Lecture 16: Contracting, or The Rules of the Game

(See McMillan, Chapters 8, 9)

Topics:

1. **Strategising versus Economising**
2. **Using Game Theory to Enhance Efficiency**
3. **Creating Incentives**
4. **Designing Contracts**
5. **Application to Financial Contracts**

1. Strategising versus Economising

Strategising ...

(See Williamson's paper in the Package)

Game Theory is usually applied to issues of *"strategising"*, i.e., beating rivals or consumers:

- **Pre-emptive threats/entry deterrence.**
- **Cartel enforcement.**
- **Bargaining and bidding.**

... versus Economising

***Economising* — the positive-sum, efficiency-enhancing aspects — often neglected in game theory (and in corporate strategy).**

Why is it neglected?

There are two illusions:

1. **Illusion from micro theory that it's easy to minimise costs: set Wage = Value of the Marginal Product of Labour.**

   But this is very difficult and costly to monitor on the shop floor.

2. **Illusion that powerful tools from game theory don't help to economise, in Finance or in Human Resource Management.**

But game theory can be very useful, especially for economising.

Contracts Integrate ...

Contracts integrate game theory and standard microeconomics:

- ***A contract:*** **an agreement that supports exchange between supplier (seller) and buyer (demander).**
- **Standard microeconomics: Supply = Demand (and produce where Marginal Cost = Price) is just the Nash equilibrium of a game where no-one's decisions affect the welfare of anyone else. (Perfect competition, and all are price-takers.)**
- **Costless contracts: Even with small numbers, can achieve the perfect competition outcome.**

Prediction and Design

Game Theory helps in a real world of costly contracts — twice:

1. **Predicts (or analyses) what will happen under different contractual arrangements.**
   What are the *incentives*?
2. **Allows us to choose (or to design) the *best* one, (Choosing the Game).**
   e.g.:
   - **Make or Buy? (production integration)**
   - **Debt or Equity? (capital structure)**
   - **Privatised or Publicly Owned? (ownership)**
   - **Division or Spin Off? (organisational structure)**

2. Using Game Theory to Enhance Efficiency

General Principles

1. **Game theory is often taught via simple examples, chosen on an ad-hoc basis. e.g. battles, interactions, kids and credibility.**
2. **The Contracting perspective, by contrast, is:**
   - ➢ ***choose* the game, the contract,**
   - ➢ **solve (or simulate) for the equilibrium of the game, the contract,**
   - ➢ ***then* ask:**
     - — **are the players *pleased* with the outcomes?**
     - — **what could they do to achieve a *better* outcome? How?**

Choosing the rules of engagement

3. **Basic idea: when you negotiate a contract with someone, you are proposing to play a game, structured by the contract.**

   Since you must get them to play, *and* they solve for the equilibrium as you do, it *pays you to choose the game (the contract) with the most efficient outcome*, to maximise the size of the pie, given a claim over fixed % slice.

   e.g. employment contract — pay, conditions, work, supervisor's interests, etc;

   e.g. financing contract

   e.g. franchise contract

   e.g. outsourcing contract

3. Creating Incentives

Q: How can you make it in another person's interest to behave as you want? Especially with a divergence of interests, aims.

Q: How can you create appropriate *incentives*?

A: Rewards & punishments — carrots & sticks.

➢ **The pervasive *Principal–Agent* problems:**
- **— author v. publisher**
- **— debt v. equity**
- **— landlord v. tenant**
- **— subcontractor v. price contractor**
- **— employer v. employee**
- **— insured v. insurer**

➢ **Whereas HRM: change the agent's goals → the principal's goals, now on the contrary …**

➢ **Here: we focus on the use of monetary rewards — important (although not necessary) and simple to understand.**

Piece Rates, Commissions, & Royalties

Performance incentives are ubiquitous —

- **piece rates/bonuses/commissions for production workers**
- **pay for performance (bonuses, share options)**
- **sales representatives paid by commission**
- **professional sports? (tournaments, winner-takes-most)**
- **academic salary supplements**
- **forecasters' pay $\propto$ accuracy (?)**

Contracts can also be used in *cost minimisation* instead of maximum output:

- cost-minimisation is costly
- contracts vary from one extreme to another — who bears the risk?
  - fixed-price contracts?
  - cost-plus contracts?
  - incentive contracts?

A verbal contract isn't worth the paper it's written on.

— Samuel Goldwyn

Marginal Incentives

If the principal can cheaply, perfectly, monitor the agent's "effort":

then no problem:
$\rightarrow$ simply link payments to effort.

But usually impossible or costly to monitor the agent's effort, so

- **link pay to *performance*, not *effort*, or link pay to *output*, not *input***
- **OK if constant, predictable relationship: effort $\Rightarrow$ performance**
- **but random events, uncertainties intervene i.e. the agent may be unlucky or lucky.**
- **the agent may "slack" or "shirk"**

Principals' and agents' interests may diverge.

So: 1. Divergence of interests.

2. Imperfectly observable "efforts" of the agent.
   - not necessarily how hard the agent works
   - but to what end does the agent toil? (profits, or size, etc.?)

The incentive effort — is at the *margin*,

where costs of extra effort = gain to the agent from extra effort.

The higher the commission rate λ, then the greater the selling effort.

Carrots & Sticks

Look at from the worker's point of view:

- **if she performs better, do her pay or rewards increase?**
- **if she performs worse, does her pay fall or her punishment increase?**

Ideally we'd like:

- **Piece rates or commission as a continuum:**

$$\frac{\Delta \text{ reward}}{\Delta \text{ performance}} > 0$$

where performance is measurable.

But incentive schemes can distort behaviour.

- They are often discontinuous:

$$\frac{\Delta \text{ reward}}{\Delta \text{ performance}} = 0 \text{ or } \frac{\Delta \text{ punishment}}{\Delta \text{ performance}} = 0$$

  - threat of firing, loss of contract
  - fines
  - legal liabilities
  - prizes, promotions, bonuses

- But discontinuous incentive schemes can substitute for continuous:
  - wage ($/hr) + punishment after monitoring (firing)
  - wage ($/hr) + reward after monitoring (promotion)

Multi-Dimensional Performance

A danger:

- **not that incentive schemes fail, but**
- **but that they work too well.**

Agents concentrate on the goal with explicit incentives, often quantity (easy to count).

One tradeoff: *Quality*

- **quantity v. quality**
  e.g. jet engine blades
  e.g. production-line workers,
  "shirking" = higher defect rates
- **when quality is hard to monitor**
  e.g. solution: pay all but the quality-control workers by the piece, since it is difficult to control the quality of quality control (:-)

Moral hazard might be suspected

- even with time payment, we can use discontinuous rewards/punishments to mimic continuous incentive schemes.

e.g. Sears ended its commission to its mechanics, to enhance its credibility with its customers, who suspected over-servicing as a result of the mechanics' incentives.

The Principal's Ideal Payment Scheme

"The shortest and best way to make your fortune is to let people see clearly that it is in their interests to promote yours."
— Jean de La Bruyère (1645–1696)

Q: But how?

A: Set the agent's marginal payment scheme λ (commission, royalty, piece rate, etc.) at 100%.

Example: the salesperson example:

Q: What is the ideal amount of the agent's effort, from the principal's viewpoint?

- **Assume the agent's costs equal the principal's; and assume diminishing return to effort.**
- **If the principal acts alone: gets 100% of the benefits and incurs 100% of the costs.**
  So exerts effort to the point where marginal costs equal marginal returns
  or effort: marginal cost (effort) = marginal returns ($P = MC$?)
- **When the agent acts, he bears the full cost of any marginal effort, whatever the commission rate λ.**

Optimal commission? How to raise money?

- At $\lambda = 30\%$, the agent would exert effort up to the point where the cost of \$100 extra sales is \$30, which is less than the principal's effort (of \$100).
- With $\lambda = 100\%$, the agent reaps the full benefits, and exerts effort up to the point where the cost of \$100 extra sales is \$100, as does the principal.
- Thus $\lambda = 100\% \Rightarrow$ the agent's interests and the principal's are identical, and the gain from trade to be divided between the principal and the agent is maximised.

Q: But then how does the principal earn anything from the deal?

How about a fixed payment by the agent as well?

- As well as the commission rate λ, the deal includes a fixed payment f from A to P.
- The principal uses the rate λ to induce appropriate actions by the agent at the margin, and the fixed fee f to get some of the gains to trade for herself. (Limited by the agent's alternatives, given the agent's veto.)
- The fixed fee f is a payment from the agent to the principal.

$\therefore$ In effect the principal sells the agent the right to be the agent:
self-employed, arm's-length relationship.

e.g. Lord Cornwallis in Bengal, in the late eighteenth century.

4. Designing Contracts

Ideal contracts (100% marginal payment schemes) are seldom seen.

Two flaws:
Contracts do more than generate incentives for effort:

1. **(asymmetric information): if the principal can't know how productive the agent is, then she may want to offer a "menu" of contracts to induce the agent to reveal his productivity — private information; *screening*, sorting.**
2. **the agent's performance is a function of outside events, but the agent bears all of the risk — but if the agent is *risk averse*, it may not be in the principal's interest to force the agent to bear the risk.**

Contracting with Private Information

e.g. The sales manager (the principal) knows only that the value of a particular area is either high or low, but only the salesperson (the agent) knows which.

Possible for the manager to offer the agent a different package (commission rate λ and base salary B) depending on whether the agent reports his sales potential as high or low, subject to the agent's fallback position.

Accountability for what they report?

Honesty?

Possible (with appropriate packages — see McMillan Ch. 9) to induce the agent to give an honest report:

- **Total package payments must be higher when the potential is correctly reported as high than when correctly reported as low.**
- **Commission rate λ must be higher, and the base salary B lower, for a report of high potential than for a report of low potential.**

How well does the principal do?

The commission rate λ must do double duty:

1. **elicit information, and**
2. **elicit effort (as above)**

$\therefore$ **it must be less than 100%,**

$\therefore$ **the agent's private information costs the principal.**

Useful to use salespeople's information in contracts and in corporate planning.

Differential wages

500 U.S. firms in footwear and clothing (after controlling for sex, union status, etc.): Why did piece-rate workers earn 14% more than workers on fixed wages? Three possibilities:

1. **self-selection: more skillful workers choose companies with piece-rate payments, while others prefer fixed salaries;**
2. **people work harder when rewarded for the results of their extra effort;**
3. **since piece-rate workers' pay is not only higher but more volatile than fixed-wage workers' pay, to some extent the higher earnings are compensation for *higher risk* borne by the piece-rate workers.**

Risk-Sharing versus Incentives

Performance-based contracts subject the agents to risk.

Most people are *risk-averse*: insure against risk by forgoing some of their anticipated earnings.

The agent is often more risk averse than the principal: a firm is better able to bear risks than its individual employees are.

$\therefore$ We might expect a smaller average payment to the agent in return for the principal absorbing some of the risk.

But this will weaken the agent's incentives:

NB: Any contract will be a compromise between risk-bearing and incentives.

What is the principal's best tradeoff between "risk-bearing" and "incentives"?

Two questions:

1. **How much discretionary scope does the agent have to produce variations in performance?**
2. **How much money would the agent be prepared to forgo to have the risk associated with the task removed from his shoulders?**

The commission rate λ should depend on the relative size of these two numbers.

So long as the principal is less risk-averse than the agent, sharing risk is a win-win proposition.

Risk-Sharing via Contracts

A fixed-price contract **will give the agent — the firm or person contracting with the firm or government (the principal) — the incentive to choose the effort level that maximises the total return from the transaction, but at risk.**

A cost-plus contract **puts the risk on the principal, but has the disadvantage of giving the agent no incentive to limit production costs.**

An incentive contract **is an intermediate form: allows the agent to pass on some fraction of added cost as higher price to the principal.**

Relative Performance Evaluation

With perfect information, in order to infer the agent's actions, the principal could design a contract to elicit the desired actions.

The principal can obtain more information than just the agent's output: the outputs of others.

This can be obtained through *benchmarking* with other firms, or though tournaments among agents, with prizes and rewards.

(See McMillan Ch. 10 on Setting Executives' Incentives.)

5. Application to Financial Contracts (e.g. Hollywood)

Or: Why standard finance theory doesn't tell you much about choice of contract.

1. Fundamentals:

- **A project costs $1 million to start.**
- **It pays:** $10 million with probability = ¾; $0 with probability = ¼
- **Investors are risk-neutral; and the market interest rate is 0% p.a.**

Hence, expected NPV = $10 × ¾ + 0 × ¼ − $1
= $6.5 mn > 0.

Finance theory and contracts.

2. Two common ways to raise capital: Equity, Debt.

➢ ***Equity contracts:***

The principal promises a share λ of returns ($0 \leq \lambda \leq 1$) to investors.

To raise \$1 million, promise λ to solve:

$$\lambda\,[10 \times 3/4 \;+\; 0 \times 1/4\,] \;\geq\; 1,$$

which $\Rightarrow \lambda \geq 0.133 = 13.3\%$ (because their Expected Net Return ≥ 0)

The principal gets $(1-\lambda) \times 3/4 \times 10 \leq$ \$6.5 mn, the net wealth created.

... and Debt Contracts

- *Debt:* Promise to pay first $\$D$ dollars to investors if a Success. Solving:

$$D \times 3/4 = 1, \Rightarrow D = \$1.33 \text{ million}$$

The principal gets $(10 - 1.33) \times 3/4 = \$6.5$ million

- Financing choice (debt or equity) is irrelevant (Modigliani-Miller).
  But if bankruptcy has cost b, then stay away from debt, as it gives Entrepreneur an expected value of $6.5 - \frac{b}{4}$, where the probability of bankruptcy is 1/4.

Q: So why are most projects like this (large inside ownership) financed with debt?

The Simplest Answer (with asymmetric info, such as Hollywood and little investors):

Cannot contract directly on realised returns, since only the *insider* knows whether the project succeeded or failed (or how successful the project was). Now compare the two securities:

5.1 Equity finance:

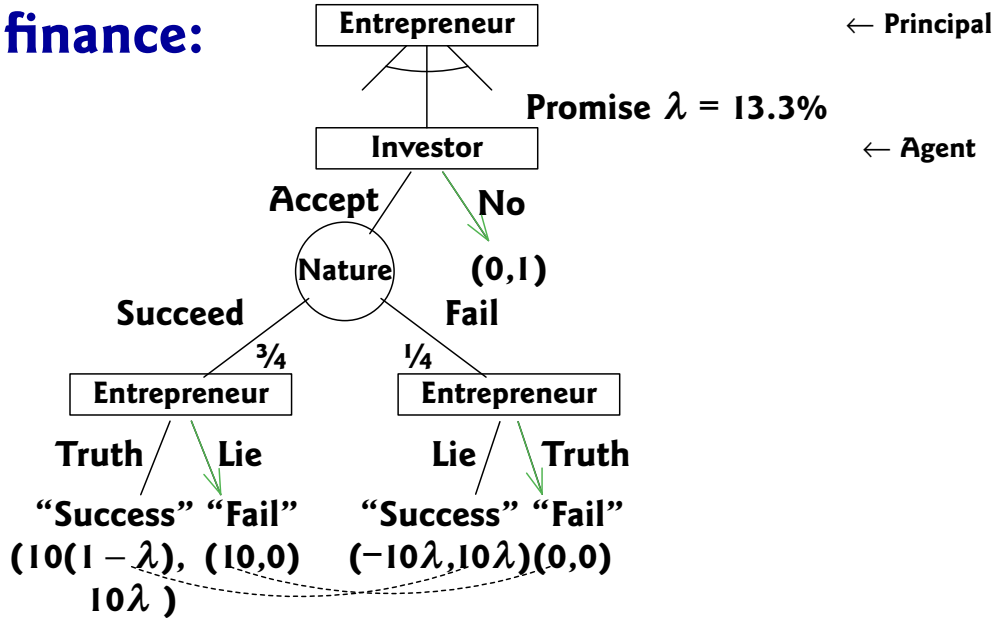

Fig 1: Equity Finance **(Entrepreneur, Investor)**

No investment — Inefficient outcome

The outside Investor's information set: he knows what the Entrepreneur says, but not Nature's outcome (whether there has been success or not).

- $\therefore$ **The Entrepreneur announces "Failure" in *both* cases: $10 > 10(1-\lambda)$ (Probability 1)**
- $\therefore$ **The Investor says No, no investment: because $1 > 0$**
- $\succ$ **Mutual tragedy — inefficient.**

5.2 Debt Finance with bankruptcy penalty *b* (a dead-weight loss).

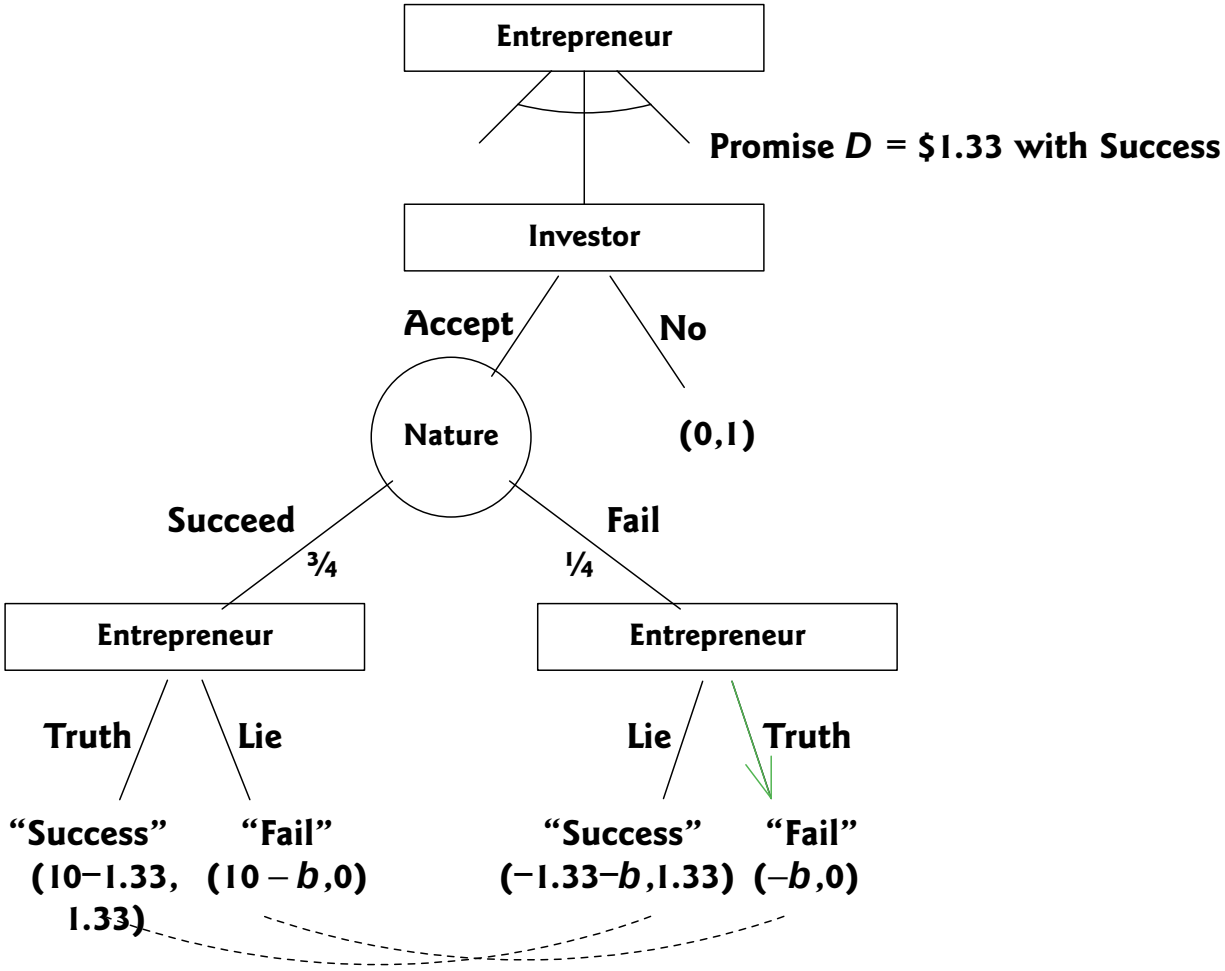

Fig 2: Debt Finance (Entrepreneur, Investor)

The cost of bankruptcy can induce honesty:

- The Entrepreneur tells the Truth with Success if $b \geq \$1.33$ mn
  (In the real world, the necessary b is scaled down by other forces, e.g., honesty, etc.)
- The Investor then *participates*: Accept.
  Is this efficient?
- The penalty b *must* be invoked when failure occurs or when Entrepreneur announces "Failure".

Small companies (which can hide $ flows) can issue these contracts.

Q: ways to achieve at lower cost to Ent. than $\frac{b}{4}$?

More efficient, because dead-weight loss b.

Intermediaries?

Large banks less often?

5.3 *"Relationship Investing" (Equity plus Monitoring)*

By spending X mn dollars, the equity investor *finds out* whether success or failure by monitoring.

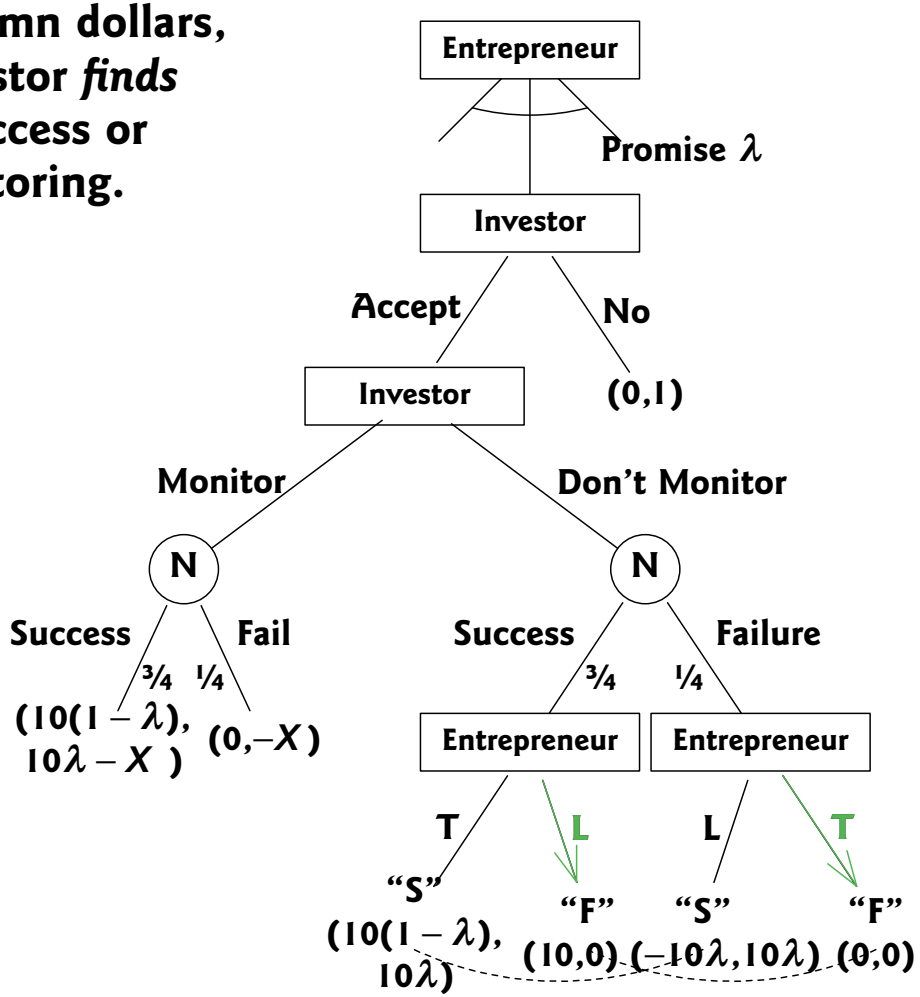

***Fig 3: Relationship Investing* (Entrepreneur, Investor)**

When will monitoring and investment occur?

- From Fig 3 we see that Investors know that:
  - if they don't monitor, they get 0 *for certain*, but
  - if they do monitor, then they get
$$\tfrac{3}{4}(10\lambda - X) + \tfrac{1}{4}(-X) = 7.5\lambda - X.$$
- Thus they monitor after investing, if $7.5\lambda - X > 0$,
  i.e., if $X < 7.5\lambda$ million dollars.
- But they'll only Accept the contract if
$$7.5\lambda - X \geq 1,$$
  so we must have $\lambda \geq 0.133 + \frac{X}{7.5}$,
  where the second term is the compensation for monitoring expense.

5.4 *Conclusion*: Debt or Relationship?

Consider the return to the Entrepreneur in Fig 2. (with b = \$1.33 mn to induce truth-telling) and in Fig 3:

then choose Relationship Investing over Debt Finance if the expected return to you the Entepreneur is higher for Relationship Investing than for Debt Finance, i.e., if:

$$7.5(1-\lambda) > \frac{3}{4}(10-1.33) - \frac{b}{4},$$

where $\frac{b}{4} = \frac{1.33}{4}$ is the dead-weight loss associated with Debt Financing, and where $\lambda = 0.133 + \frac{X}{7.5}$,

i.e., if the monitoring cost X < \$0.33 mn, then choose Relationship Investment (Fig 3).

Idea: to have sunk monitoring cost before knowing the outcome, then it's redundant if you find out it's successful.

But don't have to do messy ex-post bankruptcy.