The Role of Intermediaries: A Model of Task Monitorability and Incentive Design

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Abstract

The paper proposes an extension of Holmström-Milgrom's multitasking model (1991), which has a principal interacting with an agent who performs multiple tasks, some being harder to monitor than others. The paper considers a framework where the principal cannot directly monitor the agent's actions and thus decides to hire an intermediary to supervise the agent, with the idea that hiring such an intermediary as a monitor will enable better incentive contract design. Leveraging the literature on the skill vs. judgement duality and their respective ease of monitoring, the analysis of the model provides some insights on the design of economic incentives in case of imperfect information, showing that the principal can improve their situation by hiring such an intermediary, provided that the latter has good judgement ability.

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1 Introduction

1.1 Purpose and Approach of Research

In the second half of the twentieth century, microeconomic theory underwent a revolution, namely the characterization of "incentives" as major economic dynamics (Laffont and Martimort 2001). Economists went from treating organizations (such as, for example, firms) as "black box[es]" (Laffont and Martimort 2001, 11; Schumpeter 1954) to recognizing the need for more focus on their internal workings. Indeed, firms, for example, encompass several "members", basically workers and a boss (in the most simple and reduced framework), and they all interact with each other through the intermediary of contracts providing incentives to act a specific way (Williamson, 1975, 1985). A firm can thus be defined as a nexus of contracts between different parties (Jensen and Meckling 1979): workers, employers, shareholders, debtholders, states as regulators, and so on. Incentives are central to this framework.

A major contemporaneous economic question is thus the following: how can one design institutions and organizations in order to effectively provide appropriate incentives for economic agents? Indeed, over the past decades, the emphasis put on incentives also shed light on some "complications". In a principal-agent framework, where an "agent" (for example a worker) takes actions on behalf of a "principal" (for example a boss), it appears necessary to ensure that both actors have similar motivations and objectives as the principal delegates tasks to the agent (Marschak and Radner 1972). On top of this, a fundamental question arises: how can the principal create contracts and design incentives if they only have imperfect information about the agent's skills or motives? (Arrow 1968). Absence of aligned objectives and of perfect information can lead to situations of moral hazard for example, where an agent has incentives to take actions (for example, to increase their exposure to risk) that are not in the best interest of the principal because the agent does not bear the full consequences or costs of those actions (or risk) (Laffont and Martimort 2001).

The underlying reasons why we may have imperfect information are numerous (Arrow 1968), but we will focus here on a specific framework, namely the duality skill-judgement and its ramifications in organizational design settings (Seabright 2000). According to Seabright (2000), there is a fundamental asymmetry or difference between skills and judgement, partly due to the unequal ease of monitoring of both abilities. This duality has consequences on how organizations should be organized because agents can be asked to use one ability or the other: some tasks can be based on skills (for example, agents can be asked to manufacture products in "quantity", which is easy to monitor) and some tasks can be based on judgement (for example, agents can be asked to make strategic decisions, which may be harder to monitor).

Thus, in the context of the major contemporaneous economic question mentioned before (how can one design institutions and organizations in order to effectively provide appropriate incentives for economic agents?), there is a need to design incentives to allocate the agent's efforts across different kinds of tasks

in order to properly align the objectives of the principal and of the agent, as studied by Holmström and Milgrom (1991). According to them, a principal in charge of monitoring an agent engaged in two kinds of tasks (one whose output can be relatively easily measured and one for which it cannot be done) can (paradoxically) worsen the agent's performance by giving them more "high-powered" contracts (i.e. linked to the measurable outcomes of their actions) because it forces them to divert their energy away from the "unobservable tasks" to the "observable tasks".

We propose to extend Holmström-Milgrom's multitasking model (1991) by considering a challenge about mechanism design, which is to think about the following question: how would we design an organization in which the principal has to "monitor" an agent (who does different kinds of tasks) but the former cannot directly observe the agent's actions? We think that hiring an "intermediary" as a monitor can potentially lead to better incentive contract design, since it can enable the principal to palliate the fact that they may not be able to directly and accurately observe or monitor the actions of the agent.

Needless to say, the question of intermediary supervision is a very topical and contemporaneous issue. According to Kropp, Cambon, and Clarkhe (2021), the COVID-19 crisis has pushed for big changes in workers' habits in today's corporate world, with an increasing number of workers now doing remote or hybrid work. It is thus even harder to monitor or assess agents' work from the principal's point of view. These trends may reinforce the need for intermediaries, monitors of some kind.

1.2 Plan of the Paper

This paper is organized as follows: part 2 provides a critical summary of the existing literature on issues related to principal-agent models, to Holmström-Milgrom's model, and to Seabright's skill-judgement duality; part 3 lays out potential extensions of Holmström-Milgrom's multitasking model, as well as a deeper definition of our research topic; part 4 deals with the construction of the model related to our topic; part 5 provides the main results from the model; part 6 concludes this paper.

2 Literature Review

2.1 Towards Holmström-Milgrom's Model

2.1.1 *Principal-Agent Model with Unidimensional Task*

In a basic principal-agent model with unidimensional task (meaning that the agent's output depends on a single task, which does not encompass several subdimensions that could potentially be unequally monitored by the principal), the agent is allowed to make decisions (with respect to this unidimensional task) on behalf of the principal (Laffont and Martimort 2001).

In this simplified unidimensional-task framework, the principal-agent relationship is underpinned by some forms of compensation systems or schemes with the goal of aligning the objectives of both parties as much as possible (Sappington 1991) (if it is not the case, for example, a principal who is willing to maximize overall company's profit could end up "supervising" an agent who is more interested in maximizing their own utility rather than company's profit). Compensation schemes act through two main ways (Sappington 1991; Laffont and Martimort 2001):

- **Allocating Risks:** Compensation schemes can be designed in order to balance risks between both parties, the principal and the agent. For example, if a principal sets a fixed salary for an agent's work, then this compensation system will lead to a low risk level for the agent (because the wage will be the same for them whether they work effectively or not) and a higher risk level for the principal; whereas performance-based compensation will lead to a higher risk level for the agent (who needs to perform well). In theory, the risk should be borne by the party who is better able to manage it (often the principal).
- **Rewarding Productive Work:** Here, the goal is to motivate the agent to work in the principal's best interest.

Thus, we get from this that there is a trade-off between risk and incentive (Stiglitz 1974; Holmström 1979), which economists want to optimally solve. Indeed, the agent finds it costly to provide the work or service, so there is a need for performance-based compensation. But at the same time, performance is often not perfectly measured, so such a compensation scheme will induce some risk on the agent. By risk aversion of the agent, we get the trade-off.

2.1.2 *Principal-Agent Model with Multidimensional Tasks*

In reality, "multidimensional tasks are ubiquitous in the world of business" (Holmström and Milgrom 1991, 25). Unidimensional-task principal-agent model is a big simplification. Tasks are always multidimensional, or at least there are several unidimensional tasks competing for the agent's attention. This is in fact the reason why performance-based compensations are even a thing: the level of compensation relies on a specific metric, but the level of this metric depends on the specific commitment the agent has towards

this specific task versus other competing tasks. However, a major problem is that if the principal only considers some specific tasks for the performance-based compensation, the tasks that are not considered can be neglected by the agent (Holmström and Milgrom 1991).

Let's consider a famous example, namely the debate surrounding potential teachers' incentive pay based on students' grades (Neal 2011; Holmström and Milgrom 1991):

- **In a unidimensional-task setting**, i.e. in a case where we only consider a unique task for the students which is to do an exam, and a unique dimension which is "having good grades", then in this simplistic framework it is easy to defend incentive pay for teachers, because it will push them (and thus their students) to focus exclusively and efficiently on exam preparation. As a consequence, the students have better grades and the teacher has more money.
- **But in a multidimensional-task setting**, i.e. if we introduce a second task for the students, such as the promotion of creative thinking, then such an incentive scheme could be problematic because it could push teachers and students to neglect creative activities.

Thus, in a multidimensional-task setting, there is a need for the principal to design appropriate incentives in order to (better) allocate the attention of the agent **between the tasks**. This also enables us to introduce the issue of measurability or monitorability of tasks, further developed by Holmström and Milgrom (1991).

Holmström and Milgrom (1991) provide us with the following idea: if there is a principal in charge of an agent that is engaged in two kinds of tasks (so there are trade-offs involved), one whose output can be relatively easily monitored or measured and one for which it cannot be done, and if the overall quality of the agent's output depends on both kinds of tasks, then the principal can (paradoxically) worsen their accomplishment by giving them more "high-powered" contracts (i.e. contracts that give more money to the agent based on their performance, thus linked to the measurable outcomes of their actions) because this pushes them to divert their energy away from the "unobservable tasks" to the "observable tasks". Here, this incentive scheme, which focuses on easily observable tasks, would lead to an inefficient allocation of the agent's attention between the different tasks. An incentive scheme must take the trade-offs into account and direct the agent's effort where it is most beneficial.

2.2 Towards an Extension of Holmström-Milgrom's Model

2.2.1 *Preliminaries: Skill vs. Judgement*

The monitorability issue is particularly prevalent in the skill vs. judgement framework studied by Seabright (2000). Indeed, "all economic activities [...] involve some combination of the exercise of judgement and the exercise of skill" (Seabright 2000). However, there are three fundamental differences between skills and judgement:

- **First, there is a difference in the ease of monitoring:** To put it simply, skill is easier to monitor than judgement. An observer does not need to have a specific skill (such as, for example, being a good bricklayer, to reuse Seabright's example (2000)) to observe whether bricks have been laid properly, whereas the observer will usually need to have some knowledge of architecture in order to assess whether the building was designed properly. Therefore, in order to tell whether somebody else has (good) judgement, one needs to have (good) judgement oneself, which is not the case with

skills. It is also usually easier to monitor skill because the output of skill-based tasks is often more visible or tangible, whereas judgement involves making decisions based on "subjective" factors (which are not necessarily visible from an observer's point of view).

- **The second difference lies in the "codifiability" of tasks:** Skill-based tasks are more "codifiable", i.e. one can give an algorithm for correct performance (to put it simply, the task "follows a recipe", it can be broken down into steps that can be followed and evaluated), whereas judgement-based tasks are not (as) "codifiable" (indeed, the tasks may involve nuanced or subjective decision-making rather than clear sets of rules; thus there is no standardization of these judgement-based tasks).
- **Finally, a third dimension of asymmetry lies in the delay before effects are realized.** To put it simply, the outcome of judgement takes time to realize. As a consequence, one usually has to wait before being able to assess whether someone else has had good judgement.

Thus, Seabright's framework (2000) can enable us to further characterize and develop Holmström-Milgrom's trade-off between easy-to-monitor and hard-to-monitor tasks.

2.2.2 *What Does Judgement Consist In?*

In order to further characterize the trade-off, we need to focus our attention on the definition of judgement. We saw previously that judgement is hard to monitor or assess (which could have implications). According to Einhorn and Hogarth (1981), one of the reasons why good judgement is difficult to assess is that many of the processes involved are somewhat unconscious: there is a form of uncodifiability, complexity, subjectivity of judgement. It is not algorithmic. Moreover, as a decision-making process, it is a cognitive activity that involves forming and evaluating perceptions towards several potential choices or options and understanding the likely outcomes of each of them. Judgement could thus be influenced by factors such as biases, personal experiences, context in which some decisions are made, and so on (Likierman 2020).

Moreover, according to Seabright (2000) and Likierman (2020), judging involves giving answers to questions that are not currently verifiable, i.e. giving answers that cannot be verified in the time scale required for the actions, which would be contingent on the answers, to be implemented. For example, the question "Will a specific country invade another specific country in the next ten years?" will only have a definitive answer in ten years by definition. However, we could imagine that if someone clearly explains with several arguments why they think that the invasion will happen, then if I have good judgement I can assess whether the given arguments are sound, even if I cannot observe the outcome. Thus, in order to evaluate judgement, there is a need to elaborate strategies to compensate for the fact that we usually cannot observe the pure outcome (for example, one could focus on the reasoning process).

2.2.3 *How Can One Assess Judgement?*

Judgement may appear to be paradoxical by nature: as seen before (Einhorn and Hogarth 1981), there is a need to call upon opinions and (potentially) past experiences to form judgement, but without being entirely biased by past experiences and personal opinions. Hence, there is a need to develop potential judgement metrics.

Dowding and Thompson (2003) provide us with potential options. The quality of judgement can be assessed or monitored through various methods such as:

- **Criterion-Based Approaches**, where the monitor tries to assess the accuracy of judgement by comparing it with an independent criterion;
- **Inter-Judge Approaches**, where multiple judges compare their respective judgements to examine agreements and disagreements, the latter indicating potential errors;
- **Process-Based Assessment**, where one tries to evaluate the (reasoning) process by which the decision was made, as seen previously.

Thus, there is no standard technique or metric to assess judgement. It relies a lot on comparisons, or on some intermediary (or secondary "observer") that could manage to assess judgement when the actual primary "observer" is not capable to do so, which is an idea we will develop further after. Indeed, if some Holmström-Milgrom's agent (1991) allocates their efforts between easy-to-monitor and hard-to-monitor tasks, how could we make up for the fact that the principal may not be able to (accurately) observe and assess the output of the hard-to-monitor task?

2.3 Previous and Other Extensions of Holmström-Milgrom's Model

First, thought should be given to previous extensions of Holmström-Milgrom's multitasking model. According to Baker (1992; 2002), multitasking implies that the agent needs to allocate effort across different tasks, such that the allocation aligns with the principal's objectives. This creates some challenges (on top of those mentioned by Holmström and Milgrom (1991)) in a framework where tasks are interdependent, especially when the two types of tasks compete for the agent's effort and attention or if the performance measures are not well aligned with the principal's objectives. Holmström (2016, 428) explains the latter very simply. Let's consider that the principal's value is $p_1e_1 + p_2e_2$ and that the performance measure is $g_1e_1 + g_2e_2$ for tasks 1 and 2 (e_1 and e_2). If the vectors p and g are not aligned, for example if the performance measure is $e_1 + e_2$ but the principal's value is only e_1, then "if the principal pushes too strongly on measured performance $e_1 + e_2$ in the hope of getting the agent to work hard on the main task" (Holmström 2016, 428), then the agent will end up working on the second task as well, and the principal will end up "compensating the agent for worthless performance, so misalignment causes waste" (Holmström 2016, 428).

Moreover, according to Tayan (2016), if there is an "excessive" pressure on the agent to perform (well), then this can result in some form of manipulation of performance measures, and agents can end up cheating.

Furthermore, Neal (2011) attempts to find a way to alleviate the tension between easy-to-monitor and hard-to-monitor tasks emanating from Holmström-Milgrom's multitasking model. From Holmström-Milgrom's model (1991), we know that if an agent can do two types of tasks, one being easy to measure (such as routine work) and the other being measured with important noise (such as innovation), and that the agent's output depends on both types of tasks, then providing low-powered incentives on the easy-to-measure task is appropriate as an incentive for innovation. One way to alleviate the tension between routine work and innovation is specialization, i.e. the distribution of specific tasks between specific workers, meaning that the two tasks should be split between two agents: one agent deals with the routine work while another agent specializes in the innovative work (Holmström 2016).

Finally, career concern models (Dewatripont, Jewitt, and Tirole 1999) exhibit the same kinds of visible trends as Holmström-Milgrom's model (1991). Such models study the fact that workers want to be ap-

preciated (for their work), through a "dynamic signaling mechanism" (Holmström 2016, 434): "employers are learning about the value of employees from past performance" (Holmström 2016, 434), and "employees try to make a favorable impression because better performance can lead to [future rewards (such as promotion)]" (Holmström 2016, 434). Firms can leverage workers' motivation by clearly communicating expectations and utilizing key performance indicators to guide and assess performance. However we can see here the same problems as in Holmström-Milgrom's multitasking framework: high-powered career incentives can lead to "wasteful pandering activities" (Holmström 2016, 434; Prendergast 1993). A way to regulate this can be the following: the firm can implement "practices that do not respond to performance as strongly" (Holmström 2016, 434), such as basing promotions on seniority for example.

3 Extending the Model

3.1 Potential Extensions

In Holmström-Milgrom's multitasking model (1991), there is no issue about organizational design and about how the person who monitors the agent (i.e. the principal) is selected. This principal-monitor observes some easy-to-monitor tasks and some hard-to-monitor tasks (with potential errors), and designs some incentive schemes.

However here, we observe that there is potential ground for improvement from the principal's point of view. If we focus on the micro-foundation of such a principal-agent relationship, we can ask ourselves: how could we improve the situation for the principal? Is there a way to alleviate the principal's inability to monitor the second task properly? So we can think of a challenge that is more about mechanism design, which is to think about how we would design an organization in which the principal has to set incentives for some agent, and the latter has to do two kinds of tasks, one being easy to monitor (for example, being "based on skills"; routine work for example) and the other being harder to monitor (for example, being "based on judgement"; taking strategic decisions for example). Here, there is an obvious trade-off between these two kinds of tasks, just like in Holmström-Milgrom's model, and the agent's output depends on both kinds of tasks as seen before. However, the trade-off is underpinned by micro-foundation because it is the principal's challenge to determine whether the agent is exercising judgement or whether they are exercising skills. Let's deepen the characterization of difficult monitorability. Here we consider hard-to-monitor tasks. We saw before that in order to assess the judgement ability of a person, one needs to have (good) judgement oneself, but also needs to develop some strategies or methods to make up for the fact that it may not be possible to accurately observe and assess the output of the hard-to-monitor task.

Thus, we have to think about a way the principal could alleviate their inability to monitor the second task properly. A possibility would be to hire a monitor, who would act as an observer in place of the principal. Potential reasons why the principal could not be in a position to monitor the agent are numerous: for example, the principal may have limited span of control (as an organization grows, the number of workers can exceed the capacity a single boss can effectively oversee); today's firms are geographically dispersed (they can operate across multiple locations in the world so there could be a need for supervisors on site; Lagrosen 2004); but we could potentially imagine some instances in which the principal would also want to hire somebody with better judgement.

It is worth noting some other potential extensions (stemming from Dowding and Thompson's paper (2003) dealing with methods to better assess judgement):

- We saw that we can usually only evaluate judgement with a lag (delay before effects are visible; Seabright 2000; Likierman 2020). This might imply a bias towards recruiting older people for a task, because though agents might tend to be less efficient when they are old, more evidence has

accumulated about their judgement ability.

- Following the inter-judge approaches, we might imagine a model where the principal hires two monitors, and the agent works, but if both monitors agree on the fact that the agent's strategic judgement isn't good, then it can be vetoed.
- The process-based assessment of judgement implies that monitoring judgement is possible but it involves high costs (as well as delay). For example, it is perhaps not enough to look at a candidate's CV, what may need to be done is to interview them over a long(er) period of time and introduce them to several different challenges (and figure out what they do in such situations), in order to assess their judgement ability.

So, as extensions, we could think of what the principal could do to improve their ability to recruit people with good judgement:

- The principal could be biased towards choosing people when they are older or when they have accumulated more experience;
- The principal might need to recruit two distinct monitors or supervisors and look at the concordance of those supervisors' judgements (which is also costly);
- The principal may need to spend more money and time investigating the person (through a longer interview process for example).

3.2 Our Choice of Extension

Here, we will focus on the simple case where the principal hires a single intermediary to monitor the agent. Thus, the goal of our model is to extend Holmström-Milgrom's multitasking model (1991), which has a principal interacting with an agent who performs multiple tasks, some being harder to monitor than others. Our extension is interesting because we believe that there are many circumstances in which the principal cannot (accurately) monitor what the agent is doing (because, for example, the principal might lack time due to multiple other responsibilities, or there can also be too many agents in big companies for the principal to be able to monitor each of them efficiently). Thus, the principal has to not only work out a scheme for monitoring the agent but he also has to decide who is going to implement that scheme, i.e. the principal has to select an intermediary. The underlying idea is that hiring such an intermediary as a monitor will enable better incentive contract design.

The big challenge was to figure out what we meant by "judgement". From the literature review, we can conclude that we expect the intermediary to have "good" judgement, which can be characterized here along two dimensions:

- The intermediary must have incentives that are more closely aligned with the principal;
- And the intermediary can recognize good work as being good work and bad work as being bad work (for example), so the intermediary can assess the judgement capacity of the agent.

Judgement is not "impossible" to monitor, it is rather that fewer people are able to monitor it. Moreover, we are worried about the fact that the agent may make widely wrong strategic guesses even if they are

very good at the routine tasks. Hence, there is a need for a "safeguard", i.e. a monitor or an intermediary. The routine task just requires monitoring, but the second thing is that the intermediary has to look at the strategic choices the agent makes and has to assess them. If the principal appoints an intermediary who has no judgement on the strategic issues, then said intermediary will not be able to do anything to correct or compensate for the bad choices. A bad intermediary would never veto any of the strategic choices made by the agent, or they would veto randomly; whereas a good intermediary would decide to do what the principal would have done if the latter had been able to spend time reviewing the choices of the agent (and assuming the principal has good judgement ability).

4 The Model

In our model, there are three economic actors:

- **An Agent:**
  - The agent can work on **two types of tasks**:
    - Task 1, which is easy to monitor (or, similarly, whose output is easy to measure) for the intermediary, and to which the agent decides to contribute an effort level e_1;
    - Task 2, which is harder to monitor (measuring the output of such a task is done with potential measurement errors), and to which the agent decides to contribute an effort level e_2.
  - The **two tasks are substitutes**: the more effort the agent spends on one task, the higher their marginal cost of spending effort on the other task is.
  - The **agent's utility function** is
    $$U(e_1, e_2, C)$$
    where C is a compensation received for their work.
- **An Intermediary:**
  - The intermediary is chosen by the principal among a pool of potential intermediaries, and they can be **either of the two following qualities**:
    - High quality, with probability q, where they can monitor the agent's effort on task 2 with low (i.e. zero) level of errors;
    - Low quality, with probability $1 - q$, where they cannot (accurately) monitor the agent's effort on task 2.
  - The intermediary **chooses what to report** (r_1 and r_2) to the principal.
  - We assume that a **low-quality intermediary** who fails to observe the effort level on task 2 will mistakenly believe that they have observed the actual effort (after all, people with poor judgement often don't know that they have poor judgement). The low-quality intermediary observes a random realization of either the efficient effort or zero effort.
- **A Principal:**
  - The principal **decides the incentive schemes**.
  - The principal **decides who is promoted as intermediary**. Let's consider that the effort of the principal to observe the quality of the intermediary is f (between 0 and 1). The principal can be **either of the two following qualities** (where $q_H = 1$ and $q_L < 1$):
    - High quality, which makes the probability q of getting a high-quality intermediary equal to $q(f) = q_H \times f$;

* Low quality, which makes the probability q of getting a high-quality intermediary equal to $q(f) = q_L \times f$.

– The **principal's utility function** is

$$V = Y(e_1, e_2) - C - B - f$$

where Y is the payoff of the principal (i.e. the output), C is the payment to the agent, and B is the payment to the intermediary. Since we presumed that the principal cannot directly monitor the agent, then they have to base C and B on what they can observe about the intermediary (i.e. r_1 and r_2).

The progression of events is roughly as follows: 1) The principal decides the incentive schemes; 2) The principal chooses the intermediary; 3) The intermediary will (or won't) observe e_2; 4) The agent chooses the levels e_1 and e_2; 5) The intermediary chooses what to report; 6) The outcomes / payoffs are realized.

5 Solving and Results

The main question we want to answer here is the following: **When can the principal do better (with respect to a baseline case where both the principal and the intermediary exert no effort)?**

5.1 Baseline Case

If the principal cannot monitor the agent and therefore has to pay the agent to do their job without any monitoring, then we can figure out what the baseline effort of the agent would be and thus what the baseline payoff to the principal would be.

- Let's consider a very simple production function $Y(e_1, e_2) = 2e_1 + 2e_2$, a very simple incentive scheme $C(r_1, r_2) = C_0$ (here there are no r_1 nor r_2 because there is no monitoring, so we can assume that C would be minimal and constant because the principal minimizes wage costs and there is no verifiable performance), and a very simple cost of effort function $Cost(e_1, e_2) = \frac{1}{2}(e_1^2 + e_2^2) + e_1 e_2$ (for substitutability of tasks).

- Since the principal and the intermediary exert no effort in monitoring the agent's actions, then the agent might act in a way to maximize his own utility with minimum effort, given that the effort costs are not counterbalanced by precise reward mechanisms from monitoring. Given the agent's utility function $U(e_1, e_2, C)$ and in absence of monitoring, the agent will minimize e_1 and e_2 to reduce the effort cost. The utility maximization problem simplifies to $\max_{e_1,e_2}[U(e_1, e_2, C) = C_0 - (\frac{1}{2}(e_1^2 + e_2^2) + e_1 e_2)]$. The FOCs are $\frac{\partial U}{\partial e_1} = -e_1 - e_2 = 0 \implies e_1 + e_2 = 0$ and $\frac{\partial U}{\partial e_2} = -e_2 - e_1 = 0 \implies e_1 + e_2 = 0$. So in a situation of no monitoring, we would have $e_1 = e_2 = 0$.

- The principal's utility function is $V = Y(e_1, e_2) - C - B - f = Y(0, 0) - C_0 - 0 - 0 = -C_0$ (because $B = 0$ since the intermediary doesn't monitor so they are not paid, and $f = 0$ because the principal doesn't do any effort; it makes no difference whether we assume that there is no intermediary or that the intermediary is hired but is not expected to do any work).

This analysis suggests that in the absence of monitoring, the agent will exert no effort ($e_1 = e_2 = 0$), and the principal will not earn any payoff ($Y = 0$) and their utility is $V = -C_0$. This is inefficient, highlighting the potential importance of effective monitoring.

5.2 Monitoring Case

To answer the main question, we can go through potential intermediary questions: What does the agent have to be offered in order to be willing to exert some effort other than the baseline effort? What is necessary to get the agent to do the optimal effort? What will it cost the principal to do this? How much should the principal invest in effort to try to get a high-quality intermediary in order to make this possible?

5.2.1 *Efficient Effort of the Agent*

- To find the efficient level of effort for the agent, we need to solve the agent's utility maximization problem: the agent's goal is to choose effort levels e_1 and e_2 that maximize their utility, while taking into account the costs of these efforts and the compensation they receive.

- Let's consider a very simple production function $Y(e_1, e_2) = 2e_1 + 2e_2$, a very simple linear incentive scheme $C(r_1, r_2) = r_1 + r_2$, and a very simple cost of effort function $Cost(e_1, e_2) = \frac{1}{2}(e_1^2 + e_2^2) + e_1e_2$ (for substitutability of tasks).

- The agent's utility function is given by $U = C(r_1, r_2) - Cost(e_1, e_2) = e_1 + e_2 - (\frac{1}{2}(e_1^2 + e_2^2) + e_1e_2)$ (because $C(r_1, r_2) = e_1 + e_2$ here, because we can restrict ourselves to the high-quality intermediary case, because a high-quality intermediary is capable of accurately monitoring both tasks which ensures that the reports on the agent's effort levels (r_1 and r_2) are reliable; we thus capture the best-case scenario in terms of organizational efficiency here).

- The FOCs are $\frac{\partial U}{\partial e_1} = 1 - e_1 - e_2 = 0 \implies e_1 + e_2 = 1$ and $\frac{\partial U}{\partial e_2} = 1 - e_2 - e_1 = 0 \implies e_1 + e_2 = 1$. So we have $e_1 + e_2 = 1$. If we assume symmetry due to the similar form of their influence in the production and cost functions, we can set $e_1 = e_2$. And thus $e_1 = e_2 = \frac{1}{2}$.

To determine the least costly contract that can induce the agent to exert the efficient level of effort $e_1 = e_2 = \frac{1}{2}$, we must consider both the compensation scheme and the cost of effort. The goal is to ensure that the compensation is just enough to offset the cost of the effort, thus motivating the agent to exert the desired effort while minimizing the cost to the principal.

- Given $e_1 = e_2 = \frac{1}{2}$, the total cost of effort is $Cost(\frac{1}{2}, \frac{1}{2}) = \frac{1}{2}\left(\left(\frac{1}{2}\right)^2 + \left(\frac{1}{2}\right)^2\right) + \left(\frac{1}{2}\right)\left(\frac{1}{2}\right) = \frac{1}{2}\left(\frac{1}{4} + \frac{1}{4}\right) + \frac{1}{4} = \frac{1}{2}$.

- The compensation must at least match the cost of effort: $C \geq \text{Cost}(\frac{1}{2}, \frac{1}{2}) = \frac{1}{2}$. But we know that $C = e_1 + e_2 = \frac{1}{2} + \frac{1}{2} = 1$. Thus the least costly contract that effectively induces the agent to exert the efficient level of effort, while covering the cost of those efforts, would be $C = 1$.

5.2.2 *Introducing the Intermediary*

To simplify the framework, we will consider here an adverse selection model (i.e. there are different intermediaries with different abilities to monitor as explained in the model section, which the principal has to figure out), we just assume that the intermediary observes (a signal about) the two tasks and then their only function is to transmit the signals. This is the simplest model where the intermediary is like a robot and the principal's choice is just about how to figure out what is a good quality robot. The uncertainty in the model comes from the fact that the principal does not know whether they have a high- or low-quality intermediary. This simple framework enables us to set $B = 0$: as a robot, we can assume that the intermediary does not need to be incentivized to monitor and report. The high-quality intermediary will automatically report $r_1 = e_1$ and $r_2 = e_2$, and the low-quality intermediary will report $r_1 = e_1$ and $r_2 =$ a random realization of either the efficient effort or zero effort.

5.2.3 *The Principal*

To summarize, the efficient effort of the agent is $e_1 = e_2 = \frac{1}{2}$ and compensation is $C = 1$ (in the best case of a high-quality intermediary); the intermediary has no compensation so

$B = 0$**; and the principal has utility** $V = Y(e_1, e_2) - C - B - f = 2 - 1 - 0 - f = 1 - f$**. We are now wondering how much the principal should invest in effort** f **to try to get a high-quality intermediary in order to make this situation possible.**

- We need to consider how f influences both the likelihood of getting a high-quality intermediary and the principal's overall utility. Moreover, just like for the intermediary, and because people with poor judgement might not realize that they have poor judgement, we assume that the principal does not know their own quality.
- If the principal is of high quality, then $q(f) = q_H \times f$ with $q_H = 1$. If the principal is of low quality, then $q(f) = q_L \times f$ with $q_L < 1$ (in this case, the principal's effort f is less effective at increasing the probability of securing a high-quality intermediary).
- Given the fact that the principal may not know their own quality, they need to consider a weighted average of the two scenarios: $q(f) = \alpha \times q_H \times f + (1 - \alpha) \times q_L \times f$ where α is the subjective probability (or belief) that the principal is high quality. To simplify, we assume that $\alpha = \frac{1}{2}$, so we have $q(f) = \frac{1}{2} \times f + \frac{1}{2} \times q_L \times f = \frac{f(1+q_L)}{2}$.
- To choose the optimal f, the principal should maximize their expected utility by setting f such that the marginal cost of increasing f (the reduction in utility V) is justified by the corresponding increase in the probability of securing a high-quality intermediary.
- Let's consider a threshold probability π that reflects the minimal acceptable level of confidence in having a high-quality intermediary. We have $\frac{f(1+q_L)}{2} = \pi$ so $f = \frac{2\pi}{1+q_L}$. This f represents the effort level required to achieve the desired confidence level in the quality of monitoring.
- *Let's just consider one sample application. Let's assume that* $q_L = 0.5$ *(meaning that for an effort level* f*, the high-quality principal will have a probability* f *of securing a high-quality intermediary, whereas a low-quality principal will only have a probability* $\frac{f}{2}$ *of securing one) and that* $\pi = 0.9$ *(desired 90% confidence in high-quality monitoring). We get* $f = \frac{2 \times 0.9}{1+0.5} = \frac{1.8}{1.5} > 1$ *which is impossible. Thus for a framework where* $q_L = 0.5$*, it is impossible for the principal to exert an effort level capable of achieving the desired 90% confidence level in the quality of monitoring (at most,* $\pi = 0.75 = 75\%$ *when the principal exerts maximum effort* $f = 1$*).*

6 Conclusion

To sum up, on the one hand, in the absence of monitoring (baseline case):

- The agent will exert no effort ($e_1 = e_2 = 0$);
- And the principal will not earn any payoff ($Y = 0$), and their utility is $V = -C_0$.

On the other hand, if the principal hires an intermediary to monitor the agent, then in the specific framework developed previously:

- The efficient level of effort of the agent is $e_1 = e_2 = \frac{1}{2}$;
- The least costly contract that can induce the agent to exert this efficient level of effort is to give the agent a compensation $C = 1$;
- Here the intermediary has no compensation so $B = 0$;
- The principal has utility $V = 1 - f$;
- And $f = \frac{2\pi}{1+q_L}$ represents the effort level required to achieve the desired confidence level (π) in the quality of monitoring, in the case where the subjective probability (or belief) that the principal is high quality is $\alpha = \frac{1}{2}$.

We can see here that the principal can do better with respect to the baseline case. Indeed, we have $V_{monitoring\ case} = 1 - f \geq 0 \geq -C_0 = V_{baseline\ case}$. However, this improved situation (with an agent doing efficient levels of effort) relies on the assumption that the intermediary is high quality. In order to reach this improved state of the world, the principal has to invest in effort to increase the probability of getting a high-quality intermediary, which isn't certain. But investing in effort f creates greater cost for the principal. So the latter has to balance the greater (but non certain) opportunity of getting a high-quality intermediary through effort investment with the cost of the effort investment. For example, in the previous sample application where $q_L = 0.5$, the principal (who doesn't know their own quality) can have at most a 75% chance (when the principal exerts maximum effort $f = 1$) of getting a high-quality intermediary to reach the efficient state of the world. If the principal exerts $f = 1$ and is lucky enough to get a high-quality intermediary, the principal's utility will be $V_{monitoring\ case} = 1 - f = 0$ which is still better than $V_{baseline\ case} = -C_0$. But the principal could also decide to take more risk and lower f, which will increase $V_{monitoring\ case}$ above 0 if they are lucky enough to get a high-quality intermediary. Further analysis of the model should focus on the fact that the principal could end up with a low-quality intermediary who would only provide partial, incomplete, random monitoring.

Finally, the extension of Holmström-Milgrom's multitasking model (1991) provides some insights on the following major economic questions: How can one design organizations in order to effectively provide appropriate incentives for economic agents? How can the principal create contracts and design incentives if they only have imperfect information about the agent's skills, motives, abilities, efforts and so on? (Arrow

1968). The duality skill-judgement provides some insights on the reasons why we may have imperfect information, and it enables us to focus on a specific framework related to the crucial notion of monitorability of actions (Seabright 2000). As Holmström and Milgrom (1991) showed, the question of the intrinsic monitorability of tasks is crucial for effective incentive design, but we add a layer of understanding by also considering the economic actors' intrinsic ability to monitor such tasks, and how they reflect on their (in)ability to do such monitoring: indeed, Holmström-Milgrom's hard-to-monitor task is not necessarily intrinsically hard to monitor, it is just that only some people can monitor it accurately (high-quality vs. low-quality intermediaries). As we showed in the literature review, judgement abilities play a crucial role in the monitoring ability of the intermediary and of the principal as only people with (good) judgement can accurately monitor and assess (good) judgement, hence the active search for high-quality intermediaries on part of the principal. Effective judgement assessment and monitoring is important because any agent may make widely wrong strategic guesses even if they are very good at the routine tasks, which highlights the need for a "safeguard" (an intermediary) who can look at the strategic choices the agent makes and assess them. Finally, the model's insights highlight the overall importance of monitoring the agent's actions to palliate the drawbacks caused by incomplete information.

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