Lecture 10 Game Plan

- Hidden actions, moral hazard, and incentives
- Hidden traits, adverse selection, and signaling/screening
Hidden Information

“A little knowledge is a dangerous thing. So is a lot.”
- Albert Einstein
Strategic Manipulation of Hidden Information

- **Hidden Actions: Incentives**
  - Associates others’ unobservable actions with observable outcomes

- **Hidden Traits: Signaling & Screening**
  - Associates others’ unobservable traits with their observable actions
Incentives

- High hurdle and a lot of money
- Low hurdle and a little money
Hidden Effort

- You are contracting a project to an outside firm. The project has an uncertain outcome.
  - Probability of success depends on firm’s effort:
    - prob. of success = 0.6 if effort is routine
    - prob. of success = 0.8 if effort is high
  - Firm has cost of effort:
    - cost of routine effort = $100,000
    - cost of high effort = $150,000
  - Project outcome = $600,000 if successful
Compensation Schemes

I. Fixed Payment Scheme
II. Observable Effort
III. Bonus Scheme
IV. Franchise Scheme
Incentive Scheme 1: Fixed Payment Scheme

- If firm puts in routine effort:
  - Profit = Payment - $100,000
- If firm puts in high effort:
  - Profit = Payment - $150,000
- Firm puts in low effort!
  \[ \Rightarrow \text{“moral hazard”} \]
- Optimal Payment: lowest possible.
  - Payment = $100,000
- Expected Profit
  \[ = (.6)600,000 - $100 = $260K \]
Incentive Scheme 2
Observable Effort

- Firm puts in the effort level promised, given its pay
- Pay $100,000 for routine effort:
  - $\text{E}[\text{Profit}] = (0.6)600,000 - 100,000$
  - $= 260,000$
- Pay additional $50K for high effort:
  - $\text{E}[\text{Profit}] = (0.8)600,000 - 150,000$
  - $= 330,000$
  - → want to induce high effort
- Expected Profit = $330K
Problems

- Fixed payment scheme offers no incentives for high effort
  - High effort is more profitable

- Effort-based scheme cannot be implemented
  - Cannot monitor firm effort
Suppose effort can not be observed
Compensation contract must rely on something that can be directly observed and verified.

- Project’s success or failure
  - Related *probabilistically* to effort
  - Imperfect information
Salary + Bonus Schemes

A successful scheme must

1. Be “Incentive Compatible”
   - Firm must prefer to put in high effort

2. Induce Participation
   - Firm must prefer to take the job
On-Line Game #7

Incentive Pay
Incentives

- Cost of routine effort: $100K
- Cost of high effort: $150K
- Added cost of high effort: $50K

- Benefit of routine effort: .6b
- Benefit of high effort: .8b
- Added benefit of high effort: .2b
Incentive Compatibility

- Firm will put in high effort if
  \[ s + (0.8)b - 150,000 \geq s + (0.6)b - 100,000 \]

- \[(0.2)b \geq 50,000\]
  \textit{marginal benefit > marginal cost}

- \[b \geq 250,000\]
Participation

- Expected salary must be large enough to make work worthwhile
- If induce high effort: \( b > \$250K \)
  expected salary = \( s + 0.8b \)
  but even if \( s = 0 \):
    \[ 0.8b = \$200K > \$150K \]
- No base salary needed!
Profitability Summary

- Greatest Profit from inducing high effort: $280K (unless s<0)
- Greatest Profit from inducing low effort: $260K
  - Using the “no brainer” solution
  - Salary = $100K, no bonus

- Do we want to induce high effort?
- Carefully.
- Don’t give away the farm to do it.
Optimal Salary and Bonus

- Incentive Compatibility:
  - Firm will put in high effort if $b \geq 250,000$

- Participation:
  - Firm will accept contract if $s + (0.8)b \geq 150,000$

- Solution
  - Minimum bonus: $b = 250,000$
  - Minimum base salary:
    $s = 150,000 - (0.8)250,000 = -50,000$
Negative Salaries?

- Ante in gambling
- Law firms / partnerships
- Work bonds / construction
- Startup funds
Interpretation

- $50,000 is the amount of capital the firm must put up for the project.
- $50,000 is the fine the firm must pay if the project fails.

- Expected profit:
  
  \[
  (.8)600,000 - (.8)b - s
  = (.8)600,000 - (.8)250,000 + 50,000
  = $330,000
  \]

- Same as with observable effort!!!
Incentive Scheme 4
Franchising

■ Charge the firm $f$ regardless of profits
  • Contractee takes all the risks and becomes the “residual owner” or franchisee

■ Charge franchise fee equal to highest expected profit
  • Routine effort: \(0.6(600K) - 100K = 260K\)
  • High effort: \(0.8(600K) - 150K = 330K\)

■ Expected Profit: $330K
Summary of Incentive Schemes

- Observable Effort
  - Expected Profit: 330K
  - Expected Salary: 150K

- Salary and Bonus
  - Expected Profit: 330K
  - Expected Salary: 150K

- Franchising
  - Expected Profit: 330K
  - Expected Salary: 150K
Upside of Assigning Risk

- Assign risk to the *agent*, the party that has control of the hidden action.
- This leads to
  - more efficient outcome
  - more profit for the principal
Downside of Assigning Risk

- Employees (unlike firms) are rarely willing to bare high risks

- Salary and Bonus
  - 0.8 chance: 200K
  - 0.2 chance: –50K

- Franchising
  - 0.8 chance: 270K
  - 0.2 chance: –330K
Risk Aversion

Risk Seeking
- Lottery (small stakes)

Risk Neutral
- Multiple Gambles

Risk Averse
- Corporations one-time deals
- Insurance (big stakes)
Summary So Far

- Suppose you know agent’s payoffs but can’t observe its actions.
- You can still induce agent to take action you want by making it bear more risk
  - Franchising
  - Salary and bonus
- Such schemes can give as much profit as if you could observe actions perfectly!
Venture Capital

- A venture’s success depends on whether a new technology will work
  - 50% chance it works
  - venture worth $20M if it works
  - venture worth $0 if it doesn’t work
- Entrepreneur knows whether the technology works or not
Venture Capital

- Entrepreneur approaches you: “I am somewhat risk averse and hence prefer to take a smaller than 100% stake”
- How much are you willing to pay if she offers you
  - 50% stake?
- 90% stake?
Problem of Adverse Selection

- Expected value of venture given that she wants to sell 50%
  - $(50\% \times 20 + 50\% \times 0) = $10M$
- Expected value of venture given that she wants to sell 90%
  - $100\% \times 0 = $0M$
- Because of this “adverse selection”, you are willing to pay less for a larger stake!!
Problem of Average Selection

- Only “bad” entrepreneur is willing to sell 90% of venture
  - adverse selection if you buy 90%
- But both “good” and “bad” are willing to sell 50% of venture
  - average selection if you buy 50%

- Still not ideal: you only want to invest when technology works!
Signaling & Screening

- High hurdle and a lot of money
- Low hurdle and a little money

Screen = “Jump over this while I watch”

Signal = “Watch while I jump over this”
How to Screen

- Want to know an *unobservable* trait

- Identify a “hurdle” such that:
  - those who jump the hurdle get some benefit but at some cost
  - “good” types find the benefit exceeds the cost
  - “bad” types find the cost exceeds the benefit

- This way we get **self-selection**: only “good” types will jump the hurdle
Auto Insurance

- Hidden Trait = high or low risk?
  - Half of the population are high risk, half are low risk
  - High risk drivers:
    - 90% chance of accident
  - Low risk drivers:
    - 10% chance of accident
- Accidents cost $10,000
Example: Auto Insurance

- The insurance company can not tell who is high or low risk
- Expected cost of accidents:
  - \( \left( \frac{1}{2} \times 0.9 + \frac{1}{2} \times 0.1 \right) \times 10,000 = \$5,000 \)
- Offer $6,000 premium contract to make $1,000 profit per customer
- What happens?
Self-Selection

- **High risk drivers:**
  - Don’t buy insurance: \((.9)(-10,000) = -9K\)
  - Buy insurance: \(= -6K\)
  - High risk drivers buy insurance

- **Low-risk drivers:**
  - Don’t buy insurance: \((.1)(-10,000) = -1K\)
  - Buy insurance: \(= -6K\)
  - Low risk drivers do not buy insurance

- **Only high risk drivers buy insurance**
Adverse Selection

- Expected cost of accidents in population
  - \((\frac{1}{2} \times 0.9 + \frac{1}{2} \times 0.1) \times 10,000 = $5,000\)

- Expected cost of accidents among insured
  - \(0.9 \times (10,000) = $9,000\)
    - Insurance company loss: $3,000

- Cannot ignore this “adverse selection”

- If only going to have high risk drivers, might as well charge more ($9,000)
Screening

- Offer two contracts, so that the customers self-select

- Compare contracts aimed at high- and low-risk drivers.
  - Which will have the higher premium?
  - Which will have the higher deductible?
“New Issues Puzzle”

- Firms conducting seasoned equity offerings (SEOs) afterwards perform worse on average than other firms.
- Loughran and Ritter (J Finance 1995) argue you lose 30% over five years investing in a SEO.
- 1970-1990 data. Comparison is relative to performance of “matched firm”, i.e. one having similar characteristics that did not have any SEO in the following 5 years.
SEO Underperformance

For this table, please see Table II from:

Is the market failing?

- Why doesn’t the market assimilate this information immediately?
- One possible explanation: *positive selection*
  - “Matched firms” are chosen retrospectively to be firms that will not have any SEO in *next* five years
  - Even if the market had *already* priced in the negative info, it might not have assimilated the (future) positive info about the matched firm!
The seasoned offering is a signal about the status of the companies current projects as well as future ones.

- Seek outside equity
- Fund projects internally

LOW  HIGH
Profitability of current/future projects
... & Adverse Selection

- If the current projects are not profitable, the cost (in dilution) to the owner-manager of issuing new share is lower.

- Therefore, seasoned offering is likely associated with
  - bad news about the firm’s present condition
  - low threshold for profitability of new project.
Dividends

“It would be uneconomic as well as pointless [for firms to pay dividends and raise capital simultaneously]”

- Merton Miller and Kevin Rock, 1982
Dividends

Why might it be make sense for a firm to issue a dividend and for investors to view this positively?
Bargaining with a Customer

- Customer either willing to pay $20 or $10, equally likely
- Your price is $15 (zero costs), but customer asks for a deeply discounted price of $5
- You don’t know whether the customer has value $20 or $10
Bargaining with Customer

"Nature" moves first

High Value (prob p)
- Give Discount
- Don’t

Low Value (prob 1-p)
- Give Discount
- Don’t

Information set represents that seller can't distinguish whether buyer has high or low value

\[
\begin{array}{c|c|c}
\text{High Value} & \text{Buy} & \text{Low Value} \\
\hline
\text{Don’t} & 15, 5 & 15, -5 \\
\text{Give Discount} & 0, 0 & 0, 0 \\
\text{Don’t} & 5, 15 & 5, 5 \\
\end{array}
\]
Solving for “Sequential Eqm”

Seller’s equilibrium choice depends on its belief about likelihood of High Value vs. Low Value

- By Don’t Discount, seller is “risking 5 to gain 10”
- Don’t Discount if \( p > \frac{1}{3} \)
Other Approaches?

- If a customer “pleads poverty” for a discount, you have other options than simply to grant/refuse request
- What else might you do?
Clearance Sale

Product only available with prob. \( q \) for those who Wait

Running the Clearance Sale costs 1
Clearance Sale as Screen

Clearance is an *effective screen* if \( q < \frac{1}{3} \)
Clearance Sale?

Clearance Sale or Sale?

Clearance Sale or No Sale?

\[ p = \Pr(\text{High}) \]

- \( p > \frac{1}{3} \): No Sale better than Sale
- \( p < \frac{1}{3} \): Sale better than No Sale
When (not) to have Clearance Sale (p < 1/3)

Clearance Sale or Sale?

Clearance Sale or No Sale?

1/3

p = Pr(High)

- Clearance Sale vs. Sale
  - Clearance gives +9 more on High
  - Clearance loses 1 + 5(1-q) on Low

- Only have Clearance when chance of High is sufficiently large
When (not) to have Clearance Sale ($p > 1/3$)

- Clearance Sale vs. No Sale
  - Clearance gives $-1 + 5q$ more on Low
  - Clearance loses 1 on High

- Only have Clearance when chance of High is sufficiently low
When to have Clearance Sale ($p = 1/3$)

1/3

Clearance Sale or Sale?

Clearance Sale or No Sale?

$p = \Pr(\text{High})$

- If Clearance is ever your best strategy, it must be when you are indifferent between Sale and No Sale ($p = 1/3$).

  - “when you can’t decide whether to offer a High- or Low-Quality product, offer both!!”
Versioning

- Suppose that high-quality/high-cost item will be equally profitable as low-quality/low-cost item.

- In this case, you can always do better offering a *menu* of both items that acts as a consumer screen.
**Versioning: Example**

<table>
<thead>
<tr>
<th>Customer willingness-to-pay</th>
<th>GOOD PRODUCT</th>
<th>BAD PRODUCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH CUSTOMER</td>
<td>$35</td>
<td>$20</td>
</tr>
<tr>
<td>LOW CUSTOMER</td>
<td>$20</td>
<td>$15</td>
</tr>
</tbody>
</table>

Good product costs $5, bad product $0
Versioning: Example

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</table>

- Sell only Good $\rightarrow$ 2*(\$20-$5) or ($35-$5)
- Sell only Bad $\rightarrow$ 2*(\$15-$0)
- Sell both $\rightarrow$ ($15-$0) + ($30-$5)
Good-quality vs. Bad-quality

or

$35
$20
$15

Good-quality only

Bad-quality only

Menu of both

$35
$20
$15

= Consumer surplus

= Profit

= Cost
Summary

- Strategic issues arise when different players have different information
- Moral hazard given hidden action
  - role for incentives / tying one’s hands
- Adverse selection given hidden trait
  - role for screening / signaling

Next time: using hidden traits about yourself to make a credible commitment