# Slide 1

Kosmas Marinakis, Ph.D.

Economics
& Society

## Lecture 5

Strategic Competition

SMU

**1**

# Slide 2

* Monopoly
* Supply curve in monopoly
* Market power
* Market efficiency ▶
    consumer surplus, producer surplus, DWL
* Taxation ▶
    PC & Monopoly
* Case: Market of human kidneys ▶

**2**

**2**

# Slide 3

## Modeling real markets
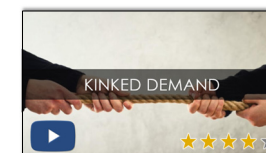
* There are *no perfectly competitive* markets out there
* There are *no pure monopolies*, either
* Then, *why* do we consider such models?

**3**

**3**

# Slide 4

## Strategic Competition

Estimated duration: 130min

MONOPOLISTIC COMPETITION

OLIGOPOLY

COURNOT OLIGOPOLY

BERTRAND OLIGOPOLY

COLLUSION

KINKED DEMAND

Lecture 5

**4**

**11**

---

## Assumptions

1. **Small number** of firms:
   ▶ The number of firms is low enough, so that <u>interaction</u> is **possible** and **meaningful**
   ▶ Every firm needs to **consider** other firms' actions.

2. **Homogeneous** product:
   ▶ **Market power** results from the <u>small number of firms</u>, NOT from <u>product differentiation</u>
   ▶ <u>Coca-Cola</u> has **power** on consumers because they can **replace** it only with <u>Pepsi</u>.

3. **Barriers** to entry:
   ▶ Firms are large and can **create barriers** to maintain their **S-R profits** in the **L-R**
   ▶ Threatening **price wars**, excess **capacity**, excessive **advertisement**, **proliferation**

**12**

---

## Strategic game

★ The **key-**characteristic of oligopoly is **interaction**
   we cannot think of firms' actions **independently**, anymore

★ In <u>other market structures</u>, every firm is simply **doing its best**
   no matter what **other firms** do

★ In <u>oligopoly</u>, every firm must plan its actions considering **how its competitors will react** to those actions
   every firm's **outcome** is **affected** by the **actions of its rivals**

★ Therefore, actions in oligopoly are **strategic**
   "strategic" **does not mean** "smart"

**13**

---

## Examples of oligopolistic markets

★ Middle-high class **sedans**
   BMW, Mercedes, Audi, Volvo

★ High-end **smartphones**
   iPhone, Galaxy, Huawei

★ Web based **email**
   Hotmail, Gmail, Yahoo

**14**

## Competition with respect to what?

* Firms have to choose in **which field** they will compete:
  * Apple and Samsung are competing with respect to **technological advancement**
  * BMW and Benz are competing with respect to **quality**
  * Coke and Pepsi are competing with respect to **advertisement**
  * DKNY and Calvin Klein compete with respect to **design**
  * Firefox and Chrome compete with respect to **market share**
  * SMU and NUS compete with respect to **research**
  * Oil producing nations are competing with respect to **quantities**
  * Supermarkets compete with respect to **price**

15

---

## Oligopoly models

* **Cournot:** Competition with respect to quantities
  the choice variable of the firm is the **quantity**

* **Bertrand:** Competition with respect to prices
  the choice variable of the firm is the **price**

* **Collusion:** Firms cooperate and act as if they were a monopoly

* **Kinked demand model:** Firms are reluctant to reduce prices

16

---



COURNOT OLIGOPOLY

17

---

## The Cournot duopoly (1838)

* Two **identical** and **symmetric** firms produce a **homogeneous** good
  firm 1 & firm 2

* **Fixed** and **marginal costs** for both sellers are assumed to be zero
  for instance, two firms selling **water** from a **natural spring**

* The **market demand** is
$$p = 100 - Q$$
  where $Q = q_1 + q_2$

* Firms decide **how much** to produce:
  1. Separately
  2. Simultaneously
  3. Irrevocably

18

## MR for firm 1 ⚠️

* The market demand *can be written* as
$$p = 100 - q_1 - q_2$$

* In this demand function, firm 1 can *control* $q_1$
  but sees 100 and $q_2$ as *fixed* and *constant*

* Thus, demand *as seen by firm 1* is
$$p = \underbrace{(100 - q_2)}_{\text{intercept}} - \overbrace{q_1}^{\text{gradient}}$$

* Thus, *marginal revenue* for firm 1 is
$$MR_1 = (100 - q_2) - 2q_1$$

**19**

---

## Optimal choice of output ⚠️

* Profit maximization for firm 1 implies:
$$MR_1 = MC \quad \text{or} \quad (100 - q_2) - 2q_1 = 0 \quad \text{or} \quad \boxed{q_1 = \frac{100 - q_2}{2}} \quad (1)$$

* *Equation* (1) is called firm's 1 "*best response*" or "*optimal reaction*" function
  because it yields the profit maximizing $q_1$ *for every* $q_2$ that firm 2 may choose

* Firm 2 *responds symmetrically* to firm 1:
$$\boxed{q_2 = \frac{100 - q_1}{2}} \quad (2)$$

* Since both firms are *identical*, in the end $q_1 = q_2$, so we can write (1) as:
$$q_1 = \frac{100 - q_1}{2} \quad \text{or} \quad 2q_1 = 100 - q_1 \quad \text{or} \quad \boxed{q_1 = q_2 = 33.33}$$

**20**

---

## Price & profits

* Price in *Cournot*: $p = 100 - q_1 - q_2 = 100 - 33.33 - 33.33$ or $p = \$33.33$

* Profit per firm: $\Pi_1 = R_1 - C = p \cdot q_1 - 0 = \$33.33 \cdot 33.33$ or $\boxed{\Pi_1 = \Pi_2 = \$1,111.11}$

* If both firms *acted as PC firms*:
  $p = MC$ or $100 - Q = 0$ or $Q = 100$ or $q_1 = q_2 = 50$.
  $p = \$0$; and $\Pi_1 = \Pi_2 = \$0$.

* If firms *collude* and form a *monopoly*:
  $MR = MC$ or $100 - 2Q = 0$ or $Q = 50$ or $q_1 = q_2 = 25$.
  Price: $p = 100 - q_1 - q_2 = 100 - 25 - 25$ or $p = \$50$.
  Profit per firm: $\Pi_1 = R_1 - C = p \cdot q_1 - 0 = \$50 \cdot 25$ or $\Pi_1 = \Pi_2 = \$1,250$.

**21**

---

## Comparing models

|  | *Price* | *Quantity per firm* | *Profit per firm* |
|---|---|---|---|
| PC | $0 | 50 | $0 |
| Cournot | $33.3 | 33.33 | $1,111 |
| Collusion | $50 | 25 | $1,250 |

* Price, quantity and profit of oligopoly are *between* PC and Monopoly

* What if **price** in this market was

* What if **price** was

* It is *more profitable* for firms to *collude* by setting $q = 25$

**22**

## Incentive for cheating ⚠️

|  | Price | Quantity per firm | Profit per firm |
|---|---|---|---|
| PC | $0 | 50 | $0 |
| Cournot | $33.3 | 33.33 | $1,111 |
| Collusion | $50 | 25 | $1,250 |

★ Assume that <u>firm 1</u> sets $q_1 = 25$ and **expects** <u>firm 2</u> to also produce $q_2 = 25$:
  ▶ Firm 2 can produce $q_2 = 25$ and each firm earn **profit** $1,250
  ▶ OR firm 2 can produce $q_2 = (100 - q_1)/2 = (100 - 25)/2 = 37.5$.

★ If $q_2 = 37.5$, **price** will be: $p = 100 - q_1 - q_2 = 100 - 25 - 37.5 = \$37.5$
  ▶ Profit for firm 2:  $\Pi_2 = R_2 - C = p \cdot q_2 - 0 = \$37.5 \cdot 37.5$  or  $\boxed{\Pi_2 = \$1,406.25}$
  ▶ Profit for firm 1:  $\Pi_1 = R_1 - C = p \cdot q_1 - 0 = \$37.5 \cdot 25$  or  $\boxed{\Pi_1 = \$937.5}$

★ Each firm has a strong **incentive to cheat** hurting the other firm

★ Without **commitment mechanism**, collusion is **not sustainable**

---

# BERTRAND OLIGOPOLY

★★★★☆

---

## Bertrand competition (1883)

★ Firm 1 and firm 2 produce a **homogeneous** good

★ **Market demand** is $p = 100 - Q$

★ **Cost** is constant, $c > 0$

★ Firms simultaneously choose **prices**

★ Since the good is **homogeneous**, consumers buy from **cheapest** seller

★ Thus:
  ▶ The **cheapest** firm serves the **entire** demand
  ▶ If $p_1 = p_2$, firms **share** the demand as in Cournot ($p = 100 - q_1 - q_2$)

---

## Bertrand equilibrium

★ If firm 1 charges any $p_1$ <u>above cost</u>
  firm 2 would

★ If firm 1 charges any $p_1$ <u>below cost</u>
  firm 2 would

★ If firm 1 charges $p_1$ <u>equal to cost</u>
  firm 2 would

★ The Bertrand **equilibrium** is $p_1^* = p_2^* = c$

★ In Bertrand, firms end up producing the **PC output** and earning **PC profit**

★ If firms tried to **collude** by setting $p_1^* = p_2^* > c$
  they would each have a **strong incentive to cheat** by undercutting

## The Bertrand paradox

* The Bertrand equilibrium is *paradoxical*

  firms are supposed to have *market power* but *behave as if they do not have*

* *The source* of the paradox is the particularly *strong motive* for undercutting

  even 1-cent *price-cut* may shift the *market share* from 0% to 100%

* There are 3 *major ways* to *resolve* this paradox:

  1. *Capacity constraints*: if the cheaper firm does not have the *capacity* to serve the entire market alone, its rival can profit from exploiting the *residual* customers
  2. *Repeated interaction*: the <u>benefit from cheating</u> is *high* but *for only one* period – the <u>benefit from collusion</u> is *lower* but for *more periods*
  3. *Differentiation*: when a firm's product is perceived as *better* by its customers, they *will not abandon* it if a rival undercuts the price

27

---

## External video

*In this Al Jazeera Video, watch how Russia and Saudi Arabia found themselves amid a harsh price war during one of the worst economic downturns of the last century. Try to figure out what kind of game petroleum is: Cournot or Bertrand?*

YouTube

Oil price war: Analysts expect prices to drop further
Al Jazeera English ✔ 92K views • 2 months ago
Top energy officials in the US and Russia will meet to tackle an historic collapse in global oil markets. The meeting comes after a ...
SAUDI-RUSSIAN OIL PRICE FEUD  5:17

28

---

Thank you!

(you are welcomed to stay for *consultation* or *discussion*)

36

---

## ⚠ WARNING! ⚠

The slides in this handout are created with the intention to serve a visual aid for the audience during the live presentation of the material in the lecture. As such, **they are not designed to be standalone reading material** and should be used strictly as **reference**, side by side with notes taken in the lecture. Studying solely from the slides **is not recommended** and might in some cases **mislead** those who have not attended the relevant lecture. **Less than 20% of tasks in test and exam can be answered solely from the slides**.

37