N. GREGORY MANKIW NINTH EDITION

PRINCIPLES OF

ECONOMICS

CHAPTER 17

Oligopoly

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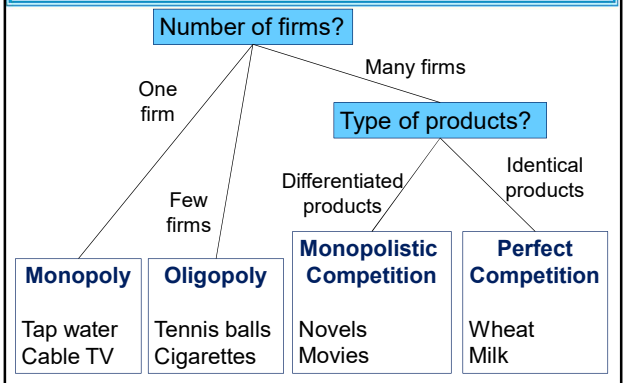
IN THIS CHAPTER

- What outcomes are possible under oligopoly?
- Why is it difficult for oligopoly firms to cooperate?
- How we can use game theory to analyze the economics of cooperation?
- How are antitrust laws used to foster competition?

Review

- Concentration ration
  - Measure a market's domination by a small number of firms
  - Percentage of total output in the market supplied by the four largest firms
  - The higher the concentration ratio, the less competition
  - Less than 50% for most industries
    - A few exceptions: light bulbs (84%), batteries (87%), tobacco (88%), beer (88%), and home refrigerators and freezers (93%)

Review: the four types of market structure



Oligopoly

- Oligopoly
  - Market structure in which only a few sellers offer similar or identical products
- Strategic behavior in oligopoly:
  - A firm's decisions about ***P*** or ***Q*** can affect other firms and cause them to react
  - The firm will consider these reactions when making decisions
- Game theory: the study of how people behave in strategic situations

Markets with Only a Few Sellers

- Oligopolists
  - Best off when they cooperate and together act like a monopolist
  - Strong incentives hinder a group of firms from maintaining the cooperative outcome
- Duopoly
  - A market with only two sellers
  - Simplest type of oligopoly

EXAMPLE 1: Gas Station Duopoly in Daiwan – 1

P	Q
$0	10,000
5	9,200
10	8,400
15	7,600
20	6,800
25	6,000
30	5,200
35	4,400
40	3,600
45	2,800

- Daiwan, not to be confused with Taiwan, has 23 million residents
- The table: Daiwan's demand schedule for gasoline
- Daiwan has only two gas-selling firms: T-CPC and FPC (Duopoly)
- ***Q***: liters of gasoline
- Each firm's costs are

  MC = $5 and ***FC*** = $0

EXAMPLE 1: Daiwan, Competition vs. Monopoly – 2

P	Q	Revenue	Cost	Profit
$0	10,000	$0	$10,000	-$10,000
5	9,200	46,000	46,000	0
10	8,400	84,000	42,000	42,000
15	7,600	114,000	38,000	76,000
20	6,800	136,000	34,000	102,000
25	6,000	150,000	30,000	120,000
30	5,200	156,000	26,000	130,000
35	4,400	154,000	22,000	132,000
40	3,600	144,000	18,000	126,000
45	2,800	126,000	14,000	112,000

Competitive outcome:
P = ***MC*** = $5
Q = 9,200
Profit = $0

Monopoly outcome:
P = $35
Q = 4,400
Profit = $132,000

Collusion

- One possible duopoly outcome: collusion
- Collusion:
  - Agreement among firms in a market about quantities to produce or prices to charge
- Cartel:
  - A group of firms acting in unison

Active Learning 1: Collusion in Daiwan?

P	Q
$0	10,000
5	9,200
10	8,400
15	7,600
20	6,800
25	6,000
30	5,200
35	4,400
40	3,600
45	2,800

Duopoly outcome with collusion: Each gas company agrees to sell ***Q*** = 2,200 at ***P*** = $35, each earns profit = $66,000

A. If FPC cheats on the agreement and plans to sell ***Q*** = 3,000, what happens to the market price? Calculate FPC profit.

B. Is it in FPC interest to cheat on the agreement?

C. If both gas companies cheat and plan to sell ***Q*** = 3,000 each, calculate their profits.

Active Learning 1: Answers

P	Q
$0	10,000
5	9,200
10	8,400
15	7,600
20	6,800
25	6,000
30	5,200
35	4,400
40	3,600
45	2,800

If both stick to the agreement, each earns profit = $66,000

A. If FPC cheats: Q_1 = 3,000
- Market quantity = 3,000 + 2,200 = 5,200
- ***P*** = $30
- FPC's profit = 3,000×(30 – 5) = $75,000

B. Yes. Higher profit!

C. If both cheat: $Q_1 = Q_2$ = 3,000
- Market quantity = 6,000
- ***P*** = $25
- Each firm's profit = 3,000×(25-5) = $60,000

Collusion vs. Self-Interest

- Both firms would be better off if both stick to the collusion agreement (form a cartel)
  - But each firm has incentive to cheat on the agreement.
- Lesson:
  - It is difficult for oligopoly firms to form cartels and honor their agreements.

Active Learning 2: Duopoly Equilibrium in Daiwan

P	Q
$0	10,000
5	9,200
10	8,400
15	7,600
20	6,800
25	6,000
30	5,200
35	4,400
40	3,600
45	2,800

If each firm sells ***Q*** = 3,000, ***P*** = $25, and each firm's profit is $60,000

A. Should FPC increase ***Q*** to 3,800?

B. Should T-CPC increase ***Q*** to 3,800?

Active Learning 2: Answers

P	Q
$0	10,000
5	9,200
10	8,400
15	7,600
20	6,800
25	6,000
30	5,200
35	4,400
40	3,600
45	2,800

If each firm sells ***Q*** = 3,000, ***P*** = $25, and each firm's profit = $60,000

A. If FPC increases ***Q*** to 3,800:

- Market ***Q*** = 6,800, ***P*** = $20
- FPC's profit = 3,800×(20–5) = $57,000

FPC earns a lower profit at ***Q*** = 3,800 than at ***Q*** = 3,000

B. The same is true for T-CPC.

The Equilibrium for an Oligopoly

- Nash equilibrium
  - Economic actors interacting with one another, each choose their best strategy
  - Given the strategies that all the other actors have chosen
- When firms in an oligopoly individually choose production to maximize profit
  - Produce ***Q***: greater than monopoly ***Q***, less than competitive ***Q***
  - The price: is less than the monopoly P, greater than the competitive ***P*** = ***MC***

The Output & Price Effects

- Increasing output has two effects on a firm's profits:
  - Output effect: if ***P*** > ***MC***, increasing output raises profits
  - Price effect: raising output increases market quantity, which reduces price and reduces profit on all units sold

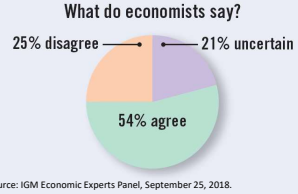
The Size of an Oligopoly

- As the number of sellers in an oligopoly increases:
  - The price effect becomes smaller
  - The oligopoly looks more and more like a competitive market
  - The price approaches marginal cost
  - The market quantity approaches the socially efficient quantity
- Another benefit of international trade

ASK THE EXPERTS

Market Share and Market Power

"If a small number of firms have a large combined market share in a properly defined market, it is strong evidence that those firms have substantial market power."



Source: IGM Economic Experts Panel, September 25, 2018.

The Economics of Cooperation

- The prisoners' dilemma
  - Particular "game" between two captured prisoners
  - Illustrates why cooperation is difficult to maintain even when it is mutually beneficial
- Dominant strategy
  - Strategy that is best for a player in a game
  - Regardless of the strategies chosen by the other players

EXAMPLE 2: The Prisoners' Dilemma – 1

The police have caught Bonnie and Clyde, two suspected bank robbers, but only have enough evidence to imprison each for 1 year.

- The police question each in separate rooms, offer each the following deal:
  - If you confess and implicate your partner, you go free.
  - If you do not confess but your partner implicates you, you get 20 years in prison.
  - If you both confess, each gets 8 years in prison.

EXAMPLE 2: The Prisoners' Dilemma – 2

Confessing is the dominant strategy for both players.

Nash equilibrium: both confess

Clyde's decision \ Bonnie's decision	Confess	Remain silent
Confess	Bonnie gets 8 years; Clyde gets 8 years	Bonnie gets 20 years; Clyde goes free
Remain silent	Bonnie goes free; Clyde gets 20 years	Bonnie gets 1 year; Clyde gets 1 year

EXAMPLE 2: The Prisoners' Dilemma – 3

- Outcome of the game: Bonnie and Clyde both confess, each gets 8 years in prison.
  - Both would have been better off if both remained silent.
  - But even if Bonnie and Clyde had agreed before being caught to remain silent, the logic of self-interest takes over and leads them to confess.

Oligopolies as a Prisoners' Dilemma

- When oligopolies form a cartel
  - Hoping to reach the monopoly outcome, they become players in a prisoners' dilemma
  - The monopoly outcome is jointly rational, but each firm has an incentive to cheat: self-interest makes it hard to maintain the cooperative outcome with low production, high prices, and monopoly profits

EXAMPLE 3: FPC and T-CPC: Prisoners' Dilemma

Each firm's dominant strategy: cheat on the agreement, produce $Q = 3{,}000$.

FPC \ T-CPC	Collude $Q = 2{,}200$	Cheat $Q = 3{,}000$
Collude $Q = 2{,}200$	T-CPC's profit = \$66,000; FPC's profit = \$66,000	T-CPC's profit = \$75,000; FPC's profit = \$55,000
Cheat $Q = 3{,}000$	T-CPC's profit = \$55,000; FPC's profit = \$75,000	T-CPC's profit = \$60,000; FPC's profit = \$60,000

Other Examples of the Prisoners' Dilemma – 1

- Ad Wars
  - Two firms spend millions on TV ads to steal business from each other.
  - Each firm's ad cancels out the effects of the other, and both firms' profits fall by the cost of the ads.
- Organization of Petroleum Exporting Countries
  - Member countries try to act like a cartel, agree to limit oil production to boost prices and profits.
  - But agreements sometimes break down when individual countries renege.

Other Examples of the Prisoners' Dilemma – 2

- Arms race between military superpowers
  - Each country would be better off if both disarm, but each has a dominant strategy of arming.
- Common resources
  - All would be better off if everyone conserved common resources, but each person's dominant strategy is overusing the resources.
- Public goods contribution
  - Everyone would be better off if we all contributed to the pool, but it's a dominant strategy to free ride.

Welfare of Society

- Noncooperative oligopoly equilibrium
  - May be bad for oligopolists
    - Prevents them from achieving monopoly profits
  - May be bad for society
    - Examples: Arms race game, Common resource game
  - May be good for society
    - Quantity and price – closer to optimal level

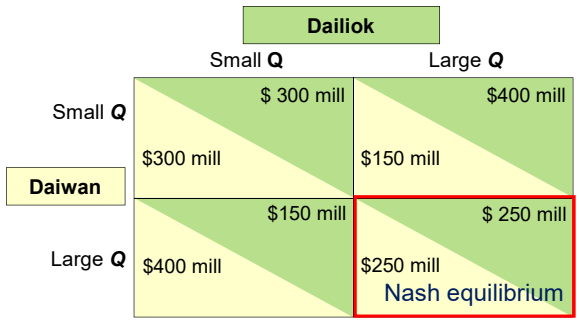
Active Learning 3: Go fish! Around Matsu

Assume there are only two companies that own the entire commercial fishing fleet, Daiwan and Dailiok, and there are no restrictions on commercial fishing around the off-shore Matsu Islands.

- If both choose to catch a small quantity, each earns $300 million profit. If both choose to catch a larger quantity, each earns $250 million profit
- If one company chooses to catch a small quantity but the other chooses a large quantity, the one choosing the small quantity earns $150 million, and the other earns $400 million profit
- What is the colluding outcome? What is the Nash equilibrium?

Active Learning 3: Answers

Colluding outcome: both catch a small quantity.



EXAMPLE 4: Negative Campaign Ads – 1

- The Upcoming Daibak Mayoral Election has two candidates, "Enoch" and "Wayne."
  - If Enoch runs a negative ad attacking Wayne, 300k fewer people will vote for Wayne (100k of these people vote for Enoch, the rest abstain).
  - If Wayne runs a negative ad attacking Enoch, Enoch loses 300k votes, Wayne gains 100k, 200k abstain.
- Enoch and Wayne agree to refrain from running attack ads. Will each of them stick to the agreement?

EXAMPLE 4: Negative Campaign Ads – 2

Each candidate's dominant strategy: ***run attack ads.***

Enoch's decision

Wayne's decision	Do not run attack ads (cooperate)	Run attack ads (defect)
Do not run attack ads (cooperate)	no votes lost or gained / no votes lost or gained	Enoch gains 100k votes / Wayne loses 300k votes
Run attack ads (defect)	Enoch loses 300k votes / Wayne gains 100k votes	Enoch loses 200k votes / Wayne loses 200k votes

EXAMPLE 4: Negative Campaign Ads – 3

- Nash equilibrium
  - Both candidates run attack ads.
- Effects on election outcome: NONE
  - Each side's ads cancel out the effects of the other side's ads.
- Effects on society: NEGATIVE
  - Lower voter turnout, higher apathy about politics, less voter scrutiny of elected officials' actions.

Why People Sometimes Cooperate

- When the game is repeated many times, cooperation may be possible
- Two strategies may lead to cooperation:
  - "Grim-Trigger"
    If your rival reneges in one round, you renege in all subsequent rounds.
  - "Tit-for-tat"
    Whatever your rival does in one round (whether renege or cooperate), you do in the following round.

Public Policy Toward Oligopolies

- Governments can sometimes improve market outcomes.
- Policymakers
  - Try to induce firms in an oligopoly to compete rather than cooperate
  - Move the allocation of resources closer to the social optimum

Antitrust Laws

- The Sherman Antitrust Act, 1890
  - Elevated agreements among oligopolists from an unenforceable contract to a criminal conspiracy
- The Clayton Act, 1914
  - Further strengthened the antitrust laws
- The laws are used to prevent:
  - Mergers that would give a firm excessive market power
  - Oligopolists from acting together in ways that would make their markets less competitive

Active Learning 4: The Airline Fare Wars Game

The players: China Airlines and EVA Airways.

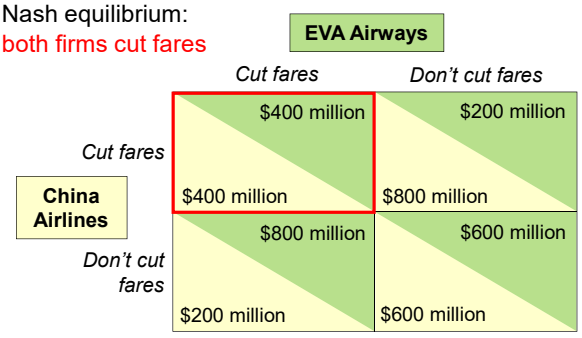
The choice: cut fares by 50% or leave fares alone.

- If both airlines cut fares, each airline's profit = $400 million
- If neither airline cuts fares, each airline's profit = $600 million
- If only one airline cuts its fares, its profit = $800 million; the other airline's profit = $200 million

- Draw the payoff matrix, find the Nash equilibrium

Active Learning 4: Answers

Nash equilibrium:
both firms cut fares



Controversies Over Antitrust Policy

- Most people agree that price-fixing agreements among competitors should be illegal.
- Some economists are concerned that policymakers go too far when using antitrust laws to stifle business practices that are not necessarily harmful, and may have legitimate objectives.
- We consider three such practices…

1. Resale Price Maintenance

- A manufacturer imposes lower limits on the prices retailers can charge
  - Often opposed because it appears to reduce competition at the retail level
  - Yet, any market power the manufacturer has is at the wholesale level
    - No gains from restricting competition at the retail level
  - Legitimate goal: preventing discount retailers from free-riding on the services provided by full-service retailers

2. Predatory Pricing

- A firm cuts prices to prevent entry or drive a competitor out of the market
  - So that it can charge monopoly prices later
- Illegal under antitrust laws
  - Difficult: when a price cut is predatory and when it is competitive & beneficial to consumers?
- Many economists doubt that predatory pricing is a rational strategy:
  - It involves selling at a loss (costly for the firm)
  - It can backfire

3. Tying

- A manufacturer bundles two products together and sells them for one price
- Critics
  - Tying gives firms more market power by connecting weak products to strong ones
- Others: tying cannot change market power
  - Buyers are not willing to pay more for two goods together than for the goods separately
- Firms may use tying for price discrimination
  - Sometimes increases economic efficiency

THINK-PAIR-SHARE

New on campus in a small town, your best friend, Elijah, is amazed that both grocery stores in town are open 24 hours. He says "This is a great idea! Staying open all the time must mean that both stores make lots of profit!"

A. Since there are only two grocery stores in town, is it likely they make "lots of profit" by staying open 24 hours?

B. Can you use prisoners' dilemma to explain why the stores are open 24 hours a day?

CHAPTER IN A NUTSHELL

- Oligopolists maximize their total profits by forming a cartel and acting like a monopolist.
  - Yet, if oligopolists make decisions about production levels individually, the result is a greater quantity and a lower price than under the monopoly outcome.
  - The larger the number of firms in the oligopoly, the closer the quantity and price will be to the levels that would prevail under perfect competition.

CHAPTER IN A NUTSHELL

- The prisoners' dilemma shows that self-interest can prevent people from maintaining cooperation, even when cooperation is in their mutual interest. The logic of the prisoners' dilemma applies to many situations, including arms races, common-resource problems, and oligopolies.
- Policymakers use the antitrust laws to prevent oligopolies from engaging in behavior that reduces competition. The application of these laws can be controversial, because some behavior that can appear to reduce competition may in fact have legitimate business purposes.

Chapter 17: Oligopoly

- When there are only a few firms
- Firms care about each other's actions
  - Game Theory; Nash Equilibrium
  - Dominant Strategy; P.D.
- Collusion (Monopoly) vs. Self-Interest
- Policy: Increase competition; Antitrust Laws

- Homework: Mankiw, Ch.17: 1-3, 6, 8-9

Challenge Questions (Past Finals)

- 2007 - Part 1
- 2008 - Essay B
- 2010 - Essay C, D
- 2012 - Part III 10-14
- 2013 - Part III, IV
- 2014 - Essay A5-10
- 2015 - Essay C, D
- 2016 - Essay A, B, C
- 2017 - Essay B1-B5, C, D4
- 2018 - Essay B1-3, C1, 3-4
- 2019 - Essay D1-D6