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Task assignment under agent loss aversion[☆]

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HIGHLIGHTS

- A principal assigns a task to one of two agents depending on future states.
- If the agents have concave utility, a state-dependent task assignment is optimal.
- If the agents are loss averse, a state-independent assignment can be optimal.
- In addition, the optimal contract may specify the same effort levels in all states.

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ABSTRACT

We analyze a task-assignment model in which a principal assigns a task to one of two agents depending on future states. If the agents have concave utility, the principal assigns the task to them contingent on the state. We show that if the agents are loss averse, a state-independent assignment – assigning the task to a single agent in all states – can be optimal even when the principal can write a contingent contract at no cost.

1. Introduction

Assigning a task to an appropriate employee is a major determinant of firm performance. Such a task assignment can be even more important when the task requires a different skill depending on the situation. According to contract theory, in the absence of asymmetric-information problem, a principal (she) offers a contingent contract where she assigns a task to an agent (he) whose productivity is the highest in each situation. In working environments, however, a task is often assigned to a single agent regardless of the situation even if such a contingent contract is available.

We investigate this issue by incorporating a prominent behavioral aspect, *loss aversion*: people are more sensitive to losses than to same-sized gains. In our model, the principal assigns a task to one of two agents in each state. Each agent's productivity level varies across states, whereas his effort-cost function is the same across states. The principal writes a contract that specifies the wages of the agents, which agent works on the task, and his effort level depending on the state. The agents are expectation-based loss averse à la Kőszegi and Rabin (2006, 2007): the utility of each agent depends not only on intrinsic material payoffs but also on psychological gain–loss payoffs from comparing his realized outcome with his expected outcomes.

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If agents are not loss averse, then in each state the principal always assigns the task to the agent with the highest productivity. In contrast, if agents are loss averse, then the principal may assign the task to a single agent in all states based on the trade-off between improving productivity and alleviating expected losses. On the one hand, such a contract is less efficient in terms of productivity because a less productive agent works in some state. On the other hand, it reduces the principal's wage payment by alleviating the expected losses of the agent. If the latter effect outweighs the former, assigning the task to a single agent in all states becomes optimal. In addition, when the degree of loss aversion is large, the optimal contract specifies the same effort levels in all states. This result is in sharp contrast with the standard concave-utility case where the principal specifies state-specific effort levels as long as the productivities of the agents are different.[1]

The rest of the paper is organized as follows. Section 2 sets up the model. Section 3 analyzes the model. Section 4 concludes.

2. The model

2.1. Setup

Suppose one risk- and loss-neutral principal assigns a task to one of two agents. All of them are uncertain about the future state at the contracting stage. There are two states, $s = 1, 2$, and one of the states is realized after contracting. State 1 (resp. state 2) is realized with probability $q \in (0, 1)$ (resp. $1 - q$). The value of the task depends on the state and the principal can write a contract *contingent on the state*. Agent $i = A, B$ works on the task if and only if the principal assigns the task to him, and only one agent can work on the task in each state. The agent in charge of the task exerts effort $e \in \mathbb{R}_+$ with effort cost $c(e) = e^2/2$. If agent A (resp. agent B) is assigned to the task in state $s \in \{1, 2\}$ and exerts effort e_s^A (resp. e_s^B), the principal earns $\alpha_s e_s^A$ (resp. $\beta_s e_s^B$) from the task. Assume that $\alpha_1 > \beta_1$ and $\alpha_2 < \beta_2$: the productivity of agent A is higher (resp. lower) than that of agent B in state 1 (resp. state 2). For brevity, we further assume that $\beta_1 = \beta_2 = 1$ and $q\alpha_1 + (1-q)\alpha_2 > 1$: agent B's productivity is constant across states and the average productivity of agent A is higher than that of agent B.[2]

Since our focus is not on moral hazard issues, we consider a case in which *the effort level is contractible in each state*.[3] The principal offers a contract that specifies a wage scheme to each agent depending on the state $w = (w_1^A, w_2^A, w_1^B, w_2^B)$, the effort level in each state $e = (e_1, e_2)$, and which agent works on the task contingent on the state.[4] The states in which agent A works on the task are denoted by $D \in \mathbb{D} \equiv \{\varnothing, \{1\}, \{2\}, \{1, 2\}\}$. For example, $D = \{1\}$ means agent A works in state 1 but agent B works in state 2. The contract is denoted by $C(w, e; D) \in \mathbb{R}^4 \times \mathbb{R}_+^2 \times \mathbb{D}$. Each agent accepts the contract if his expected utility is larger than or equal to his reservation utility, which is assumed to be zero. We call a task assignment *state-independent* if the principal assigns the task to a single agent in both states; otherwise we call it *state-dependent*. The timing is as follows:

1. The principal offers a contract to agents.
2. Each agent chooses whether to accept the contract.
3. The state is realized.
4. The task assignment, the effort provision, and the payment are carried out according to the contract.

2.2. Reference-dependent preferences

A key assumption of our model is that each agent's overall utility comprises intrinsic consumption payoffs and psychological gain–loss payoffs. We assume that each agent has expectation-based reference-dependent preferences à la Kőszegi and Rabin (2006, 2007). In our model, the agents have two consumption dimensions: wage and effort. For each consumption dimension, they feel a psychological gain or loss by comparing a realized outcome with a reference outcome. For deterministic reference points, we denote each agent's reference point for his wage and effort cost by $\hat{w}$ and $\hat{e}$, respectively. If his actual wage and effort are w and e, then his overall utility is given by:

$$w - c(e) + \mu(w - \hat{w}) + \mu(-c(e) + c(\hat{e})),$$

where $\mu(\cdot)$ is a gain–loss function that corresponds to Kahneman and Tversky's (1979) value function. We assume that $\mu(\cdot)$ is piecewise linear to focus on the effect of loss aversion. Then, we can simply define the gain–loss function when consumption is x and the reference point is r as

$$\mu(x - r) = \begin{cases} x - r & \text{if } x - r \geq 0, \\ \lambda(x - r) & \text{if } x - r < 0, \end{cases}$$

where $\lambda \geq 1$ represents the degree of loss aversion.[5] The agent is loss neutral when $\lambda = 1$.

Following Kőszegi and Rabin (2006, 2007), we assume that the reference point is determined by rational beliefs on outcomes and that the reference point itself is stochastic if the outcome is stochastic. Each agent feels a gain–loss by comparing every possible outcome with every reference point. For example, suppose that the principal assigns the task to agent i in $s = 1$ but not in $s = 2$ with paying a constant wage w^i. Then, agent i expects to incur effort cost $c(e_1)$ with probability q and not to incur it with probability $1 - q$. If $s = 1$ is realized, then agent i incurs $c(e_1)$ and hence he feels no gain–loss with probability q and feels a loss by $c(e_1)$ with probability $1-q$. If $s = 2$ is realized, then agent i does not incur the effort cost and hence he feels a gain by $c(e_1)$ with probability q and feels no gain–loss with probability $1 - q$. Ex-ante the agent correctly anticipates all the above cases, and his expected gain–loss utility in the effort dimension is $-q(1 - q)(\lambda - 1)c(e_1)$. The expected gain–loss utility in the wage dimension is zero because the agent anticipates w^i and actually receives it.

We derive the optimal contract based on the *choice-acclimating personal equilibrium* (CPE) defined by Kőszegi and Rabin (2007). Intuitively, each agent knows that his beliefs will be adapted to his accepted contract before he actually chooses his action, and hence he takes this change into account when accepting a contract. Formally, given $C(w, e; D)$ let $\mathbf{1}_s^i$ be the indicator function that takes a value of one if agent i incurs an effort cost in state s and takes zero otherwise. Because agent i's accepted contract itself determines his reference points, the condition for accepting a contract $C(w, e; D)$ under CPE is represented by $U^i(w, e; D|w, e; D) \geq 0$, or equivalently,

$$\underbrace{qw_1^i + (1 - q)w_2^i - \mathbf{1}_1^i qc(e_1) - \mathbf{1}_2^i(1 - q)c(e_2)}_{\text{intrinsic utility}}$$
$$- \underbrace{q(1 - q)(\lambda - 1)\left(|w_1^i - w_2^i| + |\mathbf{1}_1^i c(e_1) - \mathbf{1}_2^i c(e_2)|\right)}_{\text{gain–loss utility}} \geq 0. \quad \text{(CPE-IR)}$$

[1] As related literature, Heidhues and Kőszegi (2005, 2008) and Herweg and Mierendorff (2013) analyze the optimality of state-independent pricing under consumer loss aversion.

[2] Our main results hold without imposing these specifications. See Daido et al. (2013) for general analysis.

[3] See, for example, Gill and Stone (2010) and Herweg et al. (2010) for analysis on moral-hazard problems under agent loss aversion.

[4] Note that in each state an agent who is not in charge of the task exerts zero effort.

[5] We set the weight of the gain–loss payoffs in Kőszegi and Rabin (2006, 2007), η, equal to one. Under the solution concept of this paper, η can be normalized to one without loss of generality.