

Lecture 4

Performance evaluation



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**
$$\max_{e_i} [Eu[w_i(e_i, \alpha, \beta)]] \quad (1)$$
- ★ The FOC for (1) is the **optimal response** of the agent
maps $\alpha, \beta \rightarrow e_i$
- ★ 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
$$\frac{\partial Eu[w_i(e_i, \alpha, \beta)]}{\partial e_i} = 0 \quad (IC)$$
- ★ The root of which is $e^*(\alpha, \beta)$ and **entails**
$$Eu[w_i(e^*(\alpha, \beta))] \geq Eu[w_i(e'(\alpha, \beta))] \quad \forall e': \mathcal{R}^2 \rightarrow \mathcal{R}$$
- ★ The agent will not **participate** unless
$$Eu[w_i(e^*(\alpha, \beta))] \geq u_o \quad (IR)$$

where u_o is the **reservation utility**.

The piece rate

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^*

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The piece rate

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**

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

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The tournament

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

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The tournament

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

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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

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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

ευχαριστώ!
(thank you!)

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