Chapter 9 Adverse Selection

9.1 Introduction: Production Game VI

- In moral hazard with hidden knowledge and adverse selection,
  the principal tries to sort out agents of different types.
  - In moral hazard with hidden knowledge,
    the emphasis is on the agent's action
    rather than his choice of contract
    because agents accept contracts before acquiring information.

- Under adverse selection,

  the agent has private information about his type or

  the state of the world before he agrees to a contract,

  which means that the emphasis is on which contract he will accept.

- Production Game VI: Adverse Selection

  - Players

    - ✓ the principal and the agent

  - The order of play

    0 Nature chooses the agent's ability a,
    observed by the agent but not by the principal,
    according to distribution $F(a)$.

    1 The principal offers the agent one or more wage contracts
    $w_1(q)$, $w_2(q)$, . . .

2 The agent accepts one contract or rejects them all.

3 Nature chooses a value for the state of the world, θ, according to distribution $G(\theta)$.

Output is then $q = q(a, \theta)$.

- Payoffs
  - ✓ If the agent rejects all contracts, then $\pi_{agent} = \bar{U}(a)$, which might or might not vary with his type, a, and $\pi_{principal} = 0$.
  - ✓ Otherwise, $\pi_{agent} = U(w, a)$ and $\pi_{principal} = V(q - w)$.

- Under adverse selection,

  it is not the worker's effort, but his ability,

  that is noncontractible.

- Under adverse selection, unlike under moral hazard,

  offering multiple contracts can be an improvement over

  offering a single contract.

  ✓ The principal might, for example, provide

  a flat-wage contract for low-ability agents and

  an incentive contract for high-ability agents.

- Production Game VIa: Adverse Selection with Particular Parameters

  - Players

    - ✓ the principal and the agent

  - The order of play

    0 Nature chooses the agent's ability a,

    unobserved by the the principal, according to distribution $F(a)$,

    which puts probability 0.9 on low ability, $a = 0$,

    and probability 0.1 on high ability, $a = 10$.

1 The principal offers the agent one or more wage contracts

$W_1 = (w_1(q = 0), w_1(q = 10)), W_2 = (w_2(q = 0), w_2(q = 10)), \ldots$

2 The agent accepts one contract or rejects them all.

→ 3 Nature chooses the state of the world

to be *Bad* with probability 0.5 and *Good* with probability 0.5.

→ 4 If the state of the world is *Bad*, the low-ability agent produces 0 and the high-ability agent chooses output from [0, 10].

If the state of the world is *Good*, both agents choose output from [0, 10].

- Payoffs

  - ✓ If the agent rejects all contracts,

    then depending on his type

    his reservation payoff is either $\bar{U}_{Low} = 3$ or $\bar{U}_{High} = 2$,

    and the principal's payoff is $\pi_{principal} = 0$.

  - ✓ Otherwise, $U_{agent} = w$ and $V_{principal} = q - w$.

- Output is 0 or 10 for the low-ability type of agent,

  depending on the state of the world,

  but always 10 for the high-ability agent.

- More realistically,

  the high-ability agent would have a higher reservation wage,

  but I have chosen $\bar{U}_{High} = 2$ to illustrate an interesting feature

  of the equilibrium.

- A separating equilibrium

  - Principal: Offer $W_1 = \{w_1(q = 0) = 3, w_1(q = 10) = 3\}$ and $W_2 = \{w_2(q = 0) = 0, w_2(q = 10) = 3\}$.

    Low agent: Accept W_1.

    High agent: Accept W_2.

- What action does the principal desire from each type of agent?

  - The principal will want to hire the low-ability agent
    if he can do it at an expected wage of 5 or less.

    ✓ The principal will want to hire the high-ability agent
    if he can do it at an expected wage of 10 or less.

  - The principal tries to make different actions attractive
    to different types of agent,
    so the agent's choice depends on the hidden information.

- The principal's problem is to maximize his profit subject to
  - ✓ Incentive compatibility

    (the agent picks the desired contract and actions)
  - ✓ Participation

    (the agent prefers the contract to his reservation utility).

- In a model with hidden knowledge,

  the incentive compatibility constraint is customarily called the self-selection constraint,

  because it induces the different types of agents to pick different contracts.

- In a separating equilibrium,

  there will be an entire set of self-selection constraints,

  one for each type of agent,

  since the appropriate contract depends on the hidden information.

- The incentive compatibility constraint could vanish,

  instead of multiplying.

  ✓ The principal might decide to give up on separating

  the types of agent,

  in which case all he must do is make sure they all participate.

- The participation constraints

  - The contracts in our conjectured equilibrium, $W_1 = (3, 3)$ and $W_2 = (0, 3)$, satisfy the participation constraints.

    - ✓ $\pi_i(W_j)$ denotes the expected payoff an agent of type i gets from contract j.

    - ✓ $\pi_L(W_1) \geq \bar{U}_{Low}$

      $$0.5\, w_1(0) + 0.5\, w_1(10) \geq 3$$

✓ $\pi_H(W_2) \geq \bar{U}_{High}$

$$0.5\, w_2(10) + 0.5\, w_2(10) \geq 2$$

✓ Contract W_2 would be a very risky contract

for the low-ability agent

despite being riskless for the high-ability agent.

- In our separating equilibrium,

  the participation constraint is binding for the "bad" type

  but not for the "good" type.

  ✓ This is typical of adverse selection models.

  ✓ If there are more than two types,

  it is the participation constraint of the worst type that is binding,

  and no other.

- The principal makes the bad type's contract unattractive for two reasons.

  - ✓ If he pays less, he keeps more.

  - ✓ When the bad type's contract is less attractive, the good type can be more cheaply lured away to a different contract.

- The principal allows the good type to earn more than his reservation payoff,

  because the good type always has the option of lying about his type and choosing the bad type's contract, and

  the good type, with his greater skill, could earn a positive payoff from the bad type's contract.

- ✓ The principal can never extract all the gains from trade from the good type

  unless he gives up on making either of his contracts acceptable to the bad type.

- Another typical feature of this equilibrium is that the low-ability agent's contract not only drives him down to his participation constraint, but is riskless.

  - ✓ a contract of the form $W_1' = (w_l, w_h)$

  - ✓ $W_1' = (0, 6)$ would create a big problem for self-selection, because the high-ability agent would get an payoff of 6 from it, since his output is always high.

- ✓ If the agents were risk-averse,

  the risky contract would have to have a higher expected wage

  than W_1, to make up for the risk,

  and thus would be more expensive for the principal.

♦ The self-selection constraints

◦ The conjectured equilibrium contracts, $W_1 = (3, 3)$ and $W_2 = (0, 3)$, satisfy the self-selection constraints.

✓ $\pi_L(W_1) \geq \pi_L(W_2)$

$$0.5\, w_1(0) + 0.5\, w_1(10) \geq 0.5\, w_2(0) + 0.5\, w_2(10)$$

The contract W_2 has to have a low enough expected return for the low-ability agent to deter him from accepting it.

✓ $\pi_H(W_2) \geq \pi_H(W_1)$

$$0.5\, w_2(10) + 0.5\, w_2(10) \geq 0.5\, w_1(10) + 0.5\, w_1(10)$$

The wage contract W_1 must be <u>less attractive</u> than W_2 to the high-ability agent.

- The self-selection constraint is binding for the good type but not for the bad type.

  - ✓ This, too, is typical of adverse selection models.

  - ✓ The principal will choose two contracts equally attractive to the good type.

  - ✓ The principal will have chosen a contract for the good type that is strictly worse for the bad type, who cannot achieve a high output so easily.

- Once the self-selection and participation constraints are satisfied,
  the agents will not deviate from their equilibrium actions.

- All that remains to be checked is whether the principal could increase his payoff.

  - He cannot.

    - ✓ He makes a profit from either contract.
    - ✓ Having driven the low-ability agent down to his reservation payoff and the high-ability agent down to the minimum payoff needed to achieve separation,
      he cannot further reduce their pay.

- Modellers most often expect to find the bad type's participation constraint
  and the good type's self-selection constraint
  binding in a two-type model, and
  the worst agent's participation constraint and
  all other agents' self-selection constraints in a multitype model.

  - Although it is typical that the good agent's participation constraint is
    nonbinding and his incentive compatibility constraint is not,
    it is by no means necessary.

- Competition and Pooling

  - A competition constraint

    - ✓ a nonpooling constraint

    - ✓ a nonseparating constraint

    - ✓ We only have one principal in Production Game VI, so competition constraints are irrelevant.

- It is not always the case that they accept different contracts in equilibrium.

  - ✓ If they do not,

    they do not need to satisfy self-selection constraints.

- If all types of agents choose the same strategy in all states,

  the equilibrium is pooling.

  - ✓ Otherwise, it is separating.

- In a principal-agent model,

  the principal tries to design the contract to achieve separation

  unless the incentives turn out to be too costly.

- A separating contract need not be fully separating.

  - ✓ The equilibrium is fully revealing if the agent's choice of contract always conveys his private information to the principal.

  - ✓ imperfectly separating equilibria
    semi-separating equilibria
    partially separating equilibria
    partially revealing equilibria
    partially pooling equilibria

- The possibility of a pooling equilibirum reveals one more step we need to take to establish that the proposed separating equilibrium in Production Game VIa is really an equilibrium.

  - Would the principal prefer a pooling contract?

    - ✓ The contract (3, 3) induces both types of agent to participate.

  - Would the principal prefer a separating contract that "gave up" on one type of agent?

    - ✓ There are not enough high-ability agents for that to be a good strategy for the principal.

- All adverse selection games are games of incomplete information,

  but they might or might not contain uncertainty,

  moves by Nature occurring after the agents take their first actions.