

AGENCY AND THE MARKET FOR MUTUAL FUND MANAGERS:  
THE PRINCIPLE OF PREFERENCE SIMILARITY

by

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## ABSTRACT

Mutual fund management involves an agency problem. The contractual arrangement between investor (principal) and mutual fund manager (agent) must give the manager an incentive to do well for the investor without destroying risk-sharing. In standard agency formulations investors prefer more risk tolerant agents. We assume that markets are complete and that the agent's alternative is trading on own account in security markets. We show that investors prefer agents whose preferences are similar to their own. Also, risk-sharing is efficient if and only if the investor and mutual fund manager have similar preferences. Assuming complete markets with a continuum of states is a tractable and plausible alternative to prior specifications.

## 1. Introduction

Mutual fund management involves an agency problem. The contractual arrangement between investor (principal) and mutual fund manager (agent) must give the manager an incentive to do well for the investor without destroying risk-sharing. Bad incentives can arise because of the interaction of the manager's compensation schedule, differences in risk preferences between manager and investor, and inability of the principal to observe the manager's costly effort. We examine these incentives in a limiting case in which effort is not costly and all potential agents have the same quality of information. The analysis exploits complete markets and a continuum of states, in the same spirit as Dybvig [1982, 1985a, 1985b].

In modeling this agency problem, it may seem simplest to use the familiar mean-variance framework. Specifically, we might choose constant absolute risk averse preferences and joint normality of asset returns. In practice it seems foolish to view bearing risk for the principal as an important role of the agent, because this task is performed by an efficient securities market. But since markets are incomplete in a multivariate normal world, any nonlinearity in the sharing rule leads to potential for the agent to directly expand the risk-sharing opportunities of the principal. Alternatively, a restriction to linear sharing rules, if binding, arbitrarily causes inefficiency beyond what is intrinsic to the agency problem. These problems are avoided in complete markets. In addition, we assume that there is a (nonatomic) continuum of states, which seems to be a good approximation to fact. Assuming complete markets and a continuum of states is consistent with option pricing models: even if the agent cannot hold options directly, arbitrary claims can be created by following appropriate trading strategies.

We examine the connection between Pareto efficient risk-sharing,

restrictions on the preferences of the principal and agent, and the equilibrium choice of sharing rule. To provide a clean comparison to previous agency results without complete markets, we pattern our model after Ross [1973, 1974]. We derive the class of preference restrictions that yield Pareto efficient risk-sharing. Using an incomplete markets specification, Ross [1974] established that any two of the following imply the third: 1) Pareto efficient risk-sharing between a given agent and principal, 2) the induced equivalence of the preferences of the principal and agent under the equilibrium sharing rule (similarity), and 3) the equilibrium sharing rule being affine in the terminal portfolio value (linearity). We offer an alternative definition of similarity that is directly verifiable from the specified preferences and wealth of the principal and agent (without requiring any knowledge of the endogenously determined sharing rule). We establish the equivalence of Pareto efficient risk-sharing and the similarity of preferences of the principal and agent. Therefore, similarity is desirable from a welfare point of view, as well as from the perspective of the principal. These conditions also imply that the equilibrium sharing rule is affine in the terminal portfolio payoff.<sup>1</sup>

A related intuition, formalized by Ross [1979], is that a principal will choose a similar agent out of a general class of candidates. This intuition does not hold in the conventional principal-agent model, due to an assumption that the agent's alternative is a fixed claim. The principal appropriates the premium that the market pays the agent to absorb risk. Therefore, all principals prefer agents who are as risk tolerant as possible, since increasing risk tolerance increases the size of the premium the principal can appropriate.

In the face of this difficulty, Ross [1979] has deviated from the traditional agency problem and has turned instead to an artificial "public agency" problem to formalize the intuition that principals prefer similar agents. In the

"public agency" problem, the fee schedule is exogenous and the fee is paid by a third party. We can justify the similarity intuition in a more natural agency problem because we assume that the agent's alternative is to trade on own account in the market. In our analysis, the certainty equivalent wealth level is higher for more risk tolerant agents, and therefore the premium for absorbing risk is retained by the agent, not appropriated by the principal.

Our main result is the Principle of Preference Similarity, which states that a principal prefers to select an agent whose preferences are similar to his own. Our definition of "preference similarity" is in the spirit of Ross's [1974, p. 220] definition of similarity, which we call "incentive similarity." Preference similarity means that the principal and agent have the same preferences over returns, up to leverage using the riskless asset. Under incentive similarity, both the principal and agent have the same induced preferences under the equilibrium sharing rule. Although preference similarity implies incentive similarity, it remains an open question whether the two are equivalent. Our notion of preference similarity is cleaner, since it depends only upon the future value of wealth and preferences of the principal and agent, and not upon the set of available assets or the form of the equilibrium sharing rule.

Our analysis points to the theoretical advantages of using a "complete markets" model in agency problems. In terms of tractability, the complete markets models show promise, as illustrated by the results in this paper and the simplicity of the complete markets characterization of efficiency in Dybvig [1985a] compared to the incomplete markets characterization in Dybvig and Ross [1982].<sup>2</sup> One reason complete markets simplifies the analysis is that in the absence of informational problems, the principal and agent can share risk just as well trading individually in the market as they can together.

This paper is part of the developing literature on decentralized portfolio

management. (See, e.g., Bhattacharya and Pfleiderer [1985], Haugen and Taylor [1984], Heckerman [1975], Ross [1973, 1974, 1979], Shah and Thakor [1983], and Sharpe [1981].) This literature has emphasized the structuring of agent compensation arrangements and the choice of portfolio manager or management arrangement. Some of these papers assume the presence of private information. Instead, we follow Ross by focusing upon the pure incentive conflict (without private information) between principal and agent.

In Section 2, we set up the model, and we establish the Principle of Preference Similarity in Section 3. In Section 4, we explore the relationship between Pareto efficiency, preference similarity, and linearity of the sharing rule. Section 5 concludes the paper.

## 2. The Model

We assume markets are complete over a continuum of states. The set of states of nature  $\Omega$  is the unit interval,  $\Omega = [0,1]$ . The state price per unit of probability is  $z(\theta)$  (given in the market), and we assume  $z'(\theta) > 0$  for  $\theta \in (0,1)$  (so that  $z(\cdot)$  is continuous, monotone, invertible and lacks mass points) and  $z(0) > 0$ .<sup>3</sup> The price of a payoff function  $x(\cdot)$  that returns  $x(\theta)$  dollars in state  $\theta$  is given by

$$\int_0^1 x(\theta)z(\theta)d\theta.$$
<sup>4</sup>

The principal and the agent have von Neumann-Morgenstern (state independent) expected utility functions  $U(\cdot)$  and  $V(\cdot)$ , respectively, defined on  $\mathbb{R}$ . These functions are strictly increasing, strictly concave,<sup>5</sup> and satisfy the Inada conditions given by  $U'(-\infty) = \infty$ ,  $U'(\infty) = 0$ ,  $V'(-\infty) = \infty$  and  $V'(\infty) = 0$ . The initial wealth of the principal is  $w_p$  and of the agent,  $w_A$ .

The agent invests both his own wealth and the wealth of a principal who is unable to invest directly in securities or observe the agent's decision. Of course, what we mean here by observing is really observing and understanding -- an investor who observes a list of stocks in the portfolio without understanding the list may as well be unable to observe the list at all. Since we examine the agency problem only when unconstrained Pareto efficient risk-sharing occurs, these restrictions are costless in equilibrium. In effect, our results provide the conditions on preferences under which nondisclosure of the agent's portfolio choice strictly dominates disclosure when the cost of disclosure is arbitrarily small (but positive). (The agent is precluded from separately trading securities on his own account since such activity would allow the agent to undo any incentives for proper choice embodied in the fee schedule.) Having the principal and agent pool their assets is a good stylized representation of the institutional arrangements between mutual fund managers and their funds, since mutual fund managers typically have large positions in their own funds and are severely limited in trading on own account. For example, a large trade by the fund cannot be accompanied by trading in the same security on personal account.

The compensation of an agent in state  $\theta$  is  $s(x(\theta))$ . The payoff  $s(x(\theta))$  includes the agent's share of his compensation due to his investment. The utility of the principal is defined over his net payoff, i.e.,  $x(\theta) - s(x(\theta))$ . The agency problem confronting the principal is formalized in Problem 1,<sup>6,7</sup>

**Problem 1**

$$\text{Max}_{\substack{s(\cdot) \\ x(\cdot)}} \int_0^1 U(x(\theta) - s(x(\theta)))d\theta \quad (2.1)$$

$$\text{s.t. a) } \int_0^1 V(s(x(\theta)))d\theta \geq \text{Max}_{y(\theta)} \left\{ \int_0^1 V(y(\theta)) \mid \int_0^1 y(\theta)z(\theta)d\theta = w_A \right\}, \quad (2.2)$$

and b)  $x(\cdot)$  solves

$$\text{Max}_{x(\cdot)} \int_0^1 V(s(x(\theta)))d\theta \quad (2.3)$$

$$\text{s.t. } \int_0^1 x(\theta)z(\theta)d\theta = w_A + w_P. \quad (2.4)$$

The principal picks a sharing rule (compensation schedule) that maximizes the expected utility of the principal taking into account the impact of the sharing rule on the agent's choice of payoff distribution. Constraints (2.3) and (2.4) represent the self-selection conditions that restrict the feasible  $x(\cdot)$  to those that would be selected by the agent, given the sharing rule. Since  $x(\cdot)$  is not directly observable by the principal, he cannot dictate the choice. Constraint (2.4), in particular, restricts the agent's feasible choice of payoff distribution (and hence, the payoff distribution for the master problem) to those that belong to the budget set. Constraint (2.2) captures the opportunity cost requirement. The agent participates only if the agent is at least as well off as by investing directly his own resources alone.

**3. The Market for Agents**

Before examining the principal's equilibrium choice of agent, we characterize both competitive and Pareto efficient allocations. Given the



specified prices (per unit probability),  $z(\cdot)$ , the principal and agent can each share risk directly with the market. The competitive problem of the principal is

$$\text{Max}_{x_u(\cdot)} \int_0^1 U(x_u(\theta)) d\theta \quad (3.1)$$

$$\text{s.t.} \quad \int_0^1 x_u(\theta) z(\theta) d\theta = w_P, \quad (3.2)$$

i.e., pick the payoff function consistent with the principal's wealth that maximizes his own expected utility. Necessary and sufficient conditions to this concave problem are given by

$$U'(x_u(\theta)) = \lambda z(\theta) \quad (3.3)$$

and

$$\int_0^1 x_u(\theta) z(\theta) d\theta = w_P,$$

where  $\lambda > 0$ . The competitive problem of the agent (investing only his own wealth) is

$$\text{Max}_{x_v(\cdot)} \int_0^1 V(x_v(\theta)) d\theta \quad (3.4)$$

$$\text{s.t.} \quad \int_0^1 x_v(\theta) z(\theta) d\theta = w_A, \quad (3.5)$$

so that

$$V'(x_v(\theta)) = \mu z(\theta) \quad (3.6)$$

where  $\mu > 0$ . Notice that the choice of the portfolio and the value of the objective depend upon the parties' risk preferences. The solution to the

separate portfolio problems (i.e., (3.1) and (3.2) and also (3.4) and (3.5)) are unique because of the Inada conditions and strict concavity assumptions. For the equilibrium portfolio choices, the marginal utility of wealth is proportional to state prices (per unit probability) and therefore the investor is unable to redistribute wealth across states of the world to become better off.

Pareto efficiency plays an important role in the proof of the Principle of Preference Similarity.

**Pareto Efficiency:** An allocation of wealth  $(x_U, x_V)$  is Pareto optimal if there is no reallocation  $(x_U^*, x_V^*)$  among the principal, the agent, and the market at prices  $z(\theta)$ , which will improve the welfare of one of the principal and agent without harming the other. More specifically, the reallocations we consider must satisfy the budget condition

$$\int_0^1 (x_U^*(\theta) + x_V^*(\theta)) z(\theta) d\theta = \int_0^1 (x_U(\theta) + x_V(\theta)) z(\theta) d\theta.$$

This definition is for unconstrained Pareto efficiency, since we do not require that there be any mechanism for achieving  $(x_U, x_V)$ . The necessary and sufficient first order conditions for Pareto efficiency, obtained by maximizing the principal's expected utility subject to the agent's expected utility level and the market budget constraint, can easily be seen to be  $\lambda_U U'(x_U(\theta)) = \lambda_V V'(x_V(\theta)) = z(\theta)$ . These conditions are equivalent to the combined first order conditions (3.3) and (3.6), implying the following partial equilibrium version of the fundamental theorem of welfare economics.

**Lemma 1:** For a fixed  $z(\cdot)$ , the competitive allocations are Pareto optimal, and every Pareto efficient allocation is the competitive allocation for some choice of

$w_p$  and  $w_A$ .

Here is one way to interpret the Pareto efficiency of competitive equilibrium. If an allocation will make a party better off than the competitive allocation, it must cost more (since otherwise the competitive allocation would be dominated within the party's budget set). Therefore, to construct a Pareto dominated allocation requires more wealth, i.e., the competitive allocation is the best achievable given the wealth available to allocate.

To examine directly the principal's choice of agent we first offer our definition of similar preferences.

**Preference Similarity:** The preferences of the principal and agent exhibit Preference Similarity if and only if there exists  $a > 0$  such that  $V(w) = U(aw - aw_A/P_B + w_p/P_B)$ , up to an affine transform which does not affect preferences, where

$$P_B \equiv \int_0^1 z(\theta) d\theta$$

is the price of a \$1 riskless bond.

We can then use the welfare economics theorem (Lemma 1) to prove the following result.

**Theorem 1 (Principle of Preference Similarity):** No agent makes the principal better off than an agent who exhibits preference similarity with the principal. Such an agent makes the principal just as well off as if the principal had the capability to trade in the market, and results in a Pareto optimal allocation between principal and agent.

Proof: First calculate how well off the principal is with a preference similar agent under the sharing rule  $s(x(\theta)) = s_1 x(\theta) + s_2$ , where  $s_1 = 1/(1+a)$  and  $s_2 = (aw_A - w_P)/(P_B(1+a))$ , and  $a > 0$  is given by the definition of preference similarity. The principal's expected utility under the sharing rule is

$$\begin{aligned} \int_0^1 U(x(\theta) - s(x(\theta))) d\theta &= \int_0^1 U[x(\theta)a/(1+a) + (w_P - aw_A)/(P_B(1+a))] d\theta \\ &= \int_0^1 U[x(\theta)a/(1+a) + (w_P - aw_A)/(P_B(1+a)) \\ &\quad - (1+a)(w_P - aw_A)/(P_B(1+a)) + (w_P - aw_A)/P_B] d\theta \\ &= \int_0^1 V(x(\theta)/(1+a) + (aw_A - w_P)/(P_B(1+a))) d\theta \end{aligned}$$

(by definition of preference similarity)

$$= \int_0^1 V(s(x(\theta))) d\theta, \tag{3.7}$$

which is the agent's expected utility. The agent's choice of  $x(\cdot)$  is the solution of (2.3) and (2.4). Letting  $x_V(\theta) = s(x(\theta))$  and  $x_U(\theta) = x(\theta) - s(x(\theta))$ , algebraic substitution and the choice of  $s(\cdot)$  imply that (2.3) and (2.4) are equivalent to (3.4) and (3.5) and to (3.1) and (3.2). Therefore, both principal and agent receive their competitive allocations. Any other potential agent's reservation utility level is also that potential agent's competitive utility. Therefore, to make the principal better off than he is above (with the similar agent and the particular sharing rule), we would have to Pareto dominate the competitive allocation for these two. But the budget constraint and Lemma 1 imply we cannot do so. Q.E.D.

The theorem implies that with a sufficiently rich set of potential agents, the principal's inability to trade in the market is irrelevant, so long as the principal can correctly identify a similar agent. In particular, the principal need not know  $z(\cdot)$  (except for  $P_B$ ) to match himself with his preferred agent. Furthermore, since the agent's problem is the same as the competitive problem, there is no incentive for even a dis-similar agent to misrepresent preferences or withhold wealth to invest directly, although there is no positive incentive to reveal preferences and wealth correctly, either. (We do assume that there is no direct theft by the agent, i.e., removing more wealth or investing less wealth than is required under the contract.)

The proof of Theorem 1 contains a result alluded to in the introduction, that preference similarity implies Ross's [1974] "incentive" similarity. Once a similar principal and agent are matched and use their optimal sharing rule, the principal and agent have identical preferences over outcomes, which is "incentive" similarity.

#### 4. Pareto Efficiency, Similarity, and Linearity

In this section we focus upon the solution of the principal-agent Problem 1 for a fixed assignment of agent to a principal (which may or may not be the principal's preferred assignment). We relate Pareto efficient risk sharing to preference similarity and linearity of the sharing rule. First, we define linearity.

**Linearity:** The optimal sharing rule is called linear if  $s(x(\theta)) = s_1 x(\theta) + s_2$ , where  $s_1 \in (0, 1)$ .<sup>8</sup>

Theorem 2: In a solution to Problem 1, preference similarity and Pareto efficiency are equivalent, and imply linearity.

Proof: By Theorem 1, preference similarity implies Pareto efficiency. We now prove that Pareto efficiency implies preference similarity. The necessary and sufficient first order condition for Pareto efficiency is that for some  $\lambda > 0$  and  $\nu > 0$ ,

$$V'(s(x(\theta))) = \lambda U'(x(\theta) - s(x(\theta))) = \nu z(\theta). \quad (4.1)$$

The first order necessary condition for the sub-problem in Problem 1 of the agent's portfolio choice given the sharing rule is

$$V'(s(x(\theta))) s'(x(\theta)) = k z(\theta), \quad (4.2)$$

where  $k > 0$ . Combining (4.1) and (4.2) yields

$$s'(x(\theta)) = k/\nu$$

or

$$s(x(\theta)) = s_1 x(\theta) + s_2,$$

where  $s_1 = k/\nu$ . By (4.1),  $s_1 \in (0, 1)$ , since  $\lambda > 0$  and  $V'$  and  $U'$  are both decreasing functions. Setting  $w = s(x(\theta))$  and integrating (4.1), we have that

$$\begin{aligned} V(w) &= \int \lambda U'((-s_2 + w)/s_1 - w) dw \\ &= \delta U[w(1-s_1)/s_1 - s_2/s_1] + c. \end{aligned}$$

This corresponds to preference similarity with  $a = (1-s_1)/s_1$ , provided we can show that  $-s_2/s_1 = (w_P - a w_A)/P_B$ . Pareto efficiency and linearity of the sharing rule imply that the reservation utility constraint (2.2) is binding for  $y(\theta) = s(x(\theta))$ ,<sup>9</sup> and therefore the agent's budget constraint yields

$$\int_0^1 (s_1 x(\theta) + s_2) z(\theta) d\theta = w_A.$$

Since  $x(\theta)$  satisfies (2.4), we have that

$$\int_0^1 s_2 z(\theta) d\theta = w_A - s_1 (w_A + w_P).$$

But  $s_2$  is a constant and

$$\int_0^1 z(\theta) d\theta = P_B. \quad \text{Therefore, dividing both sides by } -s_1 P_B, \text{ we have that}$$

$$-s_2/s_1 = (w_P - w_A(1-s_1)/s_1)/P_B = (w_P - a w_A)/P_B.$$

We have proven that Pareto efficiency implies preference similarity. Therefore, the two are equivalent. Since we have proven linearity along the way, linearity is implied by either of the equivalent conditions. Q.E.D.

Theorem 2 implies that if a principal is not assigned to a preference similar agent, then Pareto efficient risk-sharing cannot result. Since the agent must earn his opportunity cost, the absence of efficiency implies that the principal earns strictly less than if he invested his own wealth directly.

**Corollary 1:** The principal strictly prefers having a preference similar agent to having any agent who is not preference similar.

Corollary 1 strengthens the result of Theorem 1 in that the principal is strictly better off choosing a preference similar agent than in choosing any preference dis-similar agent.

We have demonstrated that only sharing rules of the form  $s(x(g)) = s_1 x(g)$

+  $s_2$  for  $0 < s_1 < 1$  are consistent with efficient risk-sharing. It is easy to see that every such sharing rule can occur. For any  $V(\cdot)$ , pick the preference parameter  $a > 0$  to satisfy  $s_1 = 1/(1+a)$  and pick the wealth levels to satisfy  $s_2 = (w_A - s_1(w_A + w_P))/P_B$ . Using the definition of similarity to determine  $U(\cdot)$ , we achieve efficient risk sharing, showing that all linear sharing rules are feasible. This construction also shows that the sharing rule does not pin down the particular preferences of the principal or agent, but only the relationship between those preferences.

While the principal and agent face the same induced choice problem, the principal and agent typically have different local risk aversion parameters under preference similarity. The condition  $V(w) = U(aw - aw_A/P_B + w_P/P_B)$  implies that  $A_V(w) = aA_U(aw - aw_A/P_B + w_P/P_B)$ , where  $A_V$  and  $A_U$  denote respectively the coefficient of absolute risk aversion of the principal and of the agent. Also,  $R_V(w)/w = aR_U(aw - aw_A/P_B + w_P/P_B)/(aw - aw_A/P_B + w_P/P_B)$  for the relative risk aversion measure. Therefore, neither absolute nor relative risk aversion needs to be the same for principal and agent, either at the same wealth levels or at wealth levels achieved in the same state.

## 5. Conclusion

We have shown that under optimal contracting, investors prefer mutual fund managers whose preferences are similar to their own. Previous results to the contrary rely on an unreasonable assumption that the agent's alternative wage does not depend on market opportunities. We also demonstrate that risk-sharing is efficient if and only if the investor and portfolio manager have similar preferences. The analysis illustrates the usefulness of the complete markets methodology for examining agency problems in an investments context.



There is a related literature on performance evaluation (see Dybvig and Ross [1985a, 1985b] for citations). While agency models in investments have focused on incentive issues, the performance models have focused on measurement issues. Ideally, these perspectives should be integrated.

We examine both the investor's choice of agent and sharing rules without imposing strong parametric assumptions on either preferences or distributions. A number of intriguing issues remain open. For example, the literature has emphasized the implications of private information rather than the costly production of information. Yet costly information is the motivating reason to pay for professional portfolio management. The costliness of and lack of observability of effort suggests a variety of basic issues. For example, can a variant of the Principle of Preference Similarity describing the principal's choice of agent be obtained? What is the nature of the fee schedule that deals with the pure incentive conflict and effort requirements simultaneously? Also, it would be desirable to investigate more general institutional arrangements.<sup>10</sup> Decentralized investment management remains an important area for new research.

### Footnotes

1. It is an open question whether the linearity of the sharing rule implies Pareto efficiency and similarity.
  
2. More technically, the Lagrangian multiplier on consumption in a given state is determined (up to a factor) when markets are complete, but can vary subject only to some linear (integral) restrictions when markets are incomplete.
  
3. The only essential restrictions in our structure are that asset prices are positive and linear, that there are no mass points, and that the pricing measure is continuous with respect to the probability measure. This statement can be verified using standard (but tedious) arguments from measure theory. See also Dybvig [1982, 1985a, 1985b] for related intuition.
  
4. We assume this integral is less than one so that the riskless interest rate is positive.
  
5. Risk neutral pricing is precluded because  $z'(\cdot) > 0$  (risk averse market). Absent a constant price per unit probability, a risk neutral agent would earn unlimited arbitrage profits. (Also note that our curvature assumptions presuppose  $V(\cdot)$  is strictly concave, though this objection to risk neutrality would seem inessential.)
  
6. If we formulated the problem placing state probabilities in the objective and state prices in the budget constraint (instead of expressing the prices in the budget set in the form of prices per unit probability), nothing would change.

It is straightforward to verify (for example) that the first order conditions in the two specifications are identical.

7. Throughout the analysis we assume the existence of a Pareto efficient allocation between the principal, agent and the market. (Of course, this allocation may not be achievable in the agency problem.) For example, this assumption precludes having a risk neutral principal or agent since the state price per unit probability is not constant. We also restrict attention to matchings of principals with agents for whom Problem 1 has a solution.

8. Mathematicians usually refer to this as affine, rather than linear. We follow the convention of Ross [1974].

9. If not, we can achieve an improvement by adding a constant to  $s(\cdot)$ . The response will be differentiable and the envelope condition implies an improvement.

10. For example, in our model taken literally, agents would have no disincentive to invest suboptimally if principal and agent accounts were kept completely separate. Of course, there is no positive incentive either and this result would disappear on the introduction of even a small cost to the manager of investing correctly. Nonetheless, this example illustrates the point that alternative institutional arrangements might improve on the institution described in this paper (which can be motivated by practice).

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