Cartels
Industrial Organization

K. Graddy

Cooperation

- The “best” outcome for an oligopoly is to act as one firm
- Collusion is illegal
- Cooperating without colluding

Outline

- Why cooperation is difficult
- Achieving cooperation
  - Theoretically
  - Practically
- Examples

Strategy and Game Theory

- Princeton in the 1940’s
  - John von Neumann and Oscar Morgenstern
  - John Nash: Nash Equilibrium
- Economics and Politics
  - Thomas Schelling
    - The Strategy of Conflict (1960), Arms and Influence (1966)
- Business Strategy
  - Dixit and Nalebuff
  - Brandenburger and Nalebuff
    - Coopetition (1996)

The Prisoner’s Dilemma

### Payoff structure:
- If both cooperate, each gets payoff $\pi_2$
- If both cheat, each gets $\pi_3$
- If one cheats, it gets $\pi_1$, the other gets $\pi_4$
  - $\pi_1 > \pi_2 > \pi_3 > \pi_4$
- Cheating is a dominant strategy: both cheat and end up worse off than if they had cooperated
The Prisoner’s Dilemma Applied to an Oligopoly

- Describes a situation in which the pursuit of narrow self interest by all parties makes them worse off

<table>
<thead>
<tr>
<th>Firm 1's Output</th>
<th>Firm 2's Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>42</td>
</tr>
<tr>
<td>4</td>
<td>26</td>
</tr>
<tr>
<td>4</td>
<td>32</td>
</tr>
</tbody>
</table>

Nash-Cournot Outcome

- The equilibrium of the prisoner’s dilemma game is also known as the “Nash-Cournot” outcome

Getting out of the Prisoner’s Dilemma

- Social pressures
- Mergers
- Repetition
- Change payoff structure

Repeated Interaction

- Example: Strategic alliance between Mercedes and Swatch. Each party can put high or low effort into collaboration. One-shot game is repeated.

<table>
<thead>
<tr>
<th>Mercedes’ effort</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swatch’s effort</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>46</td>
<td>76</td>
</tr>
<tr>
<td>Low</td>
<td>10</td>
<td>34</td>
</tr>
</tbody>
</table>

Repeated Play

- When game is repeated, can link current moves to future moves
- Payoffs: Present discounted value of current and all future payoffs
- Strategies: Make future moves conditional on previous moves in a way which guarantees that cheaters will be punished severely enough to be discouraged from cheating

The Grim Strategy

- Strategies:
  - Cooperate in first period
  - If opposing firm cheats, cheat forever after
- Christie’s and Sotheby’s
  - both firms charge high commission rates in both periods if each firm charged high commission rates in the past
  - both firms charge low commission rates if at any time in the past some firm has charged low commission rates
- What will outcome depend upon?
Numerical Example

\[
\begin{array}{c|c|c|c|c|c|c}
5,5 & -3,8 \\
8,-3 & 0,0 \\
\end{array}
\]

\[5 + 5\delta + 5\delta^2 + 5\delta^3 \ldots > 8 + 0\delta + 0\delta^2 \ldots\]
\[
\frac{5}{1 - \delta} > 8
\]
\[
\delta > \frac{3}{8}
\]

• If interaction is repeated and firms care enough about the future, then it is possible to achieve equilibrium co-operation in the prisoners’ dilemma

Carrot and Stick Routines

• Dilip Abreu showed (JET 1986) as part of his Ph.D. thesis, that carrot and stick routines also work
  – A massive price discount for one or more periods, followed by reversion to cooperation

Stigler (1964)

• Collusion can take many forms
  – Mergers
  – Cartels with joint sales agencies
  – Joint determination of outputs and prices by ostensibly independent firms

Mechanism of Collusion

• Colluding firms must agree on price structure (coordinating without speaking)
• All agreements whose violation would be profitable to the violator must be enforced
• Enforcement consists of DETECTION
• If enforcement is weak, can only sustain prices slightly above competitive levels, so there is less incentive to price cut.
• One way to discourage price cutting is by splitting up the market.

Market Concentration

• Tacit collusion is easier to establish and sustain with a smaller number of firms
  • Bargaining theory and anecdotal evidence suggest agreements are more difficult to reach, the greater the number of interested parties
  • In an industry with n firms, the per-period and per-firm profit is $\Pi_m/n$. A large number of firms reduces the profit per firm and thus the cost of being punished for undercutting. Furthermore, profit from defection ($\Pi_m - \Pi_m/n$) is increased.
**Collusion with Asymmetric Firms**

- Suppose firm 1 has a cost advantage over firm 2
- Maximization of joint profits says that firm 1 should set its monopoly price, firm 2 a higher price, and thus firm 2 sells zero.
- Clearly, firm 2 has an incentive to deviate. However, no punishment can detain firm two from deviating, as it makes zero profits
- Likewise, suppose both firms set the same high price. Firm 1 may now want to deviate, as firm one’s gains from deviations are large, and firm 2’s ability to punish is small

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**The Competition Act of 1990**  
(The Competition Council of Denmark)

- Article 1
  
  “The purpose of this Act is to promote competition and , thus, strengthen the efficiency of production and distribution of goods and services, etc., through the largest possible transparency of competitive conditions and through measures against restraints on the freedom of trade and other harmful aspects of anti-competitive practices.”

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**Long Information Lags and Infrequent Interaction**

- Punishment may be delayed because
  
  — Infrequency of Interaction
  
  — Secrecy of price agreement
  
  • Counterexample: Fulton Fish Market (RAND 1993)

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**Danish Concrete Industry**

- In October of 1993, the Danish antitrust authority decided to gather and regularly publish statistics on transactions prices of individual firms for two grades of ready-mixed concrete in 3 regions of Denmark
- Following initial publication, average prices of the reported grades of concrete increased by 15-20 percent within less than a year
- Inflation at 1-2%

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**Fluctuating Demand**

- In the theoretical model, never actually see price wars
- Green and Porter (Econometrica 1984):
  
  Suppose there are demand shocks, $P = \theta f(Q)$ where $Q$ is market output, and $\theta$ is a shock with mean one, and known distribution. Firms cannot observe rivals' outputs directly: only the market price.
  
  Trigger strategy: Firm produces $x$ (collusive) until market price falls below a trigger price $p$: then Cournot reversion for $T$ periods. Firm has to decide $x$, $p$, and $T$. So, in periods of low demand, cooperation may break down: in periods of high demand, cooperation more likely to be sustained.

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**Fluctuating Demand**

- Rotemberg and Saloner (AER 1986): Firms behave more competitively in periods of high demand
- In a boom, the gain from deviation is higher, so harder to sustain full collusive equilibrium.
- Firms will either
  
  — Engage in a price war
  
  — Lower the equilibrium price
- A firm that lowers its price slightly is able to capture a larger market
- Ability to punish stays roughly the same as punishments are given in the future
Conclusion

• The Prisoner’s Dilemma
• Conquering the Prisoner’s Dilemma
• Cooperation in Theory and in Practice
• The Danish Concrete Industry
• Cooperation with Fluctuating Demand
  – Green and Porter
  – Rotemberg and Saloner