Econ 476: Industrial Organization

Management and Compensation

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Lecture 13

Intro

- In our study thus far, firms have one objective: maximize their utility (their profit function).
- However, firms are not people! They are *organizations* run by people. And people have many different preferences and maximize their utility given their preferences.
  - Caveat: The firm's utility function and the worker's utility function coincide when the worker is the owner.
- The general goal of management and compensation is to create incentives for workers such that the firm's objectives are maximized (profit, quality, clout, etc..) as a by-product of each individual worker maximizing their utility.

Intro

- The theoretical framework of this concept was introduced by Stephen Ross (1973).
- The principle-agent problem can be applied to a wide variety of circumstances.
- We read the (complex/difficult) paper, but you will go over (or have gone over) a simple example in Econ 382.
  - Hence, we will forbear.

Team effort

- The principle is never able to fully monitor or map worker (agent) effort to profits.
  - imperfect information
- Similarly, how do you compensate a group of people all working on the same product when individual effort can only be imperfectly observed, but profits (or output) can be perfectly observed?
- Let's consider one avenue of compensation: profit sharing.

Team effort - model

Consider a research lab developing a future product whose value is denoted by V. There are N scientists who work on the project and each scientist contributes e_i effort where $i = 1, 2, \ldots, N$. The value of the product depends on the joint effort of all the scientist and is given by

$$V = \sum_{i=1}^{\infty} \sqrt{e_i}.$$

Assume that all the profits are divided among the scientists in some way such that $\sum_{i=1}^{N} w_i = V$, where w_i is the wage for scientist i. All scientists have identical preferences given by $U_i \equiv w_i - e_i$. From this model set-up, there are many ways we can choose share profits. As a primer, let's assume that profits are divided equally among the scientists (regardless of individual effort) so that $w_i = w = V/N$.

Team effort - model

Let's first assume that scientists can perfectly observe the effort level of their colleagues, and so, they are able to prevent shirking. What are V^* and e^* (i.e. the Nash equilibrium solution)?

Team effort - solution

Solution:

- $e^* = \frac{1}{4}$
- $V^* = \frac{N}{2}$

Now let's assume that like the principle, scientists are unable to view the effort level of their colleagues. Solve for the Nash equilibrium.

Team effort - solution

Solution:

- $e^n = \frac{1}{4N^2}$
- $V^n = \frac{1}{2}$

Team effort - difference

- $V^* - V^n = \frac{N-1}{2}$
- $e^* - e^n = \frac{N^2-1}{4N^2}$
- $U^* - U^n = \frac{2N^2-2N+1}{4N^2}$
- [graphs]

Team effort - results

Under the equal-division rule:

1. If the team consists of a single worker, the worker will provide the optimal level of effort. That is, if $N = 1$, then $e^n = e^*$.
2. If the team consists of more than one worker, each worker would devote less than optimal level of effort. That is, if $N > 1$, then $e^n < e^*$.
3. The larger the team is, the lower will be the effort put out by each worker (each would have a greater incentive to shirk). That is, as N increases, e^n decreases.

Executive pay

- Why are executives paid more than workers?
- Let's look at one aspect of executive pay – worker incentive for promotion.

Executive - model

Let's assume that in a firm there are two workers indexed by $i = 1, 2$, one of whom will be promoted to an executive position. The worker who produces the most output, q_i, will be promoted and move to the corner office and earn a wage $w^E > w^W > 0$. If $q_1 = q_2$, then management will randomly choose one of the workers for promotion. The mapping of effort level, e_i, to output is as follows:

$$q_i \equiv \begin{cases} 0 & \text{if } e_i = 0 \\ \left.\begin{array}{ll} H & \text{probability } 1/2 \\ 0 & \text{probability } 1/2 \end{array}\right\} & \text{if } e_i = e > 0 \end{cases}$$

What is the probability, p_i, that worker i will be promoted?

Executive - results

$$p_i = \begin{cases} 1/2 & \text{if } e_1 = e_2 = e \\ 1/2 & \text{if } e_1 = e_2 = 0 \\ 3/4 & \text{if } e_i = e \text{ and } e_j = 0 \\ 1/4 & \text{if } e_i = 0 \text{ and } e_j = e \end{cases}$$

Each worker has two actions: $e_i = e$ or $e_i = 0$. Set up this game in normal form.

Executive - normal form

		Worker 2	
		$e_2 = 0$	$e_2 = e$
Worker 1	$e_1 = 0$	$\frac{1}{2}w^E + \frac{1}{2}w^W$, $\frac{1}{2}w^E + \frac{1}{2}w^W$	$\frac{1}{4}w^E + \frac{3}{4}w^W$, $\frac{3}{4}w^E + \frac{1}{4}w^W - e$
	$e_1 = e$	$\frac{3}{4}w^E + \frac{1}{4}w^W - e$, $\frac{1}{4}w^E + \frac{3}{4}w^W$	$\frac{1}{2}w^E + \frac{1}{2}w^W - e$, $\frac{1}{2}w^E + \frac{1}{2}w^W - e$

Now let $w^E = w^W = w$. What is the Nash equilibrium(ia) of this game?

Executive - normal form

		WORKER 2	
		$e_2 = 0$	$e_2 = e$
WORKER 1	$e_1 = 0$	w, w	w, $w - e$
	$e_1 = e$	$w - e$, w	$w - e$, $w - e$

Let $w^E > w^W > 0$ as before. For what values of w^E would $\{e, e\}$ be the unique pure strategy Nash equilibrium?

Executive - wage differentials

Results:

- $w^E > w^W + 4e$