MORAL HAZARD

- Hidden action
- Post-contractual opportunism
- EXAMPLES:
- In the insurance transaction: the insurance company which sells a fire insurance would like the insured to "take care" of the house, building, etc. that has been insured, for instance keeping fire extinguisher on hand…
- Job transaction: the employer would like the employee to work hard at the tasks that are set to the employee

Problems due to the presence of asymmetric information are not about the different qualities of the goods exchanged, which instead are assumed to be homogenous

BUT:

- The presence of asymmetric information doesn’t allow the control of the actions, during the execution of the transaction

$\Rightarrow$The quality of goods and service, even if potentially homogeneous can be influenced by actions that can’t be observed!!!

- Perfect monitoring and enforcement may be impossible, and hence the transaction might be structured so that the party taking the action has relatively GREATER incentive to act in a way the other party prefers

In the case of the fire insurance, the insurance company may decide not to cover all the damage caused by fire, leading so the insured to take care, at least partially of the goods insured.

- There is an evident trade-off between the behavior of “taking care” and the insurance coverage.
- The more the insurance, the less will be the “care” of the insured.
- If the insurance coverage is zero, the care of the agent will be extreme
- If the insurance coverage is total, the care of the agent will be zero.
- With a partial insurance coverage, part of the effects of not taking care will fall upon the agent.

In job transactions

Wages linked to:

- Output (piecework)
- Sales
- Productivity increase (productivity bonus)
- Profits

Two conditions co-exist to have moral hazard problems:

1. Conflict of interests between the two parties of the transaction
2. Asymmetric information

PRINCIPAL AGENT MODEL

Any transaction between two parties in which the welfare of one of two parties (THE PRINCIPAL) depends on the actions and/or decisions of the other party (THE AGENT)

We consider a job transaction in which:

- Principal → employer
- Agent → employee

We consider:

- 1 Principal who hires just
- 1 Agent to perform some task

And the task will imply the maximization of her objective function (profits)

Three steps of the transaction between P and A:

I. **P offers A a contract** that the agent can accept or refuse (no re-contracting is allowed)

II. **A decide whether to accept or to refuse** the contract comparing the utility he will get from the contract with his reservation level of utility, U_R (the utility he gets from his next best opportunity)

III. If the utility A gets from the Principal's proposal is greater than $U_R \rightarrow$ the **agent** accepts the contract and **maximizes his own objective function** and not the principal's one

The contract the principal offers the agent must be such that:

- The agent will accept the contract

AND

- The agent will behave to maximize principal's benefit

We will distinguish two situation:

- Perfect information: the principal can directly observe the agent's effort (not only his productive results)
- Asymmetric information: the principal can observe just the agent's productive results (and not his effort)

Assume that:

- 1 principal
- 1 agent

And just two levels of effort:

- High effort → $\boldsymbol{e^H}$
- Low effort → $\boldsymbol{e^L}$
- Agent's reservation level of utility = U_R

Agent:

Perceives:

- utility from wage = w

and

- disutility from the cost of effort = $C(e)$

Assume that:

If the agent accepts the contract he has two possible actions at his disposal:

- Action H, which requires high levels of effort → e^H
- Action L, which requires low levels of effort → e^L

And the cost the agent has to bear for the two actions is:

$$C(e^H)$$

And

$$C(e^L)$$

With:

$$C(e^L) < C(e^H)$$

But:

Agent's outcome depends not only on his efforts but also on random variables that concern:

- exogenous events (the client who has a heart-attack and dies just before signing the sale contract)
- events linked to the agent but that are not under his control (agent's illness)

$\Rightarrow$A given level of effort won't get a given certain outcome BUT just a distribution of outcomes

However,

- agent's effort influences the probability associated to each outcome.

Assume three possible outcomes to the interaction between the agent and the client:

- The client can decide to place no orders (y_0=0)
- The client can decide to place an order of the value of 100$ (y_1=100)
- The client can decide to place an order of the value of 400$ (y_2=400)

1. If the agent works hard with a level of effort $\boldsymbol{e^H}$,

- a 400$ sale results with probability $p_2^H = 0.6$
- a 100$ sale results with probability $p_1^H = 0.3$
- a 0$ sale results with probability $p_0^H = 0.1$

2. If the agent doesn't work hard with a level of effort $\boldsymbol{e^L}$,

- a 400$ sale results with probability $p_2^L = 0.1$
- a 100$ sale results with probability $p_1^L = 0.3$
- a 0$ sale results with probability $p_0^L = 0.6$

- The principal's objective is to maximize her expected profits:

$$E(\pi) = E(R(y(e))) - E(w)$$

- The agent's objective is to maximize his expected net utility:

$$E(U) = E(\sqrt{w}) - C(e)$$

1. Conflict of interests between the two parties of the transaction:

- ***w*** is a benefit for the agent and a cost for the principal
- ***e*** is a benefit for the principal and a cost for the agent

2. the shape of agent's utility function: $\sqrt{w}$

actually we have assumed:

- risk neutral principal
- risk averse agent

Assume:

- $U_R = 9$ \$
- $C(e^H) = 5$ \$
- $C(e^L) = 0$ \$

Principal:

- If effort= $\boldsymbol{e^H}$
- Her expected revenues are:

$$E(R) = \sum_{i=0}^{2} p_i^H y_i$$

E(R) = 0.1(0) + 0.3(100) + 0.6(400) = 270$

- If effort= e^L
- Her expected revenues are:

$$E(R) = \sum_{i=0}^{2} p_i^L y_i$$

E(R) = 0.6(0) + 0.3(100) + 0.1(400) = 70$

I CASE PERFECT INFORMATION

- Agent's action (effort) is VISIBLE to the principal

P wants to incentivize A to work hard

1. P offers the agent a wage high enough so that:

- A accepts the contract and
- A is compensated for the high effort P wants to get from him:

$$\sqrt{w} - C(e^H) \geq U_R$$

$$\sqrt{w} - 5 \geq 9$$

$$\sqrt{w} \geq 14$$

$$w \geq 196\$$$

1. P could write a contract that offers the agent197$ (>196) for performing his task and trusts the agent will effectively work hard (e^H)

- Agents are opportunistic

$\Rightarrow$if P offers such <u>fixed fee contract</u> we assume that the agent will take the money, will give low effort, and will leave P paying 197$ for a task that is worth for her just 70$!!!

2. Wage is dependent on the agent's effort (which is visible to P): $w(e)$.

- Which is the contract?

- How much $w(e^H)$ and $w(e^L)$?

The contract is the solution to the following optimization problem:

$$\underset{w(e^H)}{Max}\ E(\pi) = \sum_{i=0}^{2} p_i^H y_i - w(e^H)$$

s.t.

$\sqrt{w(e^H)} - C(e^H) \geq U_R$ → **participation constraint**

$\sqrt{w(e^H)} - C(e^H) \geq \sqrt{w(e^L)} - C(e^L)$ → **incentive compatible constraint**

- **participation constraint**: the agent must be willing to accept the contract and hence the net utility he perceives from the contract, working hard, with high effort, is greater than or at least equal to his reservation utility.
- **Incentive compatible constraint:** the agent HAS to choose the higher effort and hence the net utility he perceives working hard is greater (or at least equal to) than the net utility he perceives working less (with low effort)

$$\underset{w(e^H)}{Max}\ 270 - w(e^H)$$

s.t

$$\sqrt{w(e^H)} - 5 \geq 9$$

$$\sqrt{w(e^H)} - 5 \geq \sqrt{w(e^L)} - 0$$

$$L = 270 - w(e^H) + \lambda(\sqrt{w(e^H)} - 14) + \mu(\sqrt{w(e^H)} - 5 - \sqrt{w(e^L)})$$

Solving for first order conditions:

$$\frac{\partial L}{\partial w(e^H)} = 0$$

$$\frac{\partial L}{\partial \lambda} = 0$$

$$\frac{\partial L}{\partial \mu} = 0$$

We get:

$w(e^H)$ = 196$** **$w(e^L)$ = 81$

BUT

- Since the agent's work when e= $\boldsymbol{e^L}$ is worth for the principal only 70\$, she will never accept to pay 81\$, but :

  $\boldsymbol{w(e^L) \leq 70\$}$

- CONTRACT P→A:
- If $\boldsymbol{e = e^H \rightarrow w(e^H) = 196\$}$

- If $\boldsymbol{e = e^L \rightarrow w(e^L) = 69\$}$

Agent's utility

- If $\quad$ ***e= e^H^***

  Agent's net utility will be:

  $$\sqrt{196}-5=14-5=9=U_R$$

- If ***e= e^L^***

  Agent's net utility will be:

  $$\sqrt{69}-0=8.3<U_R$$

$\Rightarrow$the agent shouldn't accept the contract if he is willing to work with $\boldsymbol{e= e^L}$

Principal's expected profits:

- **If** $e = e^H$ **:**

  $E(\Pi(e^H)) = 270 - 196 = 74\$$

- **If** $e = e^L$ **:**

  $E(\Pi(e^L)) = 70 - 69 = 1\$$

$\rightarrow \quad E(\Pi(e^H)) > E(\Pi(e^L))$

- **When Wage is contingent upon the agent's effort (which is visible to P):**
- **No agent will accept the contract if he is willing to supply e^L, but only the agents that are willing to work hard (e^H) will accept the contract**
- **What P has done is to get the agent to internalize the effect of his effort decision**

II CASE ASYMMETRIC INFORMATION

- Agent’s action (effort) is not visible to the Principal.
- Hence, the principal cannot link the agent’s wage directly to his level of effort.
- P must find some indirect measure of effort which is observable and to which wages can be linked.
- P assumes that there is a probabilistic relationship between level of effort and level of sales
- The size of the sales are observable and the agent’s wage can be made contingent upon these variables (outcome).

Which is the optimal contract that P can offer A, such that:

- A accepts the contract;
- A will work hard (***e= e^H***)

Imagine the contract P offers A is such that:

- $w(y_0) = a_0^2$ if no sales
- $w(y_1) = a_1^2$ if sales=100$
- $w(y_2) = a_2^2$ if sales=400$

$\Rightarrow$Wage is contingent upon the productive outcome that is an observable *signal* of the not observable agent's effort

The contract that P offers A is the result to the following optimization problem:

P looks for a minimum wage to pay to the agent, that maximizes her expected profits in the best case (that is when the effort is high):

$$\underset{w(y_i)}{Max}\, E(\pi) = \sum_{i=0}^{2} p_i^H y_i - \sum_{i=0}^{2} p_i^H w(y_i)$$

s.t.

$$\sum_{i=0}^{2} p_i^H \sqrt{w(y_i)} - C(e^H) \geq U_R$$

$$\sum_{i=0}^{2} p_i^H \sqrt{w(y_i)} - C(e^H) \geq \sum_{i=0}^{2} p_i^L \sqrt{w(y_i)} - C(e^L)$$

$$\underset{a_0, a_1, a_2}{Max}\ 270 - [0{,}1a_0^2 + 0{,}3a_1^2 + 0{,}6a_2^2]$$

s.t.

$$0{,}1\sqrt{a_0^2} + 0{,}3\sqrt{a_1^2} + 0{,}6\sqrt{a_2^2} - 5 \geq 9$$

$$0{,}1\sqrt{a_0^2} + 0{,}3\sqrt{a_1^2} + 0{,}6\sqrt{a_2^2} - 5 \geq 0{,}6\sqrt{a_0^2} + 0{,}3\sqrt{a_1^2} + 0{,}1\sqrt{a_2^2} - 0$$

$$L = 270 - [0{,}1a_0^2 + 0{,}3a_1^2 + 0{,}6a_2^2] +$$
$$+ \lambda(0{,}1a_0 + 0{,}3a_1 + 0{,}6a_2 - 14) +$$
$$+ \lambda(0{,}1a_0 + 0{,}3a_1 + 0{,}6a_2 - 14) +$$

Solving for first order conditions:

$$\frac{\partial L}{\partial a_0} = 0 \qquad \frac{\partial L}{\partial a_1} = 0 \qquad \frac{\partial L}{\partial a_2} = 0 \qquad \frac{\partial L}{\partial \lambda} = 0 \qquad \frac{\partial L}{\partial \mu} = 0$$

We get:

$w(y_0) = a_0^2 = 30$ if no sales

$w(y_1) = a_1^2 = 194$ if sales=100$

$w(y_2) = a_2^2 = 239$ if sales=400$

to assume a probabilistic relationship between output and effort

- if $e=e^H$:

  A will get :

  $w(y_0) = a_0^2 = 30$ with $p_0^H = 0{,}1$

- if $e=e^L$:

  A will get :

  $w(y_0) = a_0^2 = 30$ with $p_0^L = 0{,}6$

Principal’s expected profits

- ***e=e^H***

    the expected costs:

$$\sum_{i=0}^{2} p_i^H w(y_i) = 0{,}6(239) + 0{,}3(194) + 0{,}1(30) = 204{,}6\$$$

$$E(\pi(y(e^H))) = 270 - 204{,}6 = 65{,}4\$$$

with perfect information, principal’s expected profit was:

$$E(\pi(e^H)) = 73\$$$

P’s expected profit decreases in the case of wage contingent upon output

Agent’s expected utility

- ***e=e^H^***

$$\sum_{i=0}^{2} p_i^H \sqrt{w(y_i)} - C(e^H) = 0{,}6(15{,}5) + 0{,}3(13{,}9) + 0{,}1(5{,}5) - 5 = 9$$

with perfect information, agent’s expected utility was:

$$E(U(e^H)) = 9\$$$

A’s expected utility in the case of wages contingent upon output doesn’t increase.

THERE IS A LOSS OF WELFARE

***Second best* solution**

Why?

With

- Risk neutral principal and
- Risk averse agent

$\Rightarrow$ The optimal solution would be the one with **fixed fee contract**

Why?

- In general, if one party to a transaction is risk averse and the other is risk neutral, then it is efficient for the risk neutral party to bear all the risk!

- If the principal pays the agent a random wage, he evaluates the wage according to his expected value. Being risk averse, the agent values any random wage less than its certain value.
- On the other hand the principal, being risk neutral, values the cost of the wages paid at their certain value.
- With fixed wage:

$\Rightarrow$P doesn’t worsen her situation, A instead improves it.

- On the other hand, if we give the agent a riskless wage, the agent has no incentives to work hard .
- And if the agent doesn’t work hard, the principal doesn’t want to enter the transaction
- To induce the agent to work hard we have to give up some of the efficiency that is obtained putting all the risk on the principal.
- There is a trade-off between efficient repartition of risk and incentives to effort.

With incentivizing contract part of the risk has to be borne by the agent.

It is necessary to give him a reward in the case of high level of sales, outcome whose probability increases if effort is high :

$$a_2^2 = 239$$

This reward has no incentivizing aim, it is just to induce the agent to accept the contract

1 Principal and N agents

Agent's wage can't be contingent upon his own output, but upon the team's output as a whole.

Free riding problems

- Against the higher effort 1 agent has to give, the higher wage he will receive will be not proportional on the increases of output linked to his own effort:

  $w=f(\Delta y)$

  but just on 1/N of such increase:

  $w=1/N\ f(\Delta y)$

- against the reduction of his own effort the reduction in his wage will be of just ***1/N f(Δy).*** that is the reduction of output will be shared among all the participants to the team.

$\Rightarrow$All the agents can be induced to adopt a free riding behavior

How can free riding problem be solved?

- In the case that the single agent’s action is visible to the other team participants (even if still not visible to the principal), penalty mechanism may arise among the participants against the free riders (*peer pressure*),

- In the case that the job transaction is repeated among the same parties for many periods of time, the rewards the single agent may receive from his free rider behavior today may be overwhelmed by the punishment he will receive in the future by the other participants to the team

individual contribution to output is distinguishable from the other's contributions

- The others' productive outcome may even improve principal's information.
- In fact, if the agents have similar tasks, the outcome of the other (N-1) agents may reveal information on the magnitude of the exogenous events and hence on the level of effort of the single agent.

Multitask in P-A Analyses

Holmstrom, B., Milgrom, P. (1991), Multitask Principal-Agent Analyses: Incentive Contracts, Asset Ownership, and Job Design, *Journal of Law Economics and Organization*, 7, 24-52

Usually, an employee's job consists of many tasks.

Workers in the marketing area of a firm have many tasks:

- New business;
- Costumer assistance
- Gathering information and data on the competitors’ activities

The task that is easier to control is the first one, since it is directly linked to sales.

Also the other tasks are relevant for the firm’s returns, but they are difficult to control.

The employer would like the agents to fairly allocate their efforts among these different tasks.

- But what kind of contract may be used to incentivize agents' effort?
- If the employer decides to give the agents a wage dependent on the sales, the agents might decide to use all their efforts in performing only the first task.

Principle of equal compensation:

If an agent can allocates his effort between two (or more) tasks and if this allocation is not visible to the principal, the marginal benefit the agent perceives from the two tasks must be identical, otherwise he will devote harder work to the task that gives him higher benefits.

$\Rightarrow$Equal compensation for different tasks.