

ASYMMETRIC INFORMATION: MORAL HAZARD; PRINCIPAL-AGENT MODEL and INCENTIVE CONTRACTING

MORAL HAZARD: Lack of care *ex post* about the effect subject to a transaction *ex ante*; hidden action leads to insufficient supply of a good; change of behavior to actions increasing the risk/loss

Problem 1

Suppose X is a good used for the production of good Y . Firm A holds a license for the production of X , and the good can be produced at zero costs. Firm B considers purchasing a machine needed for transforming X into Y . After transforming 10,000 units of X , the machine is no longer usable. However, it cannot be resold. This machine costs 30,000 PLN, and there are no other costs of Y production than the purchase of X . Firm B is able to sell Y for the price of 5 PLN per unit. Firm A is offering to supply X to firm B for the price of 1 PLN.

- a) Assume that firms A and B can sign a binding agreement to specify the price of X .

Will firm B buy the machine? Find the profits of both firms.

- b) Assume that it is impossible to sign a binding agreement. Is firm A's promise of the unit price of X equal to 1 PLN credible? Will firm B buy the machine? Find the profits of both firms. Compare the results with those from point a).

Problem 2

John's wealth amounts to \$100,000, which includes his car worth \$20,000. The car is exposed to the risk of being stolen, and the probability of the theft is 25%. John's utility function takes the form $U(W) = \ln(W)$, where W is his wealth.

- a) Find John's expected utility in the situation when he does not buy car theft insurance.
 b) Find the fair full insurance premium, assuming that the insurance company does not bear any administrative costs.
 c) Find the maximum amount that John would be willing to pay for full insurance against the car theft.

John can also install a car alarm, which costs him \$1,750. Installing this alarm decreases the probability of the car being stolen from 25% to 15%.

- d) If John decides not to purchase insurance, will he buy and install the car alarm?
 e) What is the maximum amount that the insurance company can charge John for full insurance if it requires that John purchases and installs the car alarm and verification whether John fulfills this requirement is costless (full compensation, i.e., \$20,000, is guaranteed in a case of theft)?
 f) What can the insurance company do when it is not able to verify whether John has installed the car alarm? (Explain, no calculation needed.)

Problem 3

Mr. X's car is worth 10,000 PLN, and it is the only wealth that he possesses. X faces the risk of his car being stolen with the probability of 19/83 per year. His utility function depending on wealth (w) is $U = w^{1/2}$. Additionally, X derives the utility of 190/83 from parking regularly next to a sleazy bar, which, however, doubles the yearly risk of his car being stolen.

- a) Would X be willing to buy full insurance against theft in a competitive insurance market?
 b) Demonstrate that insurance with X's own participation at the level of 1,700 is optimal.

(Assume that monitoring where X parks or finding where his car was stolen is too costly and ignore all insurance costs except for the expected compensation level).

Incentive compatibility: giving incentives for efficiency in principal- agent settings

Problem 4

A principal is risk-neutral and cares only for the expected value of his company's revenue, while an agent is both risk- and 'work'-averse. The agent's utility function depending on wage (w) and effort (e) devoted to the work is given by $U(w, e) = w^{1/2} - e$. For simplicity, assume that only two levels of effort are possible: $e = 0$ (low) and $e = 1$ (high). The agent has a possibility to undertake work elsewhere, and his utility derived from working there will amount to 1. The company's

revenue depends both on the effort devoted to the work by the agent and on random events, which neither the principal nor the agent can control. To be precise, the revenues are given by the following lottery depending on the agent's effort (revenue, probability):

$$L_{e=0} = (10, 2/3; 30, 1/3)$$

$$L_{e=1} = (10, 1/3; 30, 2/3)$$

- What contract will the principal sign with the agent if he can observe the agent's effort? How will the risk burden be divided between them in this case? What will be the principal's (expected) profit?
- If the principal cannot observe the agent's effort, how can he incentivize the agent to choose the effort level desired by the principal? How will the risk burden be divided between them in this case? What utility level will the agent achieve, and what profit will the principal get? Does it pay off for the principal to incentivize the agent to exert the desired effort level?

Problem 5

An agent selects his effort level e from the interval $[0,1]$. Two outcomes are possible for the principal: good and bad ones, with the probability of a good one occurring equally to e ($\Pr(\text{good}) = e$). The principal's revenue is $R(\text{good}) = 4$ and $R(\text{bad}) = 3$, while the agent's utility is given by $U(w,e) = w - e^2$, where w is the wage he receives. The 'outside option' is $U_0 = 1$. Propose the optimal remuneration scheme w for the case when e is observable.

Problem 6

Which of the following situations is an example of moral hazard?

- A holder of insurance sets his house on fire.
- Somebody does not close the door to his apartment because he feels safer thanks to the insurance he bought.
- A candidate for a job dresses very attractively for an interview.
- A "less-risky" person cannot buy such insurance protection as he would be willing to.
- A car mechanic when fixing a car uses used car parts instead of new ones like he was supposed to.
- An insurance agent insists on selling insurance to a person who does not need it.

Problem 7

A farmer does not have his own land, so he uses the land of another person. He gives 20% of the harvest to the owner of the land. The farmer entirely bears the cost of cultivation on this land, equal to 80 PLN per hour. The amount of harvest depends on hours of work by the farmer x (effort) according to the function $f(x) = 1000x - x^2/2$. What is the difference between the socially optimal effort level and the optimal level from the farmer's point of view? Assume that every unit of harvest generates a revenue of 1 PLN.

- 0
- 10
- 20
- 45
- Sufficient data is not provided to solve the problem.