Multitasking

Class 6

How to Pay Teachers?

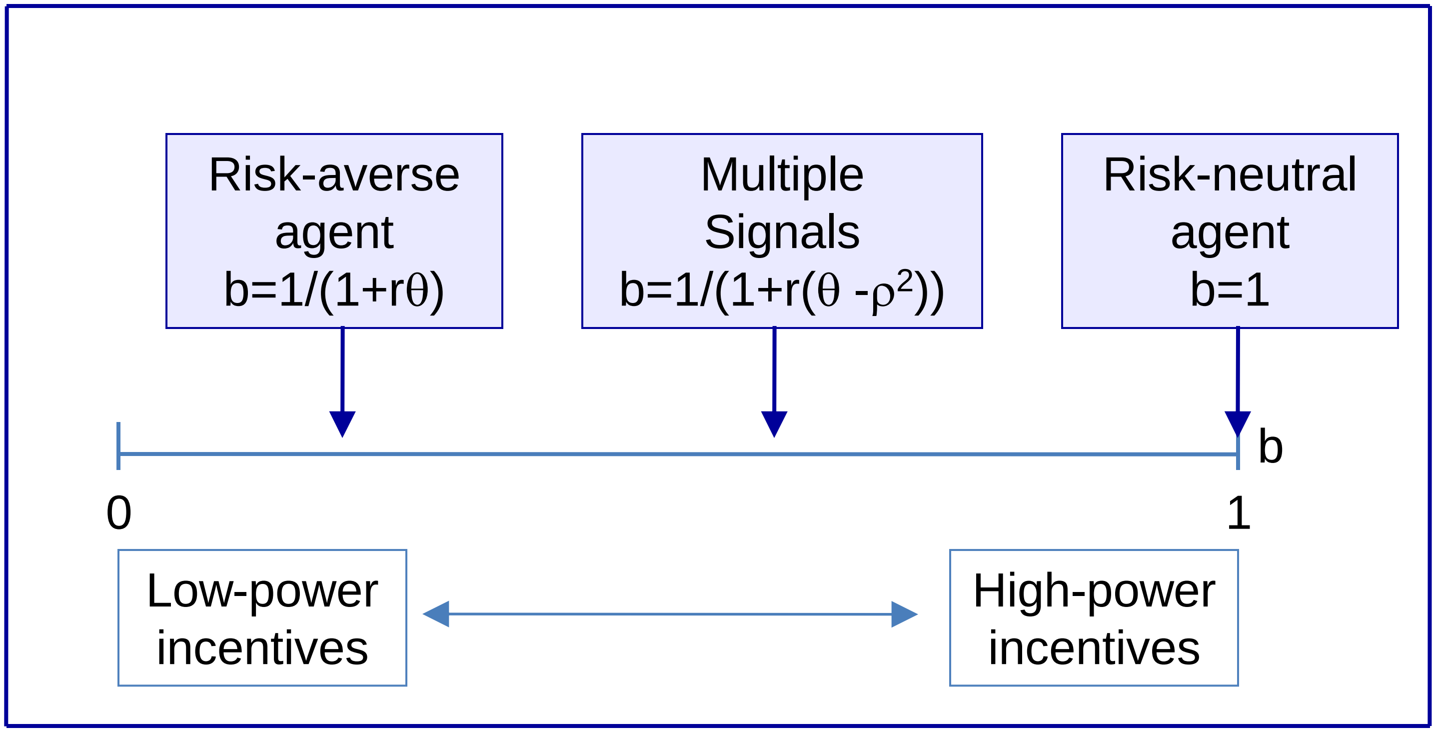
Student Achievement

Country	Reading	Math
Canada	524	527
U.S.	500	487
Germany	497	513
France	496	497
U.K.	494	492

Who is the principal and the agent? What is the outcome? What are the agent's actions? Do you recommend a P4P contract or not? If so, should it be a low-powered or a high-powered P4P contract?

Review:

Optimal Contract with Hidden Action



Pitfalls of Tying Pay to Outcomes

- However, $b \approx 0$ in many occupations!!!

$$b = \frac{1}{1+r(\theta-\rho^2)}$$

- Agent extremely risk averse ($r\to\infty$), or extreme lack of control over output ($\theta\to\infty$), and no good signals of performance ($\rho\to0$)

Other Explanations:

- **Multiple tasks** (today)
- Non-financial incentives
- Imperfect measurement

Objectives for Today

1. Optimal contract with multiple tasks
2. Application: Teachers' Compensation
3. Application: Physicians' Compensation

Examples of Multitasking

"Quantity and quality"

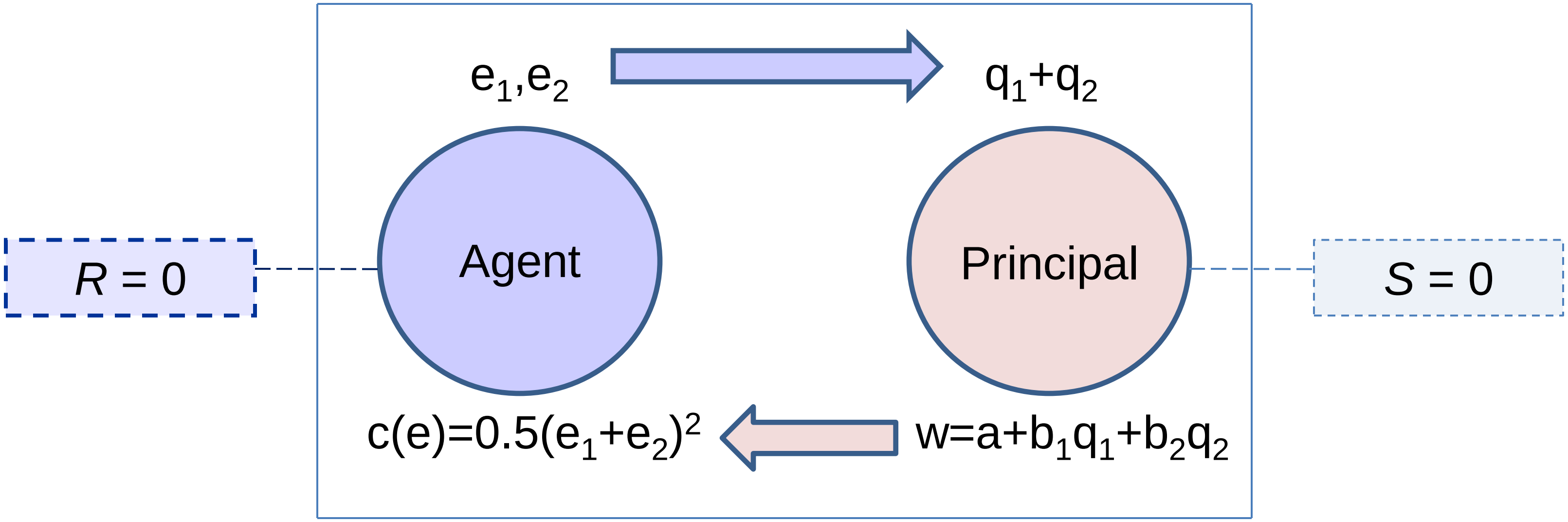
- In Teaching:
  - How many topics are covered?
  - How much time is spent on each topic?
- In Medicine:
  - How many patients are seen?
  - How many patients are appropriately treated?

Potential for Conflict

1. The Principal cares about both quantity and quality, and …
2. … the Agent decides how to allocate effort between quantity and quality, and …
3. … the Agent's efforts cannot be observed by the Principal.

➢ Therefore, how the Agent allocates effort between quantity and quality may not be what the Principal wants!

Model Description



Additional Assumptions

- $q_1 = e_1 + u_1$
- $q_2 = e_2 + u_2$
- $u_1 \sim (0, \theta_1)$
- $u_2 \sim (0, \theta_2)$
- $cov(q_1, q_2) = 0$
- A is risk averse
- P is risk neutral

Payoffs

- $E[U]=E[w]-0.5rVar[w]-c(e)$
  - $E[w]=E[a+b_1q_1+b_2q_2]=$ ____________________
  - $Var[w]=Var[a+b_1q_1+b_2q_2]=$ ____________________
  - $c(e)=0.5(e_1+e_2)^2$
- $E[V]=E[q_1+q_2-w]$
  $=$ ______________________

Timing	Decision Problem
Principal designs the contract	Choose (a,b_1,b_2) to Max E[V]
↓	↓
Agent accepts or rejects the contract	Accept if $E[U] \geq R$
↓	↓
If agent accepts, he chooses effort	Choose (e_1,e_2) to Max E[U]
↓	↓
Production and payoffs	Production and payoffs

1. Choose (e_1,e_2) to Max E[U]

$$\text{Max } E[U] = a+b_1e_1+b_2e_2 - 0.5r(b^2{}_1\theta_1+b^2{}_2\,\theta_2)- 0.5(e_1+e_2)^2$$

- First-order conditions:

$$\left.\begin{aligned} & b_1-(e_1+e_2)=0 \\ & b_2-(e_1+e_2)=0 \end{aligned}\right\} \quad b_1=b_2= e_1+e_2$$

$\Rightarrow$ (ICC) [ ]

2. Accept if E[U] ≥ R

- E[U] = R = 0
- $E[W] = a+b_1e_1+b_2e_2 = 0.5r(b^2{}_1\theta_1+b^2{}_2\theta_2)+0.5(e_1+e_2)^2$

- Substitute, from (IC), $b \equiv b_1 = b_2$ and $e \equiv e_1+e_2$, to get

$\Rightarrow$ (PC) **E[w] =**

Choose C to Max E[V] ← Accept if E[U]≥R ← Choose (e_1,e_2) to Max E[U]

3. Choose contract to Max E[V]

- $E[V] = (e_1+e_2) - (a+b_1e_1+b_2e_2)$
  $= e - 0.5e^2 - 0.5rb^2(\theta_1+\theta_2)$ (PC)
  $= b - 0.5b^2 - 0.5rb^2(\theta_1+\theta_2)$ (ICC)

- The first-order condition for b is $1-b-rb(\theta_1+\theta_2)=0$

➢ **b =**

Implications

$$b = b_1 = b_2 = 1/(1+r(\theta_1 + \theta_2))$$

1. Equal compensation principle: to induce the agent to perform tasks that are equally costly to her, the return on each task must be set equal to each other.

2. Multitasking increases risk and therefore reduces the power of incentives (the extent to which the optimal pay is tied to performance).

Application: Midterm and Class Participation

- Suppose the teacher cares about the student's participation in the class and the student's understanding of the material.
- The course grade is based on the midterm only.

➢ Therefore, the student will…

  ____

- In general, the task that is not rewarded doesn't get done!
  - You get what you pay for!

Application: Job Design for Teachers

- $b_1=b_2=1/(1+r(\theta_1+\theta_2))$

- Suppose:
  - the performance on task 1 can be measured perfectly ($\theta_1=0$)
  - the performance on task 2 is really hard to measure ($\theta_2\to\infty$)

$\Rightarrow b_1=b_2=0$ (Salary contract)

$\Rightarrow e_1=e_2=0$!

- Can the principal do better?

Hannaway (1992)

- Redesign the job:
  - Job 1: precise signal, incentive pay, $e_1=e^*$
  - Job 2: imprecise signal, pay salary, $e_2=0$

- Divide teacher's job into two parts:

1. Basic skills teacher (e.g. math)
2. Higher-order skills teacher (e.g. critical thinking)

- Easier to measure basic skills
- ➢ Use incentive pay for the basic skills teachers only

Application: Quantity and Quality in Health Care

- Physician Compensation:
  - $w=a+b_1q_1+b_2q_2$
  - q_1=medical services
  - q_2=quality (e.g. time per service)

- Quality is hard to observe ($\theta_2 \to \infty$)

- Both quantity and quality matter
  - Can't break them down into separate tasks

Salary and Fee for Service

- Salary contract ($w=a$)
  - $b_1=b_2=0$
  - Weak incentives to provide quantity or quality

- Fee-for-service contract ($w=a+b_1q_1$)
  - $b_1>0$, $b_2=0$
  - Weak incentives to provide quality

Blended Capitation Model

- Physician Compensation:

  $w = n \times (a + b_1 q_1)$

  - $a + b_1 q_1$ = payment per patient
    - a = fixed payment (i.e. capitation rate)
    - $b_1 q_1$ = payment for services provided to patient

- n = the number of enrolled patients

Blended Capitation Model

- Suppose:
  - Patients can observe quality
  - Patients prefer more quality
  - Patients select physicians based on quality ($n=q_2$)

⇒ Incentives to provide quality!

- $MB(e_2)$ =
  - $a+bq_1$ in blended capitation
  - 0 in FFS or salary

Physicians provide quality: Not because quality is directly rewarded, but because quality attracts patients, and more patients bring in more revenues!

Main Points

1. Multitasking and power of incentives: In general, contracts based on multiple tasks should tie less of the agent's pay on performance because of the increased risk that the agent must take.
2. Equal compensation principle: In general, the agent supplies inefficiently low effort for tasks that are not rewarded.