The Dynamics of Portfolio Management Contracts

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We consider the multiperiod relationship between a client and a portfolio manager and the resulting problem of motivating a manager of unknown ability to acquire valuable information. We explore the contractual forms and the optimal retention policy of the client and find that the optimal initial set of contracts features a smaller performance-based fee component paid to the manager than in a first-best contract, and the contract choice elicits only partial information about the manager. As a result, ex post performance measurement is critical to future recontracting. In general managers are retained only if the returns on their portfolio exceed the benchmark by an appropriate amount.

More than $6 trillion of investment capital is handled by pension funds, mutual funds, and other financial intermediaries whose portfolio managers control the allocation of assets. In recent years, the growth in the size of pension funds has been spectacular. Moreover,

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management of these funds has taken on increasing importance as the population ages. Given the amount of capital under management, the nature of the contractual relationship between the client (pension members, mutual fund shareholders, etc.) and the portfolio manager is of particular importance.

Empirical evidence provides some strong regularities regarding the form of the compensation contract between the client and the portfolio manager.’ These regularities seem to be puzzling from an agency-theoretic perspective. First, the overwhelming majority of contracts can be terminated on very short notice (e.g., 30 days), so that renegotiation can occur whenever either partywishes. Although there are, in practice and in our model, costs of changing the portfolio manager, the contracting environment must be viewed as multiperiod, with precommitment to long-term relationships either impossible or unenforceable.

Second, the evidence indicates that, across clients and managers, contracts are *very* similar. Lakonishok, Shleifer, and Vishny **(1992)** report little variation in fees: on accounts of $50 million, half of their sample had fees lying between 43 and 56 basis points of the value of the assets managed. In addition, they found little relation between fees and the manager’s previous performance.[2]

Third, most contracts do not contain performance-based fee components. That is, fees have little or no sensitivity to the ex post performance of the portfolio. For example, Golec (1992) reports that only 6 percent (29 of 476) in his sample of mutual fund managerial contracts contain a performance-based fee component. The fee, as a percentage of the dollar assets managed, decreases, or is constant, as assets under management increase, so that the dollar fee is a concave function of assets managed.

Finally, virtually all major institutional clients pay a professional evaluation firm to report ex post performance that clients use to monitor the manager’s performance on a regular basis[3] Thus, when contracts are signed, both parties are aware that regular evaluation may provide a reason for recontracting.

These observations are consistent with the following explanations. Similarity of contracts could arise if clients are unable to identify superior performance and/or managerial performers ex ante, or if

[1]In addition to the references cited, Robert Marchesi of Demarche has pointed out to us these regularities from his own personal involvement as a performance evaluator and managerial search consultant.

[2]Another feature of observed contracts is a “most favored nation” clause, restricting the manager from charging fees in excess of those charged to other clients.

[3]Examples of professional portfolio measurement agencies include Demarche, Frank Russell, SEI, and Wilshire Associates.

competition eliminates all but the best managers.[4] The lack of performance-based fee structures could be due to relative managerial risk aversion as compared to that of their clients. Finally, the concavity of fees as a function of assets managed may be related to the existence of fixed costs for managers.

On the other hand, our purpose is to see whether the above observations could arise from optimal contracting with a heterogeneous pool of portfolio managers. In this regard, the existence of multiple periods is crucial. Otherwise, if their relationship exists for only a single period, clients would utilize separating fee structures in an attempt to screen managers of differing ability. Moreover, performance evaluation would be unnecessary and irrelevant.

The model we derive owes much to the literature on *tournaments*.[5] This literature justifies the use of tournaments in settings in which there are elements of commonality in the output of multiple agents and where the principal may face a commitment problem. Clearly these features are germane to the portfolio management setting. A client, unaware of the manager's exact skill level, will assess the manager's investment performance against some relative benchmark. Although the benchmark could be an unmanaged index return, it is typical for managers to be compared to a sample of *other managers*. In this context, a manager is retained if his performance is "good enough" relative to an alternative for the client (i.e., other available managers). In a very simple framework, we will quantify the retention decision.

We focus on a *two-period* model in which the investment performance of the manager can be observed at an intermediate date, and this performance can be used to ascertain whether to retain the manager for the next period.[6] The multiperiod nature of the model yields significantly different results from most single-period models and offers insights into observed practical investment management.'

[4]We are assuming that the managers being compared are equivalent in observable features, such as the type of service provided (active management versus indexing, for example).

[5]Important articles are Bhattacharya and Guasch (1988). Green and Stokey (1983). Holmström (1982), Lazear and Rosen (1981), Malcomson (1986), and Nalebuff and Stiglitz (1983). In contrast with this literature, where competing agents are modeled explicitly, in our model competition takes place indirectly through the benchmark established by the threat of replacing the manager.

[6]Models with an exogenously assumed retention decision include Cuny et al. (1993) and Grossman and Zhou (1991). Also, Huberman and Kandel (1990) model a multiperiod situation in which the manager's portfolio choice may be distorted due to a signaling motive. Their article. however. prespecilies the manner by which "reputation" enters the objective function of the manager and does not consider the possibility that the client might contract optimally to reduce these agency costs.

[7]Most of the previous work on the agency relationship between a client and her investment manager has assumed a single-period relationship. Relevant articles include Bhattachatya and Meiderer (1985), Kihlsuom (1986), Dybvig and Spatt (1986), Haugen and Taylor (1987). Allen (1990).

The client's actual problem involves two key unobservables. First, the client cannot easily observe the manager's inherent *talent* to manage a portfolio, nor can the client observe the *effort* expended by the manager to take advantage of that talent. To focus on these issues we develop a model with both *moral hazard* and *adverse-selection* components. Adverse selection is important since we want to understand why contracts do not seem to totally screen managers of differential ability. Moral hazard is also important since we want to understand why explicit performance fees may not be necessary even in the presence of unobservable effort,

A finite-horizon model (in our case, two periods) with possible recontracting can lead to different contract structures at different points in time. Thus, *we* will find a *dynamic* structure to portfolio management contracting. The contract taken during the early stages of a client-manager relationship shares many features with the empirical evidence outlined above. First, we find that in the first period of a possible two-period relationship, the client optimally induces most managers to sign the same "boilerplate" contract, regardless of the manager's skill level. That is, the equilibrium is not fully separating, even though such an outcome is feasible. In the first period, only a few "exceptional" managers choose a different management contract which has a very high performance-based fee component. As a result, the client learns very little from the contracting process, in striking contrast with standard single-period models.

Because the initial contract choice, for most managers and clients, does not perfectly reveal the manager's ability, there is a positive role for performance evaluation at the intermediate date. In fact, one of our key results is that the client's interests are best served by providing incentives through the credible threat of dismissal following a performance evaluation, rather than with a large performance-based fee component in the initial contract. Thus, the empirical result that there is little relationship between incentive fees and past performance may not be due to the difficulty of measuring portfolio performance. Although a large performance-based contract is feasible in our model, and in fact optimal in a first-best world, in our equilibrium the client initially retains much of the residual return, even though the manager is assumed to be risk neutral. This result is consistent with the very limited use of incentive-based fees in practice.

As in practice, the client's optimal retention/dismissal decision in

Stoughton (1993), and Golec (1992). In a single-period relationship, contracts have to serve a number of simultaneous purposes. These include risk sharing, optimal effort inducement, and information revelation. As a result, this literature shows that contracts are unreasonably complex, as viewed from an empirical perspective. In contrast. in a multiperiod relationship. the aspects of future assessment and recontracting can have dramatic impacts on the parties at the initial stages.

our model depends on the manager's portfolio return relative to an appropriate benchmark. A manager is retained only if the client feels that the manager can perform as well as other managers that the client could employ. This is very similar to a *tournament* among the managers. Thus, we find that the manager is retained only if the excess return is positive. We also find that there is an "outlier" effect, such that portfolio returns which exceed the benchmark by an extreme amount lead to inferences that the manager is no better than average. Such performance levels are considered indications of luck rather than skill.

Finally, our two-period model predicts that the contract structure in the second period of an enduring client-manager relationship will differ from the initial contract. In our formulation, the second contract will have a high performance-based fee content and will give a larger fee to the retained manager. To the best of our knowledge, there is no empirical evidence on the dynamics of portfolio management contracts.

Section 1 contains the analysis of portfolio choice and derives the expected returns function. In Section 2 we analyze the single-period equilibria that result from client market power (the screening solution) and from managerial market power (the signaling solution). Sections 3 and 4 develop the full two-period model, solving for the optimal first-period set of contracts. A numerical example of the equilibrium is provided. Section 5 concludes.

1. The Portfolio Problem

In this section, we define the portfolio choice problem. After setting up the information structure and how this impacts the manager's portfolio choice, we compute the expected return to the portfolio. This expected return function represents the gross benefits to the agency relationship. Although we assume that the client and manager are risk neutral, our subsequent results on the nature of contracting are robust to this assumption as long as the benefits function has similar properties to those derived below.

1.1 Portfolio choice

In each period, the portfolio choice is delegated to the portfolio manager, who chooses between two assets, a riskless asset and a risky asset.[8]

Without loss of generality, we normalize returns so that the expected

[8] We focus on these two assets for simplicity. The riskless asset can also be interpreted as a benchmark portfolio, against which the returns from the manager's portfolio are to be measured.

return on the riskless asset is zero. The manager's information pertains to the return on the risky asset. At the beginning of the period, the portfolio manager observes a signal, S, that is correlated with the rate of return on the risky asset, $\tilde{P}$, over the period. Specifically,

$$\tilde{S} = \tilde{P} + \tilde{\epsilon},$$

where $\tilde{P} \sim N(0, \sigma_P^2)$, $\tilde{\epsilon} \sim N(0, \sigma_\epsilon^2)$,, and $\tilde{P}$ and $\tilde{\epsilon}$ are independent of one another. Following observation of the signal, but prior to making the portfolio choice, the manager updates his belief using Bayes' rule to obtain the posterior mean of the return on the risky asset:

$$\tilde{M} = E(\tilde{P} | \tilde{S}) = K\tilde{S},$$

where

$$K = \sigma_P^2/(\sigma_P^2 + \sigma_\epsilon^2),$$

which follows since the prior mean of $\tilde{P}$ is zero. The posterior precision is

$$H = (\sigma_P^2 + \sigma_\epsilon^2)/\sigma_P^2\sigma_\epsilon^2.$$

The portfolio manager is paid a fee that is contingent on the actual rate of return of the portfolio. We restrict our attention throughout the analysis to linear sharing rules for the risk-neutral manager, so that the manager is induced to maximize the expected return on the portfolio. Define X as the fraction of assets placed in the risky asset, with $1 - X$ put in the riskless asset whose expected return is zero. We assume that $0 \leq X \leq 1$; that is, no borrowing or shortselling is allowed on the part of the portfolio manager. Then the portfolio manager will clearly invest the whole of the client's wealth in the risky asset if and only if the posterior mean is nonnegative, or

$$X = \begin{cases} 1 & \text{if } \tilde{M} \geq 0, \\ 0 & \text{if } \tilde{M} < 0. \end{cases}$$

The rate of return of the overall portfolio is

$$\tilde{R} = X\tilde{P} = \begin{cases} \tilde{P} & \text{if } \tilde{M} \geq 0, \\ 0 & \text{if } \tilde{M} < 0. \end{cases} \tag{1}$$

1.2 Expected return

An important part of the portfolio problem is the relation between the posterior precision and the prior expected return. Define

$$h = \sigma_P^2/\sigma_\epsilon^2, \tag{2}$$

as the ratio of the prior variance of price to the variance of the noise in the signal. We are now able to derive the expression for the expected portfolio return.

Proposition 1. *The prior expected rate of return on the portfolio, R, is*

$$R(h) = \frac{\sigma_P}{\sqrt{2\pi}}\left[\frac{h}{1+h}\right]^{1/2}. \tag{3}$$

Proof. See the Appendix.

Clearly, R is an increasing function of h. This arises from the option nature of the portfolio returns [Equation (1)]. As the signal becomes more precise (i.e., σ_ϵ^2 decreases), the probability of picking the portfolio with the maximum rate of return rises, Differentiating gives

$$R'(h) = \frac{\sigma_P}{2\sqrt{2\pi}}\frac{1}{h^{1/2}(1+h)^{3/2}} > 0. \tag{4}$$

As the precision ratio approaches infinity, the expected return approaches an upper bound given by $\sigma_P/\sqrt{2\pi}$. Also, $R' \to \infty$ as $h \to 0$. The second derivative is

$$R''(h) = -\frac{\sigma_P}{4\sqrt{2\pi}}\left[\frac{2h+1}{(1+h)^{5/2}h^{3/2}}\right] < 0.$$

This shows that the prior expected rate of return is a concave increasing function of the precision ratio, h.

Although we have dealt with a fairly specific portfolio problem in this section, the only property that we shall use in the analysis of the contracting problem is that the function R is concave and increasing in h. Thus, while more general situations (e.g., managerial risk aversion) would not lead to "plunging," as long as the manager's investment in the risky asset is monotonic in the signal, S, the expected returns function, R, would still have the desired property.

2. The Single-Period Problem

We begin by defining the nature of the relationship between client and manager within a single period. Then we describe the setting for the multiperiod problem. In the remaining two subsections, we consider two specifications for the relative market power of the client and manager in a single period: the screening model and the signaling model. The analysis of these two models is important since they are components of the multiperiod model.

For simplicity, we assume that there are two types of portfolio managers that differ in their marginal return to investigative effort. In each period, managers can expend effort in order to increase the precision of the information they observe using the following linear technology. The relation between the manager's type, i, *effort*, e_i, and precision ratio, h, is

$$h_i = a_i + b_i e_i \qquad \text{for } i = 1, 2. \tag{5}$$

To represent the fact that type 2 is more efficient at translating effort into valuable information, we assume that $b_2 > b_1$. The client, however, cannot observe b_i (adverse selection) or e, (moral hazard).

We examine pairs of contracts, (α_i, F_i) $i = 1, 2$. Each contract represents a linear sharing of the portfolio returns in a given period, where a, is the fraction of the return paid to the manager and F_i is a fixed fee paid regardless of the portfolio return.[9] We also assume that effort has a private disutility to the portfolio manager and that it is measured in cost terms. Hence, the per-period expected utility of a portfolio manager of type i is

$$U_i = \alpha_i R(a_i + b_i e_i) - e_i + F_i, \tag{6}$$

where $R(\cdot)$ is given in Proposition 1.[10] So, the expected utility of the client is

$$C_i = (1 - \alpha_i)R(a_i + b_i e_i) - F_i. \tag{7}$$

After the contract is fixed, the manager decides what effort level to undertake. The optimal effort choice for a given compensation contract is determined by the first-order condition of maximizing U_i with respect to e_i:[11]

$$\alpha_i b_i R'(h_i) = 1. \tag{8}$$

It is helpful to define the first-best solution as that obtained when there is full information. The first-best level of effort is therefore obtained by maximizing the total utility, $U_i + C_i$, for each i. It is easy to see that this results only if $\alpha_i = 1$, in which case the first-best precision levels, h_i^* are defined by

$$b_i R'(h_i^*) = 1. \tag{9}$$

[9] Laffont and Tirole (1986) and McAfee and McMillan (1987) have shown that under risk neutrality of principal and agent, restricting contract choice to linear contracts is without loss of generality when there is a continuum of types. This occurs because incentive compatibility constraints are binding only locally and only the linear portion of contracts matters in a first-order sense. Unfortunately, their results are not applicable in our model, where types are discretely separate.

[10] For tractability, we assume no limited liability for the manager, so that his realized utility can be negative. This assumption is not important to the basic results of the article, and, for a reasonable reservation level of utility and distribution of portfolio return, the probability of negative utility can be small.

[11] The concavity of R ensures that this condition is both necessary and sufficient.

Thus, managers receive all of the marginal returns to the portfolio in the first-best case. The client receives only a fixed fee, $-F_i$, which would depend on the relative bargaining strengths of the two parties.

If the type i manager's utility is plotted in the contract (α, *F)* space, then the slope of his indifference curve satisfies:

$$R(h_i)\ d\alpha + dF = 0.$$

Using Equation (8) in the total derivative of Equation (6) yields

$$\frac{dF}{d\alpha} = -R(h_i). \tag{10}$$

The following *single-crossingproperty* is critical to our model.

Definition. *The expected returns of the two managers satisfy the sorting property whenever, for all a Î* [0, 1] *and F,*

$$R(h_2) > R(h_1) \tag{11}$$

where h_1 and h_2 are determined by the optimal effort choices for a type 1 *and a type 2 manager, respectively, at the same contractpair (a, F).*

It is simple to show that concavity of *R* and optimal effort (8) implies that this property is always satisfied in our model. Using definition (11) in Equation (10) shows that the type 2 manager's indifference curves are more steeply sloped than the type 1 manager's indifference curves.

2.1 The contracting process

The description of the contracting process has an important bearing on our results. In reality, at the outset, the client has significant bargaining power because she has the discretion to choose among competing managers. Typically, clients will retain consulting firms for assistance in this process. Although consulting firms can provide some information for screening managers, there are unobservable factors that create some degree of information asymmetry. In an ideal world, the client would want to negotiate with an unlimited number of managers in order to improve her bargaining position. Since this would be prohibitively costly, however, clients limit their search process. We assume, for simplicity, that she uses information provided by the consulting firm to select a single preferred manager. She then begins the process of negotiations with this manager.[12]

[12]We explore the consequences of contracting with a finite set of managers in the final section.

In our model, we can regard the role of the managerial search consultant as altering the probability distribution of types that the client faces in making her manager selection. We assume that this alteration is sufficient to cause the client to employ the consultant. This can be justified since the client's utility of hiring a type 2 manager is negatively impacted by the frequency of existence of type 1 managers. Moreover, we assume she is insufficiently skilled (or interested) in managing her own portfolio. In Section 3.3 we discuss the use of the consulting firm in more detail in the context of the second-period negotiations.

Clearly, managers feel there are benefits to being retained by a client, beyond the value of the fees paid by that client in the next period. For example, retention by one client may be used as a marketing tool by the manager in seeking other clients' business. For tractability, we do not address this directly, but assume that, if the client chooses to retain the manager for the second period, the manager has the bargaining power in negotiating a new contract. This is equivalent to clients competing for the services of a manager good enough to retain.

Because our model features different competitive environments over time, we now consider two single-period models with very different competitive implications. The screening model, presented first, maximizes the utility of the client and the signaling model, presented subsequently, contains the competitive assumption that the client is equally well off with either type of manager.

2.2 The screening problem

In the screening model, the client offers a menu of contracts in an attempt to infer the manager's ability and extract some of the benefits associated with hiring an abler manager. Let $\hat{\mu}$ be the prior probability that the manager is type 1.[13] The set of screening contracts, (α_i^s, F_i^s), and corresponding effort levels are identified by the superscript *s*. The client's screening problem in selecting the set of contracts is as follows:

$$\max_{\alpha_i^s, F_i^s} C^s = \hat{\mu}[(1-\alpha_1^s)R(a_1 + b_1 e_1^s) - F_1^s] + (1-\hat{\mu})[(1-\alpha_2^s)R(a_2 + b_2 e_2^s) - F_2^s], \qquad (12)$$

[13] In a single-period environment, $\hat{\mu}$ therefore represents the prior probability of a type 1 manager, given that he has been recommended by the consultant. We also use $\hat{\mu}$ to represent the *posterior* probability after updating information in the two-period problem.

subject to

$$\max \alpha_i^s R(a_i + b_i e_i^s) - e_i^s + F_i^s$$

$$\geq \max \alpha_j^s R(a_i + b_i \hat{e}_i) - \hat{e}_i + F_j^s, \qquad i, j = 1, 2, \tag{13}$$

$$\alpha_i^s R(a_i + b_i e_i^s) - e_i^s + F_i^s \geq \underline{U}, \qquad i = 1, 2. \tag{14}$$

The first set of constraints (13) represents the family of incentive compatibility, or nonmimicry, constraints such that each type of manager should select the contract designed for him.[14] By the revelation principle, these constraints prescribe the set of Nash equilibria to any contracting game between the parties. The second set of constraints (14) yields a lower bound, $\underline{U}$, to the welfare of the portfolio manager, representing his opportunity value of alternative employment.

The form of the precision function (5) in utility function (6) indicates a *shirking* problem; that is, the type 2 manager may have an incentive to reduce his effort, e_2, to produce a precision, h_2, that looks like a hard-working type 1 manager. As a result (and as shown in the next proposition), the client must construct a contract menu to offer a potential manager that will keep the type 2 manager from mimicking the type 1 manager. To minimize the payment to the manager, the client will construct contract terms such that the type 1 manager receives his reservation utility. The type 2 manager will obtain a higher utility, reflecting his informational advantage of knowing that he is a type 2, which the client cannot discern in the absence of contracting. To maximize the equilibrium effort, the client sets $\alpha_2^s = 1$ and then determines an $\alpha_1^s < 1$ that maximizes (12) and distinguishes a type 1 manager from a type 2 manager.

The condition that reflects the type 2 manager's indifference between the two contract offers is

$$F_2^s + R(h_2^*) - e_2^* = F_1^s + \alpha_1^s R(\hat{h}_2) - \hat{e}_2, \tag{15}$$

where the type 2 precision is first best,

$$b_2 R'(h_2^*) = 1, \tag{16}$$

and the type 2 manager's effort if he takes the contract for type **1** is

$$\alpha_1^s b_2 R'(\hat{h}_2) = 1. \tag{17}$$

To minimize the rents paid to the managers, the client allows the type 1 manager a minimum rent of $\underline{U}$; in other words, Equation (14)

[14] The maximum contained in the incentive compatibility constraints exists uniquely since R is strictly concave.

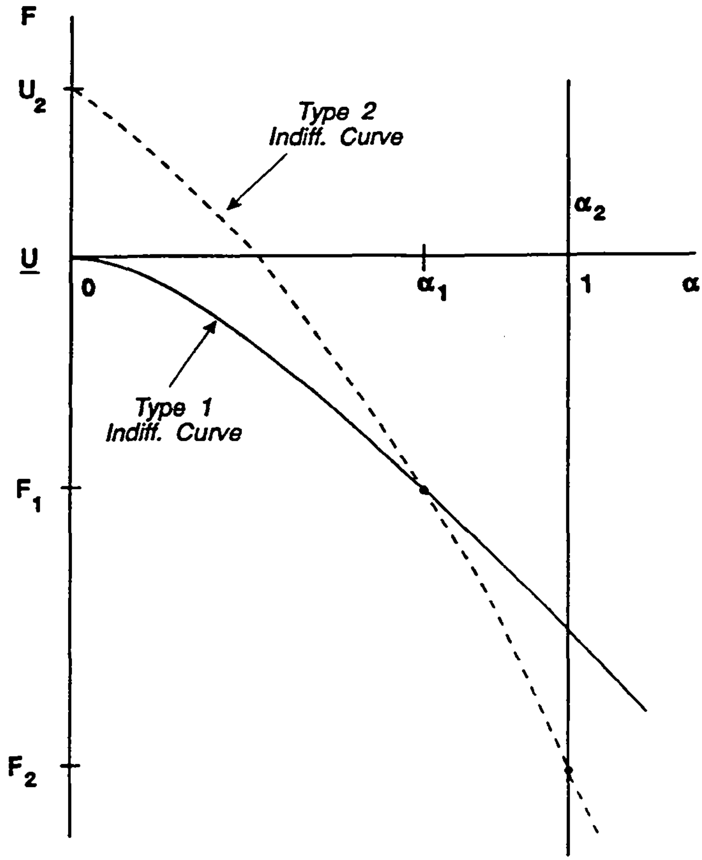


Figure 1

is satisfied with equality for this type:

$$F_1^s + \alpha_1^s R(b_1^s) - e_1^s = \underline{U}$$

so that F_1^s is defined by

$$F_1^s = \underline{U} - \alpha_1^s R(b_1^s) + e_1^s, \tag{18}$$

where $b_1^s = \alpha_1 + b_1 e_1^s$ is defined by the first-order condition (8).

Since $\alpha_2^s = 1$, the type 2 manager's utility is

$$U_2^s = R(b_2^*) - e_2^* + F_2^s$$

or, using Equations **(15)** and **(18):**

$$U_2^s = \underline{U} + Q(\alpha_1^s), \tag{19}$$

where the function $Q(\alpha)$ is defined by

$$Q(\alpha) = [\alpha R(b_2) - e_2] - [\alpha R(b_1) - e_1]. \tag{20}$$

The function $Q(\alpha)$ represents the differential total utility between manager types 2 and 1, evaluated at the *same* contract ((α, *F*). Hence, Equation (19) says that the total utility to the type 2 manager is higher than the utility given to type 1 by an amount of rent, *Q*. Taking the derivative of Equation (20) and applying the envelope condition, $\alpha b_i R'(b_i) = 1$, yields

$$\frac{dQ}{d\alpha} = R(b_2) - R(b_1) > 0$$

by the sorting condition. Hence, *Q* is an increasing function. A sufficient condition for *Q(0)* to be nonnegative [and thus $Q(\alpha)$ to be positive for $\alpha > 0$] is $a_1/b_1 \leq a_2/b_2$.

Figure 1 depicts the equilibrium described in Proposition 2. The contract designed for the type 2 manager has $\alpha_2^s = 1$ in order to extract the maximum effort from this more efficient manager. The type 2 manager can extract informational rents from his superior ability by claiming to be a less efficient type 1 manager.

The client's maximization problem can be written as

$$\max_{\alpha_1^s} C^s = \hat{\mu}[R(b_1^s) - e_1^s - \underline{U}] + (1 - \hat{\mu})[R(b_2^*) - e_2^* - \underline{U} - Q(\alpha_1^s)], \tag{21}$$

subject to Equation (8) for $i = 1, 2$. The first term in Equation (21) is the expected return net of effort for type **1** minus his utility, and the second term is the same for the type 2 manager. This discussion provides the background for Proposition 2.

Proposition 2. *The separating solution to the screening model has as its binding nonmimicry constraint the type 2 manager's utility and features*

$$0 \leq \alpha_1^s \leq 1, \qquad \alpha_2^s = 1,$$

$$F_1^s = \underline{U} - \alpha_1^s R(b_1^s) + e_1^s,$$

$$F_2^s = \underline{U} + Q(\alpha_1^s) - [R(b_2^*) - e_2^*]$$

so that

$$U_1^s = \underline{U}, \qquad U_2^s = \underline{U} + Q(\alpha_1^s),$$

and the separating contract for the type 1 *manager has* α_1^s *defined by*

$$\frac{\partial C^s}{\partial \alpha_1^s} = \hat{\mu}[R'(b_1^s)b_1 - 1]\frac{de_1^s}{d\alpha_1^s} - (1 - \hat{\mu})\frac{dQ}{d\alpha_1^s} = 0, \tag{22}$$

where

$$\frac{de_1^s}{d\alpha_1^s} = -\frac{R'(b_1^s)}{\alpha_1^s b_1 R''(b_1^s)} > 0, \tag{23}$$

and

$$\frac{dQ}{d\alpha_1^s} = R(\hat{b}_2) - R(b_1^s) > 0. \tag{24}$$

Proof. See the Appendix.

The first-order condition (22) clearly shows the trade-off between efficiency and information rent. The first term represents the probability of the type 1 manager times the total marginal net benefit of an increase in effort due to an increase in the manager's share. The second term represents the probability that it is the better manager times the increased rent the type 2 manager can obtain by choosing the contract designed for the type 1 manager. Increasing α_1^s has two effects: the client benefits from reducing the type 1 manager's inefficient effort; however, nonmimicry requires that the client raise the fee, F_2^s, as α_1^s is raised. The client equates the marginal benefit and cost. To see that Equation (22) provides an interior solution for α_1^s, note that the first term in brackets in Equation (22) is

$$R'(b_1^s)b_1 - 1 = (1 - \alpha_1^s)/\alpha_1^s$$

by Equation (8) and that this must be nonnegative, given $0 \le \hat{\mu} \le 1$ and inequalities (23) and (24). Therefore, $0 \le \alpha_1^s \le 1$.

Since the client's belief about the manager's type is endogenous in the two-period problem to be presented, we perform a comparative statics analysis to see the effect of changes in the client's prior belief that the manager is type 1, $\hat{\mu}$, on α_1^s, U_2^s and C^s.

Proposition 3. *In the separating solution of the screening problem:*

1. *The client's optimal choice of α_1^s is monotonically increasing in $\hat{\mu}$. Moreover, $\alpha_1^s = 0$ at $\hat{\mu} = 0$ and $\alpha_1^s = 1$ for $\hat{\mu} = 1$.*
2. *The utility of a type 2 manager, U_2^s, is increasing in $\hat{\mu}$:*

$$\frac{dU_2^s}{d\hat{\mu}} = \frac{dQ}{d\alpha_1^s}\frac{d\alpha_1^s}{d\hat{\mu}} > 0.$$

3. *The utility of the client, C^s, is decreasing in $\hat{\mu}$:*

$$\frac{dC^s}{d\hat{\mu}} = \frac{\partial C^s}{\partial \hat{\mu}} + \frac{\partial C^s}{\partial e_1^s}\frac{de_1^s}{d\alpha_1^s}\frac{d\alpha_1^s}{d\hat{\mu}} < 0.$$

Proof: See the Appendix.

Part 1 of the proposition states that, as the client finds it more likely that the manager is a low-efficiency type (i.e., as $\hat{\mu}$ goes to 1), the degree of informational asymmetry diminishes and the client can move closer to the socially optimal value of $\alpha_1^s = 1$. Alternatively, as it becomes more likely that it is the type 2, high-efficiency manager (i.e., $\hat{\mu}$ goes to 0), the information rent given to type 2 can be reduced by reducing F_2^s. From the nonmimicry constraint this requires α_1^s to decline, reaching zero when $\hat{\mu}$ reaches zero.

Part 2 of the proposition shows the dependence of the utility of the type 2 manager on the prior beliefs of the client. Equation (19) shows that the more efficient manager achieves the utility of the less efficient manager plus the amount by which his share of the expected return (net of his effort) exceeds that of the net benefit to the type 1 manager. That U_2^s is increasing in $\hat{\mu}$ i is intuitive, since the more certain is the client that she is dealing with the low-efficiency manager, the larger the information rent type 2 manager can capture.

Part 3 of the proposition indicates that the client's expected utility is decreasing in her belief that the manager is type 1. Thus, even though the manager is able to appropriate information rents, the client still retains enough of the surplus to make her better off with a more efficient manager.

2.3 The signaling problem

Here we examine the case in which the manager gains all the surplus from the relationship. This formulation reflects an environment in which clients compete with each other for the manager's services in a perfectly competitive manner. In this situation, the client will be indifferent to hiring either type of manager, since otherwise competing clients will bid away good managers.

As a result, the client will be forced to her reservation utility, $\bar{C}$, in both contracts:[15]

$$\bar{C} = (1 - \alpha)R(h_i) - F$$

for a contract (α, F) taken by a manager of type i Totally differentiating with respect to α and F yields

$$\frac{dF}{d\alpha} = -R(h_i) + (1 - \alpha)b_i R'(h_i)\frac{de_i}{d\alpha}.$$

Using the optimal effort condition (8) leads to

[15] The client's reservation utility, $\bar{C}$, will be determined endogenously in Section 3.3.

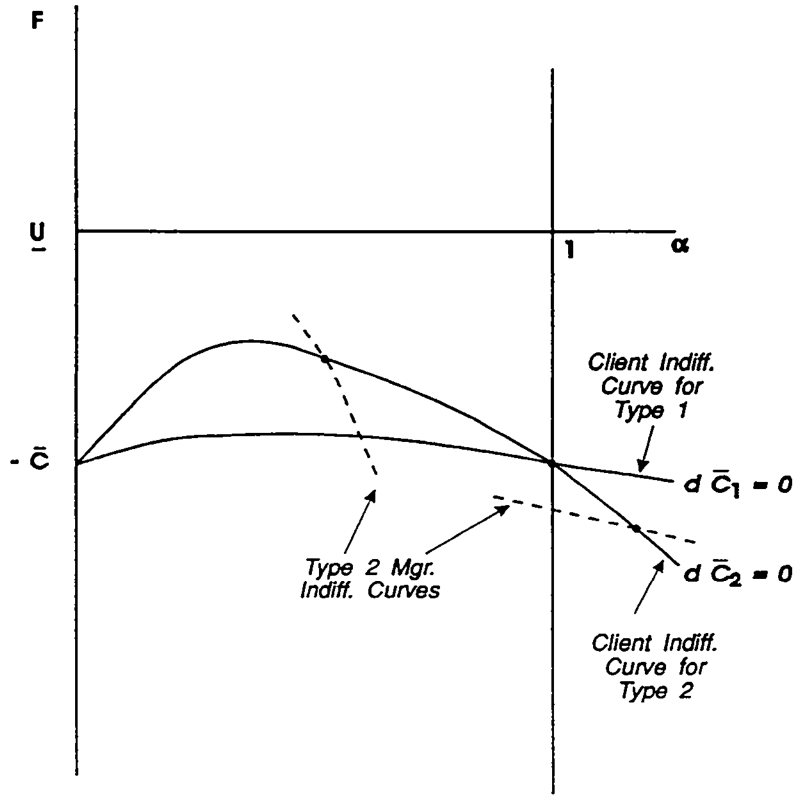


Figure 2

$$\frac{dF}{d\alpha} = -R(b_i) + \left(\frac{1-\alpha}{\alpha}\right)\frac{de_i}{d\alpha}. \tag{25}$$

This leads to the following proposition.

Proposition 4. *In the signaling model formulation with the client's reservation expected utility level at* $\bar{C}$, *both manager types offer the same equilibrium contract with*

$$and \qquad F = -\bar{C}.$$

Proof. See the Appendix.

The intuition is that, since each manager gets to keep the return to his effort, he will work efficiently (α = 1) and provide the client with a fixed payment, $F = -\bar{C}$. Thus, each manager type i offers the same contract pair $(\alpha, F) = (1, \bar{C})$. Figure 2 demonstrates this result.

The curves $d\bar{C}_i = 0$ show the contract pairs that would leave the client's expected utility unchanged if offered by manager type *i*. The slopes of these curves are given by Equation (25). The slope of the type *i* manager's indifference curve is given by Equation (10). Comparing these two indifference curve equations shows that, for either manager type, the manager's indifference curves are steeper sloped than the client's for $\alpha < 1$ and flatter than the client's indifference curves for $\alpha > 1$, as shown for type 2 in Figure 2. Thus, it is in each manager's interest to move to ($\alpha = 1$ and then to minimize the fixed payment to the client at $F = -C$.

3. The Two-Period Problem

In this section we construct a multiperiod contracting environment between the client and the manager. This includes describing the role and method of performance evaluation and the payoffs that result to the client and manager.

3.1 The sequence of actions

We consider contracting over two employment periods, with the partitioning date being defined by the availability of managerial investment performance results for the first employment period. In the multiperiod problem, both the client's and the portfolio manager's utility must be maximized from each time onward. We do not allow the portfolio manager to commit to contracts in the first period that he would have an incentive to renege upon in the second. This important assumption has the implication that it reduces the amount of surplus that the client can extract from the manager *over two periods,* even though the client is assumed to have all the market power at the outset. In other words, limiting commitment effectively allows the bargaining strengths at the time of hiring to be endogenized within the model.

At the beginning of the first period the client offers a menu of investment management contracts, and a manager, drawn from the population of managers, chooses a contract. At the end of the first period the client observes the investment position taken by the manager at the start of the period and the actual investment performance over that period. Given this information, along with anything learned by which contract the manager chose at the start, the client decides to retain the manager for the second employment period or fire the manager. If the manager is fired, the client looks for a new one.

If the manager is fired at the end of the first period, then he will find a new employer for the second period, taking with him his past performance evaluation from period 1. A new client, with only one

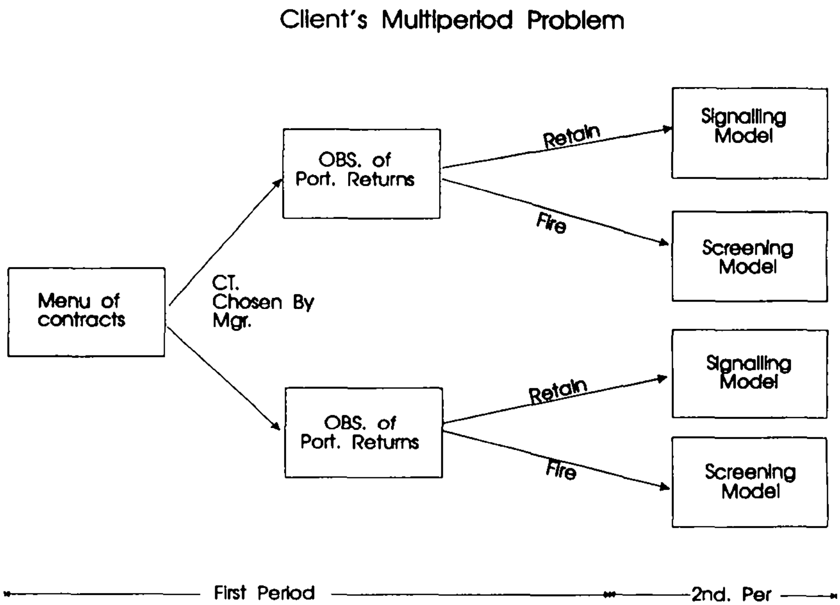


Figure 3
Client's multiperiod problem

period left, will offer this fired manager the appropriate one-period screening contract menu in a model like that described in Section 2.2.

If the manager is retained by the client at the end of the first period, then the manager achieves market power, as specified by the signaling model laid out in Section 2.3. Giving additional market power to a retained manager reflects, we believe, the tone of a continuing relationship, and creates a reason for the manager to want to be retained.

Figure 3 illustrates the decision tree facing the client in the multiperiod problem. For tractability, we simplify the multiperiod problem to a two-period problem: (i) an initial contracting period and (ii) an end-game period.

3.2 Performance evaluation

Whenever the manager's employment contract choice or portfolio strategy does not perfectly disclose his type to the client at the end of the first period, then there is *a* nontrivial role for performance evaluation. In this case, the client uses whatever information can be obtained from the choice of first-period contract, inferences about the manager's effort level, observation of the manager's portfolio choice, and, finally, the ex post rate of return on the portfolio. In statistical terms, the client is therefore interested in computing the Bayesian posterior probability that the manager is of type 1 given some prior belief, μ, that he is of type 1, given whether the manager held the risky or riskless asset, and given the actual return on the risky asset from the first period.

Suppose that the respective portfolio managers have chosen precision ratios h_1 and $h_2 > h_1$. The prior probability is denoted by

$$\mu = \mathcal{P}(h = h_1).$$

First, suppose that the manager has decided to invest all his funds in the risky asset. This implies that the client must conjecture that conditional expected return $M \geq 0$ or that the signal $S \geq 0$. From Bayes' rule, if the actual rate of return on the risky asset is P, the posterior probability, $\hat{\mu}$, must satisfy

$$\begin{aligned}\hat{\mu}_{\tilde{S}\geq 0}(\tilde{P}) &= \mathcal{P}(h = h_1 \mid \tilde{P},\ \tilde{S} \geq 0)\\ &= \frac{\mathcal{P}(\tilde{S} \geq 0 \mid h_1, \tilde{P})\mu}{\mathcal{P}(\tilde{S} \geq 0 \mid h_1, \tilde{P})\mu + \mathcal{P}(\tilde{S} \geq 0 \mid h_2, \tilde{P})(1 - \mu)}.\end{aligned}$$

Notice that, conditional on $\tilde{P}$, $\tilde{S}$ is a normally distributed random variable with mean $\tilde{P}$ and variance σ_ϵ^2. Thus, it follows that

$$\mathcal{P}(\tilde{S} \geq 0 \mid h, \tilde{P}) = 1 - N\left(\frac{-\tilde{P}}{\sigma_\epsilon}\right) = 1 - N\left(\frac{-\tilde{P}\sqrt{h}}{\sigma_P}\right),$$

where N is the standardized normal distribution function. Substituting into Bayes' formula yields

$${}_{\geq 0}(\tilde{P}) = \frac{[1 - N(-\tilde{P}\sqrt{h_1}/\sigma_P)]\mu}{[1 - N(-\tilde{P}\sqrt{h_1}/\sigma_P)]\mu + [1 - N(-\tilde{P}\sqrt{h_2}/\sigma_P](1 - \mu)}.$$

The other possibility is that the manager invests in the riskless asset. In this case, it is easy to see that the relevant conditional probability is

$$\mathcal{P}(\tilde{S} < 0 \mid h, \tilde{P}) = N(-\tilde{P}\sqrt{h}/\sigma_P).$$

In this case the posterior is

$$\hat{\mu}_{\tilde{S}<0}(\tilde{P}) = \frac{N(-\tilde{P}\sqrt{h_1}/\sigma_P)\mu}{N(-\tilde{P}\sqrt{h_1}/\sigma_P)\mu + N(-\tilde{P}\sqrt{h_2}/\sigma_P)(1 - \mu)}.$$

By symmetry, $\hat{\mu}_{\tilde{S}<0}(-\tilde{P}) = \hat{\mu}_{\tilde{S}\geq 0}(\tilde{P})$For future reference we define the general posterior function as

$$\hat{\mu}(\tilde{S}, \tilde{P}) = \begin{cases}\hat{\mu}_{\tilde{S}\geq 0}(\tilde{P}) & \text{if } \tilde{S} \geq 0,\\ \hat{\mu}_{\tilde{S}<0}(\tilde{P}) & \text{if } \tilde{S} < 0.\end{cases} \tag{26}$$

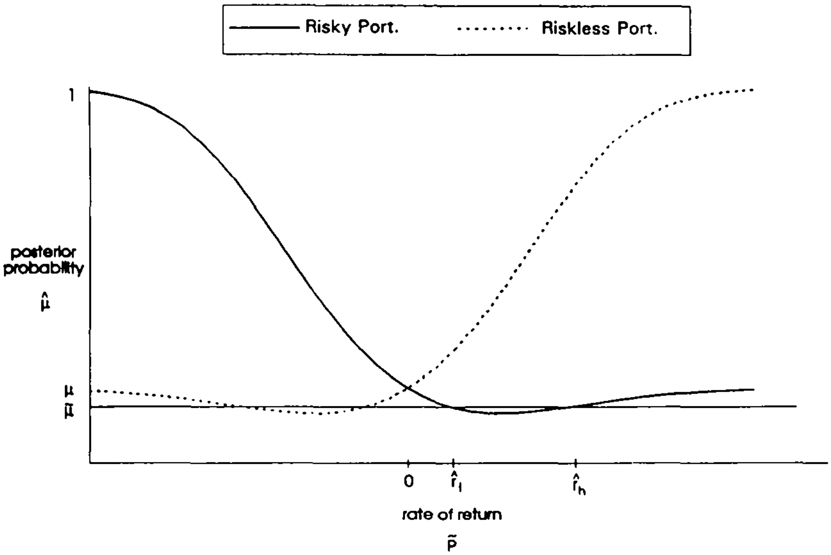


Figure 4

An illustration of these posterior probabilities appears in Figure 4. It is evident that the curves are not monotonic in the rate of return of the risky asset. Since the cases are symmetric, we focus on the case where the manager invested in the risky asset. If the rate of return were zero (equal to the riskless return), then the posterior belief, $\hat{\boldsymbol{\mu}}$, equals the prior belief, μ. In this case, each type manager has a 50-50 chance of making the right choice, regardless of h_i. Whenever the risky asset's rate of return is negative, the client updates her belief so that it becomes more likely that the manager is the lower-ability type. This is intuitive, since in this eventuality, the manager could be judged, ex post, to have been "wrong." When the manager is proven "right" (i.e., the rate of return on the risky asset is greater than the riskless asset), there is a region over which the client now believes that it is more likely that the manager is the more efficient type. However, for very high rates of return, the posterior probability reverses direction. While this might seem counterintuitive, it is due to the fact that there is very little information content in a very positive rate of return on the risky asset. For such extreme rates of return, it is highly likely that even the inefficient manager got a positive private signal, so that the portfolio performance is noninformative.

Now suppose, as will be justified shortly, that the client decides to retain or fire the manager solely on the basis of her posterior beliefs. Since $\bar{\boldsymbol{\mu}}$ represents the probability of drawing a type 1 manager from the population, if $\hat{\mu} \leq \bar{\mu}$, the client will retain the manager rather than hiring a new one; if $\hat{\mu} > \bar{\mu}$, she fires the manager. This is illustrated in Figure 4, where the manager is retained if he invested in the risky asset and the portfolio return is between $\hat{r}_l$ and $\hat{r}_b$.

3.3 Bargaining structure and client's and managers' payoffs

Consider first the contract negotiation at the start of the second employment period between a retained manager and the client. Since the client and manager find themselves in a signaling model, by assumption, this allows the manager to push the client to her reservation utility, which is determined as follows.

The client's alternative to accepting the incumbent manager's offer is to search for a new manager. We assume that this search is costly and that, as discussed in Section 2.1, a management consultant is employed to alter the likelihood of hiring a good manager. We assume that the client hires a management search firm and then offers a *screening* menu of contracts as seen in Section 2.2.[16]

The client incurs costs associated with the restructuring of her portfolio and we denote the sum of the costs of the search firm and portfolio restructuring as *I*. Thus, the client's utility if negotiations with the incumbent manager fail is $\bar{C} = C^s(\bar{\mu}) -$ where $C^s(\hat{\mu})$ is defined in Equation (21) with $\bar{\mu}$ replacing $\hat{\mu}$. Setting *I* defines the client's expected utility from firing a manager, which, through the bargaining process, defines the client's and manager's share of total benefits from *retaining* the manager for the second period. In order for the managers to be content to stay with a client that wants to retain them, the managers must achieve at least as much utility as they would get from leaving the current client and finding a new one. We identify the search cost, *I*, that yields a client reservation level, $\bar{C}$, which just provides retained managers enough utility to desire to stay with a client that offers to retain the manager.

As in Section 2.1, the management consulting fee reflects the consultant's ability to alter the probability of the client finding a type 2 manager. To provide incentives for managers offered retention to accept, the search cost must reflect the difference in client utility between hiring a type 1 manager and the expected utility of acquiring a new manager in a screening model:

$$I = C^s(\bar{\mu}) - [R(b_1^*) - e_1^* - \underline{U}].$$

In this case,

$$\bar{C} = C^s(\bar{\mu}) - I = R(b_1^*) - e_1^* - \underline{U}.$$

[16]Performance evaluation firms usually offer management search services as well.

By adding and subtracting *Q(1)* to this definition of $\bar{C}$, we obtain

$$\bar{C} = R(b_2^*) - e_2^* - [\underline{U} + Q(1)] \tag{27}$$

where *Q(1)*, as defined in Equation (20), is the maximum informational rent that could accrue to the type 2 manager in the single-period screening problem. This client reservation utility level leads to the following result.

Proposition 5. ***Assume that the client's reservation value, $\bar{C}$, is given by Equation (27). Then a type 1 manager will just receive his reservation utility, $\underline{U}$, if retained. A type 2 manager who is retained receives a payoff, $\underline{U} + Q(1)$, in excess of his utility in the single-period screening model, $\underline{U} + Q(\alpha_1^s)$. Therefore, both manager types will respond to retention by making a signaling contract offer.***

Proof. By the definition of $\bar{C}$, the type 1 manager is indifferent between his signaling and screening model payoffs. By setting the client's utility as above, the type 1 manager will, if he is retained by the client for period 2, accept the retention and offer a signaling contract of (a, $F) = (1, -\bar{C})$. If the type 2 manager is retained by the client, he will receive a rent larger than that achievable by leaving for a one-period screening solution [since $Q(1) > Q(\alpha_1^s)$ Thus, both managers will respond to retention by offering signaling contracts. ∎

Now consider what happens if the manager is fired at the end of the first period. As discussed above, the client's utility is $\bar{C}$. We assume that a fired manager loses his bargaining power but keeps his past reputation. As a result, he is offered a menu of contracts by a new client according to the single-period screening model with beliefs $\hat{\mu}$. From Proposition 2, the type 1 manager then gets $\underline{U}$ i the second period irrespective of $\hat{\mu}$. On the other hand, the type 2 manager gets utility $U_2^s(\hat{\mu}) = \underline{U} + Q(\alpha_1^s(\hat{\mu}))$.

4. The Two-Period Equilibrium

We now formulate the full two-period contracting problem, exhibit the nature of the solution, and then provide a specific numerical example. Before stating the problem, we first establish the consequence of utilizing the single-period screening solution in the first period and the single-period signaling solution in the second.

4.1 Equilibrium contract structure

Suppose that the client offers the single-period menu of screening contracts from Section 2.2 in the first period and a manager who is retained offers the signaling contract of Section 2.3 in the second period. Consider first the type 2 manager. In the first period, if he chooses the contract designed for him, his utility is equal to $U_2^s(\bar{\mu})$. Since this contract identifies him as a type 2 manager, the client will retain him in the second period. His signaling contract utility for the second period is $\underline{U} + Q(1)$ since he is able to extract maximum surplus from the client. If, on the other hand, he takes the contract designed for the type 1 manager, he will achieve the same utility in the first period, by design (Proposition 2). He will be fired by the client since he is mistakenly thought to be type 1 and will face a screening problem with a new client. Since his reputation indicates he is a type 1, his second period screening utility is $\underline{U} + Q(1)$. Therefore, we see that the type 2 manager is indifferent between the two screening contracts in the multiperiod situation.

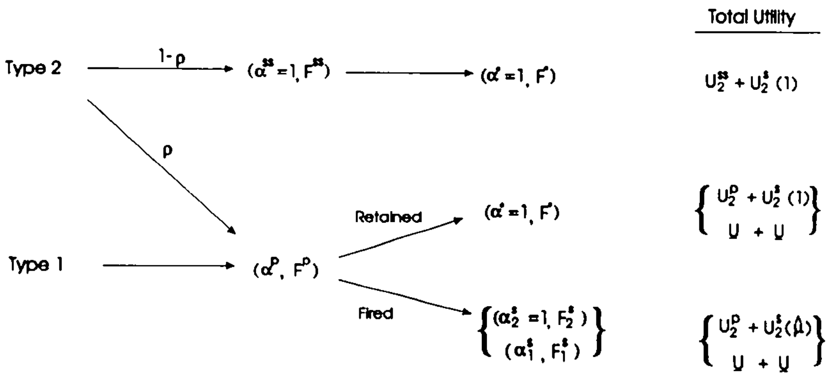
Now consider the type 1 manager. If he chooses the contract designed for him, he gets utility of $\underline{U}$ in both the first and second periods, since he is fired and goes to work for another client who pays him his reservation utility. If he misrepresents himself initially, he will be retained and will earn a second-period utility of $\underline{U}$ (Proposition 5). However, he is worse off in terms of first-period utility if he mimics the type 2 manager. Hence, the type 1 manager will not misrepresent his type.

Thus, one possibility for the two-period problem is for the client to separate the types perfectly in the first period by offering the screening contracts. However, it might be in the client's interest to *not* perfectly separate the types at the first contract date. By leaving the type 2 manager indifferent between a separating contract and a "pooling" contract (i.e., one that is also chosen by type 1 managers), the client may not learn the manager's type by the first contract choice. The client will then rely on the actual portfolio performance results, and this might induce the type 2 manager to work harder to avoid being fired at the evaluation date. The increased expected return to this effort can benefit both the manager and the client.

The more general contracting configuration is characterized in Figure 5.[17] For simplicity we assume that there is no discounting; that is, both the client and manager are interested in maximizing the additive sum of their utilities in each period. It should be clear that our results would not be substantially affected by the introduction of a modest discount rate.

In the initial period, two contracts are offered, (α^{ss}, F^{ss}) and (α^p, F^p). The contracts are structured in a way so that the type 2 manager

[17] Laffont and Tirole (1990) have demonstrated the optimality of this configuration for renegotiation. proof contracts in the context of a regulatory problem.



Note: Total utility levels and respective contracts for the second period are listed with the type 2 manager on top and the type 1 manager below.

Figure 5

is indifferent between taking each contract, whereas the type 1 manager strictly prefers the contract (α^p, F^p). This represents a semiseparating equilibrium because it is a mixture of pure separation and pure pooling. If the (semiseparating) contract, (α^{ss}, F^{ss}) is selected the client knows for sure that she is dealing with a type 2 manager. In this case, she does not rely on portfolio results to decide whether to keep the manager. She optimally retains him no matter what and the manager chooses a second-period contract that obtains first-best effort $\alpha^* = 1$, and $F^* = -\bar{C}_1$ to extract the maximum surplus from the client. As a result, the manager obtains second-period utility equal to $U_2^s(1) = \underline{U} + Q(1)$ Also, to obtain maximum efficiency of effort in the first period, the client sets $\alpha^{ss} = 1$. Defining U_2^{ss} as the utility from contract (α^{ss}, F^{ss}), the total two-period utility of the manager from selecting this contract is $U_2^{ss} + U_2^s(1)$.

On the other hand, if the (pooling) contract, (α^p, F^p) is chosen, the client knows only that type 1 is more likely to have taken the contract. In fact, if *r* represents the probability that type 2 takes the pooling contract, and she assesses ex ante probability $\bar{\mu}$ that the client is of type 1, then her probability assessment after observing the contract selection but *prior* to observing the portfolio return is

$$\mu = \frac{\bar{\mu}}{\bar{\mu} + \rho(1 - \bar{\mu})}, \tag{28}$$

from Bayes' rule.[18] Thus, the client's initial beliefs that the manager is type 1 is $\bar{\mu}$, formed before the manager selects a contract. When the manager selects the pooling contract, the client revises her beliefs to μ as shown above. When the client observes the portfolio position and actual portfolio performance, she will revise her beliefs from μ to $\hat{\mu}$, as shown in the previous section. Based on the stochastic value of $\hat{\mu}$, the client either retains or fires the manager. If the manager is retained, then the type 2 manager faces essentially the same situation as with the semiseparating contract and so chooses $\alpha^* = 1$ and a corresponding payment, F^*, so as to get $U_2^s(1)$ in the second period. The first period utility is denoted by U_2^p. If the type 1 manager is retained, he receives $\underline{U}$ as described in Section 3.3. Alternatively, if the manager is fired, he returns to the population and selects the appropriate screening contract involving α_i^s and F_i^s. In this case, the type 1 manager gets $\underline{U}$, and the type 2 manager obtains the utility associated with his first-period performance level, $U_2^s(\hat{\mu})$.

The client must keep type 2 indifferent between the pooling and semiseparating contracts; thus, the type 2 manager's two-period utility must be identical in each contract:

$$U_2^{ss} + U_2^s(1) = U_2^p + EU_2^s, \tag{29}$$

where $EU_2^s(\hat{\mu})$ denotes the expected second-period utility:

$$EU_2^s = \int_{\hat{\mu} \le \bar{\mu}} U_2^s(1) f(S, P \mid b_2^p)\, dS\, dP + \int_{\hat{\mu} > \bar{\mu}} U_2^s(\hat{\mu}(S, P)) f(S, P \mid b_2^p)\, dS\, dP, \tag{30}$$

where $f(S, P \mid b_2^p)$ is the joint density of S and P given the effort leading to b_2^p in the first period, and $\hat{\mu}(S, P)$ is determined from Equation (26). By definition,

$$U_2^p = \alpha^p R(b_2^p) - e_2^p + F^p.$$

In the pooling contract it is optimal for the client to set F^p so that $U_1^p = \underline{U}$. Using this and the definition of Q from Equation (20), we can rewrite this as

$$U_2^p = \underline{U} + Q(\alpha^p). \tag{31}$$

[18]One question is how the client can enforce her optimal choice of ρ. One justification, common to many models, is that the manager benevolently selects the client's most preferred value since he is indifferent. A second justification, which may have greater institutional content, is as follows. The client randomly produces one of two contracts with probabilities ρ and 1 - ρ, respectively. The first of these two contracts is a short-term contract involving performance evaluation at the end of the period (this corresponds to the pooling contract in our equilibrium). The second is a long-term contract with commitment by the client to retain the manager for a second period (equivalent to the semiseparating contract). The manager is allowed to reject the initial contract offered by the client, in which case the other contract is offered. Since the type 2 manager is indifferent, we assume that he always takes the initial offer. On the other hand, the type 1 manager will reject the initial offer if it happens to be the semiseparating contract.

4.2 Client's utility

Because of our assumption that the manager has market power in the second period, the client's expected utility from retaining any manager is the same as if she hires a new manager. Consequently, the client's second-period payoff is identically equal to $\bar{C}$ in each of the branches depicted in Figure 5. As a result, the client focuses exclusively on her first-period payoff in choosing her optimal strategy.[19]

We now derive explicit expressions for the client's first-period utility in each of the branches. In the semiseparating branch, $\alpha^{ss} = 1$ for the first period. Since the client's welfare is total surplus minus the utility of the manager, she obtains

$$C_2^{ss} = R(h_2^*) - e_2^* - U_2^{ss}. \tag{32}$$

Now we consider the client's welfare in the pooling branch when she deals with an agent of type 1. Given the choice of α^p in the first period, her first-period net benefit is

$$C_1^p = R(h_1^p) - e_1^p - \underline{U}, \tag{33}$$

where h_1^p satisfies

$$R'(h_1^p) = 1/\alpha^p b_1, \tag{34}$$

and e_1^p is the associated effort level.

Next, we turn to the case where the manager of type 2 selects the pooling branch. Unlike the type 1 manager, for whom the future does not matter in the selection of the first period effort, the type 2 manager considers the impact on his reputation and information rent. Thus, the manager will choose e_2 to

$$\max \alpha^p R(h_2) - e_2 + EU_2^s, \tag{35}$$

where h_2 is the corresponding precision. Given the solution to this subproblem, h_2^p and e_2^p, the client obtains first-period utility of

$$C_2^p = R(h_2^p) - e_2^p - U_2^p. \tag{36}$$

The client's two-period problem is to choose optimally the degree of randomization by the type 2 manager, r, and the sharing in the pooling contract, α^p, so as to

[19] Since she receives the same payoff at each outcome in the second period, the client is indifferent to whether the manager is retained or fired. This can be thought of as the limiting case in which the client receives nonpecuniary utility of δ (near zero) from being able to claim employment of a talented (i.e., type 2) manager. Thus, if the client fires the manager at date 1, she receives utility of $\bar{\mu}\bar{C} + (1 - \bar{\mu})(\bar{C} + \delta)$, and if she retains the manager she receives utility of $\bar{C} + (1 - \hat{\mu})(\bar{C} + \delta)$. Comparing these utilities, the client retains the manager if $\hat{\mu} < \bar{\mu}$, as assumed in Section 3.2.

$$\max C = \bar{\mu} C_1^p + (1 - \bar{\mu})\rho C_2^p + (1 - \bar{\mu})(1 - \rho) C_2^{ss}, \tag{37}$$

subject to the optimal effort conditions (34) and (35), the type 2 manager's indifference relation [Equation (29)], and Equation (31).

Substituting the definitions into Equation (37) provides

$$C = (1 - \rho)(1 - \bar{\mu})[R(b_2^*) - e_2^* - U_2^{ss}] + \rho(1 - \bar{\mu})[R(b_2^p) - e_2^p - U_2^p] + \bar{\mu}[R(b_1^p) - e_1^p - \underline{U}].$$

Rearranging terms and using Equations (29) and **(31)** yields

$$C = (1 - \rho)(1 - \bar{\mu})[R(b_2^*) - e_2^*] + \rho(1 - \bar{\mu})[R(b_2^p) - e_2^p] + \bar{\mu}[R(b_1^p) - e_1^p] - (1 - \bar{\mu})Q(\alpha^p) + (1 - \rho)(1 - \bar{\mu})[U_2^s(1) - EU_2^s] - \underline{U}. \tag{38}$$

The first three terms of Equation (38) are the investment returns net of effort in each of the three branches of Figure 5. The next two terms represent the informational rents earned by the type 2 manager. Of these two terms, the first is the expected rent that must be paid to the type 2 manager in the first-period pooling contract, and the second reflects the savings in rent for the second period by inducing some pooling. The client benefits to the extent that some probability of firing makes the type 2 manager worse off than by being retained.

4.3 Results

Because of the complexity of the two-period problem, the solution to a specific problem must be obtained by numerical means. However, we can still provide a qualitative insight into the features of the optimal solution. First, consider the case where $\rho = 0$ or, equivalently, $\mu = 1$. In this case the client is completely separating the types through the initial contract selection. After observation that a manager chooses the (α^p, F^p)contract, the client is certain that it is the type 1 manager. As a result, she infers nothing from performance evaluation and always fires the manager. This situation is characterized by the curves in Figure 4 being flat at $\hat{\mu} = 1$. This implies that even if a good type 2 manager were to choose the contract, (α^p, F^p),this will not provide any additional incentive to work hard, since he is fired after one period for sure. Hence, when $\rho = 0$, the client gains the same benefit as in the single-period screening problem. As a consequence, she optimally sets $\alpha^p = \alpha_1^s$ and gives the type 2 manager the same first-period rent, $U_2^p = U_1^s(\bar{\mu})$. Her utility equals C^s.

As the client moves away from $\rho = 0$ by moving some fraction of the type 2 manager into the pool, she trades off the efficiency losses from lower-effort expenditure of the good managers against rent extraction. The efficiency losses are indicated in the first two terms of Equation (38): fewer type 2 managers are expending first-best effort, e_2^*, and more are expending second-best effort, e_2^s. When ρ is in the neighborhood of zero, the type 2 manager who enters the pool is certain to be fired regardless of effort, because the client's posterior belief after contract selection is so pessimistic. As a result, the type 2 manager works less hard in the pool than in the semiseparating contract by virtue of the fact that $\alpha^p < 1$. Counteracting this efficiency loss is the rent extraction gain as represented in the $(1 - \rho)[U_2^s(1) - EU_2^s]$ term in Equation (38). As ρ increases from 0, this term increases because the manager's reputation improves even though fired, and this results in less information rent from going to work for a new client in the subsequent period $[EU_2^s < U_2^s(1)]$. In other words, the client saves on the fixed payment because the type 2 managers achieve lower second-period utility after being fired in the pooling contract, as opposed to being retained in the semiseparating contract. The rent extraction term dominates the efficiency term for ρ near 0 and so the client optimally moves some fraction of type 2 managers into the pool.

Eventually, as ρ gets larger, the posterior probability, $\hat{\mu}$, is sufficiently close to $\bar{\mu}$ that the possibility of retention in the pool can have a desirable effect on the first-period effort choice of the type 2 manager. In fact, the marginal benefit of additional effort becomes very significant as the posterior probability curve first breaks below the $\bar{\mu}$ barrier (as illustrated in Figure 4). It is near this point that the optimal amount of pooling occurs. This is because the loss in efficiency of the type 2 manager from choosing the lower-slope contract in the pooling branch is mitigated by the inducement of being retained in the second period. The client does not desire 100 percent pooling $(r = 1)$ since the type 2 manager is almost certain to be retained in this case. As a result, the manager again works less hard. Rent extraction gains are also nonexistent in pure pooling since the type 2 manager is almost certain to achieve $U_2^s(1)$ in the second period regardless of whether the semiseparating or pooling contract is chosen.

Table 1 contains the results from a specific numerical simulation. The values of b_1 and b_2 were selectedso that the first-best precision ratios would be $b_1^* = 0.5$ and $b_2^* = 1.0$. The assumed standard deviation of the risky asset return of 20 percent reflects the risk of a well-diversified equity portfolio. Also, we assume that a portfolio manager of either type is equally likely $(\bar{\mu} = .5)$. The first-best, one-period separating and two-period results appear also in Table 1. The first-best solution features a steeply sloped incentive contract given to

Table 1
Example

			Parameter values			
α_1	α_2	β_1	β_2	$\underline{U}$	σ_P	$\bar{\mu}$
0	0	32.56	70.90	0	0.2	.5
			First-best solution			
e_1^*	e_2^*	b_1^*	b_2^*	α_1^*	α_2^*	C^*
.015	.014	0.5	1.0	1.0	1.0	.0365
			One-period screening solution			
e_1^s	e_2^s	b_1^s	b_2^s	α_1^s	α_2^s	C^s
.0086	.014	0.28	1.0	0.59	1.0	.0320
			Two-period solution: p = .85			
e_1^p	e_2^p	b_1^p	b_2^p	α^p	α^u	C
.0091	.015	.297	1.03	.62	1.0	.0328

both types. The client's expected benefit equals $C^* = 0.0365$. By contrast, the type 1 manager works inefficiently in the one-period screening solution. This corresponds to the reduction in share down to $\alpha_1^s = .59$. As a consequence of the information rent given to the type 2 manager, the client loses some benefit and expected utility is reduced to $C^s = .032$. The data from the two-period problem refers to the pooling branch. An important feature of this example is that the type 2 manager actually works harder than in the first-best situation since $b_2^s = 1.03$. This is due to the second period chance of being retained. The share in the pooling contract, $\alpha^p = .62$, is slightly higher than in the one-period solution which gives rise to a small gain in the effort expenditure of the type 1 manager. Notice that the client's expected utility (in just the first period), $C = .0328$, is greater than the one-period screening solution. This represents the fact that the client is better off in the first period due to the second-period incentives offered to the portfolio managers. It turns out that the optimal amount of pooling in the two-period problem is $r = .85$ This corresponds to a probability of $\mu = .54$ that the type is 1 after the pooling contract is observed. Hence, most of the type 2 managers wind up being pooled with the type 1 managers in the first period, leaving an important role for ex post performance evaluation. Numerical simulations for alternative parameter values show that the optimal r must always be close to 1; otherwise, the probability of retention is zero and the client essentially gains nothing from the two-period relationship.

For this numerical example, $\hat{r}_l = .13$ and $\hat{r}_b = .32$, indicating that the manager is retained following the pooled contract if his performance is at least 13 percent but no more than 32 percent above the benchmark return.

5. Conclusion

We have examined the consequences of contracting over multiple periods between a client and portfolio manager. Our main conclusions are that the multiperiod relationship has a dramatic impact on the type of contracts that are likely to be observed, on the information revealed in the contracting process, and on the importance of ex post performance evaluation and rating services.

In a single-period relationship with a separating equilibrium, there is no role for ex post performance evaluation since the choice of contract completely reveals the information processing ability of the portfolio manager. On the other hand, in the initial period of our multiperiod equilibrium, there is only a small probability that the initial contract choice will reveal the manager's type. When it does, this can be regarded as a strong signal of the manager's expertise, and it implies a long-term relationship that is independent of portfolio performance. But in the large majority of cases, the manager is originally employed under a standard ("boilerplate") contract that is not very sensitive to actual ex post investment performance, despite the fact that a first-best contract would expose the manager to all the performance risk. When the manager chooses this boilerplate contract, the client learns very little from that choice. The client decides optimally to pool most managers in order that the more able types face a significant risk of not being retained at the time of performance evaluation. As a result of this risk, the better portfolio managers work harder than they otherwise would at the **outset** in order to distinguish themselves from their less productive counterparts.

Another important prediction from the model is that the optimal initial pooling contract features a lower level of performance incentives (smaller α) than would be produced in a single-period model. Our point here is that multiple rounds of contracting tend to weaken the need for explicit performance incentives. While the shares given to managers in this specific model are obviously much greater than those observed in practice, this is mainly due to our assumption of risk neutrality on the part of the manager. Since managers typically have very significant human and financial capital tied up in their money management firm, they are likely to be more risk-averse than their clients. In such an environment, we believe that all the α– values would be reduced without affecting the qualitative comparison between the single-period and two-period solutions.[20] Another important reason why performance fees are not often observed may be due to the involvement of a single money manager with several clients. In such situations, to avoid a perceived conflict of interest, managers might trade for clients for whom they have lower, or no, performance incentives before trading for clients with whom they have higher performance-based fees.[21]

The model predicts that observing the composition of the portfolio will be important for performance assessment. This is because the relevant benchmark depends on the type of assets chosen by the manager. Given observation of the portfolio, the optimal retention policy calls for the manager to be retained only if the actual portfolio returns exceed the benchmark by a positive threshold. Strictly speaking, the model also indicates that portfolio managers should be fired if they outperform the benchmark index by an exceedingly large degree. What this essentially indicates is that there is an "outlier" effect, in that extremely large portfolio performance relative to the benchmark is due to luck, rather than skill, and is not a reason for enhanced reputation.

Our model also provides predictions about the *dynamics* of the portfolio management contract. In particular, for managers that are retained by their clients after having achieved sufficient performance data to be evaluated, the new contract provides for higher manager fees (due to the assumed shift in bargaining power) and a high performance-based fee component, installed at the manager's initiative. These dynamic interpretations have yet to be examined empirically since they rely on time-series, rather than cross-sectional, implications.

Our model contains elements of imperfect competition between both clients and managers. We assume that the client has market power at the time of initial contracting and negotiates with a single manager but may lose market power in the second period. One alternative assumption is that the client negotiates with a finite set of competing managers. Although this gives even more market power to the client, she may still have some probability, however small, of winding up with the manager of lower ability in the first period. One would expect that competing managers would provide greater incentives for separation via the contract choice and decreased use of performance evaluation for two reasons: (1) The client can utilize the appropriate menu of contracts to be more sure that she has hired

[20]Risk-neutrality is crucial to obtaining a tractable model. Optimal contract forms with risk aversion can be quite complex [cf. Stoughton (1993)).

[21]We thank Chester Spatt for bringing to our attention this point made by Ken Dunn

the good manager; this means that there is less to be learned from the portfolio performance. (2) Managerial utility upon retention will be less because competition reduces the rents to reputation. That is, the results of the multiperiod model with increased competition tend toward those of the single-period model. However, the ability to utilize more than one manager might allow the use of tournament contracts in which explicit performance incentives would be unnecessary.

On the other hand, assuming more competition among clients for a given manager would be expected to lead to more dependence on ex post performance measurement. This can be seen from the single-period signaling model. In that case, both types of managers choose the same contract, so the client never learns anything from the contracting process, even in a single period. Also, if managers can work for more than one client simultaneously, they will clearly have even more incentives to enhance their reputations than in our model. This can only lead to greater reliance on performance monitoring and less on information from the contract choice.

Other considerations may also arise with multiple clients. To lessen conflicts, we would expect that managers who work for more than one client would have incentives to set up a pooled account so that all share in the identical portfolio returns; or, even if accounts are segregated, managers would attempt to run these in an identical manner. Thus, one interpretation of the contracts in our model is that they apply to a manager negotiating with a "representative" client.

In summary, we find that even when enforceability limitations preclude complete contracting commitments, the possibility of multiple periods can enhance portfolio management performance in the initial stages of the relationship and work to the mutual benefit of both manager and client.

A. Appendix

A.1 Proof of Proposition 1

The expected value of $\tilde{R}$ is

$$E(\tilde{R}) = \int_{-\infty}^{\infty} E(\tilde{R} \mid \tilde{M}) f(\tilde{M})\, d\tilde{M}, \tag{A1}$$

where f denotes the unconditional density of $\tilde{M}$. Notice that for $\tilde{M} < 0$, from Equation (1), $E(\tilde{R} \mid \tilde{M}) = 0$. On the other hand, for $\tilde{M} \geq 0$, again from Equation (1),

$$E(\tilde{R} \mid \tilde{M}) = E(\tilde{P} \mid \tilde{M}) = \tilde{M}.$$

Thus, Equation (A1) simplifies to

$$E(\tilde{R}) = \int_0^\infty \tilde{M} f(\tilde{M})\, d\tilde{M}.$$

Calculating the value of the expression on the RHS is basically the same as computing the value of an option on an underlying normally distributed asset that has a zero striking price. Brennan (1979) has solved such a problem; the solution is

$$\int_0^\infty \tilde{M} f(\tilde{M})\, d\tilde{M} = \sigma_M N'\left(\frac{E(\tilde{M})}{\sigma_M}\right),$$

where σ_M is the standard deviation of $\tilde{M}$ and N' denotes the density function of the standardized normal distribution function. Since the unconditional expectation $E(\tilde{M}) = KE(\tilde{S}) =$ we obtain

$$E(\tilde{R}) = \sigma_M/\sqrt{2\pi}.$$

But

$$\sigma_M^2 = K^2(\sigma_P^2 + \sigma_\epsilon^2) = \frac{\sigma_P^4}{\sigma_P^2 + \sigma_\epsilon^2}.$$

Defining $h = \sigma_P^2/\sigma_\epsilon^2$, the signal-to-noise ratio, and substituting back, we arrive at Equation (3). ■

A.2 Proof of Proposition 2

We begin by characterizing the set of incentive compatibility constraints (13). Denote e_1 and e_2 as the respective effort levels for the type 1 and 2 managers when they take their respective contracts in the solution. Let $\hat{e}_1$ and $\hat{e}_2$ denote the optimal effort choices from choosing the incorrect contracts. Also define h_i and h_i as the correct and incorrect precision ratios for manager type i. That is,

$$\alpha_i h_i R'(h_i) = 1, \qquad i = 1, 2,$$

$$\alpha_j h_i R'(\hat{h}_i) = 1, \qquad i \neq j.$$

With the respective utility levels equal to U_i for the manager, the incentive compatibility constraints can be written as

$$U_1 \geq \alpha_2 R(\hat{h}_1) + F_2 - \hat{e}_1,$$

$$U_2 \geq \alpha_1 R(\hat{h}_2) + F_1 - \hat{e}_2.$$

Using the definitions of managerial utility, these constraints can be reformulated to yield

$$U_1 \geq \alpha_2[R(\hat{h}_1) - R(h_2)] - (\hat{e}_1 - e_2) + U_2,$$

$$U_2 \geq \alpha_1[R(\hat{b}_2) - R(b_1)] - (\hat{e}_2 - e_1) + U_1.$$

Combining these constraints provides

$$\alpha_2[R(b_2) - R(\hat{b}_1)] - (e_2 - \hat{e}_1) \geq U_2 - U_1$$
$$\geq \alpha_1[R(\hat{b}_2) - R(b_1)] - (\hat{e}_2 - e_1).$$

Using the definition of Q, this expression can be rewritten as

$$Q(\alpha_2) \geq U_2 - U_1 \geq Q(\alpha_1). \tag{A2}$$

Since Q is monotonically increasing, this establishes that $\alpha_2 \geq \alpha_1$ is necessary for incentive compatibility.

We now turn to the formulation of the screening problem (12). Notice first that as long as $Q \geq 0$, Equation (A2) implies that the participation constraint of type 2 will be automatically satisfied as long as type 1's participation constraint is satisfied. Hence, the client will optimally reduce U_1^s to the point where $U_1^s = \underline{U}$. Next we can substitute from the definitions (6) to reexpress the client's objective as

$$C^s = \hat{\mu}[R(a_1 + b_1 e_1^s) - e_1^s] + (1 - \hat{\mu})[R(a_2 + b_2 e_2^s) - e_2^s]$$
$$- \underline{U} - (1 - \hat{\mu})(U_2^s - \underline{U}). \tag{A3}$$

We can think of the screening problem as maximizing this objective over α_1^s, α_2^s, and U_2^s subject to the constraints (A2). Clearly the binding constraint in Equation (A2) is going to be the lower bound. This establishes that the binding nonmimicry constraint comes from the type 2 manager. Since the upper bound in Equation (A2) is not binding, α_2^s can be maximized in an unconstrained fashion. As a result the optimal share for the type 2 manager becomes $\alpha_2^s = 1$, which implies that the effort and precision levels are first-best for type 2, $e_2^s = e_2^*$, $b_2^s = b_2^*$.

Equation (22) is established by differentiating Equation (21). Equation (23) follows from differentiating the first-order condition (8) for type 1. Equation (24) follows from the definition of Q. ■

A.3 Proof of Proposition 3

A.3.1 Part 1. The client's first-order condition can be written as

$$D^s(\alpha_1^s, \hat{\mu}) = \hat{\mu}[R'(b_1^s)b_1 - 1]\frac{de_1^s}{d\alpha_1^s} - (1 - \hat{\mu})[R(\hat{b}_2) - R(b_1^s)] = 0.$$

Then, totally differentiating gives

$$\frac{\partial D^s}{\partial \alpha_1^s}\frac{d\alpha_1^s}{d\hat{\mu}} + \frac{\partial D^s}{\partial \hat{\mu}} = 0.$$

Since $\partial D^s/\partial\alpha_1^s$ is assumed to be negative by the client's second-order condition, then the sign of $d\alpha_1^s/d\hat{\mu}$ is the same as the sign of

$$\frac{\partial D^s}{\partial\hat{\mu}} = [R'(b_1^s)b_1 - 1]\frac{de_1^s}{d\alpha_1^s} + [R(\hat{b}_2) - R(b_1^s)] > 0.$$

The first term in brackets is positive whenever $0 < \alpha_1^s < 1$, and $de_1^s/d\alpha_1^s$ is positive from Proposition 2, as is the second term above. Thus, α_1^s is increasng in $\hat{\mu}$.

As $\hat{\mu}$ goes to zero, the client's first-order condition requires $[R(\hat{b}_2) - R(b_1^s)] = 0$. This will hold when the type 2 manager can capture no informational rent. To accomplish this, the client sets $\alpha_1^s = 0$ and sets $F_2^s = \underline{U}$, completely eliminating any rent for the type 2 manager.

Alternatively, as $\hat{\mu}$ goes to 1, the client's first-order condition becomes $[R'(b_1^s)b_1 - 1]de_1^s/d\alpha_1^s = 0$. Since $de_1^s/d\alpha_1^s > 0$, it must be that $[R'(b_1^s)b_1 - 1] = 0$, which will obtain when the type 1 manager optimizes e_1^s when $\alpha_1^s = 1$. n

A.3.2 Part 2. We have already established that $d\alpha_1^s/d\hat{\mu} > 0$. The definition of Q implies that $dQ/d\alpha_1^s > 0$. The conclusion follows.

A.3.3 Part 3. The second term in the expression for $dC^s/d\hat{\mu}$ is zero by the client's envelope condition. By Equation (21) the first term is equal to

$$\frac{\partial C^s}{\partial\hat{\mu}} = R(b_1^s) - e_1^s - [R(b_2^*) - e_2^* - Q(\alpha_1^s)].$$

Substituting for Q gives

$$\frac{\partial C^s}{\partial\hat{\mu}} = (1 - \alpha_1^s)R(b_1^s) + \alpha_1^s R(\hat{b}_2) - \hat{e}_2 - [R(b_2^*) - e_2^*].$$

Since $R(b_1^s) < R(\hat{b}_2)$, we know that

$$\frac{\partial C^s}{\partial\hat{\mu}} < R(\hat{b}_2) - \hat{e}_2 - [R(b_2^*) - e_2^*] < 0,$$

since the effort and precision levels, b_2^* and e_2^*, are first-best optimal. ■

A.4 Proof of Proposition 4

We utilize the reformulated version of the incentive compatibility constraints (A2) contained in the proof of Proposition 2. We will show that the first-best efficient solution satisfies this representation of incentive compatibility and extracts maximum surplus for the manager. If the client's utility is to be $\bar{C}$ irrespective of type,

$$\bar{C} = R(h_1) - e_1 - U_1,$$

$$\bar{C} = R(h_2) - e_2 - U_2.$$

Subtracting these two equations gives

$$U_2 - U_1 = R(h_2) - e_2 - [R(h_1) - e_1]. \tag{A4}$$

Suppose first that $\alpha_1 = 1$, but $\alpha_2 > 1$. Then using the lower bound in Equations (A2) and (A4) yields

$$R(h_2) - e_2 \geq R(\hat{h}_2) - \hat{e}_2,$$

but this contradicts the first-best optimality of effort of type 2 at $\alpha_1 = 1$. Similarly, suppose that $\alpha_1 < 1$, but $\alpha_2 = 1$. Now from the upper bound in Equation (A2) we can derive

$$R(\hat{h}_1) - \hat{e}_1 \leq R(h_1) - e_1,$$

which contradicts the first-best optimality at $\alpha_2 = 1$.

Therefore, $\alpha_1 = \alpha_2 = 1$ is the only solution consistent with both incentive compatibility and maximum extraction of surplus. ∎

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