Managerial Economics

Melbourne Business School
Spring 2006

Outline for Today

- Housekeeping
- Collusion
- Information Economics
  - Without Competition between firms
  - With Competition between firms
- (This will take us into next week)

Housekeeping

COOPERATION

Overview

- Context: How do you persuade a fierce competitor to avoid a price war?
- Concepts: cooperation, competition, complementors, repeated games, punishment, facilitating practices.
- Economic principle: firms often have common interests, as well as competing ones.

War and peace

- Business is simultaneously war and peace, competition and cooperation:
  - Cooperation in creating value
  - Competition in dividing it up

You have to compete and cooperate at the same time.
--Ray Noorda, Novell

- "Co-opetition": Adam Brandenberger + Barry Nalebuff
  - Cooperate with your eyes open
  - Compete without killing opposition

Leverage from repetition

- If firms interact repeatedly, use future as source of leverage: threaten to punish rival if it behaves non-cooperatively.
- Topsy-turvy principle: the worst situation firms are able to get themselves into, the easier it is to deter non-cooperative behavior!

The Bertrand price game

- In the Bertrand price game, we contrasted
  - The "cooperative" outcome: set the monopoly price, split the market, and make (say) M/2 (M = monopoly profits).
  - The Nash equilibrium: price at MC, make zero.
- To show: cooperation can be a Nash equilibrium if the game is played repeatedly

2 firms

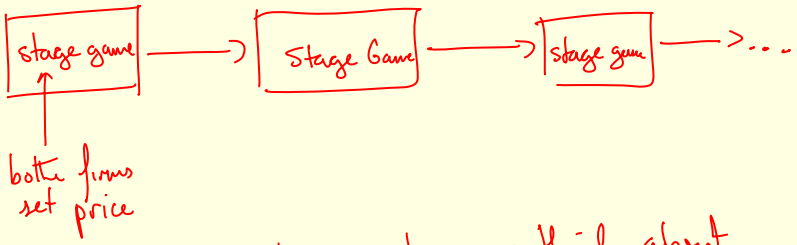
Cooperation...

- Claim: in the repeated game, the cooperative outcome (set the monopoly price) can be a Nash equilibrium.
- Equilibrium strategies that generate this:
  - If all firms set monopoly price in the past, stick to it.
  - If one firm ever sets price different from monopoly price, revert to pricing at marginal cost forever. (This "punishment" is what supports the equilibrium.)

grim trigger strategy

Recall:

here is what the game looks like now



Important: this changes how we think about a strategy

A strategy is a complete contingent plan

Cooperation...

- If firm sets monopoly price, expected payoff is M/2 + V, where V is discounted future profit along the monopoly pricing path.
- If firm undercuts rival, then expected payoff is approximately M + 0. (This assumes firm sets price just below rival and takes all of the market—for one period.)
- If follows that monopoly pricing is an equilibrium if M/2 + V > M, or simply **V > M/2**.
- In words, "if the future is sufficiently important, then cooperation is an equilibrium."

Revision Discounting

$\delta = \frac{1}{1+r}$ ← interest rate

↑ discount factor

P (is the principle)

$S = P + \delta P + \delta^2 P + \delta^3 P \ldots \delta^N P$ (sum)

how much is this worth now?

$\delta S = \delta P + \delta^2 P + \delta^3 P + \ldots \delta^{N+1} P$

$(1-\delta) S = P - \delta^{N+1} P$

$S = P\left(\frac{1-\delta^{N+1}}{1-\delta}\right)$

$N \longrightarrow \infty$

$S = P \frac{1}{1-\delta}$

Comments

- Punishment/retaliation is a disciplinary device that supports "cooperation."
- Along the equilibrium path, price wars do not actually take place, only the threat.
- Explicit price-fixing is illegal, but an understanding of repeated games may produce a similar outcome legally. More on this later.

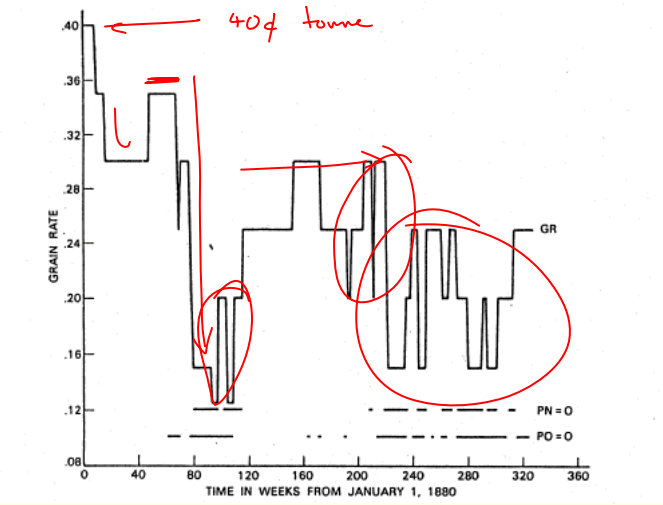
Examples of collusion

- Lysene Catel : vitamin – nutritional supplement
- http://sterntv.stern.nyu.edu:8080/ramgen/faculty/Bar-Issac/Bar-Issac.rm

Price wars

- Price wars happen in many industries on occasion. Why?
- High demand
- Low demand and imperfect observability
- Financial distress
- Signalling strength

Great Lakes shipping (1880s)



When is cooperation easier?

- Market growth (firms care more about the future)
- Likelihood of survival (ditto)
- Speed of response (future is close)
- Market structure (numbers and symmetry)
- Multimarket contact (harsh punishments)
- Probability of detection

Thursday November 15 2001

CARTEL DEMANDS RUSSIA PLAYS ITS PART IN PRODUCTION CUTBACKS ● SHARE PRICES IN SECT

Oil price falls on Opec warnin

Opec announced last night that it was ready to start taking another 1.5m barrels a day off the world market to bolster oil prices, if producers outside the cartel, notably Russia, also cut their output by 500,000 b/d.

Facilitating practices

- Best-customer clauses
  - GE and Westinghouse
- Transfer payments in sports
- Government mandated measures
  - Ready-mixed concrete in Denmark
  - Federal Election Campaign Act
  - Medicaid reimbursement rules

The law

- US
  - Sherman Act; exceptions
  - Criminal offence – jail sentences
- EU
  - Article 85 Treaty of Rome
  - Exemptions
- Australia
  - Trade Practices Act
- "It's a thin line between competition and cooperation"
  - Research agreements
  - Information exchange

Takeaways

- Firms compete, but they frequently have common interests as well:
  - Produce complementary products
  - Share a supplier
  - Benefit from informal cooperation
- Repeated interaction provides firms with strategic leverage over each other that may encourage cooperation
- Other structural or institutional features of the industry may also help to support cooperation
- If you are a CEO make sure that the corporate counsel has guidelines in place for managers about the handling of potentially cooperative interactions with competitors. Make sure that these guidelines are accompanied by an auditing procedure.

Practice: repeated pricing game

- Demand: $Q = 100 - p$.
- Two firms, each with $MC = 20$.
- Determine monopoly price and profits.
- Determine NPV of future monopoly profits, assuming interest rate r.
- Determine threshold value r below which cooperation (cartel pricing) is an equilibrium.

- firms compete in bertrand

$D = 100 - P \rightarrow P = 100 - Q$

$TR = (100 - Q)Q$

$MR = \frac{\partial TR}{\partial Q} = 100 - 2Q$

$MC = 20$

$20 = 100 - 2Q$

$Q = 40$

$P = 60$

$\Pi^M = 1600$

$\Pi^M = 1600$

Discounted Profits if Price at monopoly $\geq$ discounted profits if deviate

$\frac{1600}{2} + \frac{1600}{2}\delta + \frac{1600}{2}\delta^2 + \dots \geq 1600 + 0$

$800\left(1 + \delta + \delta^2 + \delta^3 + \dots\right) \geq 1600$

$\left(1 + \delta + \delta^2 + \delta^3 + \dots\right) \geq 2$

$\frac{1}{1-\delta} \geq 2$

$1 \geq 2 - 2\delta$

$\delta \geq \frac{1}{2}$

$\delta \geq \frac{1}{1+r}$

$\frac{1}{2} \geq \frac{1}{1+r}$

INFORMATION

Overview

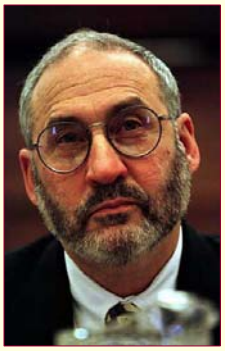
- Context: You want to reward good performance by a subordinate, but he has a better idea what that performance is than you do. What should you do?
- Concepts: principals and agents, incentives, asymmetric information, adverse selection, moral hazard, signaling.
- Economic principle: when people have superior information, expect them to use it to their advantage.

Games w/ asymmetric info

When one party has more information than the other. The 2001 Nobel Prize in Economics recognized contributions in this area (in the 1970s) by:

George Akerlof

Michael Spence



Joseph Stiglitz

Overview

- When one player has more information than the other, both change their strategies.
- When information is hidden, the game involves "adverse selection." (Hidden Type)
  - Life insurance: Do you know more about existing conditions and genetic makeup than the insurer?
- When actions are hidden, the game involves "moral hazard." (Hidden Action)
  - Car mechanic: Trust me, I did a great job.
  - Andersen: "These financial statements conform with accepted accounting principles."

Hidden Action (Moral Hazard)

- Ideal: Pay for performance.
- In Practice: Performance is hard to measure accurately. And if you reward something else, you can get into trouble.
- Terminology: We refer to the payer as the principal, the payee as the agent, and the analysis as principal-agent or agency or moral hazard theory.
- Question: What does this have to do with asymmetric information?

Auto repairs

- Sears paid piece rates to auto mechanics in California: mechanics' pay was tied to the number of things they fixed.
- What is performance here? How is it being measured?
- What's the problem? What's the solution?

Executive stock options

- Stock options reward executives for superior performance.
- What is performance here? How is it measured?
- Is there a problem here?

Auditing

- Auditing firms are paid by the firms they audit. Moreover, they often make far more from consulting relationships than auditing.
- What's the problem? (And who's problem is it?)
- What's the solution?

Managerial incentives

How should shareholders reward managers?

- Firm performance depends on manager's action:
  - Action A implies $20m profits with probability 80%, $10m profits with probability 20%.
  - Action B implies $20m profits with probability 10%, $10m profits with probability 90%.
- Shareholders cannot observe manager's action, only firm performance.
- Personal cost to manager of taking action A is $50k.
- Manager's "outside option" is to earn $200k.

Managerial incentives...

- Plan 1: fixed salary.
- Binding constraint is the "participation constraint:" must offer $200k, otherwise manager will leave.
- Manager only cares about her salary, thus she will choose action B.
- Firm's expected profit = 10% 20 + 90% 10 = $11m.

Managerial incentives...

- Plan 2: α% share in profits.
- If manager chooses A, expected payoff is α%*(80%*20m+20%*10m)-50k = α%*18m-50k
- If manager chooses B, expected payoff is α%*(10%*20m+90%*10m) = α%*11m
- If shareholders want to induce manager to choose action A, α must be at least .714%.
- But α = .714% would lead to an expected payoff of 0.714%*18m-50k = 78.5k, which is less than 200k.

Managerial incentives...

- Plan 2 (cont)
- Should set α such that α%*18m-50k is at least 200. Result: α = 1.38%. (rounding to 2dp)
- Firm's expected profit = 80% 20 + 20% 10 = $18m.
- Even taking away 1.38% for manager, this is still more than $11m. [expected wage is $250,000]
- Problem: manager is taking on a high-risk gamble. With 20% probability, her payoff is only 1.38%*10m-50k = 88k.
- What if the manager prefers have less risk rather than more?

Managerial incentives...

- Plan 3 (compensating for risk aversion): combination of fixed salary ω and profit share α.
- Imagine, manager "risk neutral" for a second
- Set α = .714%. This should be enough to induce manager to choose action A.
- Set ω = 200 – (.714%*18m–50k) = 121,5k. This implies, by construction, that manager's expected payoff is 200k.
- Firm receives the same expected profit as under Plan B, but manager is now guaranteed a minimum payoff of 121.5 + .714%*10m – 50k = $142.9k.
- Expected wage bill is as before (why?)

Managerial incentives...

- Plan 3 (compensating for risk aversion): combination of fixed salary ω and profit share α.
- Now think about how manager not liking risk changes this...
- Set 1.38% > α > .714%. Action A has more risk than Action B so you will need to make the profit share higher than 0.714% to make manager prefer A
- Set ω = 200k – ([Value to manager of outcome contingent payment]–50k)
  - the cheapest way to compensate for risk is to give a lump sum payment [the manager prefers money for sure rather than a gamble]
- Extra risk that is transfered means that the expected wage bill is > $250,000

Agency: summary

- Performance is hard to measure
  - Any measurement system can be gamed.
- Incentive schemes depend on how risk is being allocated
  - Often have to compensate a little for giving people exposure to risk
- Cheaper to use lump-sum payments where can
  - Avoids having to compensate for risk
- Incentives work
  - Expect to get exactly what you pay for.

Hidden Type (Adverse selection)

- When the uninformed player moves, she must think about how informed players will use their information about their type:
  - Examples: insurance, credit, product quality.
- General result: Tendency for low-quality products (or high-risk customers) to flood the market.
- Solutions: warranties, reputation and branding, credit rationing, verification (medical examinations).

Life insurance

- How should you price life insurance if buyers know their risk but you do not?
  - If you charge a price low enough to appeal to low risk customers, who will buy?
  - If you raise the price, who will buy?
  - What price should you charge?

Sale of Shearson

- In the early 1990s, American Express held talks to discuss the sale of its Shearson brokerage unit to Primerica (a precursor of Citigroup). The deal made strategic sense for both companies.
- The stumbling block was outstanding legal claims against Shearson: the value of these claims was hard to judge, and Primerica was in a poor position to judge them in any case.
- How would this affect the negotiation? What resolutions come to mind?

Practice: Sale of business

The problem:

- Seller's value is either \$100m, \$110m, \$120m, ..., \$180m or \$190m, each with equal probability. The seller knows the exact value, but the buyer only knows the distribution.
- Buyer's value is equal to seller's value plus \$10m (there are gains from trade).
- Buyer must make take-it-or-leave-it offer of some price p. How much?

offer of 120m

accepted if v to seller is 100 1/10
110 1/10
120 1/10

expected value to the buyer if their offer of 120 is accepted

110 1/3
120 1/3
130 1/3

$\longrightarrow E(v) = 120$

Sale of business unit...

Solution (sketch):

Recall: Prob of each value is 1/10

Offer	Probability Accepted	Expected value of business if accepted	Expected Profit
100	10%	110	1.0
110	20%	115	1.0
120	30%	120	0.0
130	40%	125	-2.0
140	50%	130	-5.0
150	60%	135	-9.0
160	70%	140	-14.0
170	80%	145	-20.0
180	90%	150	-27.0
190	100%	155	-35.0

Sale of business unit...

Suppose buyer offers 100 (in $m).

- In most cases (90%) offer is rejected.
- Offering more would imply higher probability of sale, but expected value of unit would increase by less than price paid.
- Intuition = adverse selection: seller will only sell if unit's is relatively low.

Question: Why did American Express indemnify Primerica? Because not doing so would have led to a lower price.

Takeaways

STOP

- Think about how your rival will:
  - Use its information advantage; Or
  - React to your information advantage.
- You will get what you reward.
- Beware of the Groucho Marx problem: low-quality products or customers flood the market. (Or: If this is such a good deal, why are you offering it to me?)

Practice: Sensitrum

You are the sole domestic producer of the generic antidepressant sensitrum. Your marginal cost is $2 per dose. Demand is given by $Q = 400 - 50\,p$ (Q in millions of doses, p in $). There is a second producer in India whose marginal cost is INR 145 (including transportation cost to the US). Firms set prices simultaneously.

a) What is your equilibrium profit at the current exchange rate of INR 48 / US$?

b) An advertising and retailing campaign costing $80m is expected to increase demand by 40%. Should your firm go ahead with it?

c) One macroeconomics expert tells you that "it is likely that the rupee will appreciate in the near future." How would this influence your decision?