Notes on Mayshar et al

Model of owner-tenant (principal-agent).

Output depends on randomness (weather) and effort, and effort is not observable.

Weather is either G of B, $P(G) = p$, effort ℓ, h.

The principal has some imperfect information on the exogenous factor (weather). The better the information, the more he can capture.

Minimal model.

Two values of output H and L, Effort requires an investment γ that has to be paid by the owner (e.g., seeds).

H requires good weather AND effort.

L can happen because of B or ℓ

Owner has SBS on the state (weather) with precision $q > 1/2$.

An important assumption is the owner can monitor output (contradiction in **)

Instruments:

- pay at the beginning of the yearly cycle (wage), covers subsistance and resources for investment: $w \geq \gamma$.
- bonus a for H.
- Firing, $d \in \{0, 1\}$ at some cost (for the owner) x

The farmer has an intertemporal u.f. with discount factor δ. (Important for the effectiveness of firing).

Assuming the farmer "works" (see ICC below),

$$V = w + pa - \gamma + (1 - \mu d)\delta V, \quad \mu = (1-p)(1-q).$$

$$V = \frac{w + pa - \gamma}{1 - \delta(1 - \mu d)}.$$

ICC

$$pa + (1 - \mu d)\delta V + w - \gamma \geq \delta V + w - d(pq + \mu)\delta V.$$

$$pa \geq \gamma - dpq\delta V.$$

Hence, $w = \gamma$. and

$$pa \geq \frac{\gamma}{1 + \frac{\delta pq}{1 - \delta(1 - \mu d)} d}. \tag{1}$$

Principal payoff: $p(H - a) + (1 - p)L - \mu xd - w$.

Note the principal's cost-free information about the output.

Minimize $C = pa + \mu xd$.

Two special cases:

- $d = 0$ (no stick), then the ICC reduces to $pa \geq \gamma$. Since the worker is not fired for low output, he will put the effort required for higher output only if his expected reward is greater than the cost of effort. This is a pure "carrot policy".
- $d = 1$ The stick is used whenever output is low and the principal gets the signal (which may be wrong) that crop conditions were good. In this case the ICC becomes

  $$pa \geq A\gamma, \text{with} \quad A = \frac{1}{1 + \frac{\delta pq}{1 - \delta(1 - \mu)}}.$$

  Since $A < 1$, the principal can capture more than in the previous case when output is high: the farmer does not need as much an incentive to work because there is is the threat of the stick if output is low and the principal thinks that it should be high.

If the stick is not costly to the principal, he chooses always to use it. What refrains him is a cost of using the stick (assumed in the model to be equal to x.

Consider now the two extreme cases of information.

- When there is perfect information, $q = 1$. The principal chooses the stick policy. The farmer produces the high effort. If conditions are bad, the principal knows it. Actually the principal never has to use the stick. This policy is obviously optimal. With $q = 1, \mu = 0$ and the ICC becomes

$$pa \geq \gamma\Big(\frac{1-\delta}{1-\delta(1-p)}\Big).$$

  The farmer receives a reward for high output, there is a carrot, but this reward is smaller than the expected gain from the effort (because of the stick). The reward to the principal is higher if the farmer values more the staying in his land (when δ increases). The principal captures more when the farmer has a lower discount rate (more value of staying on the job).

- No information, $q = 1/2$. In this case, the ICC becomes

$$pa \geq \gamma(1 - \frac{\delta p}{2}).$$

  Comparing with the carrot policy,

$$G = pa + \mu x - \gamma = \frac{1-p}{2}x - \gamma\delta\frac{p}{2}.$$

  The carrot policy is better if p is small, δ is small, x is high.