A two period model of

Geography, Transparency and Institutions

(Mayshar-Moav-Neeman) We study the impact of transparency on two standard elements in the (implicit) principal-agent contract:

- "Stick" – threat of dismissal
- "Carrot" – share of output

and explain regional differences in

- Institutions (private vs. state owned land)
- State capacity
- State concentration (center vs. periphery)

The principal-agent model

- The principal designs the contract to maximize its expected income
- Agents are risk neutral and choose their effort level to maximize their expected welfare
- The economy operates during two periods: 1 and 2

Output (per agent, in each period)

$$Y = \begin{cases} H & \text{if } e = h \text{ and } \theta = G \\ L & \text{otherwise} \end{cases}$$

$e \in \{h, l\}$ - effort

$\theta \in \{G, B\}$ - state of nature

$p \in (0, 1)$ - the probability that $\theta = G$

Information

$\sigma \in \{\tilde{G}, \tilde{B}\}$ - a public signal about the state of nature

Signal accuracy $q \geq 1/2$

$$q = \Pr(\tilde{G}|G) = \Pr(\tilde{B}|B)$$

$$1 - q = \Pr(\tilde{G}|B) = \Pr(\tilde{B}|G)$$

σ is observed after effort decision

Interpretation of the signal

a. Observation of output in other plots provides information about the state of nature at a specific plot depending on the correlation across plots.

Interpretation of the signal

b. An observable signal, such as the 'Nilometer' that measures the amount of water in the Nile.

The cost of maintaining the agent

0 if effort is low ($e = l$)

γ if effort is high ($e = h$)

Assumptions:

$L \geq \gamma$
(low output is larger than the maintenance cost)

$p(H - L) > \gamma$
(effort is efficient)

Agent's Income and Utility

I - agent's expected income

$U = I - \gamma$ - agent's periodic utility when exerting effort

1 - the agent's discount factor

V - the value of the agent's employment in the second period

$zero$ - agent's value of unemployment

Incentive scheme - the carrot

The principal pays the agent:

a bonus $b \geq 0$ if output is high ($Y = H$)

a basic wage $\omega = \gamma$ regardless of output

Incentive scheme - the stick

The contract could include dismissal of the agent at the end of period 1 if:

$$Y = L \text{ and } \sigma = \tilde{G}$$

(otherwise the agent is retained)

x - the cost of replacing the agent

$$x > \frac{p}{1-p}\gamma$$

→ dismissing the agent when $\sigma = \tilde{B}$ is dominated by never dismissing

→ Two types of contracts are possible in period 1

"Pure Carrot"
(denoted by subscript c)

"Stick and Carrot"
(denoted by subscript s)

In period 2, only *"Pure Carrot"* is relevant

The *IC* constraint under *"Pure Carrot"*

$$\omega - \gamma + pb_c \geq \omega$$

Minimizing the cost of incentivizing the agent

$$b_c = \gamma/p$$

The value of employment in period 2

$$V = \omega - \gamma + pb_c = \gamma$$

The cost of employment for the principal under *"Pure Carrot"*

$$Cost_c = \omega + pb_c = 2\gamma$$

The *IC* constraint under *"Stick and Carrot"*

$$\begin{aligned} & \omega - \gamma + pb_s + [p + (1-p)q]\,V \\ \geq \; & \omega + [p(1-q) + (1-p)q]\,V \end{aligned}$$

$\rightarrow$ (noting that $\omega = V = \gamma$)

$$b_s = \frac{1 - pq}{p}\gamma$$

The cost of employment for the principal under *"Stick and Carrot"*

$$\begin{aligned} Cost_s &= \omega + pb_s + (1-p)(1-q)x \\ &= (2 - pq)\gamma + (1-p)(1-q)x \end{aligned}$$

There exists a threshold $\hat{q}$ such that:

$$Cost_s = Cost_c \text{ for } q = \hat{q}$$

$$\hat{q} = \frac{(1-p)x}{(1-p)x + p\gamma}$$

For $q < \hat{q}$ *"Pure Carrot"*

For $q > \hat{q}$ *"Stick and Carrot"*

$x > \frac{p}{1-p}\gamma \rightarrow \hat{q} > 1/2$

Intuition: a principal relying on a "stick" to incentivize the agent has to incur the cost of dismissal x with probability

$$(1-p)(1-q)$$

$\rightarrow$ The expected cost of using the "stick"

$$(1-p)(1-q)x$$

is decreasing with the quality of information q

Expected Income - *Pure Carrot*

The expected income of the agent

$$I_c = \gamma + pb_c = 2\gamma$$

The expected income of the principal

$$\pi_c = p(H - L) + L - 2\gamma$$

Efficient outcome

$$I_c + \pi_c = p(H - L) + L$$

Expected Income - *Stick & Carrot*

The expected income of the Agent

$$I_s = \gamma + pb_s = 2\gamma - pq\gamma = (2 - pq)\,\gamma$$

is decreasing with q

The intuition for the decline of I with q above $\hat{q}$
Holding constant the bonus, b, a higher q implies a lower probability of dismissal, increasing the value of employment. Therefore, as q increases b has to decline to hold the incentive constraint binding.

Expected Income - *Stick & Carrot*

The expected income of the principal

$$\begin{aligned}\pi_s &= p(H - L) + L - (2 - pq)\,\gamma \\ &\quad -(1 - p)(1 - q)x\end{aligned}$$

is increasing with q
Lower payment to the agent and lower probability of paying x

Expected Income - *Stick & Carrot*

inefficient outcome

$$I_s + \pi_s = p(H - L) + L - (1 - p)(1 - q)x$$

inefficiency declines with q

An Illustrative Calibration

$E(Y) = pH + (1 - p)L = 1$ (representing about 1.5 tons of net grain)

$p = 0.75$, (a bad harvest occurs about every 4 years)

$x = 1, \gamma = 0.2$
$\rightarrow \hat{q} = 0.625$

0.0.1