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Lecture 5

Performance evaluation

Industrial Economics

Multiple agents

- Assume that there is ***one risk neutral principal*** but $N > 1$ ***agents***
- The principal can ***offer independent*** incentive compatible contracts to the agents
- However, this may be ***informationally wasteful***
  - there might be information ***generated within*** the group that the principal may be able to ***use*** to offer a more efficient contract
- This would be the case if the ***individual outputs*** of the agents are ***correlated***

Production and utility

- Each agent i ***produces output,*** x_i according to
  $$x_i = a_i + e_i + \varepsilon_i + \eta, \quad \text{where } i = 1, \dots, N$$
  - a_i is the agent's ability
  - e_i is the agent's effort ***choice***
- Stochasticity is ***split*** into two parts:
  - The ***idiosyncratic*** part, $\varepsilon_i \sim N(0, \sigma_\varepsilon^2)$
  - The ***common*** part, $\eta \sim N(0, \sigma_\eta^2)$
- Agent's ***utility*** function belongs to CARA family
  $$u_i(w_i) = -exp[-w_i + c(e_i, a_i)]$$
  risk aversion coefficient is 1

Continuous contracts

- e_i is ***unobservable*** to the principal
- x_i is ***observable***
- Thus, the contract must be ***contingent*** on x_i
- Since x_i is a continuous variable, the ***contract*** $w(x_i)$ has to be ***continuous***, too
- We will examine ***two classes*** of linear continuous contracts
  - The linear ***absolute*** contract (piece rate)
  - The linear ***relative*** contract (cardinal tournament)

The piece rate

- A ***piece rate*** is a compensation ***scheme*** of the form
  $$w_i = \alpha + \beta x_i$$
  the principal gives a ***sign-up bonus*** plus a ***piece rate***
- Each agent i will want to ***solve***
  $$\max_{e_i} \left[Eu[w_i(e_i, \alpha, \beta)] \right] \qquad (1)$$
- The FOC for (1) is the ***optimal response*** of the agent
  maps $\alpha, \beta \longrightarrow e_i$
- The FOC for (1) will ***also*** be the ***IC*** for the agent
- The principal can use it to ***incentivize*** the agent

Incentive conditions

- The ***IC*** is
  $$\frac{\partial Eu[w_i(e_i, \alpha, \beta)]}{\partial e_i} = 0 \qquad (IC)$$
- The root of which is $e^*(\alpha, \beta)$ and ***entails***
  $$Eu[w_i(e^*(\alpha, \beta))] \geq Eu[w_i(e'(\alpha, \beta))] \quad \forall\, e' : \mathcal{R}^2 \to \mathcal{R}$$
- The agent will not ***participate*** unless
  $$Eu[w_i(e^*(\alpha, \beta))] \geq u_o \qquad (IR)$$
  where u_o is the ***reservation*** utility

The principal's problem

- The principal ***knows*** how the agent ***responds*** to α and β
- She ***also knows*** when the agent will ***participate***
- The ***principal's problem*** is

$$\max_{\alpha,\beta}[x_i - w_i(e^*(\alpha,\beta),\alpha,\beta)]$$

subject to

$$Eu[w_i(e^*(\alpha^*,\beta^*))] \geq u_o \quad (IR)$$

and

$$\frac{\partial Eu[w_i(e^*(\alpha^*,\beta^*))]}{\partial e_i} = 0 \quad (IC)$$

- The solution yields the ***optimal*** contractual parameters α^* and β^* and the ***optimal effort*** e^*

The optimal piece rate contract

- Linear contracts have an ***interesting property***
  - The constant α is used to ***assure participation***
  - The coefficient β is used to ***provide incentives*** for effort
- Both incentive conditions hold with ***equality***
  - The principal will set β^* to ***implement the effort*** that maximizes her profit, $e^* = e(\beta^*)$
  - Then, given β^*, the principal will adjust α^* so that ***IR will hold with equality***

The linear tournament

- A ***cardinal tournament*** is a ***scheme*** of the form

$$w_i = a + b(x_i - \bar{x})$$

the agent receives his ***expected salary***, a, upfront and then there is a ***penalty/reward*** structure depended on b

- ***Methodology*** for the optimal contract is ***similar*** to the piece rate

$$\max_{a,b}[x_i - w_i(e^*(a,b),a,b)]$$

s.t. $Eu[w_i(e^*(a^*,b^*))] \geq u_o \quad (IR)$

and $\frac{\partial Eu[w_i(e^*(a^*,b^*))]}{\partial e_i} = 0 \quad (IC)$

The optimal contract

- The ***logic*** of the tournament is ***similar*** to the piece rate
  - The constant a is used to ***assure participation***
  - The coefficient b is used to ***provide incentives*** for effort
- Both IR and IC hold with ***equality*** for the same reasons

Insurance provision

- The tournament has another ***interesting property***

the common shock is ***filtered out*** from agent compensation

- This provides ***additional utility*** to the ***risk-averse*** agents
- Thus, the principal can ***meet*** the IR by ***paying less*** w
- This is an ***insurance transaction***
  - Agents ***are insured*** from the common shock
  - They are ready to ***accept lower wages*** for the security
  - The risk-neutral principal is willing to ***bear*** the common risk in ***exchange for the savings***
- Under the tournament ***effort is higher*** and ***wages are lower*** than under the piece rate

Limits to managerial discretion

- Managers have ***significant freedom*** of action
- However, their discretion is ***not unlimited***
- There are several ***limitations***
  1. Takeovers
  2. Reputation effects
  3. Supervision
  4. Completion in product market
  5. Internal organization

1. Takeovers

- If ***profit is low***, stock price ***will fall***
- If the market ***sees potential*** there is an incentive for ***takeover***
- The new owners will ***replace the management***
- Effectiveness:
  - Buyers assumed to have ***more info*** than owner
  - Managers may try to ***block takeovers***
  - ***Free riding:*** stockholders want to hold on to their stocks in anticipation of appreciation by the new management
  - The threat may ***distort incentives*** (S-R vs. L-R profit concerns)

2. Reputation effects

- Managers ***care*** for their careers and are ***eager*** to acquire good ***reputations***
- This may reduce slack, and may even cause managers to work ***too hard*** (i.e. harder than the socially optimal level) ***early*** in their career

3. Supervision

- Monitoring may be ***costly*** but ***feasible***
- Effectiveness:
  - Difficulty of measuring individual effort when ***team work*** is important
  - Possibility of ***collusion*** between supervisors and supervisees

4. Competition in the product market

- If a firm does not maximize profits, there is a higher probability that it will not be ***able to compete*** with more ***efficient*** firms and will therefore go ***bankrupt***
- For managers, ***having a job*** assumes that they work hard to maximize profits

5. Internal organization

- Internal organization of a firm can help ***mitigate*** managerial slack, especially by lower managers
- The **unitary firm** benefits efficiency

  but ***supervision*** by the top management becomes more difficult
- In a **multi-divisional** firm, efficiency may be compromised

  but top management can ***evaluate performance*** of the different divisions and **compare them** with one another
- Large firms tend to ***prefer*** the M-form which may ***indicate*** increased need to limit managerial discretion

The profit-maximization hypothesis

- No method ***limits discretion*** completely – no perfect way to ***align incentives***, either
- We must ***expect deviations*** from profit maximization due to the separation of ownership and control
- ***How significant*** those deviations are likely to be?
  - Large deviations will ***not allow*** a firm to ***survive*** in the long-run
  - Most firms will follow simple ***rules-of-thumb*** instead of complex maximization calculations
- Profit maximization seems as a ***reasonable approximation*** of firm behavior

Thank you!

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