $5.6 million of the common stock of their REIT, and the median value is $1.8 million. In terms of percentage ownership, the average percentage ownership of REIT managers is 4.95%, with a median ownership position of 1.53%. The median ownership percentage for self-advised REIT CEOs is 1.11%, compared to a median of 5.71% for managers of

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[27]In applying the Black-Scholes model, we use 1-year (time to expiration of two years or less), 5-year (time to expiration between three and seven years), or 10-year Treasury bond rates (time to expiration greater than seven years) as the risk-free rate. We calculate a monthly dividend yield by dividing total regular dividends paid during the year by end of year stock price divided by 12 We calculate the variance using the previous 60 months' returns, and we use the end-of-year stock price.

[28]The change in shareholder wealth coefficient remains significant (at roughly $1 per $1,000) in all specifications, when size and/or the manager ownership term is included and when the slopes across both types of REITs are held constant.

advisor REITs. Option holdings that come from previous year's option awards are also significant. The average value of outstanding options for REIT managers is $230,227, with a median of $46,810.[29]

Column four of Table II presents results from the regressions where the dependent variable is the change in the manager's total firm-related change. Total Wealth Change is defined as Total Pay plus the change in the value of the manager's stock and options. The results show that stock ownership is an important consideration in determining the overall sensitivity of manager wealth to REIT performance. The overall estimated sensitivity in these regressions is much higher than previous regressions, and this regressions is able to explain comparatively more of the variation in pay (i.e., a much higher adjusted R-squared than the previous regressions). The coefficients on both the contemporaneous change in shareholder wealth and its interaction with the advisor dummy are significant. Management ownership is significant for the self-advised REITs, an effect that is offset almost exactly for the advisor REITs. Because the dependent variable in this regression contains all of the components of manager wealth related to the performance of the firm, the coefficients provide a final estimate for the total sensitivity of REIT manager wealth to changes in REIT shareholder value. The sum of the coefficients on contemporaneous and previous year's changes in shareholder wealth implies that the total manager (of a self-advised REIT) wealth change associated with a $1,000 change in shareholder wealth is approximately $20.67. For advisors of advisor REITs, this jumps to approximately $65.58 per $1,000. For the total sample, when the slopes are constrained to be equal and

[29]This measure of option ownership is taken over the entire sample, and thus understates the extent of the option holding for the CEOs of self-advised REITs. In our sample, option grants are only used for the CEOs of self-advised REITs, and are not used for the advisors of advisor REITs. CEOs of self-advised REITs own an average of $603,450 of options (median of $150,843).

controlling for size and management ownership, the sensitivity is $25.30 per $1,000 (results not reported here).

The pay-performance measure for advisors of advisor REITs merits further discussion. The $65.58 estimate is considerably larger than the estimated $20.67 for the self-advised REIT CEOs (and much larger than the Jensen and Murphy (1990) estimate of $3.25).[30] There are a number of possible reasons for these differences. First, the advisor REITs are much smaller than the self-advised REITs and previous research has found that sensitivity is decreasing in firm size (Murphy (1986), Jensen and Murphy (1990), and Gibbons and Murphy (1992)). Second, advisors of advisor REITs own much more stock than their self-advised counterparts, which is directly reflected in the regression's dependent variable. Finally, and perhaps most importantly, the fees paid to the advisor represent all of the management expenses of the REIT, while the compensation to the CEO of a self-advised REIT is only part of the total costs of management services to the REIT. In light of these facts, the $65.58 estimate becomes more reasonable.

[INSERT TABLE III HERE]

D. Pay-Performance Sensitivity for General Partners of Real Estate Limited Partnerships

[30]While this total sensitivity is much larger than that found by Jensen and Murphy (1990), this likely can be explained by the differences in size and stock ownership across our samples. Our median advisor REIT has a size of $16.6 million, our median self-advised REIT size is $237.7 million, and the median size firm in Jensen and Murphy's sample is reported as $1.2 billion. Our managers have median stock ownership of 1.53% compared to 0.16% for the Jensen and Murphy sample.

General partners are compensated according to the terms set forth in the partnership agreement. The compensation for general partners consists of up-front origination fees for setting up the partnership and buying the property, management fees for managing the property during the life of the partnership, and liquidation-phase fees that consist of commissions and a share of the profits earned by the partnership on the sale of the property. Table III presents summary statistics on the components of general partner compensation in our sample. The front-end fees are tightly clustered around 20% of invested capital from the limited partners, with a mean of 19.5% and a median of 19.2%. Annual management fees average 5.1% across the sample with a median of 6.0%. The general partner's share of the gain on sale, which is the main performance component of general partner compensation, averages 16.9% with a median of 15.0%. Regarding ownership positions in the partnership, none of the general partners has more than a 1% ownership stake,[31] so the compensation contract represents essentially the only way that the limited partners can provide the general partner with an incentive to increase partnership value.

Calculating the pay-performance sensitivity for the general partners presents a number of challenging computational issues. Because the limited partnership shares are not publicly traded, the methodology used to calculate the pay-performance sensitivity for REIT managers cannot be used for the general partners. Gompers and Lerner (1994), in a study of the compensation of general partners of venture capital limited partnerships, use a simulation methodology to calculate the sensitivity of general partner compensation to performance. We adopt a similar methodology here, which is described in detail in

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[31]Although general partner ownership levels are not included in our data, Robert Stanger & Co. told us that most general partners invest only $1,000 in the partnership, and the maximum general partner investment that they have ever seen in public real estate limited partnerships is 1%.

section C of the appendix. Generally speaking, the performance of each partnership is simulated with a base level of property appreciation, and the present value of the cash flows accruing to the limited partners and to the general partner is calculated. From this baseline performance, we then calculate the present value of the increase in the general partner's compensation that corresponds to a $1,000 increase in the present value of the cash flows to the limited partners. This methodology provides a measure of sensitivity that is comparable to the measure calculated for the REIT managers.

[INSERT TABLE IV HERE]

Table IV presents the results from the pay-performance sensitivity calculations for the general partners of the real estate limited partnerships. The results show that the average increase in general partner compensation corresponding to a $1,000 increase in the return to the limited partners is $253.57, and the median increase is $220.00. As a general check of our methodology, we compare our results to those presented in Gompers and Lerner (1994) on the sensitivity of compensation to performance for the general partners of venture capital limited partnerships. In order to compare our results to theirs, we calculate their measure of pay-performance sensitivity which is the percentage increase in compensation associated with an increase in the asset growth rate of 1%. Our calculations show that the mean increase in general partner compensation associated with a 1% increase in the appreciation rate on the property is 6.4%, which is close to the average of Gompers and Lerner's estimates of 4.6%.

In summary, the empirical evidence is consistent with the prediction of the model. The compensation of general partners, who are more costly to fire than REIT managers, changes by $253.57 for every $1,000 change in the value of the limited partner shares, while the compensation of REIT managers changes by $25.30 per $1,000 change in shareholder value. For self-advised (advisor) REITs alone, manager (advisor) compensation changes by $20.67 ($65.58).

IV. Conclusion

This paper develops and empirically tests a compensation model that is based on the idea that optimal compensation contracts incorporate both pay-for-performance incentives and the termination incentive. The basic result of the model is that the pay-for-performance incentive and the termination incentive are substitute incentive devices; as the cost of firing the worker increases and the strength of the termination incentive decreases, the optimal contract contains more intense pay-for-performance incentives. The empirical test of the model compares the compensation of general partners of real estate limited partnership to the compensation of managers of REITs. This is a strong test of the model because while general partners of real estate limited partnerships and managers of REITs perform very similar jobs, the difference in organizational form between limited partnerships and REITs is such that general partners are more costly to fire than REIT managers. Consistent with the prediction of the model, we find that the compensation contracts of general partners of real estate limited partnerships contain much stronger pay-for-performance incentives than the compensation contracts of REIT managers.

The empirical test in this paper focuses on differences in the cost of firing managers that is caused by differences in organizational form, but there are many other sources of variation in the cost of firing, and more generally, variation in the strength of the termination incentive. The most obvious cost of firing for corporate managers is the existence of large severance packages (e.g., golden parachutes), and it would be interesting to test whether or not CEOs with large contractual severance packages also have compensation contracts with strong pay-for-performance incentives. Given the evidence in Weisbach (1988) that outsider dominated boards are more likely to replace a poorly performing CEO, another test of this model would be a comparison of the pay-performance sensitivities of the CEOs of firms with outsider-dominated boards to the pay-performance sensitivity of CEOs of firms with insider-dominated boards. If the CEOs of firms with insider-dominated boards are shielded from the threat of termination, this model predicts that the compensation for these CEOs should contain stronger pay-for-performance incentives.

Appendix

A. Derivation of the Optimal Firing Rule and the Probability of Being Fired

In order to derive an explicit function for the optimal firing rule used by the firm, first note that the profit function from the firm's point of view is

$$\begin{aligned}&\tilde{\pi}_t = \lambda \tilde{e}_t + \tilde{z}_t \\ &\text{with } \tilde{e}_t \sim N\left(\mu_e, \sigma_e^2\right), \;\; \rho_{e_t, e_{t+1}} > 0 \;,\;\; \rho_{e_t, z_t} = 0 \\ &\text{and } \tilde{z}_t \sim N\left(0, \sigma_z^2\right), \;\; \rho_{z_t, z_{t+1}} = 0.\end{aligned} \tag{A1}$$

where $\tilde{e}_t$ represents the random effort supplied by the worker and $\tilde{z}_t$ represents the noise term. Profit is then distributed

$$\tilde{\pi}_t \sim N\left(\lambda\mu_e, \lambda^2\sigma_e^2 + \sigma_z^2\right) \;,\;\; \rho_{\pi_t, \pi_{t+1}} = \frac{\lambda^2\sigma_e^2}{\lambda^2\sigma_e^2 + \sigma_z^2}\,\rho_{e_t, e_{t+1}} > 0\,. \tag{A2}$$

At the end of the first period, the firm fires the worker if expected second-period profit with a new worker is greater than the sum of the expected second-period profit with the incumbent worker and the cost of firing the incumbent worker. Let π_t^I denote the profit from the incumbent worker in period t and π_t^N denote the profit from a new worker in period t. The incumbent worker is fired if

$$E\left(\pi_2^N\right) - E\left(\pi_2^I | \pi_1^I\right) - \gamma > 0\,. \tag{A3}$$

where we are assuming that profit across workers is uncorrelated. Because profit from the same worker is correlated over time, observing first-period profit from the incumbent worker provides the firm with information regarding the expectation of second-period profit from the incumbent worker. Assuming that π_1^I and π_2^I are joint normally distributed, this expectation is given by

$$E\left(\pi_2^I \mid \pi_1^I\right) = E\left(\pi_2^I\right) + \rho_{\pi_1,\pi_2}\sigma_{\pi_2}\left|\frac{\pi_1^I - \lambda\mu_e^I}{\sigma_{\pi_1}}\right| = \lambda\mu_e^I + \rho_{\pi_1,\pi_2}\left(\pi_1^I - \lambda\mu_e^I\right). \qquad \text{(A4)}$$

The firing rule (A3) can therefore be expressed as

$$\lambda\mu_e^N - \left(\lambda\mu_e^I + \rho\left(\pi_1^I - \lambda\mu_e^I\right)\right) - \gamma > 0\,, \qquad \text{(A5)}$$

where $\rho = \rho_{\pi_1,\pi_2}$ and (A5) can be solved to express a firing rule that is determined by the observation of first period profit. That is, the firm will fire the incumbent if

$$\pi_1^I < \frac{1}{\rho}\left(\lambda\mu_e^N - (1-\rho)\lambda\mu_e^I - \gamma\right) = \pi_1^c\,. \qquad \text{(A6)}$$

The RHS of (A6) is the critical value of first period profit, π_1^c, which defines the level of profit under which the incumbent worker will be fired. The derivative of π_1^c with respect to the cost of firing, γ, shows that the critical value is decreasing in the cost of firing, i.e.

$$\frac{\partial \pi^c}{\partial \gamma} = -\frac{1}{\rho} < 0\,.$$

This expression for π^c also shows that π^c is decreasing in the expected effort of the incumbent and is increasing in the expected effort of the new worker.

From the worker's point of view, $\pi_1 = \lambda e_1 + \tilde{z}_1$ (where effort is of course not a random variable), and the firing rule given by (A6) is

$$\lambda e_1 + \tilde{z}_1 < \tfrac{1}{\rho}\left(\lambda\mu_e^N - (1-\rho)\lambda\mu_e^I - \gamma\right) \iff \tilde{z}_1 < \tfrac{1}{\rho}\left(\lambda\mu_e^N - (1-\rho)\lambda\mu_e^I - \gamma\right) - \lambda e_1. \quad \text{(A7)}$$

The probability of being fired, denoted P, is then

$$\text{P} = \Pr\left(\tilde{z}_1 < \tfrac{1}{\rho}\left(\lambda\mu_e^N - (1-\rho)\lambda\mu_e^I - \gamma\right) - \lambda e_1\right). \quad \text{(A8)}$$

Normalizing $\tilde{z}$ to a standard normal random variable, the probability of being fired can then be expressed as

$$\text{P} = \text{F}\left(\frac{\tfrac{1}{\rho}\left(\lambda\mu_e^N - (1-\rho)\lambda\mu_e^I - \gamma\right) - \lambda e_1}{\sigma_z}\right) \quad \text{(A9)}$$

where F is the standard normal cumulative density function. The derivatives of this expression with respect to the worker's choice of effort e_1 and the cost of firing γ are

$$\frac{\partial P}{\partial e_1} = f[\cdot]\left(-\frac{\lambda}{\sigma_z}\right) < 0\,,\ \frac{\partial P}{\partial \gamma} = f[\cdot]\left(-\frac{1}{\sigma_z \rho}\right) < 0\,, \quad \text{(A10)}$$

where $f[\cdot]$ represents the standard normal probability density function.

B. Closed-Form Solutions to the Model Under Simplifying Assumptions

In this section of the appendix, we re-derive the main results of the model using a simple exogenous probability function and a new cost of effort function. While these changes sacrifice the endogeneity of the original probability function, these simpler functions allow us to obtain closed-form expressions for variables for which we had to rely on numerical approximation in the body of the paper.

Specifically, let the cost of effort be given by $c(e_t) = \frac{1}{2} e_t^2$, and let the worker choose an effort level between zero and one $(0 \le e_t \le 1)$. Let the probability of being fired be given as $P(e_1, \gamma) = (1 - e_1)/\gamma$, with the cost of firing γ scaled so that $\gamma \ge 1$. Although this particular functional form is somewhat arbitrary, it has the properties of a probability $(0 \le P(e_1, \gamma) \le 1)$, it is simple, and it is consistent with the idea that the probability of being fired is decreasing in both first period effort and the cost of firing. Thus, this new function has the same basic shape properties as the endogenous probability function derived in section A. Finally, assume that λ =1, so profit, π_t, is given by $\pi_t = e_t + z_t$.

With these simplifying assumptions, the worker's objective function (the analog to equation (2) in the body of the paper) is

$$\underset{e_1}{Max} \; \left[a + be_1 - \tfrac{1}{2} e_1^2 - \tfrac{1}{2} rb^2\sigma^2\right] + \left(1 - \frac{1 - e_1}{\gamma}\right)\left[a + be_2^* - \tfrac{1}{2} e_2^{*2} - \tfrac{1}{2} rb^2\sigma^2\right] \qquad \text{(A11)}$$

The worker's problem in the second period implies that $e_2^* = b$. Substituting this into (A11) and differentiating with respect to e_1 gives the worker's first-order condition, solved here for effort:

$$e_1^* = b + \tfrac{1}{\gamma}\left[a + \tfrac{1}{2} b^2 (1 - r\sigma^2)\right]. \qquad \text{(A12)}$$

This condition yields similar comparative statics to those based on the optimal effort expression in the body of the paper, notably, $\frac{\partial e_1^*}{\partial b} > 0$ and $\frac{\partial e_1^*}{\partial \gamma} < 0$.

The firm's problem now becomes to choose *a* and *b* so to satisfy the following two equations

$$b+\tfrac{1}{\gamma}\left[a+\tfrac{1}{2}b^2(1-r\sigma^2)\right]=k\text{, and} \tag{A13}$$

$$\left[a+bk-\tfrac{1}{2}k^2-\tfrac{1}{2}rb^2\sigma^2\right]+\left(1-\left(\tfrac{1-k}{\gamma}\right)\right)\left[a+\tfrac{1}{2}b^2(1-r\sigma^2)\right]=\overline{w}\,. \tag{A14}$$

Solving (A13) and (A14) for the optimal contract parameters, *a** and *b**, gives the following solutions

$$\begin{aligned} a^* = {} & \left(\overline{w}+k-\tfrac{1}{2}k^2-1\right)\left(1-r\sigma^2\right) \\ & -\left(2\gamma^2+\gamma k\right)\left(1-2r\sigma^2\right)+\gamma\left(3-4r\sigma^2\right) \\ & -\left(1-r\sigma^2-\gamma\left(1-2r\sigma^2\right)\right)\sqrt{(2\gamma-1)^2-2\left(k-2\gamma k-\tfrac{1}{2}k^2+\overline{w}\right)} \end{aligned} \tag{A15}$$

$$b^*=1-2\gamma+\sqrt{(2\gamma-1)^2-2\left(k-2\gamma k-\tfrac{1}{2}k^2+\overline{w}\right)}\,. \tag{A16}$$

These equations are analogous to equations (12) and (13) in the main body of the paper. A graph of *b** from (A16) for various values of γ and reasonable example parameters yields a curve shaped much like the ones shown in Figure 2. Thus, these simplifying assumptions produce an equilibrium where the key decision variables can be expressed in closed-form as functions of the underlying parameters. These solutions have implications that are qualitatively similar to the more complicated versions earlier in the paper.

C. Simulation Methodology

The limited partnership data from Robert Stanger & Co. specifies the original value of the partnership property, the up-front fees and management fees paid to the general partner, and the sharing rule used to distribute both operating cash flows and terminal cash flows from the sale of the property between the limited partners and the general partner. We simulate the performance of each partnership with some base level of property appreciation and then calculate the present value of the cash flows accruing to the limited partners and to the general partner. To calculate the dollar sensitivity of general partner compensation, we increase the appreciation on the property so that the present value of the limited partner's payoff increases by $1,000, and calculate the change in the present value of the general partner's compensation associated with the $1,000 increase to the limited partners. To calculate the elasticity of the general partners compensation with respect to the limited partner's payoff, we increase the appreciation on the property so that the payoff to the limited partners increases by 10%, and calculate the change in the present value of the general partner's compensation associated with the 10% increase to limited partners. To calculate the Gompers and Lerner (1994) measure of sensitivity, we increase the appreciation on the property by 1% and calculate the percentage change in the general partner's compensation associated with this 1% increase in the appreciation rate.

In order to simulate the performance of each partnership, we need to make assumptions regarding the holding period of the property for the partnership (i.e., the time until the partnership sells the property), the base level of appreciation on the property, and the discount rate used in calculating the present value of the cash flows to the limited partners and the general partner. Specifically, we make the following assumptions:

• We assume that each partnership lasts for 15 years, and the property is sold at the end of year 15. Although we do not have the estimated life of the partnership in our data sample, Robert Stanger & Co. told us that most public real estate limited partnerships have an estimated life between 10 and 20 years.

- For partnerships that use leverage, we assume that the mortgage is a fully-amortizing 30-year mortgage, and we use published rates from the Federal National Mortgage Association (FNMA) as the mortgage rates.
- The total return to the limited partners comes in the form of both income and their share of the gain on sale. We assume that the income return is equal to the income return published in quarterly National Council of Real Estate Investment Fiduciaries (NCREIF) reports, matched by time period and property type.
- To calculate the base level of appreciation on for each partnership, we solve for the appreciation rate that gives the limited partners a total return (income and appreciation) exactly equal to their expected return (i.e., a net present value of zero). For the estimate of the expected return for the limited partners, we use the hurdle rate for general partner compensation. The hurdle rate is the minimum return to limited partners that must occur before the general partners receive their share of the profits on the sale. For example, if the partnership agreement specifies a hurdle rate of 10%, then the general partner shares in the profits from the sale only after the limited partners have received a 10% cumulative return on their investment. Using this estimate of expected return, the average expected return over the 69 partnerships is 9.51%, with a median of 10.00%, which we believe is reasonable. The average baseline (expected) appreciation rate from using this estimate of expected return is 4.28%, with a median of 4.11%, which we also believe is reasonable.

As a check on our estimate for the expected return, we calculated a weighted average cost of capital (WACC) for each partnership using capitalization (cap) rates derived from NCREIF data as the cost of equity, and 30-year mortgage rates as the cost of debt. The average expected return using this WACC method is 8.62%, which is very close to the 9.51% estimate we get using the hurdle rate. We chose the hurdle rate over this WACC method for two reasons: (1) the hurdle rate is more specific to each partnership, and should reflect the return that the general partners (who know more about the deal than anyone) expect the property to generate, and (2) the NCREIF data consists of large, institutionally owned properties, and the cap rates derived from the NCREIF data are probably lower than the applicable cap rates for the smaller properties in our partnership sample.

- We discount all cash flows for both limited partners and general partners at the expected return (hurdle rate) for the partnership.

References

Acharya, Sankarshan, 1992, Maximizing the Market Value of a Firm to Choose Dynamic Policies for Managerial Hiring, Compensation, Firing and Tenuring, *International Economic Review* 33, 373-397.

Belsley, D. A., E. Kuh, and R. E. Welsch, 1980. *Regression Diagnostics: Identifying Influential Data and Sources of Collinearity* (John Wiley and Sons, New York, N.Y.).

Black, Fischer, and Myron Scholes, 1973, The Pricing of Options and Corporate Liabilities, *Journal of Political Economy* 81, 637-654.

Gibbons, Robert, and Kevin J. Murphy, 1992, Optimal Incentive Contracts in the Presence of Career Concerns: Theory and Evidence, *Journal of Political Economy* 100, 468-505.

Gompers, Paul, and Josh Lerner, 1994, An Analysis of Compensation in the U.S. Venture Capital Partnership, Unpublished Working Paper.

Grossman, Sanford J., and Oliver D. Hart, 1983, An Analysis of the Principal Agent Problem, *Econometrica* 51, 7-45.

Harris, Milton, and Artur Raviv, 1979, Optimal Incentive Contracts with Imperfect Information, *Journal of Economic Theory* 20, 231-259.

Holmstrom, Bengt, 1979, Moral hazard and observability, *Bell Journal of Economics* 10, 74-91.

Holmstrom, Bengt, and Paul Milgrom, 1987, Aggregation and Linearity in the Provision of Intertemporal Incentives, *Econometrica* 55, 303-328.

Huddart, Steven, 1993, The Effect of a Large Shareholder on Corporate Value, *Management Science* 39, 1407-1421.

Lazear, Edward P., 1986, Salaries and Piece Rates, *Journal of Business* 59, 405-431.

McIntosh, Willard, Ronald C. Rogers, C. F. Sirmans, and Youguo Liang, 1994, Stock Price and Management Changes: The Case of REITs, *Journal of the American Real Estate and Urban Economics Association* 22, 3, 515-526.

Merton, Robert C., 1973, Theory of Rational Option Pricing, *Bell Journal of Economics and Management Science* 4, 141-183.

Milgrom, Paul, and John Roberts, 1992. *Economics, Organizations, and Management* (Prentice Hall, Inc., Englewood Cliffs, N.J.).

Murphy, Kevin J., 1985, Corporate Performance and Managerial Remuneration: An Empirical Analysis, *Journal of Accounting and Economics* 7, 11-42.

Murphy, Kevin J., 1986, Incentives, learning, and compensation: a theoretical and empirical investigation of managerial labor contracts, *Rand Journal of Economics* 17, 59-76.

Olson, Howard G., 1991, Changing General Partners in Your RELP, *Real Estate Finance* 8, 20-26.

Sappington, David E. M., 1991, Incentives in Principal-Agent Relationships, *Journal of Economic Perspectives* 5, 45-66.

Shapiro, Carl, and Joseph E. Stiglitz, 1984, Equilibrium Unemployment as a Worker Discipline Device, *American Economic Review* 74, 433-444.

Shavell, Steven, 1979, Risk sharing and incentives in the principal and agent relationship, *Bell Journal of Economics* 10, 55-73.

Stiglitz, Joseph E., and Andrew Weiss, 1983, Incentive Effects of Terminations: Applications to the Credit and Labor Markets, *American Economic Review* 73, 912-927.

Weisbach, Michael S., 1988, Outside Directors and CEO Turnover, *Journal of Financial Economics* 20, 431-460.

Weitzman, Martin L., 1980, The "ratchet principle" and performance incentives, *Bell Journal of Economics* 11, 302-308.

White, Halbert, 1980, A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity, *Econometrica* 48, 817-838.

Table I
REIT Sample Summary and Comparison Statistics

This table presents summary and comparison statistics for the REIT Sample. "All REITs" is all publicly traded REITs listed in the 1992 REIT Sourcebook. "All REITs (adjusted)" excludes 26 REITs from two sponsors (20 REITs sponsored by Public Storage Inc. and 6 REITs sponsored by Meridian Company) from All REITs. "Sample REITs" are the REITs that are included in our sample in any of the six years of the sample period (1988-1994); "Switches" is the number of REITs that switched from advisor to self-advised during the sample period. "Total Sample Compensation-Years" shows the number of years for which we have complete compensation and return data. The size measures for sample REITs are based on the market capitalization (shares outstanding times price per share) at 12/31/90 for all 37 REITs in our sample. The size measures for All REITs (adjusted) are also based on the market capitalization at 12/31/90. All size values are in millions of dollars.

	All REITs		All REITs (adjusted)		Sample REITs		Total Sample Compensation-Years	
Type	number	%	number	%	number	%	number	%
Self	30	39.5%	30	60%	18	48.6%	126	66.7%
Advisor	46	60.5%	20	40%	13	35.1%	63	33.3%
Switches					6	16.3%	-	-
Total	76		50		37		189	

	Size of Sample REITs	Size of All REITs (adjusted)
Mean	125.5	107.3
Median	67.8	56.0
Standard Deviation	145.5	133.0
Total Market Capitalization	4,518.1	5,256.2

Table II
Pay-for-Performance Sensitivty Regressions for REITs

This table presents regression results for four different measures of the change in manager's wealth. The first two columns present results for the self-advised REITs only because those two definitions of the dependent variable are not meaningful for advisor REITs. Total pay is defined as as salary plus bonus plus stock awards plus option awards plus all other pay plus the present value of the change in salary. The change in total firm-related wealth is defined as total pay plus the change in the value of stock and options owned by management. The change in shareholder wealth variable is the contemporaneous dollar-change in shareholder wealth, defined as the annual return for the year times the total value of shareholder wealth at the beginning of the year. The change in shareholder wealth year t-1 is the same measure for the previous year. The size variable is defined as shares outstanding times price per share at the end of the year. The management percentage ownership variable is the percentage of shares outstanding owned by the manager. The Advisor variable is a dummy variable that takes a value of one if the REIT is an advisor REIT, and a value of zero if the REIT is self-advised. All variables are in thousands of 1988 dollars. T-statistics are reported in parentheses underneath each variable. Column four t-statistics use the standard errors corrected for the presence of heteroscedasticity, as per White (1980).

	Dependent Variable			
Independent Variable	Δ(Salary + Bonus) (1)	Δ(Salary + Bonus + PV (ΔSalary)) (2)	Δ(Total Pay) (3)	Δ(Total Firm-Related Wealth) (4)
Intercept	8.17	40.86j	-18.65	170.68
	(1.08)	(1.00)	(-0.66)	(1.47)
Change in shareholder wealth	0.000366 ***	0.001140 **	0.001090 **	0.019437 ***
	(3.96)	(2.28)	(2.42)	(5.03)
Advisor X Change in shareholder wealth			-0.001153	0.034165 ***
			(0.77)	(3.77)
Change in shareholder wealth year t-1	0.000073	-0.000094	0.000350	0.001228
	(0.68)	(-0.16)	(0.67)	(0.34)
Advisor X Change in shareholder wealth year t-1			0.001464 ***	0.010750
			(1.18)	(1.60)
Size	-0.000034	-0.000086	-0.000040	0.000673
	(-1.51)	(-0.69)	(-0.39)	(1.15)
Advisor X Size			0.000684	0.001719
			(2.73)	(1.51)
Management Percentage Ownership	-0.04	-5.02	557.45	18615 ***
	(-0.00)	(-0.01)	(1.10)	(2.88)
Advisor X Mgmt Percentage Ownership			-618.78	-18488 ***
			(-1.18)	(-2.88)
Adjusted R-squared	0.10	0.01	0.12	0.53
F-value	4.00 ***	1.37	3.35 ***	27.20 ***
Sample Size	109	108	153	183

***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

Table III
Summary Statistics on Limited Partnership Sample

This table presents summary statistics on the limited partnership sample including the general partners' compensation terms. This panel also presents summary statistics on the discount rate used in the simulations that is derived from the stated hurdle rate for each limited partnership, and the weighted average cost of capital (WACC) derived for each partnership. Summary statistics on the implied property appreciation rate that comes from the two discount rate assumptions are also included. All rates are percentages and dollar figures are in millions of dollars.

	Mean	Median	Standard Deviation	25th Percentile	75th Percentile
Value of Partnership at Closing Date ($)	48.3	33.2	54.9	16.5	55.4
Total Investment by Limited Partners ($)	36.7	25.0	35.8	10.0	50.0
Partnership Leverage (%)	28.51	20.00	29.90	0.00	60.00
Front-End Fees as a Percentage of Total Limited Partner Contributions	19.50	19.20	4.71	16.00	20.50
Annual Management Fees as a Percentage of Partnership Gross Revenue	5.07	6.00	1.79	5.00	6.00
General Partner's Percentage Share of Distributable Cash from Operations	5.03	5.00	4.63	1.00	10.00
General Partner's Percentage Share of Gain on Sale	16.92	15.00	5.85	15.00	20.00
Hurdle Rate (%) (minimum annual return to limited partners before general partner can share in gain on sale)	9.51	10.00	2.10	8.00	10.10
Hurdle Rate	9.51	10.00	2.10	8.00	10.10
Weighted Average Cost of Capital	8.62	8.60	1.27	7.80	9.40
Implied Property Appreciation Rate from using Hurdle Rate as Discount Rate	4.28	4.11	3.63	1.79	6.31

Table IV
General Partner Pay-for-Performance Sensitivity

This table presents summary statistics on the results of the simulation used to calculate pay-for-performance sensitivity measures for the general partners.

	Mean	Median	Standard Deviation	25th Percentile	75th Percentile
Increase in General Partner Compensation corresponding to a $1,000 increase in the Value of the Limited Partner shares ($)	253.57	220.00	99.94	220.00	299.00
Increase in General Partner Compensation corresponding to a 10% increase in the value of the Limited Partner Shares (%)	8.44	7.90	3.14	6.80	9.30
Increase in General Partner Compensation corresponding to a 1% increase in the Appreciation Rate on the Property (%)	6.38	5.40	3.48	4.60	7.40

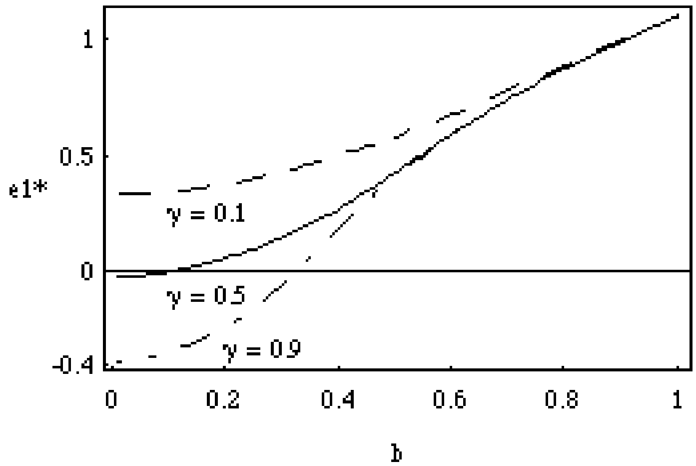

Figure 1. Optimal effort for different values of b and γ. First-period effort is chosen to satisfy equation (7). The parameter values are $\lambda = 3$, $a = 3$, r =0.1, $\mu_e^I = \mu_e^N = 0$, $\rho = 0.3$, $\sigma_z = 1$, $\gamma = \{0.1, 0.5, 0.9\}$, and $b = 0 \rightarrow 1$. This figure illustrates the partial derivatives shown in (8) and (9), i.e., $\partial e_1^* / \partial b > 0$ and $\partial e_1^* / \partial \gamma < 0$. To see that $\partial e_1^* / \partial b > 0$, note that each curve (for a particular γ) is upward sloping. To see that $\partial e_1^* / \partial \gamma < 0$, note that holding b constant, e_1^* decreases as γ increases.

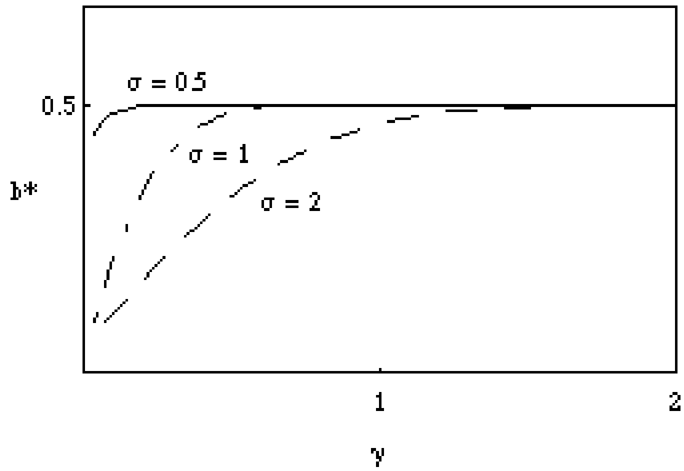

Figure 2. Optimal pay-performance sensitivity for different values of σ_z and γ. Contract parameters, a* and b*, are chosen to satisfy equations (12) and (13). The parameter values are $\lambda = 3$, $k = 0.4055$, $\overline{w} = 1$, $\mu_e^I = \mu_e^N = 0$, $\rho = 0.3$, $\sigma_z = \{0.5, 1, 2\}$, and $\gamma = 0 \to 2$. The asymptote represents b^* at the limit when γ becomes large and the probability of being fired approaches zero, i.e., $b^* = \exp(k)/\lambda$ in the absence of the termination incentive.