Industrial Organization

(CLEF – Alma Mater Studiorum – Università di Bologna)

a.a. 2018-2019

Dott.ssa Vitali Beatrice

Dott.ssa Vitali Beatrice

- Email: *beatrice.vitali8@unibo.it*
- Pagina Unibo: *https://www.unibo.it/sitoweb/beatrice.vitali8/*

Exercise Lesson

(Chapter 1-9)

Chapter 1

What is Industrial Organization?

- The study of *Imperfect Competition*.
- Analysis of *decisions* made by firms and to derive *predictions*.
- *Strategic decisions (choices)*: impact on other participants in the market (*consumers*, *rival firms*, suppliers, distributors).
- *Market outcome* as result of adoption of different *production and pricing strategies.*
- *Non Cooperative Game Theory*.

Chapter 2

Basic Microeconomic Analysis

- Profit Maximization: $Marginal\ Revenue = Marginal\ Cost$
- Competitive Market Equilibrium: $Price = Marginal\ Cost \rightarrow Max\ (consumer\ surplus + producers\ surplus)$.
- Monopoly Equilibrium: $Price > Marginal\ Cost \rightarrow Welfare\ Loss$, few resources employed in production.

Chapter 3

Market Structure and Market Power

- Market Structure:

1. *Perfect Competitive Market:* many firms.
2. *Monopoly*: one firms.
3. *Oligopoly*: few firms.

- *Firm shares* as fraction of industry's total output.
- *Concentration Indices*: measure of market structure.

1. Concentration Ratio
2. Hirfindahl-Hirschman Index
3. Lerner Index

Concentration Indices

- Concentration Ratio: $\boldsymbol{CR_n = \sum_{i=1}^{n} s_i}$
  s_i: market share of the top *n* firms.
  Cumulated sum of the only first firms in a market.

- Hirfindahl-Hirschman Index: $\boldsymbol{HHI = \sum_{i=1}^{N} s_i^2}$
  s_i: market share of the *i*th firm.
  Squared sum of all the firms in a market

Exercise 1

Consider two industries, each comprising 10 firms. In industry A, the largest firm has a market share of 49%. The next three firms have a market share of 7% each, the remaining six firm have equal share of 5%. In industry B, the top four firms share the bulk of the market with 19%. The next largest firm accounts for 14% and the smallest five firms equally split the remaining 10% of the industry.

- Compute the four firm concentration ratio and the HHI for each industry. Compare these measures. Which industry exhibit a more competitive structure? Which measure give a better indication of this?

Solution

Industry A		
Firm	***Market Share*** s_i	***Squared Market Share*** s_i^2
1	49	2401
2	7	49
3	7	49
4	7	49
5	5	25
6	5	25
7	5	25
8	5	25
9	5	25
10	5	25

Industry B		
Firm	***Market Share*** s_i	***Squared Market Share*** s_i^2
1	19	361
2	19	361
3	19	361
4	19	361
5	14	196
6	10	100
7	10	100
8	10	100
9	10	100
10	10	100

Solution

- Industry A: $CR_4 = \sum_{i=1}^{4} s_i = 49 + 7 + 7 + 7 = 70\%$
- $HHI = \sum_{i=1}^{N} s_i^2 = 2401 + 49 + 49 + 49 + 25 + 25 + 25 + 25 + 25 + 25 + 25 = 2698$

- Industry B: $CR_4 = \sum_{i=1}^{4} s_i = 19 + 19 + 19 + 19 = 76\%$
- $HHI = \sum_{i=1}^{N} s_i^2 = 361 + 361 + 361 + 361 + 196 + 100 + 100 + 100 + 100 + 100 = 2140$

- In industry A, the first firm dominated.
- In industry B the first five firms control the market for 90%.
- The HHI better captures the monopoly condition in firm A.

Lerner Index

- *Measure of Market Power*: actual efficiency costs of monopoly power.
- Comparison of *Price and Marginal Cost*: how market outcome deviates from competitive ideal.
- $\boldsymbol{LI = \frac{P - MC}{P}}$: discrepancy between Price and Marginal Cost.
- *Competitive Firm*: $LI = 0$
- *Monopolist*: $LI = \frac{1}{\varepsilon}$, inverse of elasticity of demand (the less elastic is demand the greater is *LI*).
- $\boldsymbol{LI = \frac{P - \sum_{i=1}^{n} s_i MC}{P}}$: all firm sell at the same price (homogeneous goods), different share.
- $\boldsymbol{LI = \frac{P - \overline{MC}}{P} = \frac{HHI}{\varepsilon}}$: using the average marginal cost of industry.

Chapter 4

Technology and Cost Minimization

- *Production relationship (function).*
- How a given quantity of inputs is transformed into firm's output → Profit Maximization implies *Cost Minimization* of each possible production level.
- *Total cost of production*: $\bar{\boldsymbol{q}} = \boldsymbol{min} \sum_{\boldsymbol{i=1}}^{\boldsymbol{k}} \boldsymbol{w_i x_i}$, $\bar{q} = C(q) + F$
- *Variable Cost:* $C(q)$
- *Fixed Cost:* F
- *Average Cost:* $\frac{C(q)+F}{q}$
- *Marginal Cost:* $\frac{dC(q)}{dq}$

Cost and Concentration

- *Economies of Scale*: increase concentration.
- *Economies of Scope*: increase concentration.
- *Product-differentiated Markets*: more concentrated structure.
- *Market Size*: large markets less concentrated, but higher *Sunk Cost* (advertising, research and development cost).
- *Network Externalities*: value of a good to any one consumer increase as other consumers use it → increase concentration.
- *Government Policy*: regulation increase concentration.

Chapter 5

Monopoly: Linear Pricing

- *Price Differential*: two groups of consumers, different prices.
- *Linear Pricing*: consumers can choose how much purchase at the quoted prices.
- *Third Degree Price Discrimination (Group Pricing)*:

1. *Identification Problem*
2. *Arbitrage Problem*

- *Marginal Revenue must be equalized* in each market.
- *Marginal Revenue must be equal to marginal cost*.
- Increase Total Output will increase *Social Welfare*.

Chapter 6

Non - Linear Pricing

- *Two-part Pricing*: firm charge a fixed fee plus a price per unit.
- *Block Pricing*: firm bundle the quantity being offered with the total charge for that quantity.
- Aim *to increase monopolist's profit*: increasing surplus on existing sales or extending sales to new market.
- *First-Degree Price Discrimination (Personalized Pricing):* identify different types of consumers and keep them apart → all consumer's surplus converted into firm's profit → potential distribution inequities.
- Firm supply the socially efficient level of output to each consumer type.
- *Second-Degree Price Discrimination (Menu Pricing):* consumers self select into groups → not clear welfare effect.

Chapter 7

- ***Product Variety and Quality***

- *Product Differentiated Strategies*: consumers with different tastes.
- *Horizontal Product Differentiation*: different preferences for specific product characteristic → monopolist expand its market and enhances its ability to charge consumers → socially optimal product variety.
- *Vertical Product Differentiation*: more quality is better, different willingness to pay for quality → firm must choose quality and price so that different consumers purchase quality targeted to their type.

Spatial Model of Horizontal Product Differentiation (Hotelling)

- Consumers who lives farther from the shop want to pay lower than who lives in the city center.
- Trasport cost direct proportionally to the distance.
- Producers does not do any price discriminitation.
  - *N: number of consumers*
  - *t: trasport cost for unit of distance*
  - p_1: *monopolist's price*
  - *V: consumer's reservation price*
  - x_1: *distance from the shop that make indifferent the consumer to buy or not.*

$$Full\ Price\colon\ p_1 + tx_1 = V \rightarrow x_1 = \frac{V - p_1}{t}$$

- $Monopolist's\ Price: p(N,n) = V - \frac{t}{2n}$
- $Monopolist\ Profit:\ \pi(N,n) = N\left(V - \frac{t}{2n} - c\right) - nF$

$c: variable\ cost, F: fixed\ cost$
$n: number\ of\ shop$

- $increasing\ profit: \pi(N,n+1) > \pi(N,n) \rightarrow \boldsymbol{n(n+1) < \frac{tN}{2F}}$

Exercise 3

There are five millions consumers in the market. There are fifty thousand dollars of fixed cost and transport cost of 1$. The reservation price is equal to 60$.

- Find out when is profitable for the firm add a further shop.
- Compute the monopolist's price and profit with this number of shop.

$$N = 5.000.000$$
$$F = 50.000\$$$
$$t = 1\$$$
$$V = 60\$$$

Solution

- $\frac{tN}{2F} = 50 \rightarrow n(n+1) < \frac{tN}{2F} \rightarrow 6(6+1) < 50 \rightarrow 42 < 50$

n should be less than or equal to 6.

- $Monopolist's\ Price: p(N,n) = V - \frac{t}{2n} \rightarrow p(5.000.000; 6) = 60 - \frac{1}{2*6} = 59{,}916\$$

- $Monopolist\ Profit: \pi(N,n) = N\left(V - \frac{t}{2n} - c\right) - nF \rightarrow \pi(5.000.000{,}6) = 5.000.000\left(60 - \frac{1}{2*6} - c\right) - 6 * 50.000 = 299.280.000\$$

Chapter 8

Commodity Bundling and Tie-in-sales

- *Strategic choices* of a monopoly firm.
- Aim to extract *higher surplus from consumers*.
- *Bundle two goods* as a package (Microsoft Office, holiday package).
- *Tie the sale* of a good to the purchase of the other. (cartridges for a computer printer, games of a particular console).
- *Identification* of different consumers → *charge* a higher net price to those with a higher willingness to pay.

Chapter 9

Game Theory

- Branch of social science that analyse *rational firms strategic decisions and interaction*.
- *Oligopoly*: middle ground where firms have *visible rivals → strategic interaction* → to anticipate responses of rivals.
- Each firm must consider how its *production and pricing strategies* affect *rival firms (competitors).*

1. *Cooperative Games*: *group or coalition of player (firms).*
2. *Non Cooperative Games: individual decision maker, a player (firm).*

- *Rules of game:* how *competition* takes place.

Nash Equilibrium Solution

- Outcome of any game is heavily dependent on the *rules of the game.*
- Each firm has a *set of strategies* to choose from → *payoff, outcome*.
- *Maximum payoff* for a player, given strategies chosen by other players: *Nash Equilibrium*, no incentive to change behaviour.

1. *Sequential Game*: each firm moves in order.
2. *Simultaneous Game*: firms moves at the same time, other players choice unknown (“Rock-Scissor-Paper).

a. *Dominant Strategies:* choice that always yields better results.
b. *Dominated Strategies:* choices that are never good, better ones are available.

Exercise 4

- Firm 1 and firm 2 are movie producers. Each has the option of producing a blockbuster romance or a blockbuster suspense film. The payoff matrix displaying the payoff of each of the four possible strategy combinations (in thousand) is shown below, with firm 1's payoff listed first. Each firm chooses without knowing it's rival choice.

➢ Find the Nash Equilibrium

		Firm 2	
		Romance	Suspense
Firm 1	Romance	($900; $900)	($400; $1000)
	Suspense	($1000; $400)	($750; $750)

○ Data: *Simultaneous Game*

Solution

- *Romance - Romance: if Firm 1 would choose suspense, it would obtain an higher payoff ($1000).*
- *Romance -Suspense: if Firm 1 would choose suspense, it would obtain an higher payoff ($750).*
- *Suspense – Romance: if Firm 2 would choose suspense, it would obtain an higher payoff ($750).*
- ***Suspense - Suspense**: none of the firms have incentive to switch strategy, the payoff would be lower ($400) → **Nash Equilibrium***

Cournot Model

- Earliest formal model of *Oligopoly.*
- *Static or single market model.*
- *Simultaneous Game.*
- *Firms interact only once (assumption).*
- Each seller's prediction are consistent both with *profit maximization* and with the *actual market outcome.*

Exercise 5

- Assume that there are two identical firms serving a market in which the inverse demand function is given by: $P = 100 - 2Q$. The marginal cost of each firm is equal to 10$ per unit.
- ➢ Calculate the Cournot Equilibrium output, the product price and the profit for each firm.

Data

Firm 1, output: q_1

Firm 2, output: q_2

Demand curve for both: $P = 100 - 2q_1 - 2q_2$

$MC_1 = MC_2 = 10$

Solution

- *Total Revenue Firm 1:* $TR_1 = (100 - 2q_1 - 2q_2)q_1 = 100q_1 - 2q_1^2 - 2q_2q_1$
- *Total Revenue Firm 2:* $TR_2 = (100 - 2q_1 - 2q_2)q_2 = 100q_2 - 2q_2^2 - 2q_2q_1$
- *Marginal Revenue Firm 1:* $MR_1 = 100 - 4q_1 - 2q_2$
- *Marginal Revenue Firm 2:* $MR_2 = 100 - 4q_2 - 2q_1$
- *Maximum Profit:* $MR = MC$
- *Firm 1:* $100 - 4q_1 - 2q_2 = 10 \rightarrow q_1 = \frac{100-10}{4} - \frac{2}{4}q_2 = 22{,}5 - \frac{1}{2}q_2$
- *Firm 2:* $100 - 4q_2 - 2q_1 = 10 \rightarrow q_2 = \frac{100-10}{4} - \frac{2}{4}q_1 = 22{,}5 - \frac{1}{2}q_1$
- $q_1 = 22{,}5 - \frac{1}{2}\left(22{,}5 - \frac{1}{2}q_1\right) \rightarrow \frac{3}{4}q_1 = 11{,}25 \rightarrow q_1 = q_2 = 15$
- *Aggregate market output:* $Q^* = q_1 + q_2 = 15 + 15 = 30$
- *Product Price:* $P^* = 100 - 2 * 30 = 100 - 60 = 40$
- *Profit:* $\pi_1 = \pi_2 = TR - TC = P^*q^* - MCq^* = (40 * 15) - (10 * 15) = 600 - 150 = 450$