# Econ 476: Industrial Organization Management and Compensation

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Lecture 13

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# 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.

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- 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.

- 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.

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# 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, ..., 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  $w_i = w = V/N$ .

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)?

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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.

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# Team effort - solution

### Solution:

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

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# Team effort - difference

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  $e^n < e^*$ .
- 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<sup>n</sup> decreases.

Why are executives paid more than workers?

 Let's look at one aspect of executive pay – worker incentive for promotion.

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# 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:

$$q_i \equiv \left\{ egin{array}{ccc} 0 & ext{if } e_i = 0 \ H & ext{probability } 1/2 \ 0 & ext{probability } 1/2 \end{array} 
ight\} & ext{if } e_i = e > 0 \end{array}$$

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

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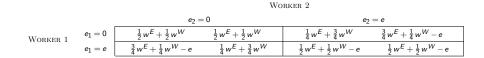
# Executive - results

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

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

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### Executive - normal form



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

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## 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?

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# Executive - wage differentials

Results:

•  $w^E > w^W + 4e$ 

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