All-or-Nothing Monitoring: Comment

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July, 2009

Abstract

Zhao (2008) presents an interesting “all-or-nothing monitoring” result for a multitask moral hazard agency problem with partial effort observation. We argue that the optimal contract based on the non-verifiable observation of the agent’s effort in Zhao (2008) can be regarded as a limitation on the incentive schemes available to the principal. We then propose some arguably more appropriate approaches for analyzing such agency problems.

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In a recent paper, Rui R. Zhao (2008) studies an interesting multitask moral hazard problem with partial effort observation: A principal (she) hires an agent (he) to undertake a project with several independent tasks. In addition to noisy but verifiable output signals from the agent’s efforts, the principal can observe the agent’s efforts in some, but not all, tasks. Such direct observation, though perfect, is non-verifiable. Zhao compares the optimal output-based contract with one that is based on both the output signals and the effort observation, where the principal reimburses the agent for the effort cost if and only if he exerts effort on the observable tasks, with such scheme being enforced by the principal’s reputation concerns. Zhao finds that the principal is strictly better off by conditioning the wage scheme only on the noisy output signals, as long as she cannot perfectly observe all effort choices of the agent, hence the title “all-or-nothing monitoring”. The rationale behind this intriguing result is that when the principal fully compensates the agent for the effort cost separately for the observable tasks, the advantageous information synergy from combining multiple independent tasks is reduced so much that she is worse off compared to her wage cost in the optimal output-based contract.

The all-or-nothing monitoring result is surprising, as more information does not benefit the principal in designing the optimal contract, which contrasts with a standard result in the moral hazard literature that additional informative signals enable the principal to better address the agent’s incentive problems. We show in Proposition 1 that the driving force of Zhao’s result lies in the assumption of a simple wage scheme for the observable tasks. In Zhao’s model, the principal is assumed to pay $kc$ when the agent works in the $k$ observable tasks, with this wage being enforced by reputation concerns. Reputation concerns, however, do not allow the principal to do more than this. In particular, the simple wage scheme restricts the principal from offering lower wages for the $k$ observable tasks when she observes bad output signals in the $(n-k)$ unobservable tasks, which is feasible as the agent is risk-neutral. As a result, a payment scheme based on both the output signals and the perfect observation indeed generates a lower expected wage.

More specifically, Zhao assumes that a forcing contract on the $k$ observable tasks plus the noisy performance bonus on the other $(n - k)$ tasks is what is available to the principal. It is, however, not obvious why one should limit oneself to this type of incentive scheme. As we demonstrate later, once one considers more general incentive schemes (in a setting where the principal’s perfect observation on the $k$ observable tasks is verifiable), the “paradox” vis-a-vis the standard result of more information being better can then be resolved.

We now present several arguably more appropriate approaches such that the effect of

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1In the sequel, the tasks with observable effort are called observable tasks and the remaining are called unobservable tasks.
the additional perfect observation of the agent’s effort in \( k \) out of \( n \) tasks can be fruitfully analyzed:

First, a contract that is based on both the noisy output signals and the perfect observation can be clearly made self-enforcing if both the output signals and the observed effort levels are verifiable. In that case, the principal’s contract can explicitly depend on both the output signals and the observed efforts, and not surprisingly, more information would indeed benefit the principal as standard theory predicts. Adopting Zhao’s notation, Proposition 1 characterizes this optimal contract and compares its expected wage (denoted as \( E[\tilde{w}(\theta)] \)) with that in the output-based contract (denoted as \( E[w(\theta)] \)), where \( w(\theta) \) is the optimal wage in Proposition 1 in Zhao (2008): \( w(\theta) = \frac{nc}{p^2 - q^2} \), if \( \theta = \theta^* \) and \( w(\theta) = 0 \) if \( \theta \neq \theta^* \).

**Proposition 1** Suppose that both the output signals and the effort observation are verifiable. The principal’s optimal wage scheme is to offer a positive wage \( \tilde{w}(\theta) \) only if \( \theta = \theta^* \) and the agent works in all \( k \) observable tasks, where \( \tilde{w}(\theta^*) = \frac{nc-kc}{P(\theta^*|H) - P(\theta^*|K)} \) if \( \frac{P(\theta^*|H)}{P(\theta^*|K)} \leq \frac{n}{k} \) and \( \tilde{w}(\theta^*) = \frac{nc}{P(\theta^*|H)} \) if \( \frac{P(\theta^*|H)}{P(\theta^*|K)} > \frac{n}{k} \). Moreover, we have \( E[\tilde{w}(\theta)] < E[w(\theta)] \).

**Proof.** Under verifiable output signals and effort observation, the least cost contract solves:

\[
\max_{w(\theta)} - \sum_{\theta \in \Theta^n} P(\theta|H) w(\theta) \\
\text{s.t.} \quad \begin{align*}
&\sum_{\theta \in \Theta^n} P(\theta|H) w(\theta) - nc \geq \sum_{\theta \in \Theta^n} P(\theta|K) w(\theta) - kc \quad (IC_1), \\
&\sum_{\theta \in \Theta^n} P(\theta|H) w(\theta) - nc \geq 0 \quad (IC_2)
\end{align*}
\]

where \((LL)\) is the limited liability constraint, and \((IC_1)\) implies that the agent prefers working in all \( n \) tasks (denoted as the effort vector \( H \)) to working only in the \( k \) observable tasks (denoted as \( K \)), while \((IC_2)\) ensures a non-negative expected payment for working in all \( n \) tasks.

If \( \frac{P(\theta^*|H)}{P(\theta^*|K)} \leq \frac{n}{k} \), which happens when the output signals are noisy and/or \( k \) is small, then only \((IC_1)\) is binding and the wage scheme can be derived as:

\[
\tilde{w}'(\theta) = \begin{cases} 
\frac{nc-kc}{P(\theta|H) - P(\theta|K)}, & \text{if } \theta = \theta^* \\
0, & \text{otherwise}
\end{cases}
\]

The principal’s expected wage payments under \( \tilde{w}'(\theta) \) and \( w(\theta) \) are \( \frac{(n-k)cP(\theta^*|H)}{P(\theta^*|H) - P(\theta^*|K)} \) and \( \frac{ncP(\theta^*|H)}{P(\theta^*|H) - P(\theta^*|L)} \), respectively. Supermodularity of \( P(\theta|e) \) then implies (or by (6) in Zhao

\[\text{Notice that the incentive system resembles a forcing contract where the agent is punished severely (a zero wage) if he shirks in any of the observable tasks. This is feasible because of risk-neutrality. Consequently, the agent’s incentives to work in the observable tasks are satisfied.}\]
If $P(\theta^*|H) > \frac{n-k}{n}$ (when the output signals are precise and/or $k$ is large), then only (IC$_2$) is binding, from which, the optimal wage scheme is:

$$\bar{w}''(\theta) = \left\{ \begin{array}{ll}
\frac{nc}{P(\theta^*|L)}, & \text{if } \theta = \theta^* \\
0, & \text{otherwise}
\end{array} \right.$$.

As $P(\theta^*|L) > 0$, we immediately obtain that $E[w(\theta)] > E[\bar{w}''(\theta)] = nc$, which is also the lowest wage payment if the principal can perfectly observe all $n$ effort levels.

As shown in Proposition 1, the principal now employs the harshest punishment whenever she observes a shirk in an observable task – a zero wage for all $\theta$’s. Moreover, if the output signals are noisy about the agent’s effort and/or $k$ is small compared to $n$, a positive rent should be offered to motivate the agent to work in all $n$ tasks; if, however, the output signals are precise enough and/or $k$ is large, the output signals and the perfect observation are jointly powerful enough to incentivize the agent to work in the tasks at a zero rent.$^3$

The second and somewhat more interesting approach is to model the contracting relationship as a repeated one, where the same outcome as in Proposition 1 would arise if both output signals and efforts on the observable tasks are non-verifiable. The principal pays the agent only if she observes both good output signals and high efforts. The agent cannot make matters to the court as there is no explicit contract to begin with. On the other hand, a similar outcome as in Zhao’s optimal contract that depends on both the output signals and the perfect observation can also be obtained when the relationship is repeated, in which case enforcement using players’ reputation concerns may then arise more naturally.

$^3$Proposition 3 in Christian Laux (2001) also characterizes the optimal wage scheme for a multitask agency problem with $N$ type A projects (with verifiable noisy output signals only), and $M$ type B projects (with verifiable perfect effort observation only). Proposition 1 is more general than Laux’s result: For the $k$ observable tasks in the current setting, the principal not only observes the agent’s effort, but also the noisy output signals. The scheme $\bar{w}''(\theta)$ uses both pieces of information. Moreover, as only supermodularity of $P(\theta|e)$ is essential, the proof of Proposition 1, with minor changes, can be readily applied to similar agency problems with asymmetric and correlated tasks. I thank a referee for bringing Laux’s result to my attention.
References
