Moral Hazard

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2015-01-01

1. Introduction

In general terms, moral hazard arises when the value of a transaction for one party can be influenced by actions or decisions taken by the other party. Two additional conditions are required for the problem of moral hazard to occur:

- Hidden action: This action is not directly observable or perfectly inferable by the party whose results are affected.
- Risk aversion: At least one of the parties must be risk-averse.

The essence of the moral hazard problem lies in the conflict between two fundamental objectives:

- Provision of adequate incentives
- Efficient risk distribution

There is a substitution effect: the extent to which one party is shielded from risk influences their incentives to take actions that are efficient for the other party.

The challenge is to design an incentive mechanism that minimizes cost, in terms of the optimal contract seen in the previous unit.

2. A Simple Moral Hazard Model

Let's assume that a company (principal) hires a manager (agent) responsible for running the business. The company's outcomes depend on both random factors (uncertainty) and the manager's effort. To simplify, assume the effort can be either high (A) or low (B), and the company's outcomes can either be success (E) or failure (F). The company's profit in the success scenario is \$360, and in the failure scenario, it is \$200. The probability of success is 75% with high effort and 25% with low effort.

Therefore, the expected profit of the principal when effort is high is:

[360 $\times$0.75 + 200 $\times$0.25 = 320]

And when the effort is low:

[360 $\times$0.25 + 200 $\times$0.75 = 240]

This can be summarized in the following table:

	High Effort	Low Effort
Success	75%	25%
Failure	25%	75%
Result	320	240

We assume that the principal seeks to maximize the expected value of their net profits (expected value minus the payment to the agent). The principal is assumed to be risk-neutral.

The agent, on the other hand, aims to maximize an expected utility function of the form:

[U = U(w) - v(e)]

Where (U(w)) is the utility of the payment received (remuneration), and (v(e)) is the cost of effort (e).

We can distinguish four possible cases:

1. Observable effort, risk-neutral agent
2. Non-observable effort, risk-neutral agent
3. Observable effort, risk-averse agent
4. Non-observable effort, risk-averse agent

2.1 Observable Effort, Risk-Neutral Agent

Let's assume an agent with a utility function (U = w - v(e)), and a reservation utility of (U = 81). The costs of effort are (v(B) = 0) and (v(A) = 63). (The numbers are arbitrary and chosen to facilitate later comparisons).

If the principal settles for low effort, they offer the agent (w = 81). The expected profit for the principal is 240, and the net benefit is (240 - 81 = 159).

If the principal wants to ensure high effort, the agent's remuneration must cover the disutility of effort, i.e., (81 + 63 = 144). The net profit for the principal in this case is (320 - 144 = 176).

Thus, for the principal, the best alternative is to offer a fixed payment of 144 and obtain an expected profit of 176.

2.2 Non-Observable Effort, Risk-Neutral Agent

Now, consider the case where the effort is non-observable but the agent is risk-neutral. In this case, the conflict between incentives and risk distribution is easily resolved. Since the agent is risk-neutral, the absolute priority is on the incentive system. The most effective way to provide incentives is to make the agent bear all the consequences of their decisions.

The contract cannot depend on effort because effort is neither observable nor verifiable. However, results such as profits are observable. Therefore, the principal can exploit the correlation between effort and profits to incentivize the agent. The principal will pay (X) in case of success (E), and (Y) in case of failure (F). This introduces uncertainty for the agent.

The principal can induce high effort by offering the agent a contract characterized by (W_E) and (W_F), with the following requirements:

1. **Individual Rationality**: The utility for the agent must be greater than their reservation utility.
2. **Incentive Compatibility**: The utility of exerting high effort must be greater than the utility of low effort, i.e., (EU(A) > EU(B)).

In our example, the constraints can be expressed as:

[0.75 W_E + 0.25 W_F - 63 > 81] [0.75 W_E + 0.25 W_F - 63 > 0.25 W_E + 0.75 W_F]

The optimal contract in this case involves:

[W_E = 184,   W_F = 24] ## 2.3 Observable Effort, Risk-Averse Agent

Now, let's examine what happens when we have a risk-averse agent. For example, assume the utility function (U = W^{1/2} - v(e)), where (v(A) = 3) and (v(B) = 0), and the reservation utility is (U = 9).

To induce low effort, it is sufficient to offer a fixed salary that yields a utility level equal to or greater than the reservation utility. The principal's expected net profit is (240 - 81 = 159).

To induce high effort, the agent needs to be compensated for the additional disutility of the high effort. This can be achieved with a fixed salary of 144, conditioned on high effort (since in this case, effort can be observed). Thus, the expected net profit for the principal is (320 - 144 = 176), higher than the profit for low effort (though it may not always be optimal to pay for high effort).

In this case, the agent's risk aversion does not pose a problem since there is no uncertainty involved. The agent's action and payment are not contingent on the state of nature. All the uncertainty falls on the principal. Additionally, if the agent has bargaining power, they could negotiate up to 161 for high effort (we will explore this through Edgeworth box representation).

2.4 Non-Observable Effort and Risk-Averse Agent

The lack of observability of effort introduces the alternative of making remuneration contingent on outcomes, which are correlated with effort, or abandoning variable compensation altogether. This is where the main conflict arises:

- **Efficient Risk Distribution**: As discussed earlier, the neutral party (the principal) should bear all the risk, while the risk-averse party (the agent) remains on the certainty line.
- **Incentive Problem**: For proper incentives, the agent must perceive differences in remuneration based on their effort level.

The challenge is to find the optimal balance between incentive provision and risk distribution. In the case of a risk-neutral agent, this was not a significant issue, as simply transferring residual control to the agent solved the problem. However, in this case, any variable compensation scheme must compensate the agent for the risk they assume.

We retain the utility function and parameters from the previous section.

If the principal desires low effort, a fixed salary of 81 is sufficient.

However, to incentivize high effort, the contract with ($w = 144$) will no longer suffice because effort is not observable, and uniform wages provide an incentive to cheat by exerting low effort.

The contract that induces high effort must meet both the individual rationality and incentive compatibility constraints, expressed as:

[$0.75U(W_E) + 0.25U(W_F) - 3 > 9$] [$0.75U(W_E) + 0.25U(W_F) - 3 > 0.25U(W_E) + 0.75U(W_F)$]

The second constraint can be written as:

[$0.5[U(W_E) - U(W_F)] > 3$]

This captures the difference in utilities associated with the remuneration in each state, ensuring that high effort is chosen over low effort.

It is useful to express remuneration in terms of utility, such that ($X_E = U(W_E)$) and ($X_F = U(W_F)$).

The constraints are now written as:

[$0.75 \times X_E + 0.25 \times X_F = 12$] [$X_E - X_F = 6$]

From this, we obtain ($X_E = 13.5$) and ($X_F = 7.5$), so that ($W_E = 182.25$) and ($W_F = 56.25$). The expected cost of the contract for the principal is ($0.75 \times 182.25 + 0.25 \times 56.25 = 159.75$), leaving them with an expected net benefit of ($320 - 159.75 = 169.25$).