Strategy:

Cartels, Reputation and Trust

Intermediate Microeconomics

OPEC

- OPEC was formed in 1960 comprised of five Arab oil-producing states.
- 1973: The policy of oil production restrictions became effective. The Arab members of OPEC sharply curtailed output, causing spot prices on the world market to shoot upwards.
- How does it function?
  - The mechanism
  - Incentives to cheat.
  - Enforcement

OPEC (Members and their shares)

OPEC oil production (millions of barrels a day) (as of Apr 2001)	millions of barrels a day	daily share
Saudi Arabia	8	0.28
Iran	3.8	0.13
Venezuela	2.9	0.10
United Arab Emirates	2.4	0.08
Kuwait	2	0.07
Nigeria	2.2	0.08
Libya	1.4	0.05
Indonesia	1.4	0.05
Algeria	1.3	0.04
Qatar	0.7	0.02
Iraq	2.9	0.10
Total	29	1.00

- Mechanism for implementing production restrictions.
- Incentives to cheat
- Enforcement requires detection and effective penalties.

Cartel Agreements

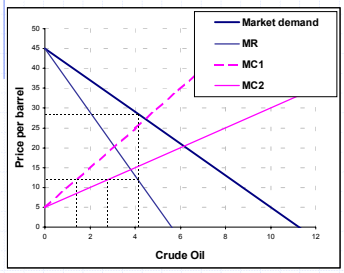
- Why do they form?
- What price and quantity will they likely choose?
- Why are they often unstable?
- There are plenty of cases in which the instability is contained. How do they do it?

What Are the Optimal Price, Quantity, and Quota Allocation?

- They would maximize joint profits.
- If there are two firms in the cartel, it would require $MC_1 = MC_2 = MR$
- Price would be selected where both MCs are equal to MR.
- Output would be determined by the combination of outputs for each firm that make $MC_1(y_1) = MC_2(y_2) = MR(y_1+y_2)$
- If firms' MCs are different, then their quota allocations will also be different.

Picture of optimal pricing and quota allocation

Suppose Firm 1's MC rises twice as fast as Firm 2's. If so, all else the same, Firm's should get one-third, and Firm 2 two-thirds, of the joint cartel output.



Why are Cartels Inherently Unstable?

Obtaining Compliance in a Cartel faces a Prisoners' Dilemma.

- Find the dominant strategies.
- Find the Nash equilibrium.
- Will the cartel form?
- Will it be stable?

Member 2

Member 1	Comply	Not agree
Comply	M1: $30Q_1$ M2: $30Q_2$	M1: $22Q_1$ M2: $33Q_2$
Not agree	M1: $33Q_1$ M2: $22Q_2$	M1: $20Q_1$ m2: $20Q_2$

Outcomes in Repeated Games

- A one-shot prisoners' dilemma will result in coordination failure.
- Repeated play can overcome the single-period non-cooperative dominant strategies.
- In repeated play, players may adopt "supergame" strategies, i.e. strategies in which one game's outcome affects the strategy a players chooses in a later game.
- One such strategy is "tit-for-tat."

Repeated Prisoners' Dilemma with "Tit-for-tat"

- Suppose in a repeated prisoners' dilemma, I announce:
  - "I will trust you to cooperate once.
  - If you prove trustworthy, I will continue to trust you in future rounds.
  - If you prove untrustworthy, I will never trust you again."
- This supergame strategy can results in a cooperative outcome.

Cartel Participation Game

Set-up: (more than two members)

- ***The agreement***: Each member (M) is to produce at an agreed quota, Q, of 10% below production capacity.
- ***Expected outcome of the agreement***: If complied with, the market will reach "cartel price" of p^C = $30 per bbl.
- ***Enforcement penalty***: If any member does not comply with its agreed quota, all other members will retaliate by abandoning the agreement. That act will cause the market price to fall to the "retaliation price", p^R.
- ***Information availability***: Whether members comply cannot be detected until after the fact each period. Therefore, retaliation cannot occur until the following period after non-compliance is detected.

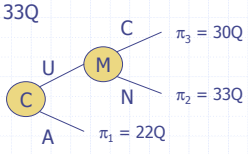
The Strategies

- ***Cartel (C):*** Uphold the agreement (U) or Abandon it (A), i.e. retaliate.
- ***Member (M):*** Comply (C) or Not comply (N)
- ***Decision Sequence:*** Members will know each period whether the Cartel will retaliate, but they will not know about each others' compliance decisions for that period. Therefore, the Cartel moves first, then the Member(s) move(s).
  - Suppose that M is small relative to the market so that a move of N will not affect the price until the other members retaliate.

Decision Tree: One Period of Play

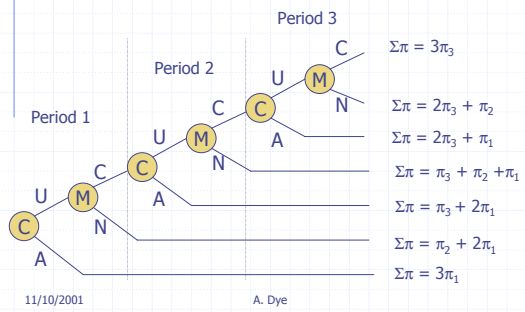
Payoffs for a single round:

π_1=20·Q(1.1) = 22Q
π_2=30·Q(1.1) = 33Q
π_3 = 30Q



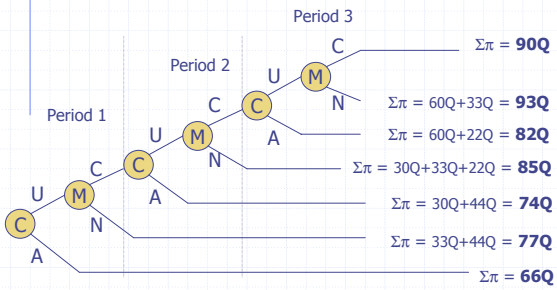
Repeated Game Decision Tree: Three periods

Payoffs for three-round game:



The payoffs in the 3-period game

Payoffs for three-round game:



Conclusions

- The retaliation rule is a form of "tit-for-tat" "supergame" (repeated game) strategy.
- It made "Compliance" a Nash Equilibrium until the "end game."
  - This result does not depend on the number of repetitions, as long as it is finite.
- Is it possible to get compliance even in the end game?
  - If yes, how?

Cartels in Practice

- Enforceability of a cartel requires:
  - detection of cheating
  - penalties
  - trust
- How do cartels in practice enforce"
  - The design of the agreement often reflects the most visible, most detectable features … to enhance detection.
- Examples
  - OPEC
  - Christie's and Sotheby's