

Lecture 19: Contracting, or The Rules of the Game, or Mechanism Design

(See McMillan, Chap. 8 & 9, and DixitSkeathReiley Chap. 14)

Topics:

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

I. Strategising versus Economising

Strategising ...

(See Williamson's paper in the Package: he shared the Nobel prize in 2009, for "analysis of economic governance, especially the boundaries of the firm".)

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).**

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

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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, we can achieve the perfect competition outcome.

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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

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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 rules of the game, the contract,
 - solve (or simulate) for the equilibrium of this game, of this contract,
 - then ask:
 - are the players *pleased* with the outcomes?
 - what could they do to achieve a *better* outcome? How?

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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

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➤ **The pervasive *Principal-Agent* problems:**

- author v. publisher
- debt v. equity
- landlord v. tenant
- subcontractor v. price contractor
- employer v. employee
- insured v. insurer

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➤ **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 (?)**

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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? The Principal or the Agent?**
 - **fixed-price contracts?**
 - **cost-plus contracts?**
 - **incentive contracts?**

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

— Samuel Goldwyn

Marginal Incentives

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- OK if constant, predictable relationship:
Agent's effort \Rightarrow Agent's 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.?)**

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**The incentive effect — 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 Agent's selling effort.

Carrots & Sticks

Look at from the worker's (the Agent's) point of view:

- **if she performs better, do her pay or rewards increase?**
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Ideally the Principal would like to set:

- **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
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➤ 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:

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

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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, the Principal can use discontinuous rewards/punishments to mimic continuous incentive schemes.**

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e.g. Sears ended its commissions to its mechanics (the Agents), to enhance its credibility with its customers, who suspected over-servicing of their cars as a result of the mechanics' incentives.

Sears' mechanics became regular employees, paid by the week.

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.”

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Q: But how?

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Q: But how?

A: The Principal sets 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?

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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 acted alone, then she would get 100% of the benefits and incur 100% of the costs. So the Principal would exert effort to the point where marginal costs equal marginal returns or effort: $\text{marginal cost (effort)} = \text{marginal returns}$ ($P = MC?$)
 - When the Agent acts, he bears the full cost of any marginal effort, whatever the commission rate λ .

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 - 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 with $\lambda = 100\%$, how does the Principal earn anything from the deal?**

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self-employed, arm's-length relationship.
- e.g. Lord Cornwallis in Bengal, in the late 18th century, sold the right to collect taxes to private individuals, (who were hated).

4. Designing Contracts

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Two flaws:

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- 2. the Agent's performance is a function of outside events, with the Agent bearing 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 $\lambda < 100\%$ 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?

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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.

(We saw a similar cost when Sally tried to screen Burt, in Lecture 12.)

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

Differential wages

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- 2. *incentives*: 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.

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∴ 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.

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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

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An incentive contract is an intermediate form: allows the Agent to pass on some fraction of added cost as a 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 through tournaments among Agents, with prizes and rewards.

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

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

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

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- The Entrepreneur (the Principal) has a risky project that costs \$1 million to start.
- It pays: $\left\{ \begin{array}{l} \$10 \text{ million with probability} = 3/4 \\ \$0 \text{ with probability} = 1/4 \end{array} \right.$
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- **It pays:** $\left\{ \begin{array}{l} \$10 \text{ million with probability} = 3/4 \\ \$0 \text{ with probability} = 1/4 \end{array} \right.$
- **Investors (Agents) are risk-neutral; and the market interest rate is 0% p.a.**

**Hence, expected NPV = $\$10 \times 3/4 + 0 \times 1/4 - \1
= \$6.5 mn > 0.**

Finance theory and contracts.

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

... and Debt Contracts

- **Debt:** The Entrepreneur promises to pay the first $\$D$ dollars to Investors if a Success. Solving:

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

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- **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 $\frac{1}{4}$.

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

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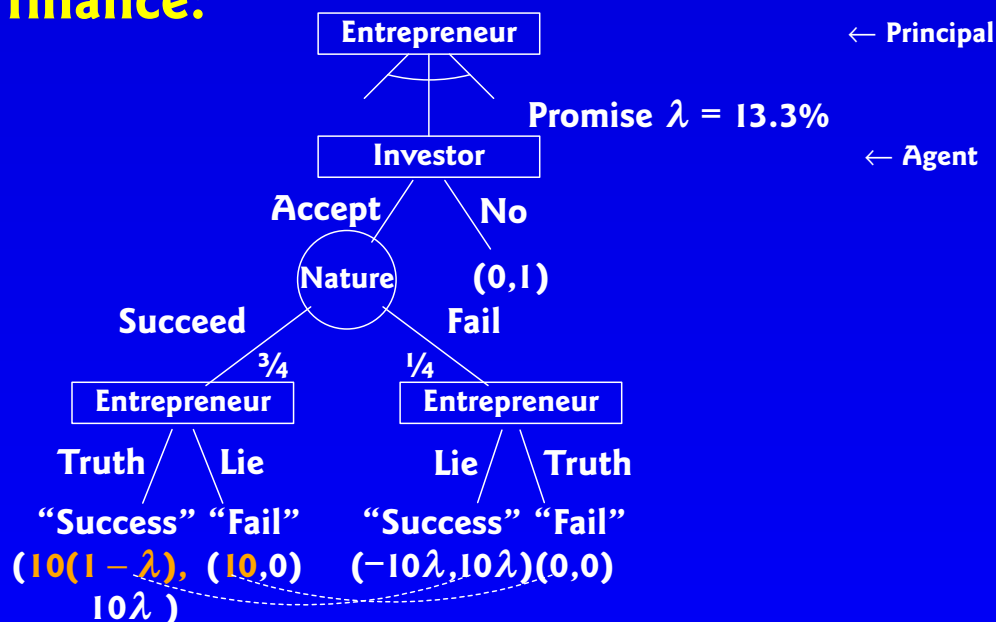
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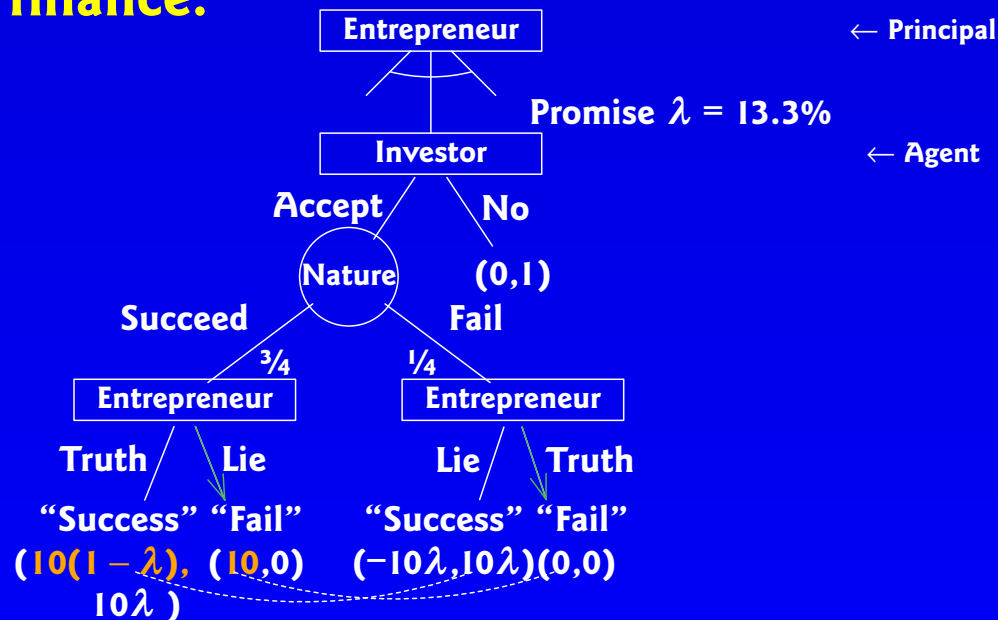
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Cannot contract directly on realised returns, since only the *insider* knows whether the project succeeded or failed (or how successful the project was). Now compare the two securities:

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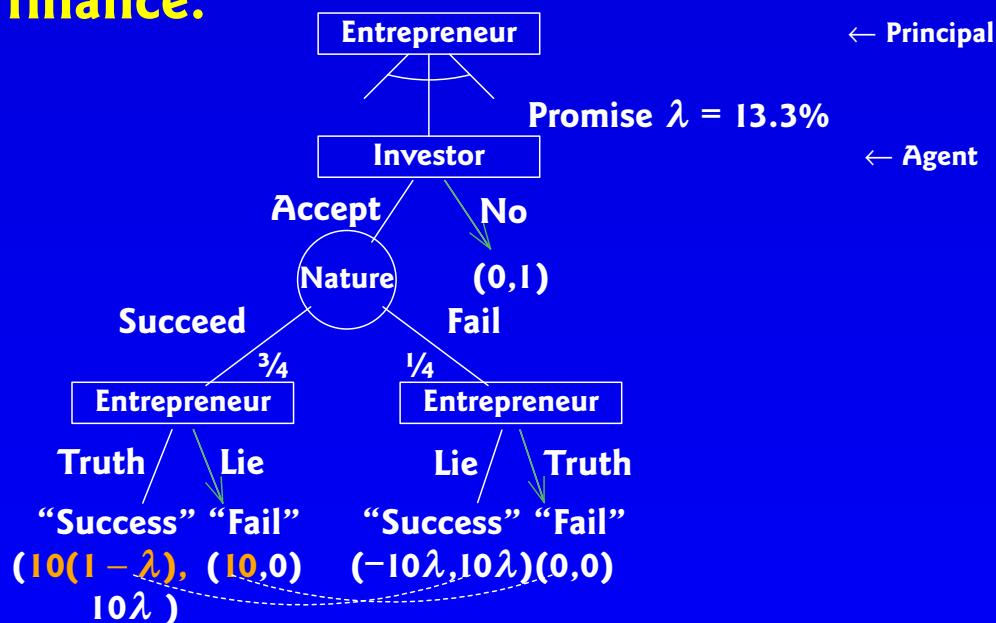


Fig 1: Equity Finance (Entrepreneur, Investor)

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).

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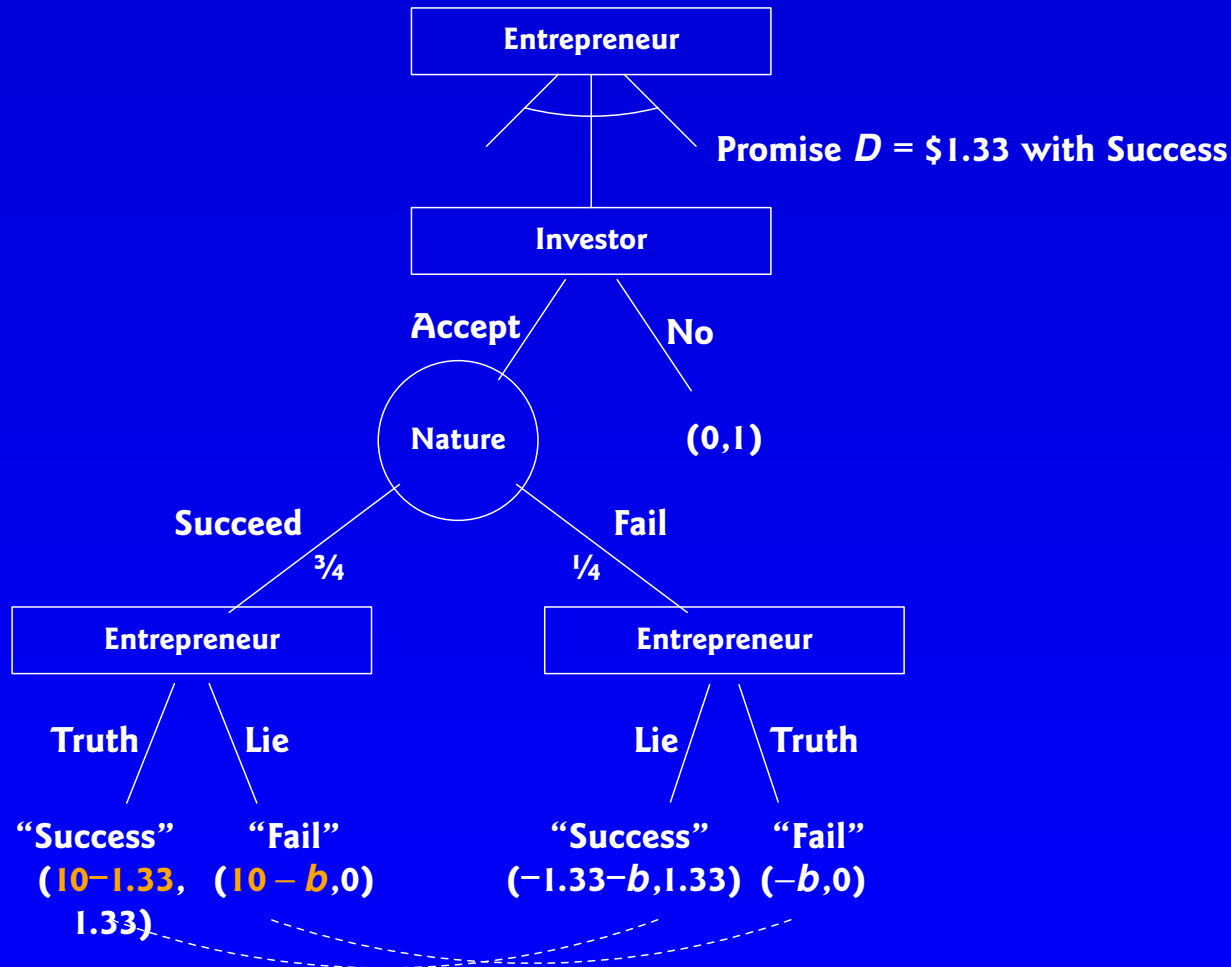
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- Mutual tragedy – inefficient.**

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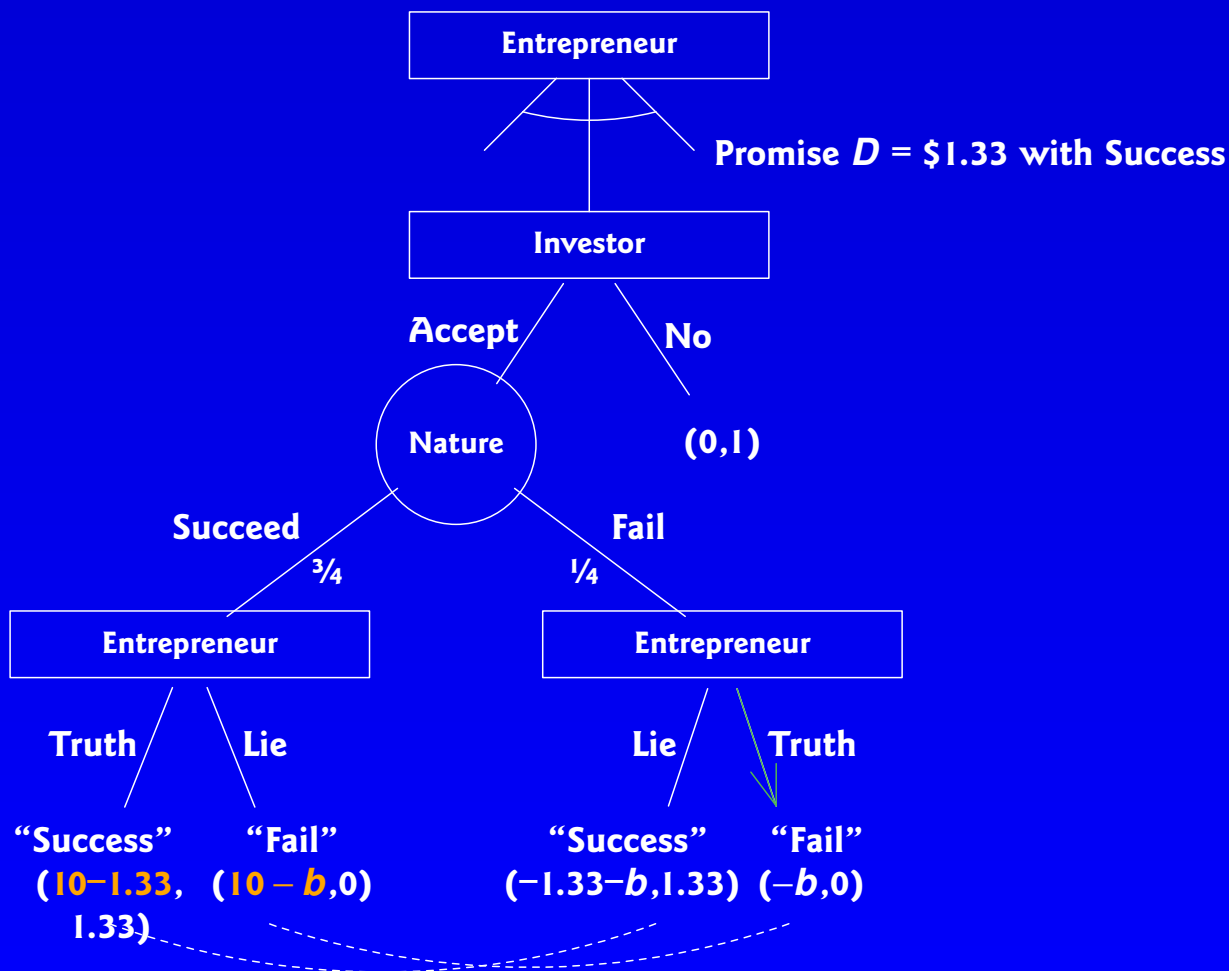


Fig 2: Debt Finance (Entrepreneur, Investor)

The cost of bankruptcy can induce honesty:

- The Entrepreneur tells the Truth with Success if $b \geq \$1.33$ mn, the penalty of bankruptcy.
(In the real world, the necessary b is scaled down by other forces, e.g., honesty, etc.)
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More efficient, because dead-weight loss b .

Intermediaries?

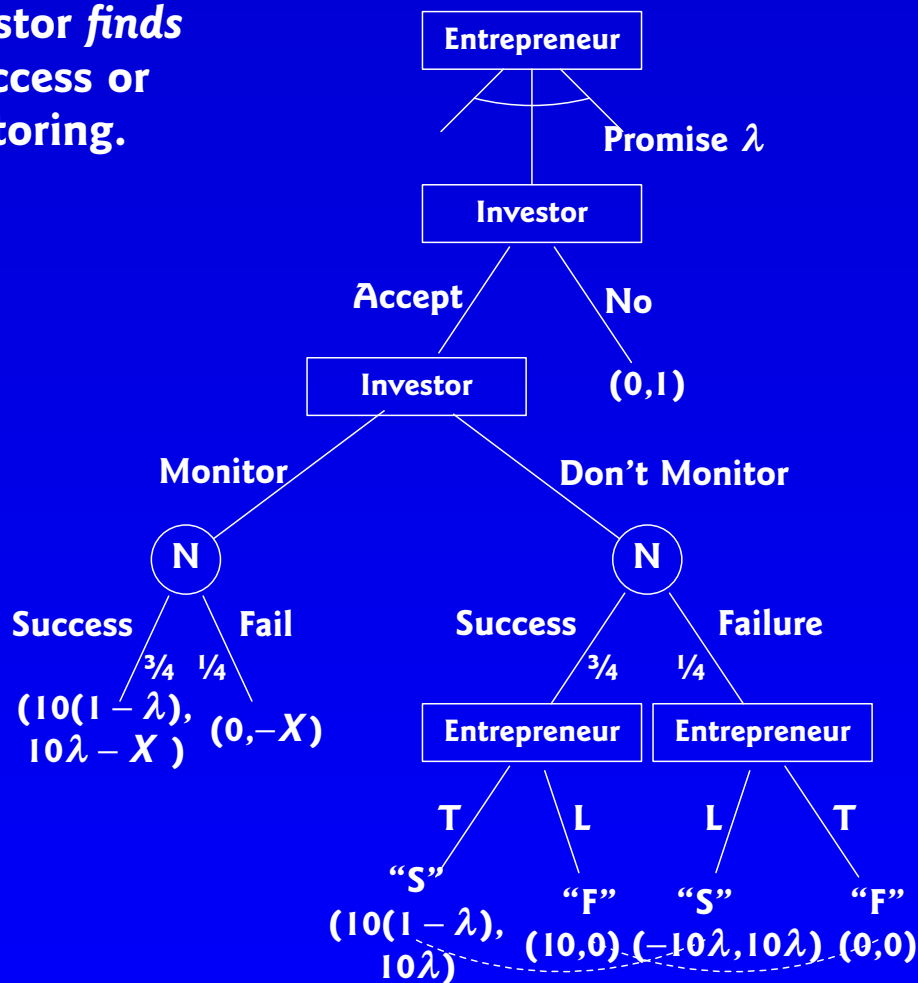
Large banks less often?

5.3 “*Relationship Investing*” (*Equity plus Monitoring*)

By spending X mn dollars,
the equity Investor *finds*
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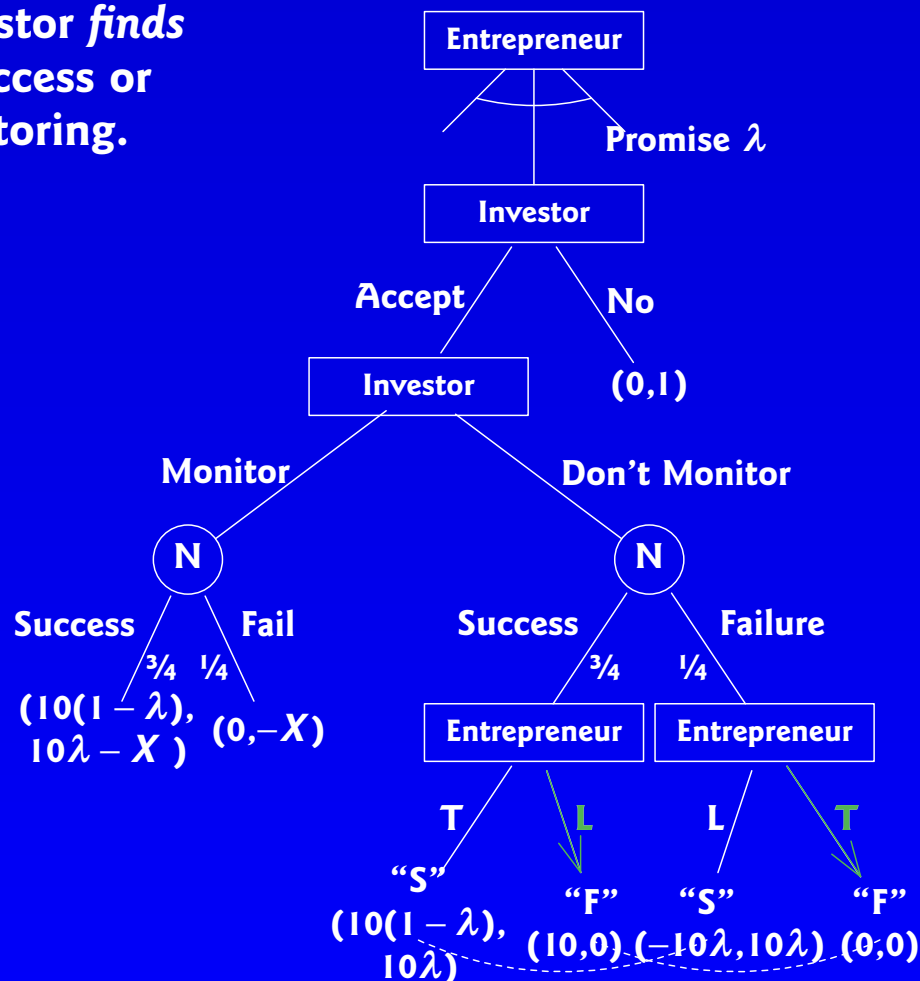


Fig 3: Relationship Investing (Entrepreneur, Investor)

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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 the Entrepreneur will choose Relationship Investing over Debt Finance if the expected return to her 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 $\lambda = 0.133 + \frac{X}{7.5}$,

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Idea: to have sunk the monitoring cost X 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.