Topics in Incentives and Organizations

Li-An Zhou

Guanghua School of Management
Peking University

November 27, 2007

Baseline Models of Incentives and Organizations I

- Incentive Contracting
- Efficiency Wages
- Career Concerns and Reputation
- Incomplete Contracts and Theory of the Firm
- Applications of Incentive Theory in Government Organizations

Incentive Contracting or Moral Hazard: The Setup I

A general model of Moral Hazard, despite a number of useful insights, is quite difficult to work with. It derives incentive contracts that can be very nonlinear in nature.

Holmstrom and Milgrom (1987) establishes an important result that the linear contract is optimal under some circumstances. Motivated by this result, many applied papers look at the following static principal-agent problem:

- The principal chooses a linear contract: $s = \alpha + \beta x$
- The agent chooses a
- $x = a + \epsilon, \epsilon \sim N(0, \sigma^2)$,

Incentive Contracting or Moral Hazard: The Setup II

- The principal is risk neutral, and the agent is risk averse with the utility function
  $U(s, a) = -exp(-r(s - C(a)))$, where $C(a) = 1/2ca^2$

Note that the agent's utility function takes the form of CARA (constant absolute risk aversion) with the degree of absolute risk aversion equal to r.
It turns out that the results of this simplified framework are very intuitive and consistent with the generalized baseline model. Now lte us derive the optimal contract in this case.

Solving the Model I

- A useful result: If $u(w) = -e^{-rw}$, and $w \sim N(\bar{w}, \sigma_w^2)$, the expected utility of the agent is
  $Eu(w) = -\int e^{-rw} f(w)dw = -exp[-r(\bar{w} - \frac{1}{2}r^2 Var(w))]$
- The optimization problem for the agent is choose a
  $max \quad E\{-exp[-r(s(a) - C(a))]\} =$
  $max \quad -exp\{-r[Es(a) - C(a) - \frac{r^2}{2} Vars(a)]\}$
- The equality follows from the normality of s,and this is equivalent to
  $max \quad Es(a) - \frac{r^2}{2} Var(s(a)) - \frac{c}{2}a^2$
  $\Rightarrow Max \quad \beta a - \frac{1}{2}ca^2 - \frac{1}{2}r^2\beta^2\sigma^2$
  $\Rightarrow a = \frac{\beta}{c}$

Solving the Model II

Solving the Model I

The principal will choose α and β to maximize

$Max \quad E[(1-\beta)(a+\epsilon)-\alpha]$

$s.t. \quad a = \frac{\beta}{c}$ (Incentive Compatibility Constraint)

$\alpha + \frac{1}{2}\beta^2(\frac{1}{c} - r\sigma^2) \geq \bar{h}$ (Paticipation Constraint)

where $\bar{h} = -ln(-\bar{H})$, $\bar{H}$ is the reservation utility of the agent. The solution to this problem is

$\beta^\star = \frac{1}{1+rc\sigma^2}, \quad \alpha^\star = \bar{h} - \frac{1}{2c(1+rc\sigma^2)}$

Note that the trade-off between efficiency and risk-sharing determines the optimal design of the incentive contract. Note the different roles of β and $alpha$. The equilibrium level of effort is $a^\star = \frac{1}{c(1+rc\sigma^2)}$

This is lower than the first-best level of effort, $a^{FB} = \frac{1}{c}$. What makes such a difference is the risk aversion and uncertainty.

The Role of Information I

Suppose that there is another signal of the effort $z = a + \eta$, where $\eta \sim N(0, \sigma_\eta^2)$

Now restricting attention to linear contracts of the form:

$s = \alpha + \beta_x x + \beta_z z$

Then the F.O.C. of the agent optimization problem is $a = \frac{\beta_x + \beta_z}{c}$, and the optimal contract can be obtained as

$\beta_x = \frac{\sigma_\eta^2}{\sigma^2 + \sigma_\eta^2 + rc(\sigma^2 \sigma_\eta^2)}$

$\beta_z = \frac{\sigma^2}{\sigma^2 + \sigma_\eta^2 + rc(\sigma^2 \sigma_\eta^2)}$

Extension A: Multitasking I

The attention on multitasking is due to Holmstrom and Milgrom (1991). It refers to a situation in which an agent has to work in more than one task. Multitasking is generally associated with problems of giving incentives to the agent in one sphere while distorting his other incentives.

Let us continue to work with the linear model above, and suppose that there are two efforts that the individual chooses, a_1 and a_2, with a cost function $C(a_1, a_2)$ which is increasing and convex as usual.

These efforts lead to two outcomes:

$x_1 = a_1 + \epsilon_1$

$x_2 = a_2 + \epsilon_2$

The principal values these outcomes in a way that leads to his return as $\phi_1 x_1 + \phi_2 x_2 - s$

where s is the salary paid to the agent.

Extension A: Multitasking I

What is different from previous setup is that only x_1 is observed while x_2 is unobserved. There are many examples of multitasking problem, such as home renovation contracting, university professor's performance in teaching and research, and employee's efforts in increasing the speed in production while maintaining the quality.

Let us take a linear contract of the form: $s(x_1) = \alpha + \beta x_1$ since x_1 the only observable output.

The first-order conditions of the agent now give

$\beta = \frac{\partial C(a_1,a_2)}{\partial a_1}$

$0 = \frac{\partial C(a_1,a_2)}{\partial a_2}$

Obviously if $\frac{\partial C(a_1,a_2)}{\partial a_2} > 0$ whenever $a_2 > 0$, then the agent will choose $a_2 = 0$ and there is no way of inducing him to choose $a_2 > 0$.

Extension A: Multitasking II

However, suppose that $\frac{\partial C(a_1,a_2)}{\partial a_2} < 0$, so without incentives the agent will exert some positive efforts in the second task. But providing incentives in task 1 will undermine the incentive in task 2 if these two efforts are substitutes (i.e., $\frac{\partial^2 C(a_1,a_2)}{\partial a_1 \partial a_2} > 0$).
To see it more formally, imagine that F.O.C. (1) has an interior solution, and differentiate these two F.O.Cs with respect to β. We can see immediately that

$\frac{\partial a_1}{\partial \beta} > 0$

$\frac{\partial a_2}{\partial \beta} < 0$ if $\frac{\partial^2 C(a_1,a_2)}{\partial a_1 \partial a_2} > 0$

Thus high-powered incentives in one task adversely affect the other task.
If the second task is sufficiently important for the principal, then she will "'shy away"' from high-powered incentives. This explains why

Extension A: Multitasking III

weak incentives are observed within organizations, such as firms and government sectors.

More formally, it can be shown that

$$\beta^{\star\star} = \frac{\phi_1 - \phi_2\Gamma}{1 + r\sigma_1^2(\partial^2 C(a_1, a_2)/\partial a_1^2 - \Gamma)}$$

where $\Gamma = \frac{\partial^2 C(a_1, a_2)/\partial a_1 \partial a_2}{\partial^2 C(a_1, a_2)/\partial a_1^2}$

This simple model aslo shows how the multitasking idea explians why the firm wants to put restrictions on the outside activities of workers or managers, and how it gives you a new perspective on thinking of how different tasks should be organized into various jobs.

Extension B: Relative Performance Evaluation I

The baseline model can also extend to the multi-agents setting if many agents work on similar tasks. Let us go back to the one-task linear model. The model is the same in all aspects except that there is another worker (perhaps working for some other principal), whose performance is given by

$\tilde{x} = \tilde{a} + \tilde{\epsilon}$

Assume that $\tilde{x}$ is publicly observed.

In equilibrium, everybody will guess the level of effort that this other agent will exert given his contract, so $\tilde{x}$, along the equilibrium path, will reveal $\tilde{\epsilon}$.

Extension B: Relative Performance Evaluation II

If ϵ and $\tilde{\epsilon}$ are uncorrelated, the equilibrium derived above applies. But suppose that these two agents are doing similar work which is subject to common shocks. That is,
$Cov(\epsilon, \tilde{\epsilon}) = \rho > 0$.
In this case, it can be shown that the optimal (linear) contract will take the form of
$s = \alpha + \beta x - \tilde{\beta}\tilde{x}$ with the solutions

$$\beta = \frac{1}{1+rc\sigma^2(1-\rho)}$$

$$\tilde{\beta} = \frac{\rho}{1+rc\sigma^2(1-\rho)}$$

The agent's payment is more sensitive to his own performance (β is now larger),but he is being punished by the successful performance of the other agent, and the extent depends on the degree of correlation

Extension B: Relative Performance Evaluation III

between the two performances. This is clearly a form of *relative performance evaluation*, where the agent is evaluated not simply on his absolute performance, but also on a relative standard set by others in the similar field.

This practice of relative performance evaluation can more generally be seen as a nature result of the Informativeness Principle developed in the principal-agent theory (Holmstrom, 1979). This principle says that all useful information should be included in the incentive contract and more information is better for the principal. But remember that this conclusion relies on the static setting and no dynamic element is concerned.

Extension C: Tournaments I

Similar to relative performance evaluation, some form of "yardstick competition", where employees are compare to each other, often occurs inside firms.

- ❐ Promotion rule inside firms or government sector
- ❐ Tenure system or "Up-or-Out" contract in academic institutions

This situation is sometimes referred to as "tournaments" in economics literature, due to a seminal paper by Lazear and Rosen (1981). Suppose a firm hiring two employees doing a similar job, one producing x_1, the other producing x_2. We know from the baseline model that the optimal contract should make their rewards a function of both x_1 and x_2.

Extension C: Tournaments II

Lazear and Rosen look at a non-optimal but intuitive contract where the renumerations are a function of their "rank", exactly is in sports tournament, where the highest prize goes to the winner.

More formally, let us assume that both the principal and the agents are risk-neutral, and the output of each agent is given by

$x_i = a_i + \theta_i$

where a_i is effort and θ_i is a stochastic term. Assume that both agents have an identical cost function, $C(a)$, which is increasing and convex as usual, and let us denote the reservation utility of both agents by $\bar{H}$ as before.

Clearly the first-best outcome will solve $max \quad x_i - C(a_i)$, which yields the first-order condition

$C'(a^{FB}) = 1$

Extension C: Tournaments III

Let us assume an extreme case where θ_1 and θ_2 are independent, so that we are dealing with a situation different from the standard "relative performance evaluation". Assume further that they are drawn from a continuous distribution function $F(\theta)$ with the density function $f(\theta)$.

The principal is restricted to the following contract:

$w_i(x_i, x_2) = \bar{w}$ if $x_i > x_j$, and $\underline{w}$ if $x_i < x_j$, and $\frac{1}{2}(\bar{w} + \underline{w})$ if $x_i = x_j$.

The principal only chooses two levels of payments $\bar{w}$ and $\underline{w}$ to maximize her expected profits. There is a dffierence here from what we have studied so far, since now conditional on the contract offered by the principal, the two agents will be playing a game, since their effort choices will affect the other agent's payoff.

More specifically, the timing of moves is now given by

Extension C: Tournaments IV

- (1) The principal chooses $\bar{w}$ and $\underline{w}$;
- (2) Agents simultaneously choose a_1 and a_2.

Formally, this corresponds to a dynamic game where to principal is like a Stackleberg leader in oligopoly theory. Let us analyze the Nash equilibrium in the subgames between the agents, and then the optimal contract choice of the principal.

Before solving the subgame perfect equilibrium, let us first work out a key variable that will be used in the subsequent analysis.

Define $P_i(a_i, a_j) \equiv Prob\{x_i > x_j \mid a_i, a_j\}$

Since $x_i = a_i + \theta_i > x_j = a_j + \theta_j \Leftrightarrow \theta_i > a_j - a_i + \theta_j$

$$
\begin{aligned}
P_i(a_i, a_j) &= Prob\{\theta_i > a_j - a_i + \theta_j \mid a_i, a_j\} \\
&= \int Prob\{\theta_i > a_j - a_i + \theta_j \mid \theta_j, a_i, a_j\} f(\theta_j) d\theta_j \\
&= \int [1 - F(a_j - a_i + \theta_j] f(\theta_j) d\theta_j
\end{aligned}
$$

Extension C: Tournaments V

Nash equilibrium in the subgame given the wage function $w(x_1, x_2)$, is defined as a pair of effort choices $(a_1^\star, a_2^\star)$ such that

$a_i^* \in max_{a_i} \quad P_i(a_i, a_j^\star)\bar{w} + [1 - P_i(a_i, a_j^\star)]\underline{w} - C(a_i)$

The first-order condition for the Nash equilibrium for each agent is therefore given by

$(\bar{w} - \underline{w})\frac{\partial P_i(a_i, a_j^\star)}{\partial a_i} = C'(a_i)$

It says that each agent will exert effort up to the point where the margianl gain, which equal to the prize for success times the increase in the probability of success, is equal to marginal cost of exerting effort. In a symmetric NE, $a_1^\star = a_2^\star = a^\star$, and we have

$(\bar{w} - \underline{w}) \int f(\theta_j)^2 d\theta_j = C'(a^\star)$

Note that $\frac{\partial P_i(a_i, a_j^\star)}{\partial a_i} = \int f(\theta_j)^2 d\theta_j$. Since $C(a)$ is convex, a bigger prize for winning induces more effort. On the other hand, holding the prize constant, it is not worthwhile to work hard when output is very

Extension C: Tournaments VI

noisy, because the outcome of the tournament is likely to be determined by luck rather than effort. If θ is normally distributed with variance σ^2, for example, then

$\int f(\theta_j)^2 d\theta_j = \frac{1}{2\sigma\sqrt{\pi}}$,

which decreases in σ, so $a^\star$ indeed decreases in σ.

We now work backwards to the first stage of the game. Suppose that the employees' alternative employment opportunity would provide utility $\bar{H}$. Since in the symmetric Nash equilibrium each worker wins the tournament with probability one-half, if the principal intends to induce the employees to participate in the tournament then she must choose wages that satisfy $\frac{1}{2}\bar{w} + \frac{1}{2}\underline{w} - C(a^\star) \geq \bar{H}$

Assume that $\bar{H}$ is low enough that the principal wants to induce the employees to participate in the tournament, she therefore chooses wages to

Extension C: Tournaments VII

$max \quad 2a^\star - \bar{w} - \underline{w}$
$s.t. \quad \frac{1}{2}\bar{w} + \frac{1}{2}\underline{w} - C(a^\star) = \bar{H}$
This is equivalent to maximizing $a^\star - C(a^\star)$, which yields $C'(a^\star) = 1$. Note this is the first-order condition for the first-best level of effort. Substituting this into agents' first-order condition of utility maximization implies that the optimal prize solves
$(\bar{w} - \underline{w}) \int f(\theta_j)^2 d\theta_j = 1$,
and the agent's participation constraint and then determines $\bar{w}$ and $\underline{w}$ themseleves.
$\bar{w} = \bar{H} + C(a^\star) + \frac{\bar{w}-\underline{w}}{2}$
$\underline{w} = \bar{H} + C(a^\star) - \frac{\bar{w}-\underline{w}}{2}$

Extension C: Tournaments VIII

- The tournament, not optimal in general, implements the first-best outcome. The environments here are so simple that both the optimal contract a la Holmstrom, and the non-optimal contract a la Lazear-Rosen achieve the first best outcome.
- Tournaments may be attractive to organization designers because they are simple and probably robust;
- But they also have adverse consequences, such as the created incentive to sabotage co-workers (Lazear, 1988) and potential collusion among the agents (Mookherjee).

Career Concerns: The Motivations I

- In practice, firm managers are not simply rewarded for the current performance with wages, but their future prospects for promotion and employment depend on their current performance. This is referred to as "career concerns" following the semianl paper by Holmstrom (1982, 1999).

- Fama (1980) informally suggested that the market for managers would be sufficeint to give them sufficient icentives without agency contracts.

- The performance of the agent is "observable" so that the market knows about it and decide whether to hire the agent or not accordingly, even though it is hard to contract upon.

Career Concerns: The Setup of the Basic Model I

We will start with a two-period model. This class of models are sometimes referred to as "signal jamming" models.

- The manager's output i is $x_t = \underbrace{\eta}_{ability} + \underbrace{a_t}_{effort} + \underbrace{\epsilon}_{noise} \quad (t = 1, 2)$
- There are no performance contracts to be signed; Output is observable but not verifiable
- $\epsilon_t \sim N(0, \frac{1}{h_\epsilon})$, h represents "precision";
- $\eta, \epsilon_1, \epsilon_2$ are independent with $\eta \sim N(m_0, \frac{1}{h_0})$

Two things are worth mentioning:

Career Concerns: The Setup of the Basic Model II

- Different from the basic moral hazard model this is an equilibrium model in the sense that there are other firms out there who can hire this agent-manager. This is the source of the career concerns. Lossely speaking, a higher perception of the markets about the ability of the agent, η, will translate into higher wages.
- Under certain circumstances the agent might have incentive in working harder to improve the perception of the market about his ability; This is why this model is also called "signal jamming" model.

The information structure of the model:

Career Concerns: The Setup of the Basic Model III

- Firms, manager, market all share prior belief about η (thereby no asymmetric information and adverse selection)
- They all observe x_t each period
- Only manager sees a_t (moral hazard/hidden action)

In equilibrium firm and market correctly conjecture a_t. This is very important from a technical point of view, because along the equilibrium path despite the fact there is a hidden action, information will stay symmetric.
In particular, competition in the labor market implies that the wage of the manager at a time t is equal to the mathematical expectation of the output he will produce given the history of its outputs.

Career Concerns: The Setup of the Basic Model IV

$w_t(x^{t-1}) = E(x_t \mid x^{t-1})$
where $x^{t-1} = \{x_1, ..., x_{t-1}\}$ is the history of his output realizations.
We also write this as
$w_t(x^{t-1}) = E(x_t \mid x^{t-1}) = E(\eta \mid x^{t-1}) + a_t(x^{t-1})$
where $a_t(x^{t-1})$ is the effort that the agent will exert given history x^{t-1}, which is perfectly anticipated by the market along the equilibrium path.
The agent maximizes
$U(w, a) = \sum_{t=1}^{T} \beta^{t-1}[w_t - C(a_t)]$
where β is the agent's discount factor and $\beta \leq 1$.
Assume the cost function satifies all standard assumptions. Note that the first-best level of effort solves $C'(a^{FB}) = 1$.
So the sequence and the associated information structure can be summarized as follows:

Career Concerns: The Setup of the Basic Model V

Period 1:

- wage w_1
- effort a_1 chosen by the agents
- output is realized $x_1 = \eta + a_1 + \epsilon_1$

Period 2:

- wage $w_2(x_1)$
- effort a_2 chosen by the agents
- output is realized $x_2 = \eta + a_2 + \epsilon_2$

Career Concerns: The Setup of the Basic Model VI

Career Concerns: Solving the Basic Model I

The equilibrium concept applied here is Perfect Bayesian equilibrium. But for our purposes what matters is that there will be backward induction again, and all beliefs will be pinned down by application of Bayes' rule. So let us start from the second period.
Backward induction immediately makes it clear that $a_2^\star = 0$ irrespective of what happens in the first period since the wage does not depend on second period output,and the world will end after that. Given this, we can write
$w_2(x_1) = E(\eta \mid x_1) + a_2(x_1) = E(\eta \mid x_1)$
Then the problem of the market is the estimation of η given information $x_1 = \eta + a_1 + \epsilon_1$. The only difficulty is that x_1 depends on the first-period effort.

Career Concerns: Solving the Basic Model II

In a perfect Bayesian equilibrium, the market will anticipate the level of effort a_1, and given the beliefs, agents will in fact play exactly this level. Let the conjecture of the market be $\bar{a}_1$.

Define $z_1 \equiv x_1 - \bar{a}_1 = \eta + \epsilon_1$ as the deviation of the observed output from this conjecture.

Once we have z_1, life is very simple since everything is normal. In particular, standard normal updating implies that

$\eta \mid z_1 \sim N\left(\frac{h_0 m_0 + h_\epsilon z_1}{h_0 + h_\epsilon}, h_0 + h_\epsilon\right)$

Intuitively, we start with prior m_0,and updated according to the information contained in z_1.

Therefore we have

$E(\eta \mid z_1) = \frac{h_0 m_0 + h_\epsilon z_1}{h_0 + h_\epsilon}$ or

$E(\eta \mid z_1) = \frac{h_0 m_0 + h_\epsilon (x_1 - \bar{a}_1)}{h_0 + h_\epsilon}$

Career Concerns: Solving the Basic Model III

Consequently $w_2(x_1) = \frac{h_0 m_0 + h_\epsilon (x_1 - \bar{a}_1)}{h_0 + h_\epsilon}$

To complete the charaterization of equilibrium we have to find the level of a_1 that the agent will choose as a function of $\bar{a}_1$, and make sure that this is indeed equal to $\bar{a}_1$, i.e., this will ensure a fixed point, as required by our concept of Perfect Bayesian equilibrium.

Let us write the optimization problem of the agent.

$max_{a_1} \quad [w_1 - C(a_1)] + \beta[E\{w_2(x_1) \mid \bar{a}_1\}]$

Here we have used the fact that $a_2 = 0$. Substituting from above and dropping w_1 which is just a constant, this is equivalent to

$max_{a_1} \quad \beta E\{\frac{h_0 m_0 + h_\epsilon (x_1 - \bar{a}_1)}{h_0 + h_\epsilon} \mid \bar{a}_1\} - C(a_1)$

$max_{a_1} \quad \beta E\{\frac{h_0 m_0 + h_\epsilon (\eta + \epsilon_1 + a_1 - \bar{a}_1)}{h_0 + h_\epsilon} \mid \bar{a}_1\} - C(a_1)$

Career Concerns: Solving the Basic Model IV

Making use of the fact that a_1 is not stochastic (the agent is choosing it, so he knows what it is!), the problem is

$$max_{a_1} \quad \beta \frac{h_\epsilon}{h_0+h_\epsilon} a_1 - C(a_1) + \beta E\{\frac{h_0 m_0 + h_\epsilon(\eta+\epsilon_1-\bar{a}_1)}{h_0+h_\epsilon}\}$$

Then we obtain the first-order condition:

$$C'(a_1^\star) = \beta \frac{h_\epsilon}{h_0+h_\epsilon} < 1 = C'(a_{FB}^\star)$$

So the agent exerts less than first-best effort in period one.

Holmstrom shows that as long as $\beta < 1$, equilibrium effort is always less than the first-best even in the infinite horizon model.

The characterization of the equilibrium is completed by imposing $\bar{a}_1 = a_1^\star$, which enables us to compute is w_1. Recall that

$$w_1 = E(x_1 \mid prior) = E(\eta) + \bar{a}_1 = m_0 + a_1^\star$$

The model has very intuitive comparative statics. In particular, we have

$$\frac{\partial a_1^\star}{\partial \beta} > 0, \frac{\partial a_1^\star}{\partial h_\epsilon} > 0, \frac{\partial a_1^\star}{\partial h_0} < 0$$

Career Concerns: Solving the Basic Model V

This model gives a number of insights about what type of professions might have good incentives coming from career concerns. For example, if we think that ability matters a lot and shows a lot of variability in politics, the model would suggest that career concens should be important for politicians.

Career Concerns: Multi-Period Model I

Let us breifly emphasize one implication of having multiple periods in this setting. There will be more learning early on than later.

To illustrate this, let us look at the same model with three periods.

This model can be summarized by the following matrix:

$w_1 \quad a_1^\star$

$w_2(x_1) \quad a_2^\star$

$w_3(x_1, x_2) \quad a_3^\star$

With the similar analysis to before, the first-order conditions for the agent are

$C'(a_1^\star) = \beta \frac{h_\epsilon}{h_0 + h_\epsilon} + \beta^2 \frac{h_\epsilon}{h_0 + 2h_\epsilon}$

$C'(a_2^\star) = \beta \frac{h_\epsilon}{h_0 + 2h_\epsilon}$

This immediately implies that $a_1^\star > a_2^\star > a_3^\star = 0$.

More generally, in the T-period model, the relevant first-order condition is

Career Concerns: Multi-Period Model II

$C'(a_t^\star) = \sum_{\tau=t}^{T} \beta^{\tau-t+1} \frac{h_\epsilon}{h_0+\tau h_\epsilon}$. Holmstrom show sthat in this case, with T sufficiently large, there exists a period $\bar{\tau}$ such that

$a_{t<\bar{\tau}}^\star \geq a_{FB} \geq a_{t>\bar{\tau}}^\star$

In other words, managers work too hard when young and not hard enough when old–think of assistant professors!

Efficieny Wages: Introduction I

In efficiency-wage models, the output of a firm's work force depends on the wage the firm pays.

- In developing countries, higher wages could lead to better nutrition;
- In developed countries, higher wages could induce more able worders to apply for jobs at the firm, or could induce an existing work force to work harder.
- Shapiro and Stiglitz (1984) develop a dynamic model in which firms induce workers to work hard by paying high wages and threatening to fire workers caught shirking.

Efficieny Wages: Introduction II

- As a consequence of high wages, firms reduce their demand for labor, so some workers are employed while others are involuntarily unemployed. The larger the pool of unemployeemnt, the longer it would take a fired worker to find a new job, the more effective the threat of firing.
- It is the combination of unemployeemnt and high wages that makes work more attractive for workers, hence the title of the paper "unemployment as a worker-discipline device".

Efficieny Wages: The Model I

The basic set-up of the model is as follows:

- The model is in continuous time and all agents are infinitely lived.
- All agents are risk neutral and there are N workers.
- Workers have to choose between two levels of effort (0 and 1), and are only productive if they exert effort (1) at the cost e.
- The efforts are not observable, and cannot be induced from output, since output is a function of all workers' efforts. This introduces moral hazard problem.
- If a worker shirks, then there is probability q of getting detected and fired.

Efficieny Wages: The Model II

- Notations: $b =$ exogenous separation rate; $a =$job finding rate; $r =$interest rate/discount factor.

- These types of dynamic models are typically solved by using dynamic programming/BEllman equations. But we will focus on steady states. In any state, we can simply think of the present discounted value (PDV) of workers as a function of their "strategy"' of shirking or working hard.

Denote the expected life-time utility or PDV of employed-shirker by V_E^S, then the fundamental asset equation for a shirker is given by
$rV_E^S = w + (b+q)(V_U - V_E^S)$
For a nonshirker, it is
$rV_E^N = w - e + b(V_U - V_E^N)$

Efficieny Wages: The Model III

Note that each of these equations is of the form " interest rate times asset value equals flow benefits (dividends) plus expected capital gains (or losses)" (See the Shapiro-Stiglitz paper for more details of mathematical derivation).

The PDV of unemployed workers V_U is $rV_U = z + a(V_E - V_U)$ where $V_E = max\{V_E^S, V_E^N\}$ and z is the utility of leisure+unemployment benefits.

Non-shirking condition is an incentive-compatibility constraint that requires the worker to prefer to exert effort. Combining three equations, we obtain it as $V_E^N \geq V_E^S$

$\Rightarrow w \geq z + e + [r + b + a]\frac{e}{q}$

The more likely is the worker to be caught while shirking, the lower is the wage. And the wages are higher when r, b and a are higher. Why? (Hint: Think about the attractiveness of the job)

Efficieny Wages: The Model IV

Steady state $\Rightarrow$ flow into unemloyment $=$ flow out of unemployment.
In equilibrium, no one shirks because the non-shirking condition holds.
Therefore, $bL = aU \Rightarrow a = \frac{bL}{U} = \frac{bL}{N-L}$
Now substituting for this we get the full non-shirking condition as
$w \geq z + e + [r + \frac{bN}{N-L}]\frac{e}{q}$
Note that a higher level of $\frac{N}{N-1}$, which corresponds to lower unemployment, necessitate a higher wage to satisfy the non-shirking condition. This is the sense in which unemployment is a worker-discipline device. Higher unemployment makes losing the job more costly, hence encourages workers not to shirk.
Now let us consider labor demand. In particular, let's suppose that there are M firms, each with access to a production function $AF(L)$, where L denotes labor. Assume that $F'(.) > 0, F''(.) < 0$.

Efficieny Wages: The Model V

Profit-maximization implies $AF'(L) = w$. Aggregate labor demand is thus given by $AF'(\frac{L}{M}) = w$.

Set $M = 1$ as a normalization, then equilibrium will be given by the equation $z + e + [r + \frac{bN}{N-L}]\frac{e}{q} = AF'(L)$

This equation basically equates labor demand with quasi-labor supply. This is quasi-labor supply rather than real labor supply because it is not determined by the work-leisure trade-off of workers, but by the non-shirking condition.

The main idea of efficiency wages can also be modeled by studying the repeated-game aspects of the model (but ignore the competitive-market aspects) by analyzing the case of one firm and one worker.

The Theory of the Firm: Motivations I

- The neoclassical theory of the firm views the firm as a "black box" associated with a technology, such as production function;
- The firm's problem is given by the profit maximization program: $max \quad p \bullet q - C(q)$. This program will sometimes give us the minimum efficiency scale (MES), that is, the quantity for which average costs are minimized.
- On the positive side, the neoclassical theory of firm is surely right to stress the role of technology in general, returns to scale in particular, as important determinants of firm size.

The Theory of the Firm: Motivations II

- There are clearly some straightforward weakness with this approach. First, it says nothing about the internal organization of the firm or about agency problems, incentives, etc.

- Second, consider any of the predictions regarding the size of the firm. The natural question that arises is, why can't two differnt firms belong to the same outfit, i.e., why can a single firm have two plants? Take this question into the extreme, why can't all the production in the world be one giant, single entity owned firm?

- So this theory seems like *a theory of plant size* given technology, and not a theory of the firm. It doesn't determine the boundaries of the firm.

The Theory of the Firm: Motivations III

- The principal-agent theories analyze and describe how parties should contract, or set incentives. So it can shed some light on the internal organization of the firm in the sense of optimal inceitves, flows of information, and contracting between parties that interact together.

- However, these theories say nothing about when firms should merge, or when we should see vertical integration. More importantly, the principal-agent relationships can occur inside the firm or between separate firms. It does not pin down the *boundaries* of the firm.

Transaction Cost Theory I

- Transaction cost theory starts from Coase (1937) which poists that the existence of transaction costs on the market justifies resorting to various coordination mechanisms in a decentralized economy, especially hierarchical coordination within firms.

- Coase's (1937) key insight was to observe that in organizing trnascations, there is a choice between placing a transaction in a market and locating it inside a firm, i.e., so-called "buy-or-make" choice. This raises the central question of what determines the boundaries of the firm.

- Williamson (1975, 1985) substantially developed Coase's ideas, which gave rise to so called "New Institutional Economics", or "Transaction-Cost Economics".

Transaction Cost Theory II

- The transcation-cost approach holds that the organizations and institutions can be understood in transaction-economizing terms.
- Williamson (1975, 1985) discussed three ingredients of bilateral relationships:
  1. Bounded rationality
  2. Opportunism
  3. Relationship specific investments
- Alinging governance structures (markets, hybrid forms, and firm) with the attributes of transaction, of which the condition of asset specificity is the most important.
- Transaction-cost theory analyzes only discrete choices

Transaction Cost Theory III

- ❒ In contrast with Incomplete Contract Theory, incompleteness in the transaction-cost theory is not due to verifiability problems but to the limited rationality of economic agents and uncertainty of environments.

Five features of Transaction-Cost Economics are summarized as follows:

- ❒ The transaction (trade, exchange, contract) is the basic unit of analysis;
- ❒ All complex contracts are incomplete by reason of bounded rationality;

Transaction Cost Theory IV

- Many contracts pose hazards especially in the case of asset specificity-assets
- Governance structures, which are the institutional frameworks within which the integrity of contact is decided, are hazard mitigating responses;
- Each generic mode of governance is supported by a distinctive form of contract law.

Incomplete Contracts and Hold-up Problem I

The hold-up problem arises when there are relationship-specific investments and a comphrensive contingent contract is infeasible. Let's use a simple model to illustrate this idea. Let B and S be, respectively, the buyer and seller of (one unit) an input. Suppose that in order to realize the benefits of the input, B must make an investment a which is specific to S; for example, B might have to build a plant next to S.
Assume that there are only two periods: the investment is made at date 0, while the input is supplied and the benefits are received at date 1. S's supply cost at data 1 is c, while B's benefit function is $b(a)$ (all costs and benefits are measured in data-1 dollars).

Incomplete Contracts and Hold-up Problem II

If no long-term contract is written at date 0, the parties will determine the terms of trade from scratch at date 1. If we assume that neither party has alternative trading partners at date 1 then there is, given B's sunk investment cost a, a surplus of $b(a) - c$ to be divided up. A simple assumption to make is that the parties split this 50:50 as the Nash bargaining solution. That is, the input price p will satisfy $b(a) - p = p - c$. This means that the buyer's overall payoff, the net of his investment cost, is

$$b(a) - p - a = \frac{b(a)-c}{2} - a$$

The buyer, anticipating this payoff, will choose to maximize it, which leads to the first-order condition

$$\frac{1}{2}b'(a) = 1$$

Incomplete Contracts and Hold-up Problem III

This leads to underinvestment becasue the efficient outcome requires the maximization of total surplus, $b(a) - c - a$, which implies $b'(a^{FB}) = 1$

In the extreme case, the hold-up problem will make a equal to zero and trade will occur at all.

Efficiency can be achieved if a long-term contract is written at date 0 specifying the input price $p*$ in advance. The B will maximize $b(a) - p^{\star} - a$, yielding the first-best investment level a^{FB}. An alternative method is to specify that the buyer must choose $a = a^{FB}$ (otherwise he pays large damages to S; the choice of p can then be left until date 1, with an up-front payment by S being used to compensate B for his investment.

Incomplete Contracts and Hold-up Problem IV

- This is a simple example of the celerated *hold-up problem*: the inability to contract on ex ante investment, together with ex post opportunism, will cause under-investment by the parties involved, so that the first-best investment cannot be realized.

- This hold-up problem lies at the heart of the arguments made in Williamson (1975, 1985) and in Klein, Crawford and Alchian (1978), which emphasize the role of a long-term contract or integration when there are relationship-specific investments.

Incomplete Contracts and Hold-up Problem V

- The hold-up problem is thought to alleviate inside the firm. The cost to vertical integration are considered to be added bureaucratic (unproductive) activities, costs of information-processing, etc. This trade-off determines the boundaries of the firm.
- Critique: We may have hold-up problem inside the firm as well as across firms. Williamson is not clear on exactly how this hold-up probelm is affected by integration.

The Property Rights Theory of the Firm and Asset Ownership: Overview I

- Grossman and Hart (1986) and Hart and Moore (1990) proposed a well-known theory of the firm from the perspective of property rights and incomplete contracts. Their work represents an important formalization of Williamson's theory of the firm.
- Firm is a collection of nonhuman assets (not including human capital or reputation);
- If contracts are incomplete, ownership on nonhuman assets matters since the owner has residual rights of control over them;

The Property Rights Theory of the Firm and Asset Ownership: Overview II

- ❒ Residual rights of control are those rights not specified in the contract, as opposed to specific rights of control;
- ❒ The allocation of residual control rights is identified with the ownership of assets. Ownership will determine who has the property rights over the assets in contingencies that were not specified by the contract. Ownership defines the default options in an incomplete contract.
- ❒ Suppose an extreme case of contratural incompleteness: we cannot describe the future states ex ante, in which case the only "contract" that can be written are those which determine the allocation of ownership. Now add the following ingredients:

The Property Rights Theory of the Firm and Asset Ownership: Overview III

1. Ex post (after private investments and uncertianty) parties have symmetric information;
2. Ex post parties can "renegotiate" (decide how to use assets);
3. Parties have "unlimited wealth" (so that any gain from trade can be realized);
4. Parties can engage in relationship specific investments after the allocation of ownership, but before uncertainty resolved.

❒ This set of assumptions yields the following set of results:

1. Always get ex post efficiency (follows from 1, 2 and 3 above);
2. We will generally get ex ante inefficiency due to hold-up problem;

The Property Rights Theory of the Firm and Asset Ownership: Overview IV

3. Ownership affects the ex post "bargaining position", which implies that ownership affects the ex ante inefficiencies.

- These results imply that we will choose the ownership structure (boundaries of the firm) so as to minimize ex ante inefficiencies.

Let's start with a simple example. Suppose that there are two persons, A and B, and a piece of land for corn production. There are only two periods, date 0 and date 1. In order to produce a certain quantity of corn (say, 100 units) at date 1, an amount of effort or investment is needed for A to make at date 0, which will cost A, say, 60 units.

The Property Rights Theory of the Firm and Asset Ownership: Overview V

If efforts are measurable and verifiable, then ownership doesn't matter. If effort is not measurable, but output is verifiable, then the ownership doesn't matter either.
But given that both effort and output are not contractible, then the ownership does matter.
To see this, think about two scenarios: one scenario is that A owns the land. A will have full incentive to invest since he will get a net profit of 40 units. The second scenario is to let B to own the land. Suppose, as we have done before, that these two guys will reach a 50: 50 split of the corn output through the Nash bargaining, i.e., each will get 50 units out of 100. Surely A will not invest anything at date 0 in this case.

The Simple Model I

Consider two assets a_1 and a_2 and two managers, M_1 and M_2. Only M_i can enhance his productivity using a_i and he can operate it ex post. M_2 then has the option, using a_2 to supply a “widget” to M_1 who uses a_1 to transform the widget into a final product.

- The timeline is as follows (see the Figure);
- *Assumption 1*: Due to incomplete contracts we cannot specify in advance which widget should be traded, or how assets should be used.
- *Assumption 2*: Parties have rational expectation with respect to future payoffs in each state, i.e., they can do dynamic programming.

The Simple Model II

- *Ownership structure*: The only "contracts" that we allow the parties to write are *ownership contracts*. Namely, at the begining, the allocation of assets can be determined. We denote by A the assets owned by M_1, and by B the assets owned by M_2. We will distinguish between 3 possible ownership structures:

Ownership type	A owned by M_1	B owned by M_2
No integration	a_1	a_2
Type 1 integration	a_1, a_2	$\emptyset$
Type 2 integration	$\emptyset$	a_1, a_2

- *Investments*: Each manager has an investment as follows:

The Simple Model III

1. M_2 invests e to reduce production costs. We assume that the personal cost to M_2 of investting e is equal to e;
2. M_1 invests i to enhence the benefits from widget. We assume that the personal cost to M_1 of investing i is equal to i.

- *Assumption 3*: Investments i and e are ex post observable but not verifiable. Also, all preferences are common knowledge.

- An immediate implication is that, if M_1 and M_2 decide to trade ex post then they will trade efficiently due to the Coase Theorem being satisfied ex post. If the parties trade efficiently at a price p then ex post payoffs (ignoring the "sunk costs" of investments) are:

$$\pi_1 = R(i) - p, \quad \pi_2 = p - C(e)$$

The Simple Model IV

and the total surplus is,

$S = R(i) - C(e)$

- We make the assumptions to get a well-behaved problem: $R^{'}(i) > 0, R^{''}(i) \leq 0; \quad C^{'}(e) < 0, C^{''}(e) > 0.$

- An important question is what determines p? To answer this question we need to specify a *bargaining process*. We will use Nash Bargaining, which requires us to specify the "disagreement point" which is a reference point for the renegotiation. For this we describe the case of "no trade" which is the natural disagreement point for this setup.

The Simple Model V

- If M_1 and M_2 do not trade they can both go to a "general" widget market and trade there. The price of the general widget set at $\bar{p}$ and the payoff of each party transacting in the general market are:

  $\pi_1 = r(i, A) - \bar{p}; \quad \pi_2 = \bar{p} - c(e, B)$

- Note that payoffs depend on investment and on which assets are owned. For this to be "consistent", the investment must be in some form of *human capital* since we assume that it has an effect on payoffs even when $A = \emptyset$ for M_1 or when $B = \emptyset$ for M_2. The total ex post surplus when the parties choose no trade is:

  $S = r(i, A) - c(e, B)$

The Simple Model VI

- *Assumption 4*: The total surplus under trade is always higher than that under no trade: $R(i) - C(e) > r(i, A) - c(e, B); \quad \forall A, B$

- This assumption captures the ideas of Williamson that the investments i and e are *relationship specific*, i.e., worth more inside the relationship than outside. we will also assume relationship specificity in the marginal sense:

- *Assumption 5*: $R'(i) > r'(i, \{a_1, a_2\}) \geq r'(i, \{a_1\}) \geq r'(i, \emptyset) \quad \forall i,$ $|C'(e)| > |c'(e, \{a_1, a_2\})| \geq |c'(e, \{a_2\})| \geq |c'(e, \emptyset) \quad \forall e$.

- The assumption 5 needs some explanations:

  1. The idea of investment in human capital is seen by the first inequality being strict. Otherwsie we allow for weak inequalities.

The Simple Model VII

2. If we only have absolute specificity, $R - C > r - c$, but we do not have marginal relationship specificity, then the results will be different.
3. It is important to remember that for ex post efficiency we are assuming that all the functions, R, r, C and c, and both investments, i and e are observable but not verifiable so that they cannot enter into a contract.

- We need to add some technical assumptions to guarantee a "nice" interior solution:
  $R'(0) > 2, R'(\infty) < 1, C'(0) < -2, C''(\infty) > -1$.

The Simple Model VIII

- **First Best Investment Levels**: In a FB world we allow the agents to contract on all varibales, so that the optimal invesments must maximize ex ante total surplus:
$max_{i,e} \quad R(i) - C(e) - i - e \quad \Rightarrow R'(i^{FB}) = 1, C'(e^{FB}) = -1.$
- **Second Best Investment Levels**: Recall that symmetric information and ex post renegotiation must imply that ex post the parties will always choose to trade. The question is, therefore,what is the role of $r(.)$ and $c(.)$?

The Simple Model IX

- The answer is that these two values must be used to determine the *disagreement point*. If M_1 owns $A \subset \{a_1, a_2\} \cup \emptyset$ and M_2 owns $B \subset \{a_1, a_2\} \cup \emptyset \setminus A$, then Nash bargaining implies that they will split the gain from trade compared to no-trade equally between themselves. Thus, profits are:

  $$\pi_1 = r(i, A) - \bar{p} + \tfrac{1}{2}[R(i) - C(e) - (r(i, A) - c(e, B))] - i$$
  $$\pi_2 = \bar{p} - c(e, B) + \tfrac{1}{2}[R(i) - C(e) - (r(i, A) - c(e, B))] - e$$

Note that earlier we described the profits from trade for M_1 to be $\pi_1 = R(i) - p$, which means that we can now get the expression for the trade price,
$p = \bar{p} + \frac{1}{2}[(R - r) - (c - C)]$.
Now given π_1 and π_2 above, we will get M_1 maximizing π_1 and the FOC is:

The Simple Model X

$\frac{1}{2}R'(i) + \frac{1}{2}r'(i, A) = 1$
and similarly for M_2,
$\frac{1}{2}|C'(e)| + \frac{1}{2}|c'(i, B)| = 1$
Proposition 1:Under any ownership structure, second-best investments are strictly less than FB investments.
Proof: This proposition follows immediately from assumptions on the marginal specificity:
$R'(i) > \frac{1}{2}R'(i) + \frac{1}{2}r'(i, A) = 1 \quad \forall A$,
which together with $R'' < 0$ implies that $i < i^{FB}$. The same is true for e. Q.E.D.
The initution is simple: There is ex post expropriation of rents which leads to a "free-rider" problem: costs are absorbed in full ex ante, but gains are split 50:50 ex post.

The Simple Model XI

Lemma 1: Transferring assets from M_i to M_j, $j \neq i$, weakly increases the investment of M_j and reduces the investment of M_i.

Proof: Without loss of generality, consider transferrring an asset to M_1 from M_2. $\Rightarrow A \subset \tilde{A}$ and $\tilde{B} \subset B$. Consider M_1, whose FOC implies that under assets A,

$\frac{1}{2}R'(i) + \frac{1}{2}r'(i, A) = 1$,

and under assets $\tilde{A}$, $\frac{1}{2}R'(\tilde{i}) + \frac{1}{2}r'(\tilde{i}, \tilde{A}) = 1$.

From the assumption 5, we know that

$\frac{1}{2}R'(i) + \frac{1}{2}r'(i, A) \leq \frac{1}{2}R'(i) + \frac{1}{2}r'(i, \tilde{A})$,

which together with the first two equations imply that

$\frac{1}{2}R'(\tilde{i}) + \frac{1}{2}r'(\tilde{i}, \tilde{A}) \leq \frac{1}{2}R'(i) + \frac{1}{2}r'(i, \tilde{A})$

Since $R'' < 0, r'' \leq 0$, then it must be that $i \leq \tilde{i}$. A similar argument works for e. Q.E.D.

The Simple Model XII

- The conlusion is clear: *Ownership matters*. It's important to note that ownership does not matter because it potentially affects the decision of trade or no trade, but rather it affects the *disagreement point*, which in turn affects the incentive through the ex post Nash bargaining solution.

- We can now answer the important question regarding the boundaries of firms, when firms are defined by the allocation of assets which are owned by the sam eperson or entity. How should ex ante ownership be allocated?

- The answer is clearly to maximize ex ante expected surplus. We have following cases:

The Simple Model XIII

- **Case 1**: *Inelastic investment decisions*: (See Hart(1995), p44) The rough idea is that the marginal effect of investments by one party are "mostly" independent of the allocation of assets, or more formally,

  $R'(i) \cong r'(i, A) \quad \forall i, A$.

- This is the case where M_1 has inelastic investments, so that M_1''s investment decision is almost constant. If this were the case, then Type 2 integration is optimal.

The Simple Model XIV

- **Case 2**: *Unimportant investment*: The rought idea is that if, for example, $C(e) - e$ is very small relative to $R'(i) - i$, then

  $$S = R(i) - C(e) - i - e = R(i) - i - (C(e) - e) \cong R(i) - i$$

  in which case Type 1 integration is optimal. Thus we don't give assets to an "unimportant" party.

- **Case 3**:*Independent Assets*: This is the case where

  $$r'(i, \{a_1, a_2\}) \equiv r'(i, a_1)$$
  $$c'(e, \{a_1, a_2\}) \equiv c'(e, a_2)$$

- In this case no integration is optimal. Why?

The Simple Model XV

- **Case 4**: *Complimentary Assets*: We consider the strict complementarity case where either

  $r'(i, a_1) \equiv r'(i, \emptyset)$,

  in which case Type 2 integration is optimal, or,

  $c'(e, a_2) \equiv c'(e, \emptyset)$,

  in which case Type 1 integration is optimal. Again, why?

- **Case 5**: *Essentail human capital*: we say that M_1 is essential if

  $c'(e, \{a_1, a_2\}) \equiv c'(e, \emptyset)$,

  and we say that M_2 is essentail if

  $r'(i, \{a_1, a_2\}) \equiv r'(i, \emptyset)$.

The Simple Model XVI

- This idea is that if a certain manager is essentail, the the assets themselves don't enhance incentives, but only the "presence" of the essential party does. Thus, if M_1 is essential then Type 1 integration is optimal. The intuition is that the assets do not help M_2 without the presence of M_1, so M_1 might as well get all the assets.

- **Corollary**: Joint ownership is never optimal.

- This follows from the argument of strict complementarity. If both parties own a_1, then neither party can use it independently if there is no trade (this assumes that joint ownership takes the form of veto power over the use of the assets in case of a disagreement). If we were able to "split" a_1 into two separate assets, that are worthless independently, then these two are

The Simple Model XVII

strictly complementary parts, and from Case 4 above they should both be owned by either M_1 or M_2.

❒ **Criticisms**:

1. Oversimplifies internal structure of the firm. First, most agents get their incentives not through ownership. Second, what is role of management or hierarchy? Third, we do observe joint ownership in professional services. Why?
2. Lack of theoretical foundations. Why property rights and not something else?
3. It spells out why individuals own assets, not firms own assets (Holmstrom, 1999).

Alternative Theories of the Firm I

- ❒ Firm as monitoring device (Alchian and Demsetz, 1972)
- ❒ Firm as incentive system (Holomstrom and Milgrom, 1991; 1994; Holmstrom, 1999)
- ❒ Firm as reputation bearer (Kreps, 1990)
- ❒ Firm as a communication network (Marschak and Radner, 1972)
- ❒ Firm as an authority structure (Simon, 1951; Aghion and Tirole, 1997)

Alchian and Demsetz, 1972, AER I

To illustrate the motivations for Alchian-Demsetz story, suppose that it takes two workers to perform a given task and assume initially that the workers form a partnership.

- The design problem ammounts to choosing a reward structure for each of the partners.
- If the inputs can be observed and contracted upon, then it suffices to pay one the cost of his input and let the other receive the residual.
- What if inputs cannot be verified so that rewards must based on joint output alone? This leads to a free-rider problem.

Alchian and Demsetz, 1972, AER II

- There is no way that each worker receives his social marginal product in equilibrium.

More formally, suppose the technology is given as $y = f(a_1, a_2)$, where a_1, a_2 are the effort levels of the two workers, measured in effort cost units. The efficient choice of effort would require that
$f_1 = f_2 = 1$
Now let $s_1(y) = y - s_2(y)$ be the rules by which the joint output is divided between the two partners. Assume for simplicity that these rules are differentiable.
In a non-cooperative equilibrium, workers would choose input levels so that
$s_1' f_1 = s_2' f_2 = 1$

Alchian and Demsetz, 1972, AER III

For this equilibrium to coincide with the efficient choice of inputs, it must be that
$s_1^{'} = s_2^{'} = 1$
But this cannot be, because $s_2^{'} = 1 - s_1^{'}$.

- Alchian and Demsetz's theory of the firm centers on the incentive problems of joint production.
- The free-riding problem in team production gives rise to an organizational response in which a monitor is brought in to measure inputs and mete out appropriate rewards.
- Who monitors the monitor? To solve this dillemma, the monitor is given the residual rights to output.

Alchian and Demsetz, 1972, AER IV

- Identifying ownership with the rights to the residual income stream, the monitor becomes the owner of the firm
- This theory explains the limited extent of partnership and cooperatives in our economy.

The simple story of owner-monitor has its problems.

- Those who do the monitoring in firms are rarely the residual claimants, except for very small firms.
- Monitoring is not the distinguishing feature of corporations. Partnerships and cooperatives certainly have supervision as well.

Alchian and Demsetz, 1972, AER V

- Most importantly, the monitoring story as told does not offer an explanation of firm boundaries. Nothing would preclude the monitor from being an employee of a separate firm with a service contract that specifies his reward as the residual output.

- Although receiving many critiques, Alchian and Demsetz's theory originated a mesurement-cost-based approach to organizations, which was echoed in Barzel's (1989) theory of property rights and organizations, and also has exerted important influence on the developemnt of Holmstrom and Milgrom (1991, 1994).

Holmstrom and Milgrom, 1994, AER I

- Grossman-Hart-Moore model can only explain why individuals own assets, but not why firms own assets.
- One of the key features of the modern firm is that it owns essentially all the productive assets that it employs. Employees rarely own any assets; they only contribute human capital.
- Holmstrom and Milgrom (1994) treats firm as an incentive system which is composed of at least compensation, ownership and task allocation (job design), not simply as a configuration of asset ownership.

Holmstrom and Milgrom, 1994, AER II

- Most analyses of the make-or-buy decision have focused on just one of the dimensions that distinguish employment from independent contracting, such as *supervision* (Coase, Simon), asset ownership (Williamson, Klein et al.,and Grossman and Hart), and compensation (Alchian and Demsetz, Holmstrom, 1982).
- The central questions center around HM model: 1) Why the three features above are more likely to cluster together? How to explain the covariance of these instruments? 2)Why sometimes one observes one incentive system (i.g., employment) and sometimes the other incentive system?

Holmstrom and Milgrom, 1994, AER III

- Think about the employment relation vs. independent contractors. They are different in three dimensions: compensation (α), ownership (λ) and task assignment (δ). Why does employment relation (or inside procurement) invlove production by a worker who is supervised by the firm *and* uses the firm's assets *and* is paid a fixed wage? Why does outside procurement tend to involve purchases from a worker who chooses his or her own methods and hours *and* owns the assets used *and* is paid only for the quantities supplied (commission-based)?

Holmstrom and Milgrom, 1994, AER IV

- The answer key lies in the *complementarity* in the *levels of incentives* provided for the different activities of a worker in the incentive problem. For example, increasing the incentive for one task could cause a worker to devote too much effort to that one task while neglecting other aspects of the job, and increasing incentives for all of the agent's activities avoides that cost.
- Weak incentives for maintaining asset values should go with weak incentives for narrowly measured performance and significant restrictions on worker freedom.

Holmstrom and Milgrom, 1994, AER V

- Then, how to explain the endogenous choice of incentive systems? Variations in the exgenous parameters, such as the cost of measuring performance, asset specificity, and uncertainty about the future, will lead to the comovements in the incentive instruments.

- Holmstrom (1999) posed the question: why is the ownership of assets clustered in firms?

- He outlines an answer based on the notion that control over physical assets gives control over contracting rights to those assets. Metaphorically, the firm is viewed as a miniature economy, in which asset ownership conveys the CEO the power to define the " rules of the game", that is, the ability to restructure the incentives of those that accept to do business on the subeconomy.

Holmstrom and Milgrom, 1994, AER VI

- The firm is viewed as a subeconomy in which the CEO has the power to regulate trade by assigning tasks, delegating authority, and delineating principles for how explicit and implicit incentives are to be structured.
- Ex post bargaining rights (Models of incomplete contracting) versus ex ante contracting rights (Holmstrom and Milgrom).

Kreps, 1990 I

- The starting point of reputation theory of the firm is the inability to sign comprehensive contracts;
- The soul of the firm is its reputation. Reputation is an intangible asset that is beneficial for transactions with unforseen contingencies.
- A fundamental difference between individual reputation and a firm's reputation is that a firm's reputation is a tradeable asset. If a reputation is acquired under a firm's name, or entity, and it is separated from the *identity* of the firm's owner, then incentives might survive throughout the owner's career.

Kreps, 1990 II

- Repuation offers an implicit promise for a fair or reasonable adjudication process when events occur that are uncovered by contract.

- Corporate culture is a main vehicle in this process which acts as the language for telling its emplyees and trading partners "how things are done and how they are meant to be done".

- Only those with residual decision rights can establish a reputation. Thus parties with significant interest invested in acquiring a reputation should typically be given residual decision rights.

- A central ingredient in a reputational theory of the firm is the mechanism for transferring reputation capital from one generation of managers to the next.

Kreps, 1990 III

- Kreps (1990) offers overlapping generations models in which transfer are feasible. They show that there are supergame equilibria in which reputation will be maintained.
- In Kreps's model, managers own the firm and thereby the title to future income streams. These can be sold to future managers, who buy themselves in to a favorable supergame equilibirum and continue to play it.

Kreps (1990): A Simple Model I

- Consider a seller and a buyer. The buyer can either "Trust" a seller or "Not trust" him. The seller can then "Honor" or " Abuse" trust. Not trusting implies a payoff of 0 for both agents. Trust followed by honor results in a payoff of 1 for both agents, while trust followed by abuse results in a payoff of 2 to the seller and -1 to the buyer.

- It is easy to see that in the one-period version of the this game, the unqiue equlibrium has no trust offered, since if trust is offered then it will clearly be abused. Any finite period version of this game will have same property by backward induction.

Kreps (1990): A Simple Model II

- If, however, this game is repeated infinitely often with some discount factor $\beta < 1$, then a version of folk theorem will apply: there are large enough discount factors for which the following "Nash reversion" strategies for a (subgame perfect) equilibrium of the game: The buyer starts by offering trust, and if trust was never abused then the buyer will cease to offer trust forever. The seller's strategy is to honor trust as long as he never abused trust in the past, and to abuse trust otherwise.

- What if there is instead a sequence of buyers, each living for only one period, who face this long-lived seller? Basically, the same argument would apply: if the seller discounts the future at a rate $\beta \geq 0.5$ then a simple revision of the strategies is an equilibrium: The first buyer starts by offering trust, and each subsequent buyer will offer trust if and only if trust was never abused. The seller's

Kreps (1990): A Simple Model III

strategy is the same. Kreps refers to this equlibrium as one in which the seller has a *reputation* of honoring trust, and this reputation is a valuable asset that is not worth destroying by absuing it.

❒ Now, what happens if the seller is too replaced by a sequence of short-lived sellers? Kreps demonstrates that reputation can become a tradeable asset–and provide incentives–even when buyers too live for only one period.

Kreps (1990): A Simple Model IV

- The argument is simple and appealing: a firm's "name" will be created by the first seller. Each subsequent seller will be trusted (by the buyer of that period), and the current seller acquired the firm's "name"' from his predecessor. Sellers' strategies will be to buy the "name" and honor trust if and only if trust was never abused. Thus, a seller will be able to seller his own good name if and only if he himself honors the trust of the client. If the loss from not being able to sell a name outweighs the benefits from absuive behavior, then sellers will have incentives to honor trust, and cooperative behavior is sustained in equilibirum.

- The appealing feature of Kreps's equilibrium is that short lived agents become "ageless"' in the sense that they do not really face a terminal period. The problem is, however, the presence of multiple equilibira.

Kreps (1990): A Simple Model V

- One problem with the reputation story, taken as the defining characterisitic of firms, is that it leaves unexplained why firms could not simply be labels or associations that carry the requisite reputation capital. The theory does not make a distinction between the firm as a label and the firm as a collection of physical and huamn capital assets.

- Another dimension that deserves elaboration is the joint responsibility for reputation in a firm with many employees. After all, reputations are in the end attached to individuals and their actions. The incentives of individuals not to milk the reputation has not been clarified.

The Internal Organization of Government I

- Government agencies and public enterprises are generally thought to perform poorly because their managers and workers lack the high-powered incentives that are believed to prevail in private firms.

- Why are the incentives in the public sector weaker than those in private sector? What are the consequences and implications of weak incentives in the public sector? These are the central issues in the studies of the internal organizations of governments and bureaucracies.

The Internal Organization of Government II

- The first issue of why weak incentives are observed in public sector can be explained by certain specificities of the government sector (although these differences could be differences in degree, not fundamental nature). Tirole (1994) suggested a number of differences between public and private sector in terms of measurement issue and governance structure.
- 1) *Multi-dimensionality of goals*
- 2) *Lack of comparison and measurement problems*
- 3) *Heterogeneity of principals' tastes*
- 4)*Dispersed ownership*

The Internal Organization of Government III

The difficulty in giving formal incentive schemes to civil servants and elected politicians suggests that capture of decision making by interest group is of greater concern in government than in private corporations.

- Laffont and Tirole (1993) have attempted to unveil the implications of the potential for capture for the organization of government and regulation. Their starting point is that the scope for capture stems from the government officials' discretionary power, which in turn results from the superiority of their information relative to that of their political principals. The officials' use of information in making policy decisions affects the welfare of interest groups. Each group has therefore an incentive

The Internal Organization of Government IV

to influence the government official to release only information that favors it.

- To reduce the government officials' tempations to be captured, one may reduce the stakes interest groups have in the regulatory decision. This means relying less on the information held by the government officials and regulating instead by the rule-book.
- The central feature of a bureaucracy is that its memebrs are not trusted to make use of information, and decisions are therefore based on rigid rules.

Dixit (1996, 1997) proposed a formal model to interpret weak incentives in government agencies and public enterprises.

The Internal Organization of Government V

- The important, distinct feature of public organizations is that they are answerable to several different constituencies with differnt objectives. In technical terms, they are "common agencies" with multiple principals. For example, an agency may be formally answerable only to the executive, but in practice Congress, courts, media and organized lobbies, all have a say.
- Dixit (1997) develops a multi-task model of common agency to show how the interaction among many principals results in a loss of the power of incentives.

The Internal Organization of Government VI

- *Politicization of private firms*. Private firms are supposed to have just one principal, nemaly, the shareholders. But recently a new concept of a “stakeholder economy” has evloved, and firms are supposed to be responsible not merely to their shareholders, but to a more varied collection of “stakeholders”: workers, creditors, the local community, and so forth. Such “politicization” f firms will lower the power of incentives, which is often already low for other reasons.

A Theory of Government Ownership and Contracting I

- When should a government provide a service in-house, and when should it contract out provision? In other words, what is the proper scope of government?
- With prison as an example, Hart, Shleifer, and Vishny (1997) develop a model based on incomplete contracts in which the provider can invest in improving the quality of service or reducing cost.

A Theory of Government Ownership and Contracting II

- If contracts are incomplete, the private provider has a stronger incentive to engage in both quality improvement and cost reduction than a government employee has. However, the private contractor's incentive to engage in cost reduction is typically too strong because he ignores the adverse effect on noncontractible quality.

- The model is based on the idea that the crucial distinction between in-house provision and out-sourcing concerns who has residual rights of control over the nonhuman assets used to provide the service–they call these assets the "Facility F" (e.g., the prison).

A Theory of Government Ownership and Contracting III

- Residual control rights matter because they determine who has the authority to approve changes in procedure or innovations in uncontracted-for contingencies.

- In contrast with previous work on government contracting (Laffont and Tirole, Tirole, 1994), H-S-V model deemphasizes the role of incomplete information in contracting, and emphasizes quality issues.

The Model I

- Suppose that the government wants a certain good or service to be provided. It can be provided either "in-house",i.e., the public employees run the prison, or by contracting out to a private company.

- In either case, the facility is run by a single manager, M. There is also a single bureaucrat or politician, represented by G.

- It assumed that G and M are able to write a long-term contract specifying some aspects of the service and the price. We call the good described in the contract the "basic" good and denote its price by P_0. P_0 has different interpretations according to whether the facility F is private or public. If F is private, then it is the

The Model II

price paid to the private owner. If F is public, then it is the wage paid to M.

- However, there are other aspects of the good that cannot be specified ex ante, such as innovation or cost reductions. We refer to these aspects as the "modified good".

- The modified good yields a benefit B to society and costs the manager C to produce. The manager can manipulate B and C through prior efforts choices. Suppose that M can devote effort to two types of innovations: a cost innovation and a quality innovation. We write $B = B_0 - b(e) + \beta(i)$, $C = C_0 - c(e)$ where e, i denote effort devoted to the cost innovation and quality innovation, respectively. $\beta(i) \geq 0$ is the quality increase net of costs from quality innovation.

The Model III

- The function b plays a key role in this model: it measures how much (noncontractible) qualtiy falls because of a (noncontractible) cost cut. This varibale introduces an element of Holmstrom-Milgrom type of multi-tasking.

- The manager's ex ante effort cost must be added to C to get M's overall costs. Assuming zero interest rate, we get M's overall costs are $C + e + i = C_0 - c(e) + e + i$.

- We also assume that $i, e, b, c,$ and G's benefits and M's costs are observable but not verifiable, and thence cannot be part of an enforceable contract.

The Model IV

- We suppose that G and M are at least locked into each other once the their relationship is under way. Specifically there is no facility available other than F that supply society, and there is no other potential customer for that service (e.g., prison), apart from G. However, M's labor services may be partially substitutable. Both G and M are risk neutral and there are no wealth constraint.

- We take the point of view that any cost or quality innovation requires the agreement of the owner of the facility F, since implementing these innovations involve a change in the way F is used.

The Model V

- The parties want to renegotiate the contract ex post when they learn the nature of potential quality improvements and cost reductions. We assume that M and G divide the gains from renegotiation according to Nash bargaining, i.e., they split the surplus 50:50.

- Nash bargaining means that the parties' default payoffs–what occurs in the absence of renegotiation–influence final payoffs.

  1. (1) If F is privately owned, then, in the absence of renegotiation, the cost innovation is implemented, but the quality innovation is not (since no payment from G will be forthcoming). G's default payoff is $B_0 - P_0 - b(e)$ and M's default payoff is $P_0 - C_0 + c(e) - e - i$.

The Model VI

2. (2) If F is publicly owned, then, in the absence of renegotiation, both cost and quality innovations are implemented. However, G must replace M and hence gets only a share $(1-\lambda)$ of the net social gains from these innovations. G's default payoff is $B_0 - P_0 + (1-\lambda)[-b(e) + c(e) + \beta(i)]$, and M's default payoff is $P_0 - C_0 - e - i$.
3. Note that λ represents the extent to which the fruits of M's effort e and i are embodied in M's human capital. It also effectively measures the weakness of the incentives of government employees.

- Some technical assumptions: $b'(.) \geq 0, b''(.) \geq 0; c'(.) > 0, c''(.) < 0; \beta'(.) > 0, \beta''(.) < 0; c' - b' \geq 0$.

The Model VII

- *The First Best*: Consider the first-best situation where e and i are contractible. In this case, G and M solve

  $max - b(e) + c(e) + \beta(i) - e - i$

  And the F.O.Cs are $-b'(e*) + c'(e*) = 1$, and $\beta'(i*) = 1$

- *Equilibrium under Private Ownership*: In light of (1), the renegotiation takes place over the quality innovation. The gains from renegotiation are $\beta(i)$, which are split 50:50. The parties' payoffs are

  $U_G = B_0 - P_0 + \frac{1}{2}\beta(i) - b(e)$,
  $U_M = P_0 - C_0 + \frac{1}{2}\beta(i) + c(e) - e - i$

The Model VIII

- Note that because M can reduce costs without seeking G's approval, G bears the full brunt of quality deterioration resulting from cost reduction.

- M chooses e and i to maximize U_M , that is , to solve

  $max \quad \frac{1}{2}\beta(i) + c(e) - e - i$

  yielding the FOCs: $c'(e_M) = 1$, $\frac{1}{2}\beta'(i_M) = 1$

- There are two deviations from first-best here. First, M ignores the deteriorations of quality resulting from cost reduction; Second, because M must get approval to implement a quality improvement, on the margin he only gets half the benefits of that improvement, which stunts his incentives to improve quality.

The Model IX

- *Equilibrium under Public Ownership*: In light of (2), the renegotiation takes place over the fraction λ of both the cost and quality innovations that G cannot appropriate: $\lambda[-b(e)+c(e)+\beta(i)]$. The gains are split 50:50, and so the parties' payoffs are

  $U_G = B_0 - P_0 + (1-\frac{\lambda}{2})[-b(e)+c(e)+\beta(i)]$,
  $U_M = P_0 - C_0 + \frac{\lambda}{2}[-b(e)+c(e)+\beta(i)] - e - i$.

- M chooses e and i to solve $max \quad U_M$, yielding the FOCs $\frac{\lambda}{2}(-b'(e_G)+c'(e_G)) = 1$, $\frac{\lambda}{2}\beta'(i) = 1$

The Model X

- In constrast with the private ownership case, because the publicly employed M needs to negotiate the cost reduction with G, he takes account of quality reductions that may result from cost-cutting innovations. However, there are new distortions in the case of public ownership.

- The optimal ownership structure is the one that produces the largest total surplus (the division of surplus can always be adjusted through P_0. Renegotiation under symmetric information ensures that all ownership structure yield an ex post efficient outcome. The only difference between the ownership structures concerns the choice of the ex ante investments e and i.

- *Main Results*. We summarize the main results in the following propositions:

The Model XI

1. **Proposition 1**: $e_M > e^\star, i_M < i^\star$.
2. **Proposition 2**: $e_G < e^\star, i_G \leq i_M < i^\star (i_G < i_M \quad if \quad \lambda < 1)$.
3. **Proposition 3**: (1) Suppose that the function $b(e)$ is replaced by $\theta b(e)$, where $\theta > 0$. Then for θ sufficiently small, private ownership is superior to public ownership. (2) Suppose that the function $b(e)$ is replaced by $\theta b(e)$ and the cost function $c(e)$ is replaced by $\phi c(e)$, where $\theta, \phi > 0$. Then for θ, ϕ sufficiently small and $\lambda < 1$, private ownership is superior to public ownership.
4. **Proposition 4**: (1) Suppose that $b(e) \equiv c(e) - \sigma d(e)$, where $\sigma > 0$. Then for σ sufficiently small and λ sufficiently close to 1, public ownership is superior to private ownership. (2)Suppose that $b(e) \equiv c(e) - \sigma d(e)$, where $\sigma > 0$. Suppose also that the function $\beta(i)$ is replaced by $\tau\beta(i)$, where $\tau > 0$. Then for σ, τ sufficiently small public ownership is superior to priavte ownership.

The Model XII

5. **Proposition 5**: Costs $(C_0 - c(e))$ are always lower under private ownership. Quality $B_0 - b(e) + \beta(i)$ may be higher or lower under private ownership.

- The trade-off between public and private ownership is the following: Private ownership leads to an excessively strong incentive to engage in cost reduction ($e_M > e^\star$) and to moderate-although still too weak-incentives to engage in quality improvement. Public ownership removes the excess tendency to engage in both cost reduction and quality improvement. Which arrangemet is superior therefore depends on which distortions is less damaging.

The Model XIII

- Authors apply this analysis to several government activities. They conclude that the case for in-house provision is very strong in such services as foreign policy, police and armed forces, and to some extent, prisons. In constrast, the case for privatization is strong for garbage collection, weapon production, and to some extent schools.

A Theory of Non-Profit Organization I

- In western market economies, there is a large share of economic activites dominated by non-profit organizations, such as schools, hospitals, hursing-homes, international aid, military services, and so on.
- According to Hansman (1980), the key chracterisitc of a non-profit firm is that it is barred from distributing any profits it earns to persons who exercise control over the firm, i.e., so-called "non-distributional constraint". Instead, a non-profit firm can distribute its profits only through improvements in the working environment.
- Why not-for-profit?

A Theory of Non-Profit Organization II

- Hansman (1980) uses the notion of "contractual failure" to explain the benefits of the non-profit status. Hansman (1996), Weisbrod(1988), and Easley and O'Hara (1983) stress more specifically asymmetric information between consumers and enterpreneurs. All these interpretations rely on the asymmetric information and measurement costs of the quality services. So the status of non-profit help signal a devotion and commitment to high quality, and also attract more donnations from the public at large. Barzel (1989) relates not-for-profit to a screening device in the presence of asymmetric information about the quality of the good or services delievered.

- Glazear and Shleifer (2001) develop a formal model motivated by Hansman's and Weisbrod's original ideas, using an incomplete contracts framework.

A Theory of Non-Profit Organization III

- Consider an enterpreneur's choice of whether or not to obtain non-profit status for his firm. At time 0, the enterpreneur decides on non-profi status.

- At time 1, he sells exactly one unit of a good to a competitive market of consumers. At the time of sell, the enterpreneur collects the price P and agrees to deliever at time 2 a product of non-verfiable quality q. At time 2, the firm produces the good of non-verfiable quality q and delievers it to consumers.

- We assume that consumers are willing to pay $P = z - m(q^\star - \hat{q})$ for the good, where $z, m, q^\star$ are all constants, and $\hat{q}$ is the consumer's expectation of the non-verifiable quality. Assume that z is sufficiently high that firms earn a positive profit when they set $q = q^\star$.

A Theory of Non-Profit Organization IV

- The total cash profits of the firm are $P - c(q)$. If the firm is for-profit, these profits are realized as income to the entrepreneur. If the firm is not-for-profit, the entrepreneur is forced to spend the revenues on perquisites, denoted by Z.

- We further assume that each entrepreneur, regardless of his firm's status, bears a non-cash cost of $b(q^\star - q)$ of shirking on quality. This non-cash cost may come from a reputational loss from low quality or something else.

- Enterpreneurs maximize a quasi-linear utility function:

  $I + V(Z) - b(q^\star - q)$ where I is income, $V(Z) = d \bullet Z$, with $d < 1$. The entrepreneur would rather have cash than perquisites at the going price for perquisites.

A Theory of Non-Profit Organization V

- When the entrepreneur chooses q, he has already collected the price P. The total utility of a for-profit enterpreneur is $P - c(q) - b(q^\star - q)$. His optima choice is given by $c'(q_f) = b$.

- The non-profit firm cannot distribute profits. This constraint defines spending on perquisites: $Z = P - c(q)$. In this case, he maximizes $d[P - c(q)] - b(q^\star - q)$, which yields the FOC $d \bullet c'(q_n) = b$.

- Obviously we have $q_n > q_f$.

- When consumers contract with the firm, they agree to pay an initial price P that correctly anticipates the quality level q. The price charged by non-profit enterpreneurs is therefore higher.

A Theory of Non-Profit Organization VI

- Th non-profit status serves as a valuable commitment to higher quality only if the enterpreneur cannot pocket the profits by converting the firm to a for-profit status after collecting the revenues.

- at time 0, the enterpreneur chooses not-for-profit status if

  $$(b+m)(q_n - q_f) - (c(q_n) - c(q_f)) > (1-d)(z - m(q^\star - q_n) - c(q_n))$$

- The left-hand side represents the benefits that a for-profit firm would obtain by committing to the non-profit firm's higer level of quality. The right-hand side represents the loss imposed on a non-profit firm by the restriction that profits can only be enjoyed as perquisites.

A Theory of Non-Profit Organization VII

- This comparison represents the fundamental trade-off between non-profit and for-profit status.

- In many situations, consumers do not directly observe the producer's commitment to quality. Non-profit status may signal that the enterpreneur cares more about quality relative to pecuniary rewards.

- The critical assumptions of the model is that ex post expropriation (1) hurts the buyers, (2) yields financial returns, and (3) has non-financial costs such as reputation. The non-profit status reduces the financial returns, but not the non-financial costs, it softens incentives and cuts ex post expropriation in any setting that has these three features.