Monitoring, Management, Compensation, and Regulation

Chapter 15. Principle and Agent

Slides Reference:
Industrial Organization: Markets and Strategies

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Chapter 15. Learning objectives

- Understand Moral Hazard and Adverse Selection.
- Understand principle-agent issue

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Moral Hazard Issue

- Examples
  - Parents do not know whether kids prepare homework
  - Owners do not know whether management shirks
  - Hidden action vs hidden characteristics
- Design payment scheme to provide incentive to exert effort.
  - Owner proposed a payment scheme (contract) that depends on observed output NOT effort
  - Worker accept or reject contract and choose optimal effort level.
  - The Owner pays the worker based on realized output.

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Principle-Agent Problem

- Model
  - Agent can choose to work hard e=2, or not e=0.
  - Agent's reservation utility=10.

$$U = \begin{cases} w - e & \text{if he devotes an effort level } e \\ 10 & \text{if he works at another place.} \end{cases} \quad (15.1)$$

  - Owners profit = f(agent's unobserved effort) – wage payment

$$R(e) = \begin{cases} H & \text{if } e = 2 \\ L & \text{if } e = 0. \end{cases} \qquad \pi \equiv R(e) - w. \quad (15.3)$$

- Participation constraint: - accept the contract

$$w^H - 2 \geq 10. \quad (15.4)$$

- Incentive constraint: work hard > no effort

$$w^H - 2 \geq w^L - 0. \quad (15.5)$$

- Contract: w(H)=12, w(L)=10. No uncertainty!

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Principle-Agent Problem with uncertainty

- Model
  - Agent can choose to work hard e=2, or not e=0.
  - **Outcome is uncertain

$$R(2) = \begin{cases} H & \text{probability } 0.8 \\ L & \text{probability } 0.2 \end{cases} \quad \text{and } R(0) = \begin{cases} H & \text{probability } 0.4 \\ L & \text{probability } 0.6. \end{cases} \qquad (15.6)$$

  - **Agent's reservation utility=10.

$$U = \begin{cases} Ew - e & \text{if he devotes an } e \text{ level of effort} \\ 10 & \text{if he works at another place,} \end{cases} \qquad (15.7)$$

  - Owners profit = f(agent's unobserved effort) – wage payment

$$R(e) = \begin{cases} H & \text{if } e = 2 \\ L & \text{if } e = 0. \end{cases} \qquad \pi \equiv R(e) - w. \qquad (15.3)$$

  - Participation constraint: - accept the contract

$$0.8w^H + 0.2w^L - 2 \geq 10, \qquad (15.8)$$

  - Incentive constraint: work hard > no effort

$$0.8w^H + 0.2w^L - 2 \geq 0.4w^H + 0.6w^L - 0. \qquad (15.9)$$

- Contract: w(H)=13>12, w(L)=8<10.

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The principle and agent can have different degree of risk aversion

- Definitions
  - Two consumers i and j. Consumer i is more risk averse than consumer j, when consumer j prefers a fixed sum of money over a lottery, then consumer I also prefers the fixed amount.
  - $$R^O(2) = \begin{cases} H & \text{probability } 0.8 \\ L & \text{probability } 0.2 \end{cases} \text{ and } R^O(0) = \begin{cases} H & \text{probability } 0.4 \\ L & \text{probability } 0.6. \end{cases} \quad (15.10)$$
  - $$R^W(2) = \begin{cases} H & \text{probability } 0.7 \\ L & \text{probability } 0.3 \end{cases} \text{ and } R^W(0) = R^O(0). \quad (15.11)$$
  - Waiter is more risk averse than the owner, as he is more sceptical about realization of high state.
  - Payoff functions:

PC: $$0.7w^H + 0.3w^L - 2 \geq 10, \text{ or } w^H = \frac{12 - 0.3w^L}{0.7}. \quad (15.12)$$

IC: $$0.7w^H + 0.3w^L - 2 \geq 0.4w^H + 0.6w^L - 0, \text{ or } w^H = 2/0.3 + w^L. \quad (15.13)$$

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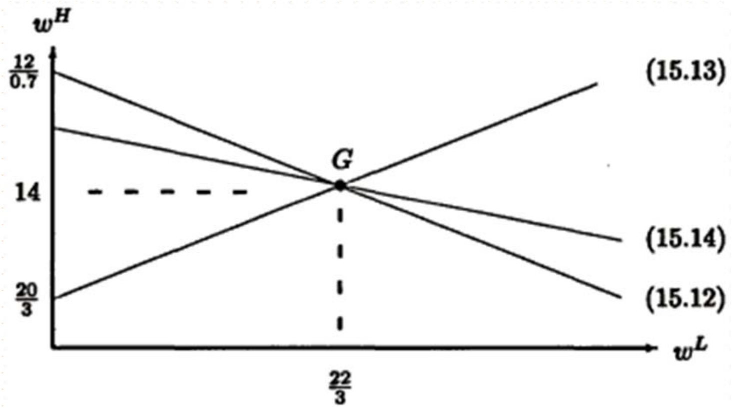
The principle and agent can have different degree of risk aversion

- Owner's expected payment: $\min_{w^H, w^L} E^O w = 0.8w^H + 0.2w^L.$ (15.14)
- 15.12 PC, 15.13 IC, 15.14, owner's payoff



- WH=14, WL=22/3 (vs 12/10, vs 13/8)
- EW=14*0.8+22/3*0.2=12.66>12

  Need to compensate more when waitress is more risk averse.

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Optimal Team Effort – free rider problem

- Output depends on team's joint effort:

$$V = \sum_{i=1}^{N} \sqrt{e_i}. \quad (15.15)$$

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$$U_i \equiv w_i - e_i, \quad i = 1, 2, \ldots, N. \quad (15.16)$$

- Optimal effort level

  w=V/N

  $$\max_e (w - e) = \frac{V}{N} - e = \frac{N\sqrt{e}}{N} - e$$

  e*=1/4 V*=N/2

- Equal-division Economic Mechanism
  - $$\max_{e_i} U_i = \frac{\sum_{j \neq i} \sqrt{e_j} + \sqrt{e_i}}{N} - e_i, \quad \text{implying that} \quad e^n \equiv e_i = \frac{1}{4N^2} \leq e^*. \quad (15.18)$$
  - When N=1, e=e*, When N>=2, e<e*, when N increases, lower effort from each individual.
  - To solve this problem $$w_i = \begin{cases} V^*/N & \text{if } \sum_{i=1}^{N} \sqrt{e_i} = V^* \\ 0 & \text{otherwise.} \end{cases} \quad (15.22)$$

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