CHAPTER 16
OLIGOPOLY

FOUR TYPES OF MARKET STRUCTURE

Extreme cases

PERFECTLY COMPETITION
• Many firms
• No barriers to entry
• Identical products

MONOPOLY
• One firm
• Huge barriers to entry
• Unique product

In between cases

MONOPOLISTIC COMPETITION
• Many firms
• No barriers to entry
• Differentiated products
  (each firm makes a unique product)
Examples: Market for restaurants, novels, movies, CDs, computer games

OLIGOPOLY
• Few firms
• Barriers to entry
• Each firm offers similar or identical product
• Firms are mutually aware and mutually interdependent
Examples: Market for long distance telephone service, tennis balls, crude oil
OLIGOPOLY

• Few firms
• Barriers to entry
• Each firm offers similar or identical product
• Firms are mutually aware and mutually interdependent

Mutually aware means that they monitor each other's behavior.

Mutually interdependent means that if one takes an action the others will respond.

*Examples*
Market for long distance telephone service, tennis balls, crude oil

We will see that there is a tension between cooperation and self-interest.

- The group of oligopolists is best off cooperating and acting like a monopolist -- producing a small quantity of output and charging a price above marginal cost.

- However... because each oligopolist cares about only its own profit, there are powerful incentives at work that hinder a group of firms from maintaining the monopoly outcome.

- The firms engage in "strategic behavior".
A Duopoly Example

A duopoly is an oligopoly with only two members.

Example: Jack and Jill have the only water wells in town. They have to decide how much water to bring to town to sell. (Assume that the marginal cost of each gallon is zero.)

The demand for the water is:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Price</th>
<th>Total Revenue (and Total Profit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$120</td>
<td>$0</td>
</tr>
<tr>
<td>10</td>
<td>110</td>
<td>1,100</td>
</tr>
<tr>
<td>20</td>
<td>100</td>
<td>2,000</td>
</tr>
<tr>
<td>30</td>
<td>90</td>
<td>2,700</td>
</tr>
<tr>
<td>40</td>
<td>80</td>
<td>3,200</td>
</tr>
<tr>
<td>50</td>
<td>70</td>
<td>3,500</td>
</tr>
<tr>
<td>60</td>
<td>60</td>
<td>3,600</td>
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<tr>
<td>70</td>
<td>50</td>
<td>3,500</td>
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<tr>
<td>80</td>
<td>40</td>
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<td>30</td>
<td>2,700</td>
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<td>100</td>
<td>20</td>
<td>2,000</td>
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<tr>
<td>110</td>
<td>10</td>
<td>1,100</td>
</tr>
<tr>
<td>120</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Competition, Monopolies, and Cartels

If the market for water were perfectly competitive, price would equal marginal cost ($0).

⇒ 120 gallons of water would be sold.

If a monopoly controlled the supply of water, profit would be maximized at a price of $60

⇒ 60 gallons of water would be sold.

The duopolists may agree to act together to set the price and quantity of water.

Collusion: an agreement among firms in a market about quantities to produce or prices to charge.

Cartel: a group of firms acting in unison.

What happens if Jill and Jack collude?

They would agree on the monopoly outcome of 60 gallons and a price of $60.

But wait….The cartel must also decide how to split the production of water. Each member will want a larger share because that means more profit.
The Equilibrium for an Oligopoly

It is often difficult for oligopolies to form cartels.


b. Squabbling among cartel members over their shares is also likely to occur.

In the absence of a binding agreement, the monopoly outcome is unlikely.

Assume that Jack expects Jill to produce 30 gallons of water (half of the monopoly outcome).

• Jack could also produce 30 gallons and earn a profit of $1,800.

• However, he could produce 40 gallons and earn a profit of $2,000.

• Jack will want to produce 40 gallons.

Jill might reason the same way.

If she expects Jack to produce 30 gallons, she could increase her profits by raising her output to 40 gallons.
If duopolists pursue their own self-interest when deciding how much to produce,

♦ they produce a quantity greater than the monopoly quantity (but less than competitive level),

♦ charge a price lower than the monopoly price (but greater than the competitive price, MC),

♦ and earn total profit less than the monopoly profit.

In this example, an equilibrium occurs when both Jack and Jill are producing 40 gallons.

Note: they could each earn a higher total profit if they cooperated with one another. Instead they pursue their own self-interest and earn a lower level of profit.

How the Size of an Oligopoly Affects the Market Outcome

What happens if there are more sellers of water? Some neighbors discover water on their property.

Could join the cartel but it is not likely to be stable.

So, how does each seller behave? What do they think about?
If I raise production by one gallon, for example, what happens?

♦ Well, since \( P > MC \), selling 1 more gallon at going price increases my profit. (output effect)

♦ But, selling 1 more gallon increases total amount sold. As a result, the price of water falls and the profit on all other gallons of water sold falls. (price effect)

The larger the number of sellers in the industry, the less concerned each seller is about its own impact on market price. (price effect becomes less and less important)

Thus, as the number of sellers in an oligopoly grows larger, an oligopolistic market looks more and more like a competitive market. (no price effect only output effect)

   Each firm in oligopoly will increase production as long as \( P > MC \).

   As a result, price will approach marginal cost.

   Output will approach the socially efficient level.
Think about free trade again.

Car makers:

Imagine in U.S. there is only Ford and GM.

In Japan, only Toyota and Honda.

In Germany, only VW and Mercedes-Benz

No trade in autos ⇒ each nation has an auto oligopoly

Free trade ⇒ car market is world market

⇒ increased competition

⇒ consumers choose from more producers

⇒ price will be closer to MC

Theory of oligopoly is another reason (in addition to comparative advantage) why free trade is good!
GAME THEORY

The study of how people behave in strategic situations.

By "strategic" we mean a situation in which each person, when deciding what actions to take, must consider how others might respond to that action.

Because the number of firms in an oligopolistic market is small, each firm must act strategically.

Each firm knows that its profit depends not only on how much it produces but also on how much the other firms produce.

In making its production decision, each firm in an oligopoly should consider how its decisions might affect the production decisions of all the other firms.

What is a game? All games share 3 features
• Rules
• Strategies
• Payoffs
A Duopoly Price-Fixing Game

Say we have a duopoly. The firms are called Jack and Jill.

Suppose Jack and Jill enter into a **collusive agreement**. They decide to restrict output in order to raise prices and profits. They form a cartel.

Note: This is illegal in the United States (so is speeding on the highway)

**Strategies available to Jack and Jill:**
- Comply with the agreement
- Cheat

Combinations of actions possible:
- Both firms comply
- Both firms cheat
- Jack complies and Jill cheats
- Jill complies and Jack cheats
Payoffs to each combination of action can be represented in a payoff matrix:

<table>
<thead>
<tr>
<th></th>
<th>Comply</th>
<th>Cheat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Jill's Strategy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheat</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Jack's Strategy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheat</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Go down the column's for Jill.

First gives profits to Jill if she complies.  
Second gives profits to Jill if she cheats.

Jill's payoff, however, depends on what Jack does.

At the same time, Jack's payoff depends on what Jill does.

Profits depend on what your competitor does along with what you do! \(\Rightarrow\) mutual interdependence.

**What will they do?**

Jill says -

"If Jack complies, the best thing for me to do is to cheat. If Jack cheats, the best thing for me to do is cheat. I should cheat."

\(\Rightarrow\) Jill has a dominant strategy (cheat).
A **dominant strategy** is a strategy that is the same regardless of the action taken by the other player.

Jack also has a dominant strategy (cheat)

The equilibrium of the game is for both players to cheat.

An **equilibrium** of a game occurs when Jack (player A) takes the best possible action given the action of Jill (player B) and Jill (player B) takes the best possible action given the action of Jack (player A).

This is called a **Nash equilibrium**.

The equilibrium is the worst outcome from the industry perspective.

<table>
<thead>
<tr>
<th></th>
<th>Jack</th>
<th>Jill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheat, cheat</td>
<td>Total profits = 0 (acting like competitors)</td>
<td></td>
</tr>
<tr>
<td>Comply, comply</td>
<td>Total profits = 20 (acting like a monopoly)</td>
<td></td>
</tr>
<tr>
<td>Cheat, comply</td>
<td>Total profits = 18 - 5 = 13</td>
<td></td>
</tr>
<tr>
<td>Comply, cheat</td>
<td>Total profits = 13</td>
<td></td>
</tr>
</tbody>
</table>

There is a tension between what's best for the industry and what's best for the individual firm.

- This is true in any sort of cartel agreement.

Note that from a social perspective the best outcome is the one in which they both cheat.
The game we have studied is an example of the prisoners’ dilemma.

- provides insight into the difficulty of maintaining cooperation.

- cooperation is difficult to maintain even if it is mutually beneficial
**Classic prisoners' dilemma:**

Two criminals have been caught by police (Bonnie and Clyde)

- Police have enough evidence to convict each of a minor crime (possession of gun)
- Police suspect they are partners in a bank robbery

Police question each separately

- Both confess to bank robbery $\Rightarrow$ both get 8 years
- Neither confess to bank robbery $\Rightarrow$ both get 1 year (for possession of gun)
- One confesses, one denies $\Rightarrow$
  - the one who confesses gets immunity (he or she has implicated the other in the crime, however),
  - the one who denies gets 20 years (he or she has been implicated in the crime)
Bonnie's Strategy

<table>
<thead>
<tr>
<th></th>
<th>Confess</th>
<th>Deny</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confess</td>
<td>8 yrs</td>
<td>20 yrs</td>
</tr>
<tr>
<td>Deny</td>
<td>Free</td>
<td>1 yr</td>
</tr>
</tbody>
</table>

Clyde's Strategy

<table>
<thead>
<tr>
<th></th>
<th>Confess</th>
<th>Deny</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confess</td>
<td>8 yrs</td>
<td>Free</td>
</tr>
<tr>
<td>Deny</td>
<td>Free</td>
<td>1 yr</td>
</tr>
<tr>
<td></td>
<td>20 yrs</td>
<td>1 yr</td>
</tr>
</tbody>
</table>
Other examples of prisoners' dilemma:

♦ Cartels

♦ Arms races

♦ Advertising (both are trying to attract the same customers)

♦ Common resources
**Common resources**

Example: Two firms have adjacent oil fields --- under field is common pool of oil worth $12 million.

♦ Drilling well to recover oil costs $1 million.

♦ If each drills a well, each gets half the oil and makes profits of \( \frac{1}{2}(12) - 1 = 5 \) million.

♦ But, each firm can drill an additional well.

Both firms drill a well (so there are two wells) \( \Rightarrow \) each get \( \frac{1}{2}(12) - 1 = 5 \) million

Both firms drill two wells \( \Rightarrow \) each get \( \frac{1}{2}(12) - 2 = 4 \) million

One firm drills one well, one firm drills two wells \( \Rightarrow \) there are 3 wells in total

firm that drills one well gets \( \frac{1}{3}(12) - 1 = 3 \) million

firm that drills two wells gets \( \frac{2}{3}(12) - 2 = 6 \) million
Exxon's Decision

<table>
<thead>
<tr>
<th></th>
<th>Drill 2 wells</th>
<th>Drill 1 well</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 wells</td>
<td>$4</td>
<td>$3</td>
</tr>
<tr>
<td>1 well</td>
<td>$4</td>
<td>$6</td>
</tr>
</tbody>
</table>

Arco's Decision

<table>
<thead>
<tr>
<th></th>
<th>Drill 2 wells</th>
<th>Drill 1 well</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 wells</td>
<td>$4</td>
<td>$3</td>
</tr>
<tr>
<td>1 well</td>
<td>$6</td>
<td>$5</td>
</tr>
</tbody>
</table>
Notes:

♦ Dominant strategy is drilling two wells for each company

♦ The extra wells are pure waste (throw away $2 million)

♦ Society would be better off if the two players could reach the cooperative outcome

Interesting!

Why? In case of oligopolists trying to maintain monopoly profits, lack of cooperation is good from the standpoint of society as a whole.

Monopoly outcome good for oligopolists, bad for consumers of the product.

Recall, competitive outcome is best for society as a whole since it maximizes total surplus.

When oligopolists fail to cooperate, the quantity they produce is closer to optimal (socially efficient) level.

Invisible hand guides markets to allocate resources efficiently ONLY when markets are competitive. And markets are competitive ONLY when firms in the market fail to cooperate.
Why People Sometimes Cooperate

Repeated games

Realistically, Jack and Jill will compete more than once.

Repeated games can have different, richer strategies. A common strategy examined by economists is called tit-for-tat.

"I'll do to you this time what you did to me last time."

This strategy makes it more likely that the players end up in the "cooperative equilibrium" where both comply.

Definition: A **cooperative equilibrium** is an equilibrium in which the players make and share the monopoly profit.
Why are Jack and Jill more likely to cooperate in a repeated game?

Let's look at 3 periods.

Look at what Jill will do if Jack plays a tit-for-tat strategy.

It's now December and Jill has been complying with the agreement

What happens if Jill decides to cheat in December?

<table>
<thead>
<tr>
<th></th>
<th>Jill</th>
<th>Jack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov.</td>
<td>comply</td>
<td>comply (since Jill complied in October)</td>
</tr>
<tr>
<td>Dec.</td>
<td>cheat</td>
<td>comply (since Jill complied in November)</td>
</tr>
<tr>
<td>Jan.</td>
<td>cheat</td>
<td>cheat (since Jill cheated in November)</td>
</tr>
</tbody>
</table>

What is the payoff to Jill of cheating in December?
18m in Dec. + 0m in Jan. = 18m

Suppose instead Jill complied in December?
10m in Dec. + 10m in Jan. = 20m

It's better to comply! (but this does not guarantee that firms will always comply ----)
**Game theory** has been very useful for studying a variety of firms decisions including whether to enter or leave an industry, how much to spend selling the product, whether to modify its product, and whether to undertake research and development.