Strategic Behavior in Concentrated Industries
Oligopoly and Game Theory

• Extreme market structures: Monopoly and perfect competition => No need to consider rivals’ reactions

• Intermediate case: Oligopoly (*Greek*=few sellers) or concentrated industry => Need to consider rivals’ reactions

• Game Theory: formal study of strategic behavior, relation between inter-dependent agents (firms, trade authorities, armies, litigation…)

Fashion pricing

- You are working for Armani’s London shop on Bond Street, next to Ralph Lauren’s store
- It’s nearing the end of the season, and you and your competitor consider (independently and simultaneously) whether to have sales or keep the normal prices
- Roughly half the consumers have a preference for Armani. The other half prefer Ralph Lauren
- If only you have a sale you will attract some of Ralph Lauren’s customers. If only Ralph Lauren has a sale it will take some of your customers
- If both stores have a sale then the market shares will be unaffected
Market information

- **You are maximizing revenues P*Q (for simplicity)**
- If both Armani and Ralph Lauren keep their normal prices, $p_A = 3$ and $p_{RL} = 3$, then they will each sell to 20 customers: $q_A = 20$ and $q_{RL} = 20$
- If both Armani and Ralph Lauren have sales, $p_A = 1$ and $p_{RL} = 1$, then they will each sell to 40 customers: $q_A = 40$ and $q_{RL} = 40$
- If Armani keeps its normal price ($p_A = 3$) while Ralph Lauren has a sale ($p_{RL} = 1$), then Ralph Lauren sells to 70 customers and Armani only to 10: $q_A = 10$, $q_{RL} = 70$.
- If Armani has a sale ($p_A = 1$) while Ralph Lauren keeps its normal price ($p_{RL} = 3$), then Armani sells to 50 customers and Ralph Lauren only to 10: $q_A = 50$, $q_{RL} = 10$.
- **Should you, as Armani’s store manager, have a sale or not?**
Fashion pricing game

Ralph Lauren

<table>
<thead>
<tr>
<th>Sale</th>
<th>Normal Price</th>
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<tbody>
<tr>
<td>40</td>
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Armani

<table>
<thead>
<tr>
<th>Sale</th>
<th>Normal Price</th>
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<tr>
<td>40</td>
<td>50</td>
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<table>
<thead>
<tr>
<th>Sale</th>
<th>Normal Price</th>
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<tbody>
<tr>
<td>30</td>
<td>60</td>
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Think through the strategy of your rival!
The Prisoner’s Dilemma

Coordination Breakdown

**Prisoner 2**

<table>
<thead>
<tr>
<th></th>
<th>Hold Out</th>
<th>Confess</th>
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</thead>
<tbody>
<tr>
<td><strong>Hold Out</strong></td>
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<td>1</td>
</tr>
<tr>
<td><strong>Confess</strong></td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

(Numbers in table are number of years in jail)

“Paradox:” Although both prisoners would be better off by holding out they will both confess!!!
What is a game?
- **Players** (e.g. Coca-Cola and Pepsi-Cola)
- **Rules** (e.g. simultaneously choose advertising level)
- **Strategies** (low or high cost ad campaign)
- **Payoffs** (sales-production costs-ad costs)

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<thead>
<tr>
<th></th>
<th>High Ad</th>
<th>Low Ad</th>
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</thead>
<tbody>
<tr>
<td><strong>High Ad</strong></td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Low Ad</strong></td>
<td>4</td>
<td>3</td>
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Note: Numbers in the table are firm profits.
Nash Equilibrium = concept of “reasonable” outcome


**Definition:** Given what other players are doing, no player would want to change strategy *unilaterally* (i.e. each player’s strategy is an optimal response to the other players’ strategies)
Getting to a Nash Equilibrium

- Put yourself in the shoes of your rival
- What is the best course of action for your rival?
  - It depends on what you are doing!
- But how does your rival know what you are doing?

At a Nash equilibrium, your expectations about your rival’s strategy are correct and your rival’s expectations about your use of strategy are correct
Pricing Rivalry: Price Wars

• In July 1999, Sprint announced a nighttime long distance rate of 5 cents per minute.
• In August 1999, MCI matched Sprint’s off-peak rate. Later that month, AT&T acknowledged that revenue from its consumer long-distance business was falling, and the company cut its long-distance rates to 7 cents per minute all day, everyday, for a monthly fee of $5.95.
• AT&T stock dropped 4.7% the day of the announcement.
• MCI’s stock price dropped 2.5%; Sprint’s fell 3.8%. 
Pricing Rivalry: Questions

- What determines price competition in an industry?
- Why are some firms able to coordinate their pricing behavior and make large profits while other firms engage in vicious price wars?
The Pricing Game: Relevance

- Price war at rival gas stations
- OPEC quantity production decisions
- Advertising battles (e.g. Coke and Pepsi)
- R&D wars (e.g. Giga-chip race between Intel and AMD)
The Pricing Game: Strategy Formulation

Price war at rival gas stations

You and your rival simultaneously choose a price every morning for the entire day. To simplify, say that you can either choose high price or low price and the payoffs correspond to a prisoner’s dilemma game. Formulate a strategy for setting the price every morning that you will hand out to your replacement.
The Prisoner’s Dilemma

Example: One-Shot Pricing Game

Your Rival’s Price

Your Price

H
100

L
150

H
100

L
30

30

80

150

80
The Prisoner’s Dilemma
(Continued)

- Dominant strategies: low price.
- Equilibrium payoffs are (80,80), much worse than attained by high price, (100,100).
- Conflict between individual incentives and joint incentives.
- Typical of many business situations.
The Prisoner’s Dilemma: Discussion

• Is there something that troubles you about the prisoner’s dilemma?
• Do you really believe that the firms (prisoners) will price low (confess)?
• In practice, we sometimes see firms (prisoners) colluding (not confessing)
• Which assumptions are violated?
One-shot vs Repeated Games

- A repeated game is simply a game made up of a finite or indefinite repetition of a one-shot game.

- The equilibrium of a repeated game may be very different from the repetition of the equilibrium of the one-shot game. Reasons:
  - Learning about competitors
  - Influencing their learning/expectations
  - achieving a “co-operative solution”

- How repetition can make co-operation an equilibrium?
The Repeated Pricing Game

- What is a good strategy?
  - When does a strategy work well?
  - How do you take your rival’s actions into account?
  - What is a best response to a given strategy?
- Is tit-for-tat (T4T) a good strategy?
  - What are the properties of T4T?
  - When will it perform well?
Cooperation with Tit-for-Tat

Is Tit-for-tat Compelling?

- **What are the advantage of T4T?**
  - **Niceness:** Do no strike first (not too greedy)
  - **Reciprocate both good and bad**
    - Provocability: Immediately punish deviators
    - Forgiveness: Return to cooperation if rival does too
  - Act simply and clearly
- **Robustness:** does pretty well on average and it is very simple!
The Pricing Game: Lessons

- In a competitive environment, it may not be optimal to try to beat others
- Cooperation occurs even in the absence of formal agreements
- In fact, you do not even need face-to-face interaction
- Cooperation, however, is unstable
- The game parameters (e.g. length, payoffs) matter
The Pricing Game: Lessons

- You need to take your competitor’s actions into account
- You can influence your competitor’s decisions
- Having long term vision helps
- You can build trust and reputation
- Punishment is an enforcement mechanism
- Be careful toward the end of a game
The graphite electrode cartel

- In July 2001, the European Commission fined eight companies € 218.8 million for fixing the price and sharing the market for graphite electrodes in the 1990’s
- Used in recycling of scrap steel in mini-mills. Annual sales in Europe € 420 million
- Fines in million euros: SGL Carbon (80.2), UCAR International (50.4), Tokai Carbon (24.5), Showa Denko (17.4)…
EC’s new leniency program

- The European Commission started an investigation in June 1997
- EC offered 70 percent reduction of fine to the member that first provided evidence against the cartel
- Game: Prisoner’s dilemma situation with eight players rushing to be the first to confess
  - Showa Denko K.K. (Japan) gave details early 1998
  - UCAR International followed and got 40 percent reduction
  - Other companies paid in full…

http://europa.eu.int/comm/competition/antitrust/cases/2001/
http://europa.eu.int/rapid/start/cgi/guesten.ksh?p_action.gettxt=gt&doc=IP/01/1010|0|RAPID&lg=EN
The Ford Price Promise

- In September 1999, customers were “unsettled” by rumors of future price reductions
- Ford launched the £400,000 “Price Promise” national advertising campaign
- Under the “Price Promise”, Ford will reimburse any reduction in the recommended retail price difference
- a.k.a. “Most Favored Customer Clause”

http://www.media.ford.com/article_display.cfm?article_id=2702
The Ford Price Promise
Game between Ford and its Consumers

• Should consumers buy early or wait?

• Will Ford have much inventory at the end of the season?
  • Should Ford lower price at the end of the season?

• How does the price promise changes the bargaining game between Ford and its customers?
The Ford Price Promise
Game between Ford and its Consumers

• Consider those consumers who want to buy a Ford before January 2000
• Without the Price Promise, they wait if they believe that Ford will lower its price before January
• With the Price Promise, they have a dominant strategy which is to buy right away
• The Price Promise transforms the game between Ford and consumers as a tragedy of the commons
The Ford Price Promise
Game between Ford and Competitors

1 - Recall Pricing Rivalry Game. NE is both firms with low price

2 - Ford makes a move that increases its costs in the event of lowering prices. NE - same NE, Ford worse off

3 - GM understands and copies Ford move. New NE - both firms with high price!!!

Conclusion - both firms make their situation worse in the event of low prices and thus are able to credibly commit to high prices
Strategic Barriers to Entry

Entry Deterrence

- Strategy 1: Increase entrant’s costs
- Strategy 2: Commit to fierce response
- Strategy 3: Decrease entrant’s demand
Strategy 1: Increase entrant’s cost

Examples

- Airport takeoff and landing slots (BA in London)
- Sleeping patents (Rank Xerox, Procter&Gamble)
- R&D and marketing
Strategy 2: Commit to a fierce response
Predatory Pricing: Should you punish entry?

“Paradox:” It is difficult to commit to low prices
Cheap-talk is not credible!
Strategic Barriers
Some logic of entry

The Entrant
• Anticipate the likely reactions of incumbent firms
• Only post-entry competition matters: “Look forward and reason backward”

The Incumbent
• When do entry deterring strategies succeed?
• The strategy must change the entrants’ expectations about the nature of post-entry competition
Entry Deterrence/Exit Hastening

Why do we observe predatory pricing?

• Asymmetric information about cost (e.g. American Tobacco)
• Reputation building (e.g. DeBeers, AAirline)
• Deep pockets (e.g. UK supermarket)
• Learning curve (e.g. Boeing)
Strategy 2: Excess Capacity
DuPont titanium dioxide

DuPont
- Monopoly Capacity
  - E
    - DuPont
      - 2
      - 1
    - NE
      - 4
      - 0
  - NE
    - Excess Capacity
      - E
        - Rival
          - 1
          - -1
      - NE
        - 3
        - 0

E=Enter
NE=Do not enter
Excess Capacity
The sequence of move matters!

Simultaneous moves

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<thead>
<tr>
<th></th>
<th>EC</th>
<th>MC</th>
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<tbody>
<tr>
<td>DuPont</td>
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</tr>
<tr>
<td>E</td>
<td>-1</td>
<td>1</td>
</tr>
<tr>
<td>Rival</td>
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<td>4</td>
</tr>
<tr>
<td>NE</td>
<td>0</td>
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Sequential moves

Equilibrium: Monopoly Capacity and Enter