How to Sell Innovative Ideas: Property right, Information Revelation and Contract Design

Based on James Anton & Dennes Yao’s two papers

1. Expropriation and Inventions: Appropriable Rents in the Absence of Property Right (AER, 1994)
2. The sale of Ideas: Strategic Disclosure, Property Rights, and Contracting (RES)

This presentation will start with the brief introduction of contract theory (Section 1). Then I will explain how to fit the selling of innovative ideas into the standard contract theory model (Section 2). In section 3, I will present the 3 different contracting models based on the 2 papers. Section 4 is a brief summary.

I. A Brief Literature Review of Asymmetric Information and Contract Theory

Asymmetric information: one party in the transaction has private information that the other party does not know

- Hidden information → Adverse Selection:
  - Uninformed party lacks information before contracting
    - Ex ante contracting problem
- Hidden action → Moral Hazard:
  - Uninformed party lacks information about performance of the other party or lacks the ability to retaliate for a breach of the agreement
    - Ex post contracting problem

Example: agent-principle (Boss and employee)

Boss’s objective: Hire a skilled employee who works really hard to maximize utility

Employee’s objective: Maximize utility according to the contract

Private information: the skill level and the real effort of employee → adverse selection & moral hazard

Strategies to overcome the asymmetric information problems

- Employee: (informed) → signaling:
  - To use actions or evidence to signal one’s type
- Boss: (uninformed) → screening:
  - To provide a menu of choices to induce other party to reveal real information or encourage desired actions

Contract Design:

Design the menu of choice here is contract design (mechanism design). Here are two key components

Indirectly rationality constraint (IR): Agent of every type likes the contract that Principal intended for that type more than not signing any contract → give agent incentive to participate

Incentive compatibility constraint (IC): Agent of every type likes the contract that Principal intended for that
type more than contracts of other types → give agent incentive to truthful reveal private information.

II. Abstraction of the model of “sales of innovative ideas”

Innovative ideas and intellectual properties (invention) are considered as important production factors in business. Sometimes, the owners of invention are independent inventors, who are outside the production companies. The invention owners have limited finance ability to create their own organizations to take commercial advantage of their invention, so they have to cooperate with the existing companies to realize their invention’s commercial benefit through selling their invention. This section is aimed at abstract the model of “sales of innovative ideas into” the standard contract theory model. After simplification, the investor is the agent, the manufacturing firms is principle, the contract design is a designing a wage plan. However, the sales of invention are faced with severe problem of asymmetric information:

1. The quality of invention is private information for investors, so it is hard for the buyers to know the real quality of invention without information disclosure. Low quality invention owners can take chance to mimic the high quality invention owners.

   (Adverse selection)

2. The property rights of invention are weak or even nonexisting (Source are ambiguous), so if the investors signal the quality of invention with information disclosure to buyers, the buyers can easily steal the invention without any payment.

   (Moral Hazard)

The rationale for designing contract for sales of invention

The IR and IC constraints:

1. To provide effective protection for the investor to enhance invention transaction, by guaranteeing their payment from buyers.(IR)

2. To effectively separate the types of inventions, by driving the bad invention owners quit the market, the good invention owners finish the transaction.(IC)

The basic rationale for designing contact in the context of sales of invention is contingent payment, if the innovation succeeds, the company will give the inventor a certain amount of payment. If the innovation fails due to the poor quality of invention or the investor’s violation of the contract anyway, the inventor will be punished. I will combine and summarize the two papers into three different contracting models.

III. Three Models of Contracts Design

Setting:

The invention transaction is between two parties. The authors model a setting with an investor (seller) and two manufacturing firms, which are competing in a duopoly market. Denote the investor as I, firm as Bi and Bj.

All the parties in the transaction are risk-neutral.

Four possible market results depend on how many firms successfully make good innovation, results in the firm profit metric.
<table>
<thead>
<tr>
<th>Bi</th>
<th>Good Invention</th>
<th>No Good Invention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bj</td>
<td>((\Pi_D,\Pi_D))</td>
<td>((\Pi_M,\Pi_L))</td>
</tr>
<tr>
<td>No Good Invention</td>
<td>((\Pi_L,\Pi_M))</td>
<td>((\Pi_o,\Pi_o))</td>
</tr>
</tbody>
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\[\Pi_M + \Pi_L > 2^* \Pi_D\] (Industry profits are largest when only one firm uses the Invention.

\[\Pi_M > \Pi_D, \Pi_D > \Pi_L, \Pi_D > \Pi_o\]

The source of invention can be either the inventor or the firms, each firm has internal research ability, so each firm discover the good invention with probability of \(\alpha \in (0,1)\)

The quality of invention owned by the investor can different, either bad or good, only the good invention can help the firms make a profit, bad invention is useless.

The quality of invention is private information for investor, \emph{en ante}, firms believe investor discovers a good invention with probability of \(q \in (0,1)\)

Contracting on payment to investor: \(R = (R_o, R_i, R_j, R_D)\), \(R_x\) is the payment at state \(x, x=0,i,j,D\)

The firms have more bargaining power, take it or leave it offer.

The contract between investor and one firm can be observed by the other firm.

The investor has a limited liability (financial resources) \(L>0\), \(L\) is comment knowledge for all parties, the payment should satisfy IR to allow participation.

\(IR:\)

\[R_x \geq -L \text{ and } R_x + S_x \geq -L\]

\[x \in \{0, i, j, D\}_{(AER, 1994)}\]

**Model A \textit{ex post} contracting (With moral hazard but without adverse selection)**

Under the \emph{ex post} contracting mechanism, investor reveals the invention prior to receiving a contract offer.

The sequence of game is described in Figure I.
The equilibrium path in this model has the following feature:\footnote{In game theory, a Bayesian game is one in which information about characteristics of the other players (i.e. payoffs) is incomplete.}

The author discusses the perfect Bayesian equilibrium (PBE). A good investor reveals the invention to a randomly selected firm, denoted by Bi, before signing any contract (the firm Bi is called the informed firm). Firm Bi offers the ex post contract $R^*$ to the investor. The investor accepts $R^*$, and no other contracts are signed between investor and Bj, and the investor does not reveal invention to Bj.

**Necessary condition for equilibrium:**

This subpart is about some critical elements in supporting the equilibrium.

Expected payoff for a good I (investor) is

$$ (1 - \alpha)R_i^* + \alpha R_j^* \equiv \Pi_i^* $$ \hspace{1cm} (M1)

(Bad I enters on contracts and thus earns zero)

Expected payoff for firm Bi (informed firm) is

$$ (1 - \alpha)(\Pi_M - R_i^*) + \alpha(\Pi_D - R_j^*) \equiv \Pi_i^* $$ \hspace{1cm} (M2)

Expected payoff for firm Bj (having observed $R_i^*$ between investor and Bi) is

$$ (1 - \alpha) \Pi_L + \alpha \Pi_D \equiv \Pi_j^* $$ \hspace{1cm} (M3)

*The first necessary condition* for $R_i^*$ is to remove incentive for a second contract between I and Bj, (Bj has incentive to avoid receiving $\Pi_L$, so Bj will try to induce I to reveal to Bj as well by offering a contract $S$, to get the duopoly market outcome, I will accept the second offer if profitable. **Mutual profitability should be excluded**)

Additional contract is profitable for investor if,
**Additional contract is profitable for Bj if,**
\[ \Pi_D^* - S_D > (1-\alpha)\Pi_L + \alpha \Pi_D \] (M5)

Rearrange (M4&M5) to get the feasible range for \( S_D \) with mutual profitability:

\[ (1-\alpha)(\Pi_D - \Pi_M^*) > S_D > (1-\alpha)(R_D^* - R_D^*) \] (2)

Exclude mutual profitability to get

\[ R_D^* - R_D^* \geq \Pi_D - \Pi_L \] (3)

The second necessary condition is to exclude expropriation by firm Bi, (Since I reveals to Bj without any prior contract, firm I has the incentive to expropriate the invention without any payment to I, rather than offering \( R_D^* \). But if Bi choose pay I zero, the investor can threaten to reveal the invention to Bj, which can decrease the profit of Bi from \( \Pi_M \) to \( \Pi_D \).)

Exclude the profitability of expropriation by threatening to reveal to Bj,

\[ (1-\alpha)(\Pi_M - R_D^*) + \alpha(\Pi_D - R_D^*) \geq \Pi_D \] (4)

(condition 4 reveals that firm Bi would always expropriate if the inventor were to receive too large a share of the rents from monopoly use of the invention)

Discuss the role of limited liability L

Rearrange(3&4) get

\[ R_D^* \geq (\pi_D - \pi_L) + R_D^* \] (5)

\[ R_D^* \leq (\pi_M - \pi_D) + \alpha(1-\alpha)^{-1}R_D^* \] (6)

Graph \( R \) against \( R_D \), the author draw two graphs with different level of \( L \)

**Figure 2.** \( L < (1-\alpha)(\pi_D - \pi_L) \)

**Figure 3.** \( L \geq (1-\alpha)(\pi_D - \pi_L) \)

(\( \Pi_M + \Pi_L > 2^* \Pi_D \) implies the shaded region exists)
(7) \( \Pi^*_i \geq 0 \)

Isoprint line for investor is \( \Pi_i = (1 - \alpha)R_i + \alpha R_D \)

**When L is relatively small**, see figure II, the zero isoprofit line passes through origin and does not intersect the feasible region. The isoprofit line should be move northeast to reach the equilibrium, guaranteeing \( \Pi^*_i > 0 \). This means, in the ex post contracting design, an investor with little or no liability can make a significant expected payoff. The intuition behind is that to prevent the additional contract with \( B_j \), \( R_i^* \) must have a large enough gap \((\Pi_D - \Pi_L)\) between \( R_i^* \) and \( R_D^* \), by setting \( R_D^* \) to large negative value and holding down the value of \( R_i^* \) (condition (5) binds). But when the L is small, the small L prevents \( B_i \) setting \( R_D^* \) at a large negative value, thus maintains \( R_i^* \) at a higher value.

In sum, the limited liability and incentives required to maintain a monopoly profit work together to make a positive expected payoff investor.(See from the graph, equilibrium reached at the intersection of \( R_D = L \) and (5))

**When L is relatively large**, see figure III, the zero isoprofit line passes through origin and intersects the feasible region, this means the expected payoff for investor is zero. Since the L is large, \( R_D^* \) can be set at a large negative level, and \( R_i^* \) can be set a relatively lower level, making \( \Pi^*_i = 0 \).

Summarize all the analysis above into proposition 1, which describes the equilibrium contract in different level of L.

**PROPOSITION 1:** Consider an equilibrium, for the extensive form, in which the equilibrium path exhibits ex post contracting, and let \( R^* \) denote an equilibrium contract. Then \( R^* \) satisfies:

(a) when liability is small, that is, \( L < (1 - \alpha)(\pi_D - \pi_L) \), we have

\[
R_i^* = \pi_D - \pi_L - L \quad \text{and} \quad R_D^* = -L
\]

(b) when liability is large, that is, \( L \geq (1 - \alpha)(\pi_D - \pi_L) \), we have

\[
R_i^* = \alpha(1 - \alpha)^{-1}R_D^*
\]

for \(-L \leq R_D^* \leq -(1 - \alpha)(\pi_D - \pi_L)\).
Small $L$, \[ \Pi_i^* = (1 - \alpha)(\Pi_D - \Pi_M) - L > 0 \quad (M6) \]

Large $L$, \[ \Pi_i^* = 0 \quad (M7) \]

The payoff to investor decrease as $L$ increases. In each case, the firm $B_i$ designs $R^*$ to take strategic advantage of the $L$ of inventor. $R_D^*$ and $R_i^*$ decease with the increasing of $L$. If $L$ is small, $R_D^*$ binds at $L$, it reduces the strategic advantage of $B_i$, so $R_i^*$ cannot decease too much because firm $B_i$ wants to eliminate the additional contract between investor and $B_j$.

**Sufficient condition for equilibrium: (Existence of equilibrium)**

This subsection is aimed at illustrating that an informed firm finds it optimal to offer $R^*$ to the investor. This main intuition behind is if the informed firm does not offer $R^*$, the investor will reveal the invention to the other firm. The authors mainly focus on the case of “expropriation” in which the firm $B_i$ offer zero.

If the firm $B_i$ deviates $R^*$ and offers zero, the investor have incentive to approach firm $B_j$ to seek for a contract. The authors discuss both the cases of *ex post* contract and *ex ante* contract.

**PROPOSITION 2**: Suppose that $\pi_M + \pi_L > 2\pi_D$. Then there exists an equilibrium with *ex post* contracting.

*For the *ex post* contract*, when investor was to reveal the invention to $B_j$ before receiving an offer, then market will end up with duopoly ($D$). For firm $B_i$, the duopoly result will be worse off than the monopoly ($M$), given $\Pi_M + \Pi_L > 2\times \Pi_D$, offering $R^*$ would yield higher profits.

*For the *ex ante* contract*, when investor was to seek a contract with $B_j$ before revealing invention to $B_j$, the belief of $B_j$ comes to play a role. The beliefs are specified as

\[
\begin{align*}
\rho &= \text{probability } I \text{ is good and has revealed to the other firm} \\
0 &= \text{probability } I \text{ is good and has not revealed to the other firm} \\
1 - \rho &= \text{probability } I \text{ is bad}
\end{align*}
\]

(8)

The uninformed firm $B_j$ anticipates that ex *ante* contracting with a good $I$ takes place only after the invention has been revealed to $B_i$, which means the belief is that a good investor has been expropriated after revealing to $B_i$, the only result of market is $D$, if investor contracts with $B_j$. This belief leads to $B_j$ will offer a small positive payment in the $D$ state $R_D = \varepsilon$, $R_i = L$ for other states. By this way the uninformed $B_j$ can screen out a bad investor. Again, for firm $B_i$, the duopoly result will be worse off than the monopoly ($M$), given
\[ \Pi_M + \Pi_L > 2^*\Pi_D, \text{offering } R^* \text{ would yield higher profits.} \]

The authors offer complete analysis of the full range of deviation in the appendix. The main rationale behind is checking whether the deviation is more profitable than the \( R^* \) equilibrium.

**Model B  \textit{ex ante} contracting (Without moral hazard but with adverse selection)**

Under the \textit{ex ante} contracting mechanism, investor reveals the invention after receiving a contract offer. The fundamental difference between contracting on \textit{ex post} and \textit{ex ante} mechanism is the information position of the firms. In the \textit{ex post} system, the firm clearly know about the quality of investor, since the invention has been revealed. However, in the \textit{ex ante} system, the firm is uninformed with the quality of investors, both good and bad investor can approach a firm, which brings the problem of adverse selection.

The main rationale of designing an \textit{ex ante} contract is to solve the adverse selection problem by separating the good and bad investors and driving out the bad one.

This discussion starts from investor holds large liability \( L \).

**Necessary Conditions for equilibrium,**

**First is to exclude the Mutual profitability of additional contract between investor and Bj as the previous analysis,** get

\[
R_i^* - R_j^* > \Pi_D - \Pi_L, R_i^* - R_j^* > \Pi_M - \Pi_L. (B-2)
\]

Slightly different with previous section, because in the current system, the firm does not know whether itself is the first or the second firm the investor approaches.

**Second is to separate the bad from good investor,** the contract \( R^* \) should make a good investor accept the offer and the bad one reject. The expected payoff of bad one should be less than zero.

\[ 0 > E_{\alpha,\alpha}(R^*) \equiv (1 - \alpha)^2 R_0^* + \alpha(1 - \alpha) (R_i^* + R_j^*) + \alpha^2 R_D^* \]

By setting \( R_i^* = R_j^* = R_D^* = -L \) and \( R_i^* = \Pi_I^* \), the contract set the wedge of payoff as large as possible and also minimize the incentive for bad investor.

Proposition 3 is the general format of equilibrium, with consideration of both the small and large size of \( L \).
PROPOSITION 3: Necessary conditions for an equilibrium with ex ante contracting involving a monopoly contract and separation are

(a) \[ L > \alpha (\pi_M - \pi_L) \]

(b) \[ \Pi^*_i = (1 - \alpha)(\pi_M - \pi_L) \]

where \( \Pi^*_i \) is the equilibrium payoff to a good inventor. This equilibrium exists if \[ L > \alpha (\pi_M - \pi_L) \].

The equilibrium contract, \( R^* \), is given by

(c) \[ R^*_i = \pi_M - \pi_L + \alpha(1 - \alpha)^{-1} L \]

\[ R^*_x = -L \] for \( x = 0, i, D \).

Intuitive explanation of Proposition 3: Under the current ex ante system, the largest possible payoff for a firm is \((1 - \alpha)\Pi_M + \alpha \Pi_D\), the smallest possible payoff for a firm is \((1 - \alpha)\Pi_L + \alpha \Pi_D\), the difference between these two extremes is the rent that investor can get, \( \Pi^*_i = (1 - \alpha)\Pi_M - \Pi_L \). In equilibrium, the offer from each firm must provide an identical payoff of \((1 - \alpha)\Pi_M - \Pi_L = (1 - \alpha)R_i + \alpha R_D\). Then solve out \( R^*_i \) (given \( R_i = -L \)), the solution satisfies the condition that expected payoff for bad investor is negative.

The vital part of proposition 3, is \( L > \alpha (\Pi_M - \Pi_L) \). The intuition is from expected payoff for a bad investor is negative, \( E_{\alpha, i}[R^*] = (1 - \alpha)[\alpha(\Pi_M - \Pi_L) - L] < 0 \), this makes the separation possible.

In sum, when \( L \) is relatively small, the separation is infeasible. If \( L = 0 \) \( R^*_i = (\Pi_M - \Pi_L) \), \( Rx = 0 \), the bad investor is faced with no punishment whatever the market result, so the bad one cannot be screen out. Under the current system, both are both good and bad investor, the probability of investor is good is denoted as \( q \), \( q \) is important here, because low \( q \) will lead to the problem of lemon market. If the firm perceives the percentage of bad one is high, their expected profit will decrease, so they will be reluctant to offer \( R^*_i \) contract to the investor. Summarize in proposition 4

PROPOSITION 4: Suppose that (a) firms and the investor enter into contracts voluntarily and (b) a good inventor makes an optimal choice regarding revelation of the invention only after entering into contracts. Then, as the liability of the inventor becomes small \((L \to 0)\) and the adverse-selection problem becomes acute \((q \to 0)\), the payoff to a good inventor goes to zero.

The lesson learns from ex ante contracting design, the moral hazard problem (Expropriation) has been
avoid, but bring in the new problem of adverse selection. The level of L is the most important tool to screen bad investor. When L is small, the market will fail, so if the investor has some kinds of approach to finance themselves, the transaction of invention will be executed. The venture capital and loan can be useful to enhance the exchange of invention.

**Model C  Partial disclosure contracting (With moral hazard and with adverse selection)**

Under the partial disclosure contracting mechanism, investor reveals part of invention to firms to indicate the quality of invention. This part of disclosed invention can be expropriated by the firms.

This model C is based on the RES 2002 paper. The model setting changed a little bit from the previous two models.

**Setting:**

**Public disclosure:** The investor (called as Seller in this section according to the paper) discloses part of his invention to two ex ante symmetric competing buyers at the same time, the amount of disclosure can be different.

**The amount of disclosure:** denote the amount of disclosure as \( r \).

**Type of seller:** rather than discrete level of value (good and bad), the type is denoted as \( \theta \) which is continuous on \([\underline{\theta}, \bar{\theta}]\), \( \theta \) is a draw from \([\underline{\theta}, \bar{\theta}]\).

**Payoff of different market results:** This model simplified the payoff by setting the monopoly state payoff as \( \Pi \), other state are all zero for convenience.

**Expected payoff for Bi:** \( r_i (1 - r_i) \Pi, i=1,2, i<>j \), which is the probability that Bi succeeds and Bj fails times \( \Pi \).

**Sequence of Game:**

1. The seller, \( S \), privately observes a draw \( \theta \in [\underline{\theta}, \bar{\theta}] \) according to a c.d.f. \( F \). The value of \( \theta \) is the IP possessed by \( S \).
2. \( S \), having observed \( \theta \), chooses a disclosure \( r \) of IP that is observed by \( B^1 \) and \( B^2 \), the buyers. Feasible disclosures satisfy \( r \leq \theta \). The disclosure \( r \) can be used freely by either buyer to pursue the innovation.
3. Each \( B^i \) having observed \( r \), offers the seller a contract \((R^i_M, R^i_0)\). Feasible contracts satisfy \( R^i_M \geq -L \) and \( R^i_0 \geq -L \) for \( i = 1, 2 \).
4. \( S \) chooses which contract to accept, if any, and then choose a revelation of any remaining IP, \( t_i \), where \( r \leq t_i \leq \theta \) for \( i = 1, 2 \), to the buyers.
5. The innovation success or failure for each \( B^i \) is realized along with payoffs and contract payments, according to the success probability implied by the underlying IP input, \( \max(\alpha, t_i) \).

The **equilibrium path** in this model has the following feature

The authors discuss the perfect Bayesian equilibrium (PBE) for this dynamic game of incomplete information. \( r = \varphi(\theta) \), \( \varphi \) is assumed as a one-to-one function, which indicates the disclosure equilibrium is separating, according to the Bayes' rule under the PBE. Then, each equilibrium disclosure of \( r \) has a unique inference of \( \varphi^{-1}(r) \) for the buyer's belief regarding the seller's invention.
Basic properties for equilibrium: (From Lemma 1&2)

**Lemma 1.** Consider a disclosure equilibrium and let \( r = \varphi(\theta) \) be the observed disclosure by the seller. Then, for \( \theta > r \geq \alpha \), the contracting stage satisfies

(i) each buyer offers a contract such that \( R_M^i \geq R_0 \) and

\[
\theta (1 - r)(\Pi - R_M^i) - [1 - \theta(1 - r)]R_0 = r(1 - \theta)\Pi
\]

(ii) the seller, who is indifferent between offers, accepts one contract, say from \( B_i \), and then reveals fully and exclusively to \( B_i \), with \( t_i = \theta \) and \( t_j = r \);

(iii) the payoff to the seller is \( \Pi^3 = (\theta - r)\Pi \) and the payoff to each buyer is \( \Pi^B = r(1 - \theta)\Pi \).

The intuition behind (1) is the payoff of losing the bidding should be indifferent with winning a bidding, due to the property of competitive bidding of two firms. Under this setting, the seller will garner all the expected rents. From (iii), it is straightforward to see that the larger \( r \), the less \( \Pi_i \), the disclosure of invention is a costly signal.

**Lemma 2.** Consider a disclosure equilibrium. Then \( \varphi(\theta) > \alpha \) for each \( \theta > \theta \). Further, for the lowest-type seller, \( \theta \), we have \( \varphi(\theta) \leq \alpha \) and \( \Pi^S(\theta) = (\theta - \alpha)\Pi \). Thus, in the case of \( \theta = \alpha \), we have \( \Pi^S(\theta) = 0 \).

The main purpose of Lemma 2 is to set \( \Pi_i = 0 \), which means the seller with worst quality earn nothing from contracting with a firm.

**Analysis of equilibrium**

What the results that the authors want to derive under the equilibrium is the function form of \( r = \varphi(\theta) \), and the parameter of contract \( R^* \)

IC for equilibrium:

All the type truthfully signal their own type by \( r = \varphi(\theta) \), rather than mimic other type by signaling \( \hat{r} \).

To eliminate the incentive of mimicking other types, the authors start with the analysis or incentive of deviation.

\[
\theta (1 - \hat{r}) \hat{R}_M + [1 - \theta(1 - \hat{r})]R_0. \quad (2)
\]

Seller with higher \( \theta \) benefit from a larger spread between \( \hat{R}_M \) and \( \hat{R}_o \) (gap between this two value), since the probability weight on \( \hat{R}_M \) is larger. A seller with smaller \( \theta \) prefers a smaller spread. These differential incentives across seller types related to incentive to disclose invention, providing foundation for separating.

Use Lemma 1 and (1) and (2) (for typo \( \theta \) who signals \( \hat{r} \))

\[
U(\theta, \hat{r}, \hat{R}_0) = (\hat{\theta} - \hat{r}) \Pi \left( \frac{\theta}{\hat{\theta}} \right) - \hat{R}_0 \left( \frac{\theta}{\hat{\theta}} - 1 \right). \quad \text{(I fall to replicate it by myself)}
\]
Thus, $U(\theta, \hat{\theta}, \hat{r}, \hat{R}_0)$ is the payoff a type $\theta$ can obtain by disclosing (a feasible) $\hat{r}$ when buyers infer the seller is type $\hat{\theta}$ and offer a contract (with $R_0$) that has an expected value of $(\hat{\theta} - \hat{r})\Pi$ for a type $\hat{\theta}$ seller.

IC requires the truthfully signaling, thus

$$\Pi^S(\theta) \geq U(\theta, \hat{\theta}, \varphi(\hat{\theta}), -L) \ (R_0 = -L, \text{ as previous section screen out bad seller to prevent adverse selection})$$

Then the authors put forward a equilibrium solutions by proposition 1 (I fail to see the solving procedure).

Then the authors testify all the elements in propositoin1 and corollary 1 is consistent with the required properties of equilibrium and IC.

**Proposition 1.** Consider the case of $\theta = \alpha$ and suppose that $\alpha \Pi > L$. Then an equilibrium with partial disclosure exists and is given by the disclosure strategy

$$\varphi(\hat{\theta}) = \frac{L}{\Pi} + \left(1 - \frac{L}{\alpha \Pi}\right)\theta,$$

for $\alpha \leq \theta \leq \bar{\theta}$, the contract offer of $R_0 = -L$, $R_M = \left(\frac{1}{\alpha \varphi(\hat{\theta})} - 1\right)L$, and the implied acceptance and revelation strategy for the seller from Lemma 1.

**Corollary 1.** The seller’s expected payoff for type $\theta$ is $\Pi^S(\theta) = \frac{\theta - \alpha}{\alpha} L$. Each buyer’s expected payoff (pointwise in $\theta$) is $\Pi^B(\theta) = (1 - \theta)[\theta \Pi - \Pi^S(\theta)]$.

Under this equilibrium condition, $L < \alpha \Pi$, which guarantees the positive slope of $\varphi(\hat{\theta})$.

The authors find two features of the equilibrium:

**First,** in the equilibrium, disclosure is a substitute for the lack of large liability (L). As L increase, the slope decreases, the amount of $r$ decrease, the payoff for Seller increases, given other parameter constant. The underlying intuition is large L allows $R_0$ to be more negative, thus remain the large enough wedge of $R_M$ and $R_0$. "The larger wedge alters the incentive to deviate since a lower (higher) type than $\theta$ would now find the disclosure of $r$ to be less (more) attractive than before. This relaxes the IC constraint." As L increases, less disclosure is required and the seller’s payoff increases. Hence, disclosure can be interpreted as a costly strategic substitute for posting a bond.

**Second,** disclosure incentives lead to a dissipation of seller rents with regard to $\Pi$. $\Pi$ increasing leads to the buyer’s willingness to pay increases, $U$ as increase, which leads to IC more easily to bind. To maintain the IC hold, the equilibrium of disclosure increases, drug down the WTP of buyers.

If $L > \alpha \Pi$, separating equilibrium involves only a part of seller’s wealth, the seller will disclose nothing to the buyer, and the seller will capture the full $\Pi$.

If $L < \alpha \Pi$, the ability of seller to capture surplus is limited.

Then the authors prove the uniqueness of disclosure equilibrium.

**First,** they start with discuss the importance of $R_0 = -L$ at boundary condition(BC)
Condition BC. At the disclosure $\alpha$, each buyer offers the contract $(R_M, R_0)$ where $R_0 = -L$ and $R_M = \left[\frac{1}{\alpha(1-\alpha)} - 1\right]L$.

If seller Bi offers $R_i^i > -L$, Bj can increase the payment in state M and push down Ro a little bit down side to $-L$, and main the expected payoff to seller type $\alpha$ constant. This slight adjustment will make the Bj’s offer more profitable to Bi’s offer for any other type higher than $\alpha$, and the seller will accept the offer of Bj. So the equilibrium requires $R_0=-L$.

Proposition 2. Consider a disclosure equilibrium for the case where $\theta = \alpha$. Suppose that BC holds at $\varphi(\alpha)$. Then $\varphi$ from Proposition 1 is the unique equilibrium disclosure strategy. Let $\phi$ be a disclosure strategy in any disclosure equilibrium in which BC is not satisfied. Then $\phi(\theta) > \varphi(\theta)$ for all $\theta \in [\theta, \bar{\theta}]$.

Corollary 2. Across the set of all disclosure equilibria, the equilibrium with disclosure $\varphi$ is Pareto dominant with respect to the payoff of the seller in that $\Pi^S(\theta) = [\theta - \varphi(\theta)]\Pi$, for all $\theta > \hat{\theta}$, is strictly greater than the equilibrium payoff in any equilibrium with a disclosure strategy other than $\varphi$.

In sum, in this model, the seller uses partial disclosure to signal the quality of invention. The buyers can expropriate the disclosed invention (Moral Harzard) but the buyers are uncertain about the real quality of the invention (adverse selection). This model trades the adverse selection with moral hazard. The terms of the trade-off depend on how liability the seller has to put at risk. Disclosure benefits the seller by overcoming the adverse section problem with competitive bidding, but the simultaneous moral hazard absorbs the benefit bring by overcoming adverse selection.

IV. Conclusion

This presentation is focus on introducing the basic idea of contract design, with three different models under the context of selling ideas. The basic problem of asymmetric information is adverse selection and moral hazard, a good contract should be designed to overcome both of the problem. The three models in this presentation show the tradeoff between solving problems adverse selection and moral hazard.

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