10.5 An Illustration: Employee versus Independent Contractor

(From Gerry Garvey)

1. Basic issues (to employ or to subcontract):

- You need human resources to perform various tasks, of which one is "toilet-scrubbing" (or some similar task)
- You can *order* an employee to scrub,
  but an independent can walk away, so ordering her is useless.
- Say scrubbing costs her $\$e$ of disutility,
  and gives you a gain of $300/day.
- A potential scrubber:
  — has a next-best opportunity of $1000/day, and
  — is worth $\$\Pi$/day to you if she doesn't scrub.
- You hire/contract with a payment of $\$w$/day.

2. *How to decide:* Find the subgame perfect equilibrium of the interaction, under two alternative arrangements of the Employment Relationship. Solve backwards.

Employee Case

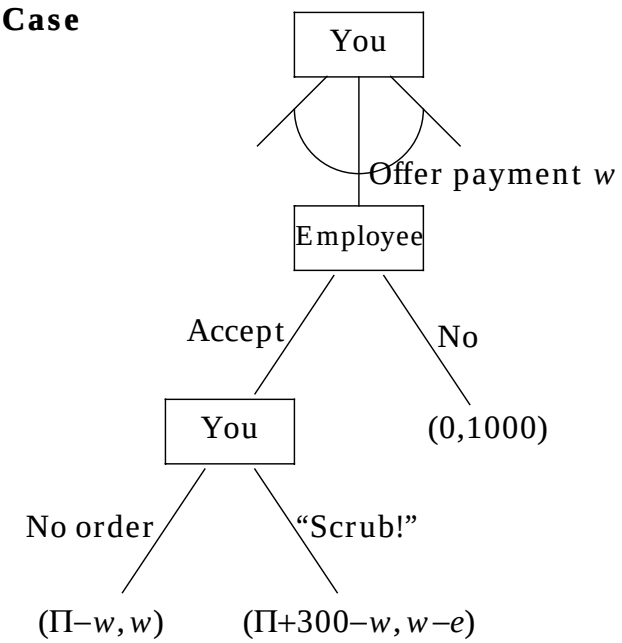

Fig 1: Employer–Employee (You, Her)

The employer bears the cost of scrubbing.

- You will certainly order her to scrub, since $\Pi+300-w > \Pi-w$.
- Hence the employee will accept the contract if $w-e \geq 1000$.
- Hence your wage offer w must be $1000+e$.
- Hence your profits are $(\Pi-1000)+(300-e)$.
- Note that the employer bears the costs e,

  ∵ the employee knows that the employer will order the toilets scrubbed.

Q: Is the contract efficient?

(If $w-e > 1000$, then $w > 1000+e$.)

3. **The Independent Contractor Case.**

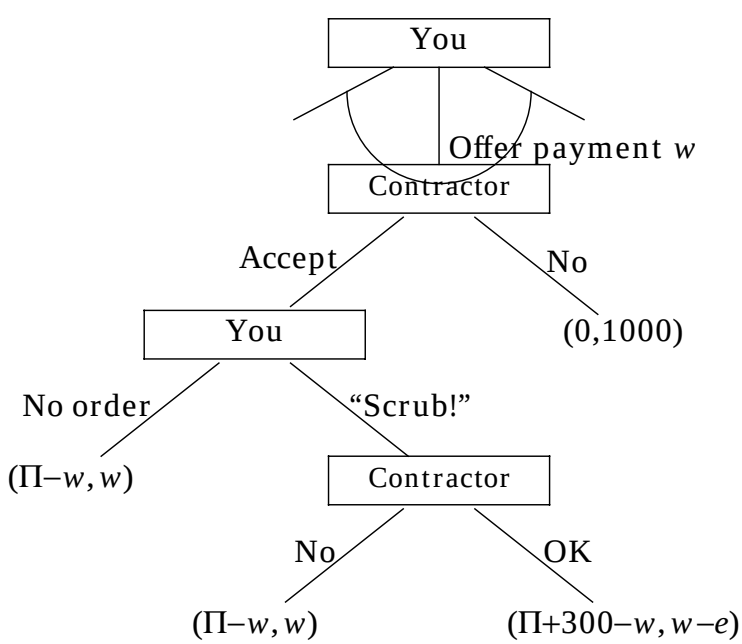

Fig 2: Independent Contractor (You, Her)

("No": $\Rightarrow w = 1000$.)

The scrubbing remains undone.

- Now the contractor will say No: because $w > w - e$.
- Now your *profits* are $\Pi - 1000$, since $w = 1000$.

Comparing the two cases:

- The Employer–Employee relation (Fig 1) allows the employer to commit to scrub.
- The Independent Contractor relation (Fig. 2) allows employer to commit not to force the independent worker to scrub.
- The former Fig. 1 (latter Fig. 2) is more profitable for you if $e < (>)\ 300$.
- You are seeking the cheapest way to keep the toilets clean.
  By using game theory, you're able to select the contractual arrangement that achieves this goal.

Fig 1: When $w \geq 1000 + e$, then the payoff to you = $(\Pi - 1000) + (300 - e)$

Fig 2: Payoff to you = $(\Pi - 1000)$.

We're overpaying him, but he's worth it.

— Samuel Goldwyn

10.6 Application to Financial Contracts

10.6.1 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, NPV = $\$10 \times \frac{3}{4} + 0 \times \frac{1}{4} - \$1$
   = \$6.5 mn > 0.

Finance theory and contracts.

2. Two possible ways to raise capital:

   - *Equity contract:*
     promise a share λ of returns ($0 \le \lambda \le 1$) to investors. To raise \$1 million, promise λ to solve:
     $$\lambda\,[10 \times \tfrac{3}{4} + 0 \times \tfrac{1}{4}] = 1,$$
     which $\Rightarrow \lambda = 0.133$ ($\because$ their Expected Return = 0)

     You get $(1-\lambda) \times \tfrac{3}{4} \times 10 =$ \$6.5 mn, the net wealth created.

   - *Debt:*
     promise to pay first \$$D$ dollars to investors, solving:
     $$D \times \tfrac{3}{4} = 1, \quad D = \$1.33 \text{ million}$$
     You get $(10 - 1.33) \times \tfrac{3}{4} =$ \$6.5 million

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

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

10.6.2 The Simplest Answer (with asymmetric information):

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:

1. **Equity finance:**

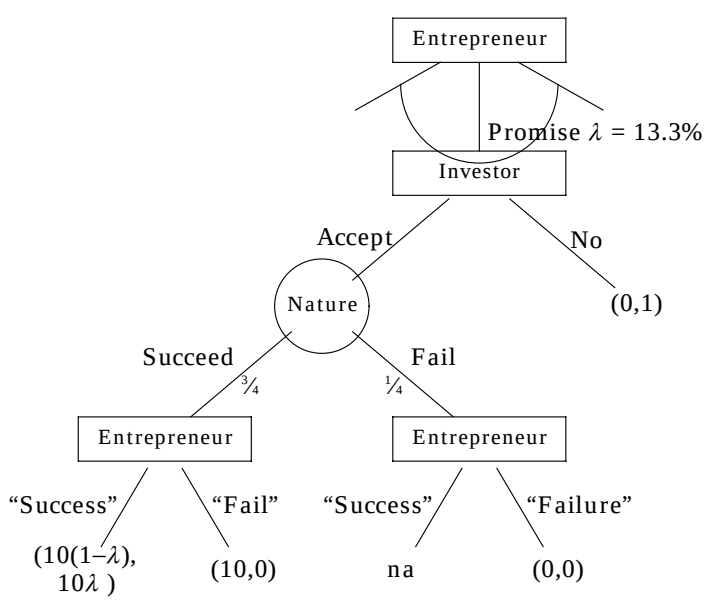

Fig 3: Equity Finance (Entrepreneur, Investor)

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).

∴ The Entrepreneur announces failure in *both* cases: $10 > 10(1-\lambda)$ (Probability 1)

∴ The Investor says No, no investment: because $1 > 0$

- Mutual tragedy — inefficient.

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

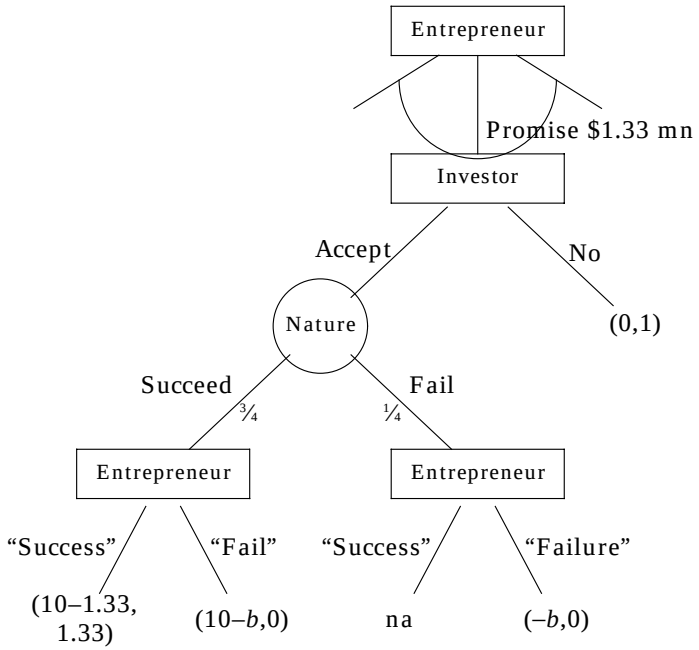

Fig 4: Debt Finance (Entrepreneur, Investor)

The cost of bankruptcy can induce honesty

- The Entrepreneur tells the truth 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*. Is this efficient?
- The penalty *must* be invoked when failure occurs or when you announce "Failure".

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

Q: ways to achieve at lower cost than $b/4$?

More efficient, ∵ dead-weight loss.

Intermediaries?

Large banks less often?

3. "**Relationship Investing" (Equity plus Monitoring)**
   By spending X mn dollars, the equity investor *finds out* whether success or failure by monitoring.

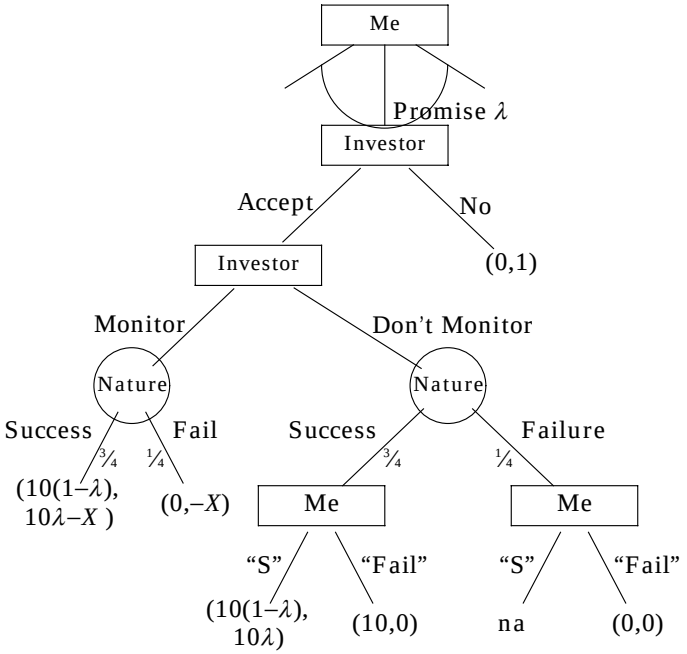

Fig 5: Relationship Investing (Me, Investor)

When will monitoring and investment occur?

From Fig 5: the Investor will:

Monitor if $X < 7.5\lambda$
Accept if $7.5\lambda - X > 1$
$\therefore\ \lambda \geq 0.133 + \dfrac{X}{7.5}$.

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

4. **Conclusion**:

Consider the return to the Entrepreneur in Fig 4. (with b = \$1.33 mn to induce truth-telling) and in Fig 5:

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:

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

where $b/4 = 1.33/4$ is the dead-weight loss associated with Debt Financing, and

where $\lambda = 0.133 + X/7.5$,

i.e., if monitoring cost $X <$ \$0.33 mn, then choose Relationship Investment (Fig 5).

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

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

10.7 Application to Profit-Sharing and Franchising

10.7.1 One-Dimensional Problem

How does the Principal (you) motivate the Agent (your franchisee) to perform properly, especially when you can't observe the quality of the potential franchisees beforehand?

- Your franchise idea is worth $10 million if an energetic franchisee takes it on,
- but only $5 million if a "sloth" takes it on.
- There are 90% sloths, 10% energetics, but no easy way to tell them apart, ex ante.
- The energetic franchisee has a next-best option of $8 mn;
- Sloth's next-best is $6 mn.
- Thus the sloth is *not* specialised to your business.
- You offer two kinds of payment to the franchisee:
  - — the wage or fee f,
  - — plus a share λ of the final profits.

The franchising game.

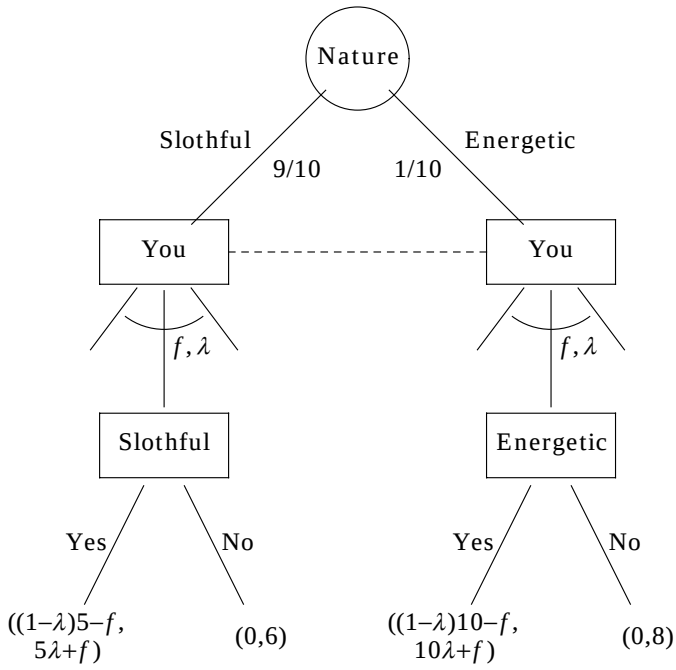

Fig. 6: Franchising 1 (You, Agent)

You want a separating equilibrium.

- Energetic types say Yes, if $10\lambda + f \geq 8$ mn.
- At $\lambda = 0$, you must pay $f = \$8$ mn to get energetics,

  in which case (*pooling*) you get *both* types, since $5\lambda + f = f = 8 > 6$ mn.
- and you get gross expected profits of $0.9\times5 + 0.1\times10 = 5.5$ mn, which is less than your fixed payments of \$8 mn.
- To keep good types (*separating*), you *must* have $10\lambda + f > 8$, or pay $f \geq 8-10\lambda$.
- Substitute this into the *sloth* objective, to get:

  sloth's share + fixed fee for energetics, or

  $$5\lambda + f = 5\lambda + (8-10\lambda) \leq 6,$$

  i.e. $$8-5\lambda \leq 6 \text{ or } \lambda \geq 2/5.$$
- If $\lambda > 2/5$, then sloths stay away, and energetics come. (*Separating* equilibrium)
- Your net profit is now $(1-\lambda)10 - (8-10\lambda) = \$2$ mn,
- equals the wealth created by energetic types.

This exemplifies *screening* to exclude sloths, a naive pay-for-performance.

Qustions.

Q: but why not always pay for performance?

Q: Why not franchise contracts only λ?

A: Underlying story more complex —
no externalities or other franchisees.

or why not pay $\geq 4/5$ of production? $\rightarrow$ screening.

10.7.2 Multi-Dimensional Problem

- The previous model assumed that all costs and benefits were reflected in the franchisee's profit stream. No externalities.
- Suppose franchisees can also increase their profits by $2 million by neglecting the promotion of the franchise as a whole, or by taking "wild" actions that actually damage other franchisees (reputation effects).
- Or they can undertake a promotion which generates $4 million for the franchisor. (Through other franchises.)

The game now has the additional branch:

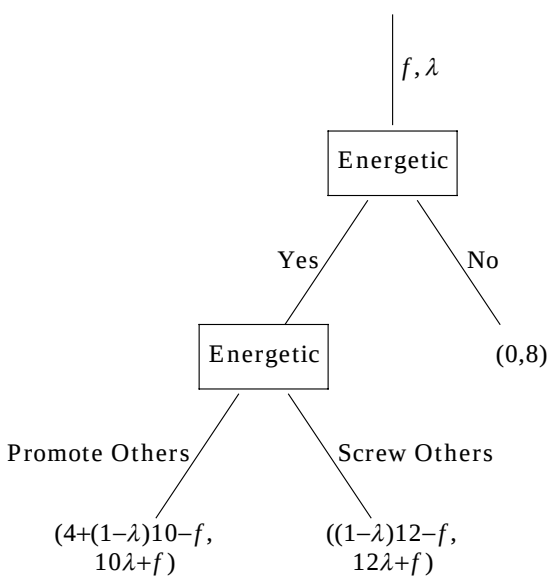

Fig 7 Franchising 2 (You, Agent)

No profit share (a flat fee) but no incentive for the energetics to promote others.

Inducing good behaviour.

- Recall: we had to set $\lambda \geq 2/5$ to screen out the sloths.
- But now the energetic type will choose to screw others: since for any $\lambda > 0$, $12\lambda+f > 10\lambda+f$.
- The basic answer is to set λ as low as possible (at $2/5$), and *not* to pay all of f up front.
- When $\lambda = 2/5$, we set total payments f assuming that the franchisee behaves OK so that he'll just participate, i.e.,

$$2/5(10) + f = 8 \Rightarrow f = \$4 \text{ mn.}$$

- Thus, if we pay only \$1 mn of f *up front*, and defer the other \$3 mn until after we've determined how helpful he was to other franchisees, then his new payoffs are:

$$10(2/5) + 4 = \$8 \text{ mn if he promotes, and}$$

$$12(2/5) + 1 = \$5.8 \text{ mn if he doesn't.}$$

- Now it pays him to promote.
- Relies on franchisor's good graces — promised to pay additional \$3 mn: reputation?

10.7.3 The Full-Blown Problem The game tree is now extended to include the franchisor's precommitment decision on payment.

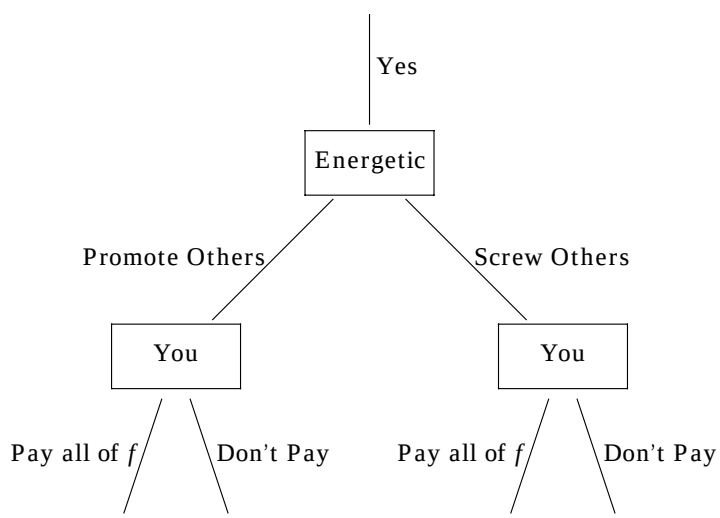

Fig. 8: Franchising 3

10.8 Summary of Contracting

There are wo components to the incentives question:

1. a divergence of interests between the principal and the agent; and
2. the principal's inability to isolate the effects of the agent's effort from random factors outside the agent's control: the agent's output is only an imperfect measure of his output.

The principal must design the agent's reward structure to align the agent's interest closely with her own.

Marginal incentives are key: the fraction of the return to extra effort the agent may keep:

- the higher the marginal rate of payment, the greater the effort it will elicit;
- with 100% marginal payment rate, the agent's interests are aligned with the principal's.

Discontinuous incentive schemes can substitute for continuous ones, and are effective if there are lags about performance.

Contracts as screening devices.

The *terms of a contract* are set as a compromise between providing performance incentives, and eliciting information and sharing risk.

Agents faced with *a menu of packages* may reveal their private information, as a cost in terms of performance incentives. *Screening.*

Risk-averse agents may forgo some pay in order to reduce the risk they bear, but again at a cost in terms of performance incentives.

The principal can compare agents' performances to reduce their discretionary action.