Why Do CEOs Make So Much Money?

Facts and Theories of Executive Pay

- Average CEO in a Fortune 500 company makes US$12 million
- Ratio of CEO pay to average worker pay is 354 in the U.S.
- Ratio is 148 in Switzerland, 147 in Germany, 104 in France, 93 in Australia, 84 in U.K., 67 in Japan, 48 in Denmark
- Three predominant theories
  - incentive pay
  - captured board
  - assignment model

Basic Ingredients

- Each company can only have one CEO
- Output depends on size of company (y) and quality of CEO (x): $Q = f(x,y)$
- Production function exhibits complementarity: $\partial^2 f(x,y)/\partial x \partial y > 0$
- This means that the marginal product of a higher quality CEO is larger in a larger company

Assortative Matching

- Under complementarity, total output is maximized by assigning a higher quality CEO to a larger company
- Suppose $x_2 > x_1$ and $y_2 > y_1$

$$f(x_2,y_2)+f(x_1,y_1) > f(x_2,y_1)+f(x_1,y_2)$$

- The above is the same as

$$f(x_2,y_2)-f(x_1,y_2) > f(x_2,y_1)-f(x_1,y_1)$$

- LHS is marginal product of managerial quality in large company; RHS is marginal product of managerial quality in small company
- Better CEO get paid more for two reasons:
  - they are more productive than lower quality CEOs
  - they get to manage larger companies than lower quality CEOs

Example

- Production function is $f(x,y) = xy$
- CEOs are paid what shareholders in the next competing company are willing to pay

manager quality	company size	output	CEO wage	profits
1	1	1	0	1
2	2	4	$2 \times 1 - 1 = 1$	3
3	3	9	$3 \times 2 - 3 = 3$	6
4	4	16	$4 \times 3 - 6 = 6$	10
5	5	25	$5 \times 4 - 10 = 10$	15
$\ldots$				
10	10	100	45	55
$\ldots$				
x	x	x^2	$x^2/2$	$x^2/2$

Managerial Supervision and Control

- Managers perform two tasks:
  - make decisions
  - supervise workers
- Quality of manager is r, quality of worker i is q_i
  - manager spends time t_i supervising (or working together with) worker i
  - output of worker i is $f(rt_i, q_i)$
  - production function exhibits complementarity: $f(\cdot) = (rt_i)^{\alpha} q^{1-\alpha}$
- Value of output depends on managerial decisions
  - total value of production by the team is

$$V = g(r) \sum_i f(rt_i, q_i)$$

  - better managers make better decisions: $g(r) = r^{\beta}$

Allocation of Managerial Time

- Choose t_i to maximize $V = r^\beta \sum_i (rt_i)^\alpha q_i^{1-\alpha}$ subject to $\sum_i t_i = 1$
- First-order condition requires the manager to equalize the marginal product of his time spent with every worker i:

$$r^\beta \alpha (rt_i)^{\alpha-1} r q_i^{1-\alpha} = \lambda$$

- This implies that q_i/t_i is equalized across workers
- Lesson 1: Spend more time with your more productive workers

Size of Team

- Let $t_i = kq_i$
- Sum over all i to get $1 = k\sum_i q_i = kQ$
- Think of Q as the size of the team
- Profit maximization: Choose q_i to maximize

$$\begin{aligned}\Pi &= r^\beta \sum_i (rt_i)^\alpha q_i^{1-\alpha} - \sum_i wq_i \\ &= r^\beta \sum_i (rkq_i)^\alpha q_i^{1-\alpha} - \sum_i wq_i \\ &= r^{\alpha+\beta} k^\alpha \sum_i q_i - w\sum_i q_i\end{aligned}$$

- But $\sum_i q_i = Q$ and $k = 1/Q$. So this is the same as choosing Q to maximize

$$\Pi = r^{\alpha+\beta} Q^{1-\alpha} - wQ$$

Span of Control

- First-order condition is

$$r^{\alpha+\beta}(1-\alpha)Q^{-\alpha} - w = 0$$

- Therefore $Q = \left(\frac{1-\alpha}{w}\right)^{1/\alpha} r^{(\alpha+\beta)/\alpha}$
- Lesson 2: Better managers manage larger teams
- $Q/r = \left(\frac{1-\alpha}{w}\right)^{1/\alpha} r^{\beta/\alpha}$ is larger when r is larger
- Lesson 3: Better managers manage disproportionately larger teams

Managerial Earnings

- Substitute optimal Q into manager's objective function and use the first-order condition:

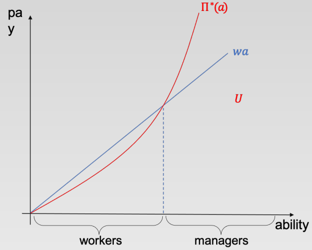
$$\begin{aligned}
\Pi &= r^{\alpha+\beta} Q^{1-\alpha} - wQ \\
&= Q\left(r^{\alpha+\beta} Q^{-\alpha} - w\right) \\
&= Q\left(\frac{w}{1-\alpha} - w\right) \\
&= \left(\frac{1-\alpha}{w}\right)^{1/\alpha} r^{(\alpha+\beta)/\alpha}\left(\frac{\alpha}{1-\alpha} w\right) \\
&= \alpha(1-\alpha)^{(1-\alpha)/\alpha} w^{-(1-\alpha)/\alpha} r^{(\alpha+\beta)/\alpha}
\end{aligned}$$

- Elasticity of managerial pay with respect to managerial quality is larger than 1: $\partial \log \Pi / \partial \log r = (\alpha + \beta)/\alpha$

- Lesson 4: Small differences in managerial ability can lead to larger differences in managerial pay

Sorting

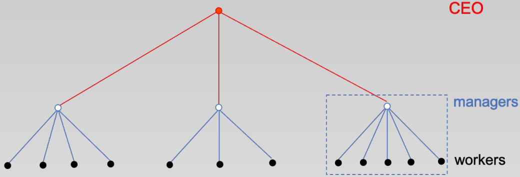
- A person's ability is a. If he is a worker, his quality is $q_i = a$. If he is a manager, his quality is $r = a$
- Labor earning is linear in ability for workers: $W = wa$
- Labor earning is convex in ability for managers: $\Pi = \alpha(1-\alpha)^{(1-\alpha)/\alpha} w^{-(1-\alpha)/\alpha} a^{(\alpha+\beta)/\alpha}$



- Lesson 5: Higher ability people become managers; lower ability people become workers

Hierarchies

- CEOs control different manager-teams



- Lessons:
  - CEO should spend more time with better managers
  - better CEOs control disproportionately larger companies
  - small differences in ability translates into larger differences in CEO pay
  - highest ability people become CEOs; medium ability people become managers; lowest ability people become workers