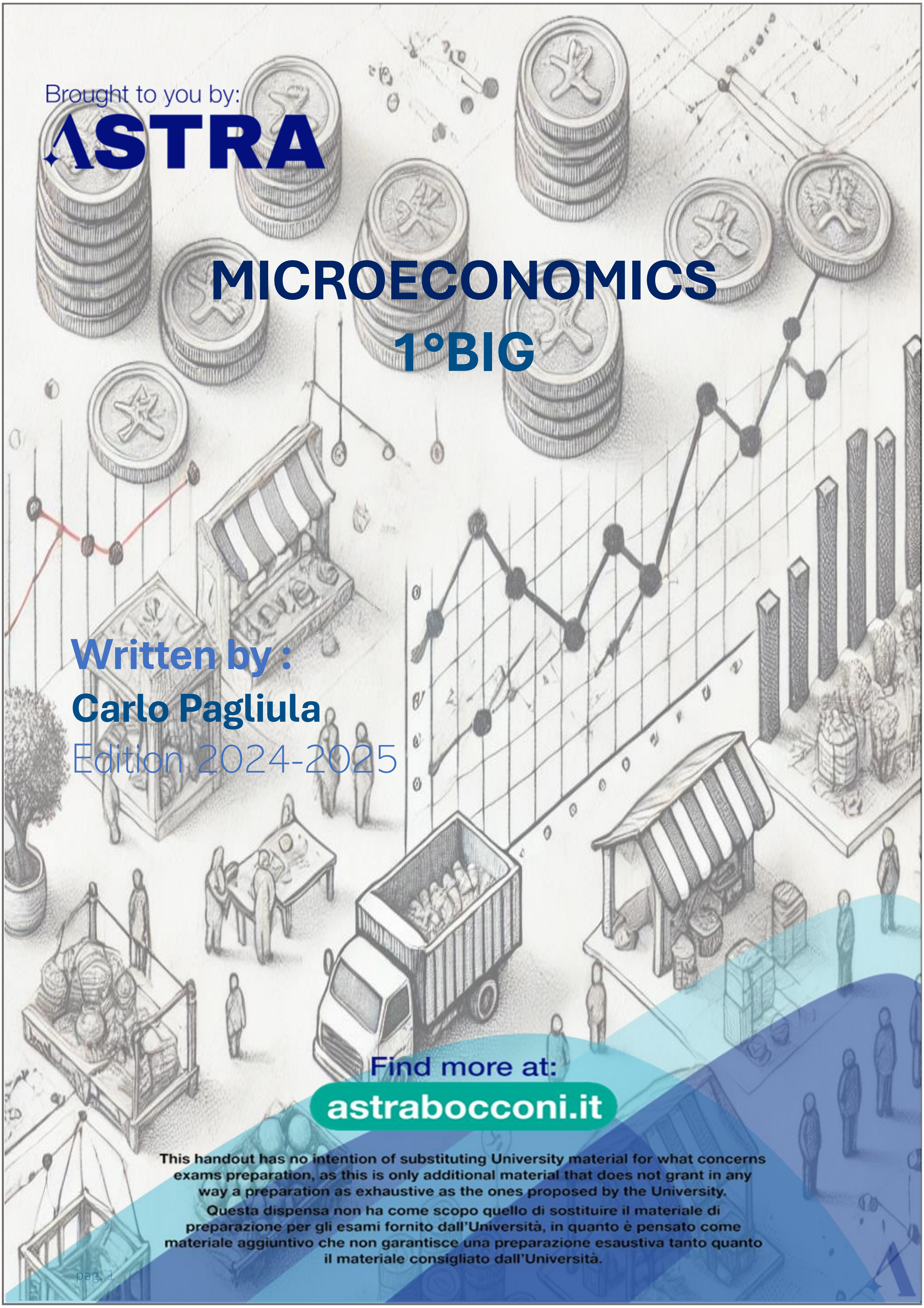

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MICROECONOMICS
1°BIG

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Edition 2024-2025

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LECTURE 1

Microeconomy is the study of how agents in a society use their limited resources to produce, exchange and consume goods and services. *(economics decision=only when resources are limited)*

- Limited budget for consumers
- Limited ability to produce (time, capital, tech costraints…) for producers/sellers

- **MICRO**: deals with decision making of INDIVIDUAL economic units and exchange of resources/goods/services…;
- **MACRO**: deals with aggregate economic quantities (economic growth, booms and busts, unemployement)

PRODUCTION AND CONSUMPTION DECISIONS

- Workers, firms and consumers must make **trade-offs (compromise)** (time, budget, resources)
- ASSUMPTION in this course: people are motivated by self-interest

How are these trade-offs best made? OPTIMIZATION PROCESS

MARKET: collection of buyers and sellers who, through actual or potential interaction, determine the prices of highly interchangeable products

- **Buyers**: consumers purchase goods, companies purchase labor and inputs
- **Sellers**: consumers sell labor, resources owner sell inputs, firms sell good
- **Price**: rate at which someone can swap money for a good

MARKETS

- Extent of a market:

Ex: Are fast-food restautants in Rome and Milan part of the same market? It depends…

- In Micro, a market is:
  - Associated with a single group of closely related products
  - Offered for sale within particular geographic boundaries
- **COMPETITIVE MARKETS: many firms**
- **MONOPOLIES: one firm and many consumers**
- **OLIGOPOLIES: few firms and many consumers**

1. How do we determine the market price and quantities exchanged?
2. Market efficiency? (efficiency=maximizations of benefits for all agents)
3. Gov intervention to restore efficiency? (liberalism and communism) (intervention with taxes and subsidies

TOOL FOR THE ANALYSIS

- Initial observation
- Theorizing: models
- Identification of additional implications

- Further observation and testing
- Refinement of the theory->broad applications and specific implications

MODELS CAN BE

- Quantitative: if production costs increase by 10%, price of good x will increase by 5%
- Qualitative: if production costs increase, price of a good should increase

(be careful:some assumptions are easy to criticize, they concentrate on the most important explanations for a particular phenomenon)

COMPETITIVE MARKET *SUPPLY AND DEMAND*

Determinants of Demand

- **Price of good**
- **Population growth**
- **Consumer tastes and incomes** (trends)
- **Prices of other related products**
  - *Substitutes* (ex: if iphone's prices go up, samsung's demand goes up)
  - *Complements* (ex: price of oil goes up, buying of cars goes down)
- Gov taxes and regulations
- Income
  - Normal good: if income increases, quantity demanded increases
  - Inferior good: if income increases, quantity demanded decreases (essential goods)

LECTURE 2

DEMAND CURVE (consumption)

- *Market **demand curve** of a good* shows: how much of the good consumers want to buy at each possible price holding fixed all other factors that affect the demand;
- **Downward** sloping: buying the product is less attractive when the price is high than when the price is low;

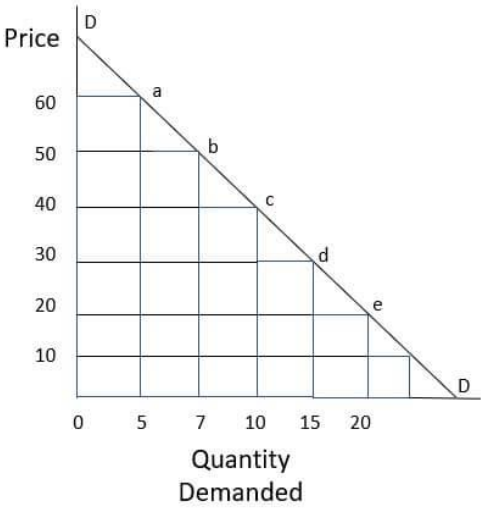


Figure 1

- **Historically**: prices=dependent, quantity=independent;
- **Real life**: prices=independent, quantity=dependent;

- Change in *price* → **movement** along curve, change in quantity demanded
- Change in *other factors* → **shift** in curve (eg iphones and samsungs, (*substitutes*) Samsung shifts to right, grows; films and polaroid (*complementary*) both shift to the left)

DEMAND FUNCTIONS

Quantity demanded= D(Price, Other factors)

- Assume linear function Q^d=A-BP
- To plot a demand curve: use inverse demand function: P=A/B-Q/B
- Y-intercept: A/B
- X-Intercept: A
- Slope (m): -1/B

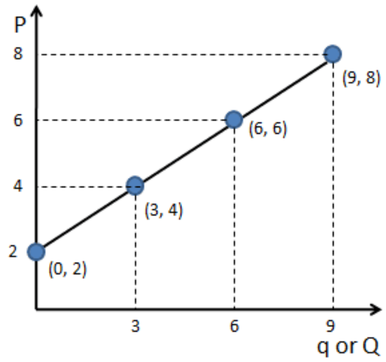
- **MINUS SIGN (-)** = COMPLEMENTARY
- **PLUS SIGN (+)** = SUBSTITUTES

EG $Q^d_{corn} = 5 - 2P_{corn} + 4P_{potatos} - 0.25P + 0.0003M$

- 5 → something's missing, computer generated
- Potatoes are **substitutes** for corn
- M → income

SUPPLY CURVE (production)

Determinants: *technology, cost of capital, availability of raw materials, prod cost, profit of good, gov taxes or subsidies, number of firms on market, labor.*



What does it show?

- **Product's curve:** *how much sellers of the product want to sell at each possible price holding fixed all other factors that affect supply;*
- **Upward sloping:** *selling the product Is less attractive when the price is low than when the price is high;*
- **Line does NOT start at 0,0:** *price would be lower than cost of production;*

- Change in *price* → **movement** along curve, change in quantity supplied;
- Change in *other factors* → **shift** in curve (bad news=shift to left; good news= shift to right).

SUPPLY FUNCTIONS

Quantity supplied= S(Price, Other factors)

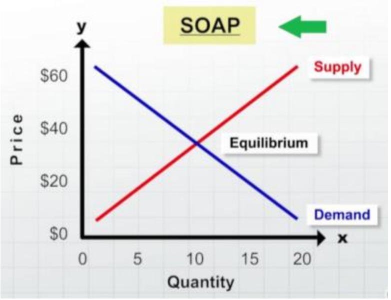
- Assume linear function Q=BP-A
- To plot a demand curve: use inverse demand function: P=Q/B-A/B
- Y-intercept: A/B
- Slope (m): 1/B

- **MINUS SIGN (-)** = SUBSTITUTES
- **PLUS SIGN (+)** = COMPLEMENTARY

MARKET EQUILIBRIUM

Equilibrium price is the price at which the amounts supplied and demanded are equal, graphically, the price is the point at which the supply and demand curves intersect.

To find it: set the two equations of supply and demand equal to each other.

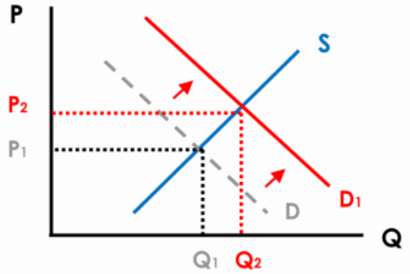


LECTURE 3

MARKET EQUILIBIUM

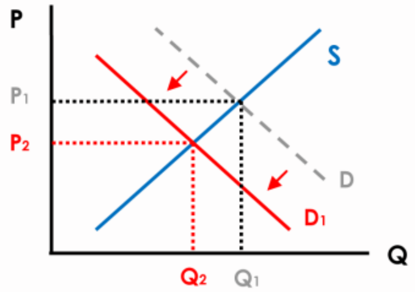
Changes in market equilibrium: demand increases or decreases, supply increases or decreases

Market Equilibrium



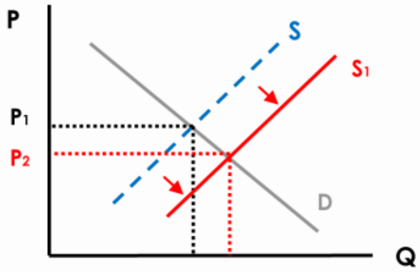
RISE IN DEMAND

1. ↑Ps Price of substitute good
2. ↓Pc Price of complementary good
3. ↑Y Income (normal good)
4. Change in Tastes (t) in favour of good
5. Expectations (E) of future scarcity and price rise



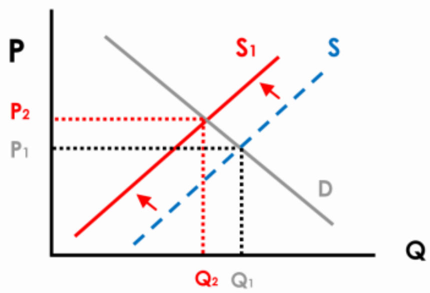
FALL IN DEMAND

1. ↓Ps Price of substitute good
2. ↑Pc Price of complementary good
3. ↓Y Income (normal good)
4. Change in Tastes (t) against good
5. Expectations (E) of future abundance and price fall



RISE IN SUPPLY

1. ↓PR Price of related good
2. ↓C Cost of production
3. ↑T State of technology
4. Favourable unplanned factors (i.e. good growing conditions for crops)



FALL IN SUPPLY

1. ↑PR Price of related good
2. ↑C Cost of production
3. Unfavourable unplanned factors (i.e. severe growing conditions for crops)

KEY: The interaction of **supply** and **demand** determines the optimal **PRICE** and **QUANTITY DEMANDED** (aka **Equilibrium P** and **Q**)

So, what changes the **equilibrium price** and **equilibrium quantity?** Looking at these graphs…

Change	Equilibrium Price	Equilibrium Quantity
Demand Rises	Rises	Rises
Demand Falls	Falls	Falls
Supply Rises	Falls	Rises
Supply Falls	Rises	Falls

Sometimes both supply and demand will both shift

- Will be able to determine the necessary direction of price or quantity movement, but not both

1st case

- Eg: both supply and demand increase→
  - **<u>With supply up: quantity up, price down</u>**
  - **<u>With demand up: quantity up, price up</u>**
- So we can't say exactly the price, only depending on what shock will be stronger, on the relative size of the effects on price

2nd case

- Eg: both supply and demand decrease→
  - **<u>With supply down: quantity down, price up</u>**
  - **<u>With demand down: quantity down, price down</u>**
- we can't say exactly the price

3rd case

- Eg: supply increases, demand decreases→
  - **<u>With supply up: quantity up, price down</u>**
  - **<u>With demand down: quantity down, price down</u>**
- we can't say exactly the quantity

4th case

- Eg: supply decreases, demand increases→
  - **<u>With supply down: quantity down, price up</u>**
  - **<u>With demand up: quantity up, price up</u>**
- we can't say exactly the quantity

ELASTICITY OF DEMAND

The slope of the curves will also influence the new equilibrium, as it indicates how sensible the quantity is to a change in price.
Slope depends on the unit of measurement we use to indicate quantity, however, it often differs on the type of market →we consider the elasticity of the slope.
<u>**ELASTICITY** is a numerical value that indicates how sensible the quantity is to a change in price. It does not depend on price/market</u>

ELASTICITY OF X TO Y

- a measure of the responsiveness of X to small changes in Y

PRICE ELASTICITY OF DEMAND: E_p^D (it involves price and quantity)
Measure how responsive the quantity demanded is to small changes in prices

$$E_p^D = \frac{\%change\ in\ Q}{\%change\ in\ P} = \frac{\frac{100\cdot(Q_n^D - Q_0^D)}{Q_0^D}}{\frac{100\cdot(P_n \cdot P_0)}{P_0}} = \frac{\partial Q}{\partial P}\cdot\frac{P_0}{Q_0}$$

$\partial = derivative$
$\frac{\partial Q}{\partial P} = derivative\ of\ the\ FUNCTION!$ Q=a-bP

CATEGORIES OF ELASTICITY OF DEMAND

- $\boldsymbol{E^d} < -\mathbf{1}$ → Elastic. It means: 1% rise in price reduces consumption by more than 1%
    - *competitive markets, plenty of substitute goods*
    - *price of good has large impact on the impact*
    - *luxury and unnecessary goods*
- $\mathbf{0} < \boldsymbol{E^d} < -\mathbf{1}$ → Inelastic. It means: 1% rise in price reduces consumption by less than 1%
    - *Necessary goods*
- $\boldsymbol{E^d} = -\mathbf{1}$ → Unit elastic. It means: 1% rise in price reduces consumption by 1%

EXTREME CASES

- $\boldsymbol{E^d} = -\infty$ → Perfectly Elastic (horiz. line). It means: a rise in price of a good induces consumers to stop purchasing it.
- $\boldsymbol{E^d} = \mathbf{0}$ → Inelastic. It means: It means: a rise in price of a good won't affect consumption.

LECTURE 4

On the same curve, at different prices, there could be different elasticities.

- Higher price→more elastic
- Lower price→less elastic

ELASTICITY AND TOTAL EXPENDITURES (TE)

TE=PQ (it gives info about total revenue without taxes)

$$\%\Delta TE = \%\Delta P + \%\Delta Q$$

A. PRICE INCREASES

- If demand is elastic → $\left|\frac{\%\Delta Q}{\%\Delta P}\right| > 1 \rightarrow |\%\Delta Q| > |\%\Delta P|$ P up, Q down MORE, TE down.
- If demand is inelastic → $|\%\Delta Q| < |\%\Delta P|$ P up, Q down LESS, TE up.
- If demand is unit elastic→no change in total expenditure

B. PRICE DECRESEAS

- If demand is elastic: P down, Q up more than price decrease → TE up
- If demand is inelastic: P down, Q up less than price decrease → TE down
- If demand is unit elastic: P down, Q up same as P down→ TE equal

Maximum point of TE graph corresponds to the point of unit elasticity of P/Q graph

INCOME ELASTICY OF DEMAND

It measures by how much Q^d changes when income changes by a little

$$E_M^D = \frac{\%change\ in\ Q}{\%change\ in\ M} = \frac{\partial Q}{\partial M} \cdot \frac{M_0}{Q_0}$$

$$Q^d = a - bP \pm cM$$

- If $E_M^D > 0 \rightarrow normal\ good$
- If $E_M^D < 0 \rightarrow inferior\ good$

CROSS PRICE ELASTICITY

It measures by how much Q_x^d changes when Py changes by a little

$$E_{Pb}^{Dx} = \frac{\%change\ in\ Q_x^D}{\%change\ in\ P_y} = \frac{\partial Q_x^D}{\partial P_y} \cdot \frac{P_y}{Q_x^0}$$

$$Q_x^d = a - bP_x \pm dP_y$$

- If $E_{Py}^{Dx} > 0 \rightarrow substitute\ good$
- If $E_{Py}^{Dx} < 0 \rightarrow complement\ good$

ELASTICITY OF SUPPLY TO PRICE

It indicates by how much the quantity supplied changes when the price changes by a little.

$$E_p^S = \frac{\%change\ in\ Qs}{\%change\ in\ P} = \frac{DQs}{DP} \cdot \frac{P_0}{Q_{s_0}}$$

$$Q^s = -a + bP$$

CATEGORIES OF ELASTICITY OF DEMAND

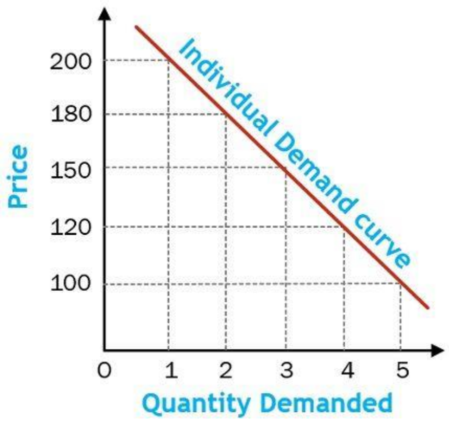
- $|\boldsymbol{E^s}| > \mathbf{1}$ → Elastic supply.
- $|\boldsymbol{E^s}| < \mathbf{1}$ → Inelastic supply.
- $|\boldsymbol{E^s}| = \mathbf{1}$ → Unit elastic supply.

EXTREME CASES

- $|\boldsymbol{E^s}| = \infty$ → Perfectly Elastic (horiz. line).
- $|\boldsymbol{E^s}| = \mathbf{0}$ → Perfectly Inelastic (vertical line). It means: you want to sell a certain quantity of product at any given price

LECTURE 5

INDIVIDUAL DEMAND: tells how many units of the good an individual wants to buy for every possible price, holding fixed the other factors.



CONSUMER'S PROBLEM: how to use the income to buy different goods with fixed prices, which goods best maximize our wellbeing? If price of a certain good changes, the demand changes only for related goods (complementary or substitutes)

1. STEP
   a. **PREFERENCES** (no prices and no income enter this step): they must follow rationality principles
   b. The higher in the ranking, the higher number associated to the good.
2. STEP
   a. **BUDGET CONSTRAINT**: given prices, what the agent can afford given their income (M)
3. STEP
   a. **CHOICE**: choose best alternatives in the subset of goods the agent can afford
4. STEP
   a. To construct: demand curve for y: change Py holding fixed prices of other goods and M→change budget constraint (step 2)→choice will change (step 3)

BETTER ANALYSIS OF STEPS

1st. An alternative is called ***consumption bundle:*** A=(Xa, Ya) etc

a. A>B: A better than B for this agent
b. A<B: B better than A
c. A=B: A and B are indifferent

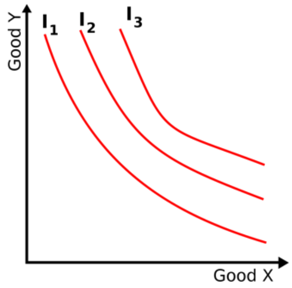
The agent is able to rank in order of preference all the bundles. Preferences are complete (the agent is able to explicit the preferences between every 2 bundles) and transitive (D>C, C>B→D>B)

2nd. Choice principle: if an agent ranked the alternatives in terms of preferences, he will choose the bundle he ranked first (among those he can afford). 3rd principle agents usually follow (not a rationality principle): the more is better principle (based on free disposal: you can dismiss things you do not use without additional costs) (B>A because it contains more X and more Y than A. (NOT USABLE WITH CERTAIN CASES REMEMBER COFFEE AND SUGAR). LOOK UP GRAPHS IDK.

LECTURE 6

Indifference curve: contains all the bundles that are indifference to each other for this agent

- Everything to the right is BETTER than those on the indifference curve (for the "the more is better" principle) o Everything to the left is WORSE than those on the indifference curve



FAMILY OF INDIFFERENCE CURVES

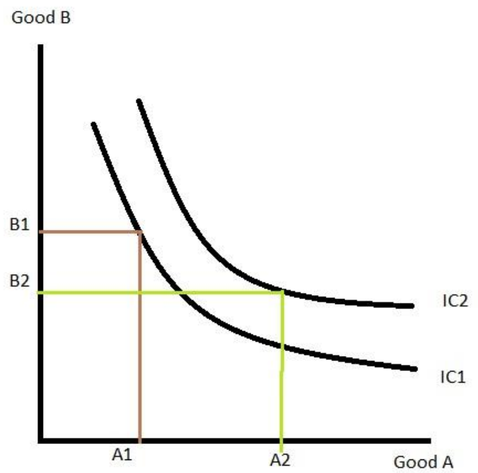
The set of all the indifference curves that represent the preferences of 1 individual on bundles containing x and y

Function of indifference curve

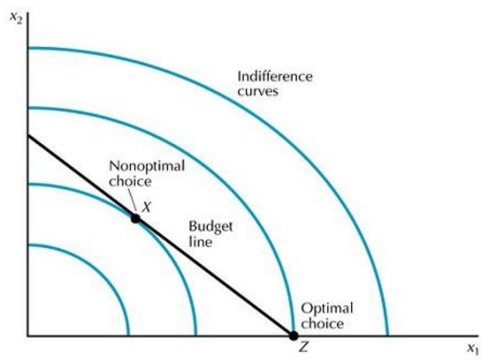
Y=f(x)

1. Indifference curves cannot be "fat" curves
2. Indifference curves cannot have positive slope (only negative slop, or vertical or flat)
3. Indifference curves belonging to the same family cannot cross each other

A. ***CONVEX CURVES (standard preferences):*** *people prefer goods that have same quantity on x and y → better middle than extremes. (eg. Variety of foods)*



B. ***CONCAVE CURVES:*** *people prefer extremes. (eg bags)*



C. INDIVIDUAL DOES NOT VALUE X OR Y

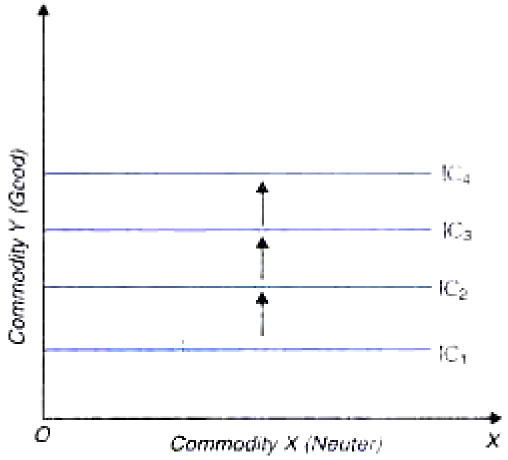


Fig. 8.11. Indifference Curves between a Neuter and Good

X has no value

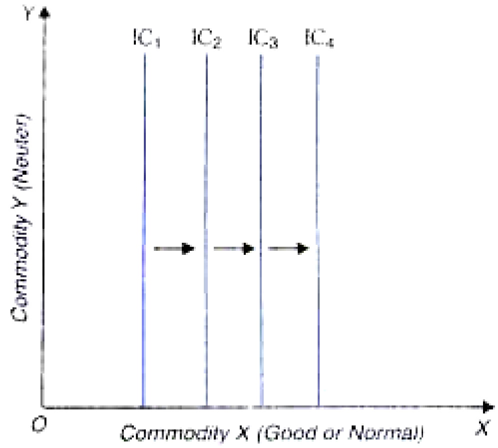
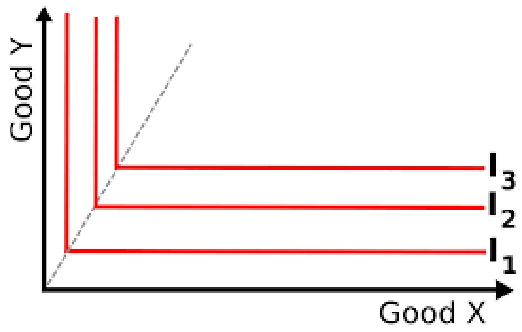


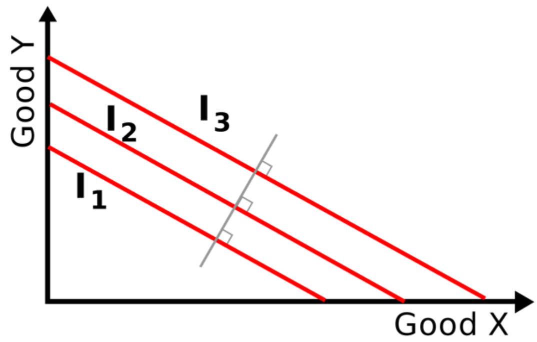
Fig. 8.12. Indifference curves between Good and Neuter

Y has no value

D. PERFECT COMPLEMENTS (eg shoes)



E. PERFECT SUBSTITUTES (don't care about the good purchased, only quantity)



WHAT ARE BADS?

When you consume these items, your wellbeing decreases
When you have a bad, the indifference curves have positive slope

RATE OF SUBSTITUTIONS BETWEEN X AND Y (at 2 points A and B on the indifference curve)
Tells how many limits of Y the agent is willing to give away to get some extra X and be indifferent with the initial bundle
Eg. A (2,3); B (3,2)
-(DY/DX)→ -(-2/1)→ 2

SUBJECTIVE VALUE OF X IN TERMS OF Y
High rate of substitution means that the agent prefers X relative to Y

MARGINAL RATE OF SUBSTITUTION (MRS)
Tells how many limits of Y the agent is willing to give away to increase X by a small amount (to be on the same indiff. Curve). MRS→|derivative of I.C. in point A|

INDIFFERENCE CURVES FOR DIFFERENT AGENTS
Eg. MRS(ann)>MRS(mark)→ Ann prefers X to Y more than Mark

- The steeper the curve the higher the MRS

LECTURE 7

Utility: number associated with a bundle that represents the relative preferences of this bundle to all the other bundles
UTILITY FUNCTION ASSOCIATES TO EACH BUNDLE (X, Y) A UTILITY LEVEL
u(x, y)=f(x, y)
+The utility function must:

1. Give the same numerical value to all the bundles on the same indifference curve
2. Assign a higher number to bundles on a higher indifference curved

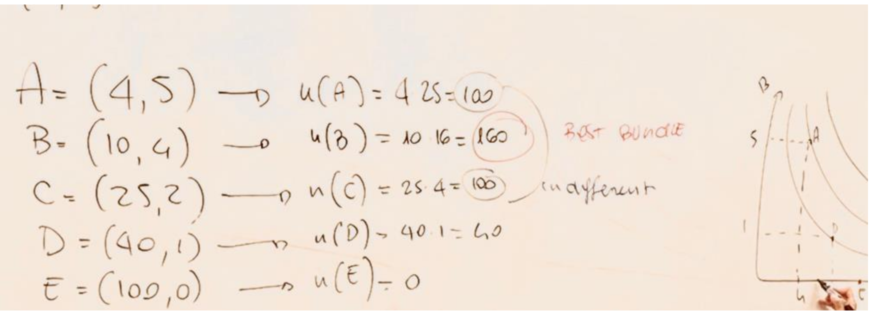
When a function follows 1 and 2, for sure preserves the ranking of the bundles

For every point on the utility function graph, you can relate an entire indifference function

Eg. U(M, B)= M+2B
Indifference curve?

1. Fix U
2. B= U-M/2 → function of the indifference function

Eg2
U (M, B)



UTILITY AND MRS

To know the effect of one unknown on the utility, we fix the other unknown

(MOST COMMON) UTILITY FUNCTION
U(X, Y)=X^a Y^b: Cobb-Douglas
Convex indifference curves

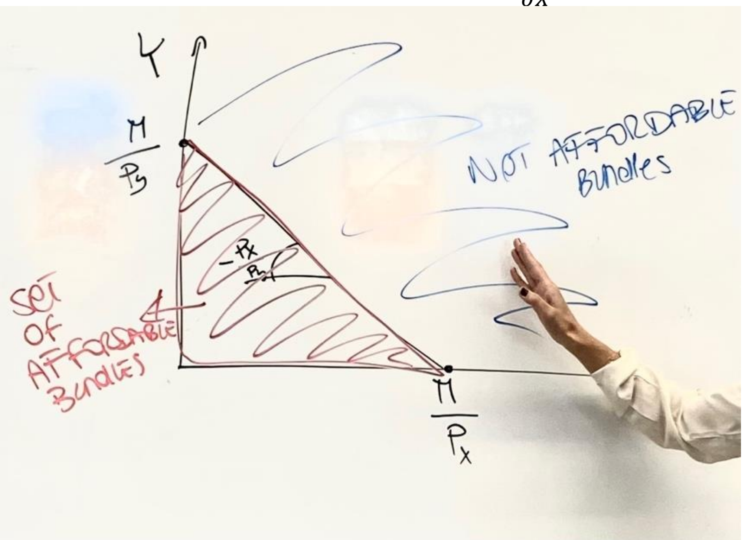
LECTURE 8

STEP 2: BUDGET CONSTRAINT

Bundle (X, Y) is affordable if it costs less (or equal) to the income of the consumer
$PxX+PyY \leq M$: Budget constraint

- **Budget set contains all bundles such that**: PxX+PyY<M
- **Budget line contains all bundles such that**: PxX+PyY=M

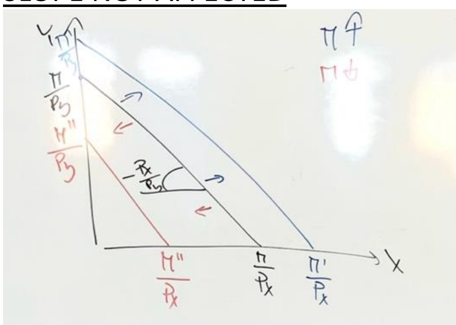
Budget line→ Y=M/Px-PxX/Py → Slope: $\frac{\partial Y}{\partial X}$= - Px/Py: -Price Ratio



INCOME (M) CHANGES

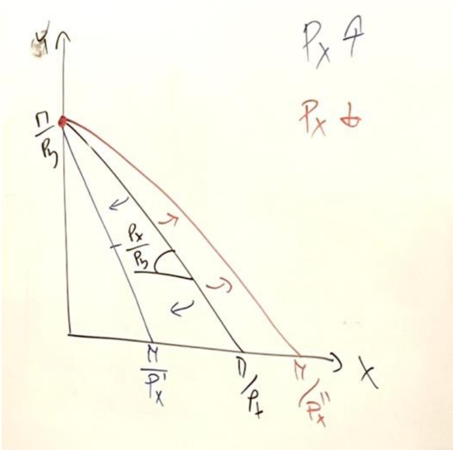
- *M increases*→ line shifts to the right
- *M decreases*→ line shifts to the left

<u>SLOPE NOT AFFECTED</u>



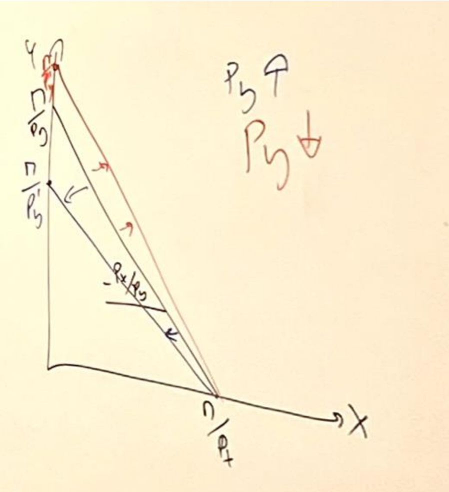
PRICE X (Px) CHANGES

- *Price increases*→ rotates to left and slope changes
- *Price decreases*→ rotates to right and slope changes



PRICE Y (Py) CHANGES

- *Price increases*→ rotates to left and slope changes
- *Price decreases*→ rotates to right and slope changes



EG. Px= 4
Py= 2
M=200
Budget line→ 4x+2y=200
Slope→ -price ratio→ -4/2= -2

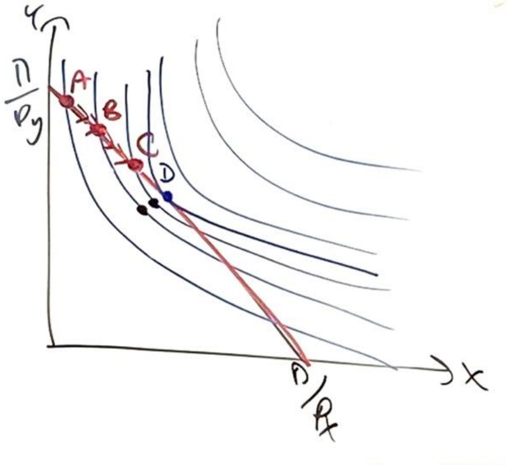
STEP 3: CHOICE

Eg.

- Step 1→ A, B, C, D, E→ ranking C, B, D, A, E
- Step 2→ budget constraint→ B, A, E
- Step 3→ choice→ B is the choice, preferred bundle among the affordable ones

GRAPHICAL REPRESENTETION OF CHOICE

- For the more is better principle (X*, Y*) belongs to the budget line (it costs M)
- Consumers will pick a bundle on a high indifference curve
- **<u>We need the indifference curve that is tangent to the budget line</u>**



D is the choice: it is the bundle where the budget line is tangent to an indifference curve

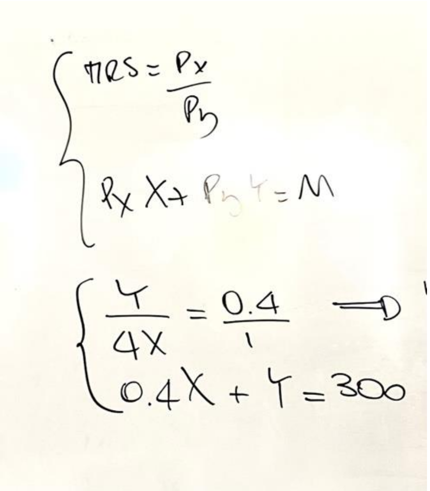
MATHEMATICAL REPRESENTATION (for convex curves)

Find (X, Y) that maximizes U(X, Y) given that we have a budget constraint.
Max (X, Y) U(X, Y)

- 1st condition: slope of budget line and indifference curve have to be equal→ -Px/Py=-MRS→Px/Py=MRS
- 2nd condition: Budget line: PxX+PyY=M

EG:
U(X, Y)= XY^4 (cobb douglas→ convex)
M= 300

Px=0.4
Py=1
(X*, Y*)



MRS= aY/bX= 1/4 Y/X (a and b powers)

Mux/Px=MUy/Py

- How much every euro I put in x will contribute on the utility Mux
- How much every euro I put in y will contribute on the utility MUy
- At the optimal point it is indifferent If you put one euro in x or y→ it wil change by the same amount
- MRS>Px/Py→ Mux/Px>MUy/Py→ x increases, y decrease
- MRS<Px/Py→ Mux/Px<MUy/Py→x decreases, y increases

STEP 4: DEMAND CURVE FOR GOOD X

Demand function tells ,e how many units of x the consumer will buy for every PX holding fixed the other factors thar influenced the demand

- We need to change Px, holding fixed Py and M
- Negative slope

Mathematically

- Two conditions for the optimal point, fixing income and price of y→ only price of x is the term unknown

X*=f(Px)→ demand function for x
Y*=f(Px)
Possible outcomes

- Y and X substitutes: eg→ Y=10Px
- Y and X complementary: eg→ = 10/Px
- Y and X not related→ eg: y constant Y=40

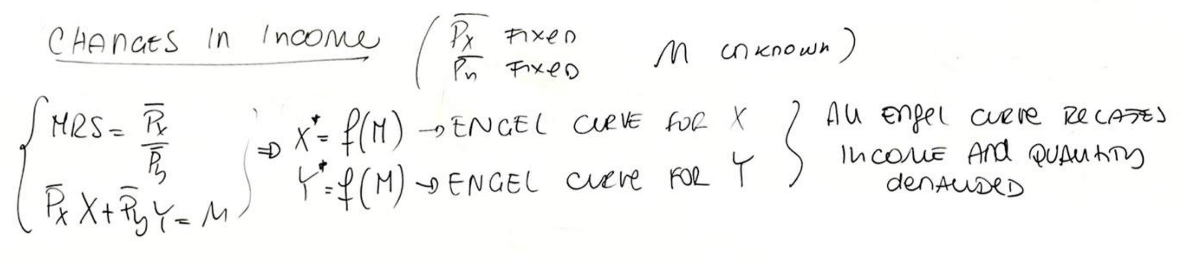
Consequences: Px increases→X decreases

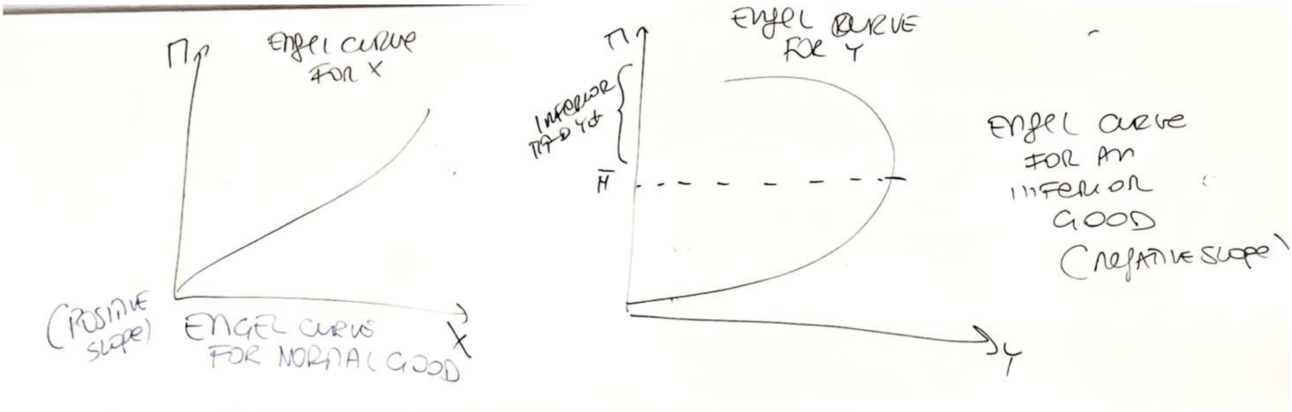
Some luxury goods and Giffen goods (super inferior)→ Px increases→ X increases

LECTURE 9

CHANGES IN INCOME

- We fix Px and Py→ M unknown





Two goods cannot be inferior goods at the same time→ doesn't make sense because less than you budget lime

- Preferences are given
- Px and Py (they come frome equilibrium)
- M
  - Work
  - Lendings and borrowing
  - Inheritance (initial endowment)←given

SUPPLY OF LABOR

Tells for every wage how many a worker is willing to work

1st. Demand for leisure time→ labor supply

A. **Preferences: convex** (cobb douglas)
   a. X: leisure time (N)
   b. Y: consumption good (C)
   c. X and Y normal goods
   d. T: total number of hours (per day, excluding sleep) you can spend on leisure time or working
   e. L: labor time

B. **Budget constraint**
   a. Pc= 1 : price of C
   b. W: price of N (time is money) (W= salary)
   c. E: initial endowment

PcC= E+WL (L=T-N)
PcC=E+W(T-N)

LECTURE 10

C. Choice

$$\begin{cases} MRS = \frac{W}{P_c} \\ PcC = E + W(T-N) \end{cases}$$ **→ (N*,C*)→ L*=T-N***

II case→ not possible because not enough T available→ the best he can do is to move back to another indifference curve and in practice he shouldn't work

New optimal bundle: N*=T, C*=E/Pc

DEMAND FUNCTION FOR N AND SUPPLY OF L

- Pc fixed
- E fixed
- T fixed
- W unknown

$$\begin{cases} MRS = \frac{W}{Pc} \\ PcC + WN = WT + E \end{cases}$$

N*=f(W)→ demand function for leisure time
L*= T-N= T-f(W)→ labor supply function

With consumption goods
Px up→ purchasing power (income) decreases: X down
X more expensive→ x down

Worker
A.Purchasing power increases → N up
B.N is more expensive→N down
For W<W fixed: B>A
W>W fixed: A>B

INTERTEMPORAL CONSUMPTION

Preferences for the Timing of Consumption

- Consider a consumer who cares about two goods: food this year and food next year
- 2 periods t_0 and t_1 ➢2 goods c_0 and c_1 ➢2pricesp$_0$ andP$_1$
- 2 incomes M_0 and M_1
- Agents can borrow or lend money at the interest rate R

Consumption over more than 1 period→ Savings and borrowing

- PRINCIPAL: Amount of money a consumer borrow or lend
- INTEREST: Price of the loan
- INTEREST RATE: Interest/principal x 100
- M0: initial amount of money
- I (or r or R)
- M1= M0+M0i= M0(1+i)

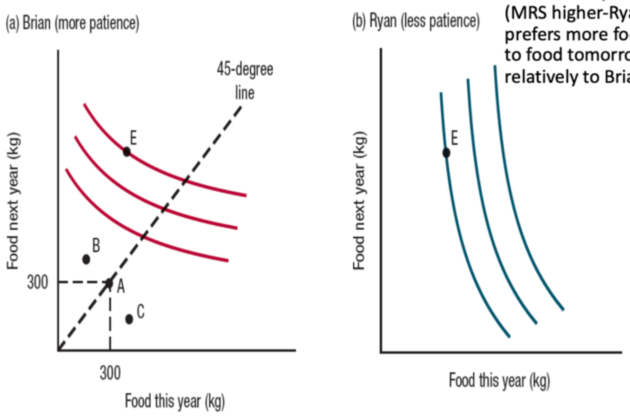
PDV of consumption stream = PDV of income stream

$$P_0C_0 + \frac{P_1C_1}{1+R} = M_0 + \frac{M_1}{1+R}$$

.

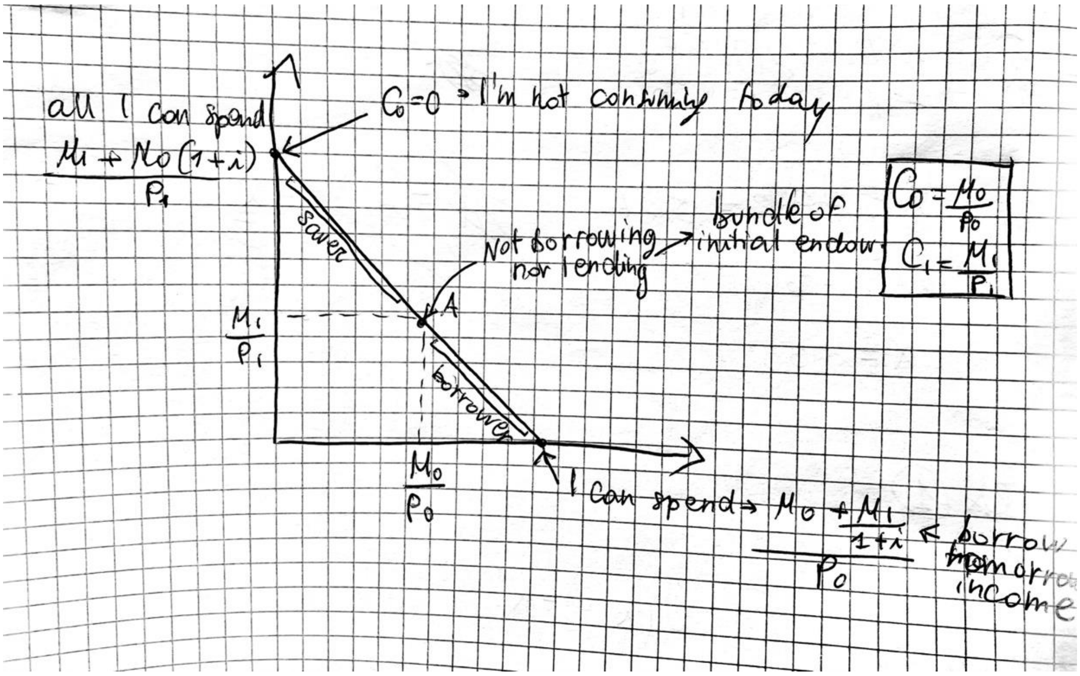
Preferences for the Timing of Consumption

➢Steeper indifference curves: less patience (MRS higher-Ryan prefers more food today to food tomorrow relatively to Brian)



➢The slope of the budget is equal to the (negative) ratio of the goods' prices. P_0 is the price of the good this year and $P_1/(1+R)$ *the* price of the good next year (from today's perspective).

$$Slope\ Of\ Budget\ Line = -\frac{P_0}{P_1/(1+R)} = -(1+R)(\frac{P_0}{P_1})$$



If C0<M0/P0→saver
If C0>M0/P0→borrower

MARKET SUPPLY CURVE=$\sum individual\ supply\ curve$

Individual supply curve: tells for every price how many units a firm is willing to sell, holding fixed all the other factors that influence the supply

GOAL→MAXIMIZE PROFITS

→A firm will choose how many units to sell, given a certain price, in order to maximize profits

PROFIT FUNCTION (specifies forever Qi what are the associated profits

$$\Pi i(Qi)(profits) = total\ revenues\ [(TR) = PQi] - total\ costs[TC(Qi)]$$

1.construct function of total costs

- Associate to every quantity the costs of that product→how much does it cost to produce a certain amount of units
- Firstly, how many units of input (labor, resources, capital…) do we need to reach the output→production function
- Q=S, there are many ways to produce this Q:
  a. 1 worker+1 machinery
  b. 3 workers+0 machinery
  c. 0 workers+ 2 machinery

2.Pick the input combination that costs the less

3.Max Qi

$$\Pi i(Qi) = \bar{P}Qi - TC(Qi)$$

For given Pfixed

4.Repeat "3" for every price

1. PRODUCTION FUNCTION

- INPUTS: Resources to produce a good→labor (L) and capital (K)
- OUTPUT: good the firm produces (Q) (1 only output)
- $Q = F(L, K)$: it associates to every input combination (L,K) an output (it depends on technology level of the firm)

LECTURE 12

➢**Variable input**: can be adjusted over the time period being considered
➢**Fixed input**: cannot be adjusted over the time period being considered

- **Short run**: a period of time over which one or more inputs is fixed
- **Long run**: a period of time over which all inputs are variable
    - Length of long run depends on the production process being considered:

Average product with two inputs

➢To define Average Product of any one input, we hold all other inputs fixed

AP_L =Q/L=F(L,K)/L

AP_K = Q/K=F(L,K)/K

➢Example Q=KL
➢AP_L=KL/L=K for a given K
➢AP_K=KL/K=L for a given L

Marginal product with two inputs

➢To define Marginal Product of any one input, we hold all other inputs fixed

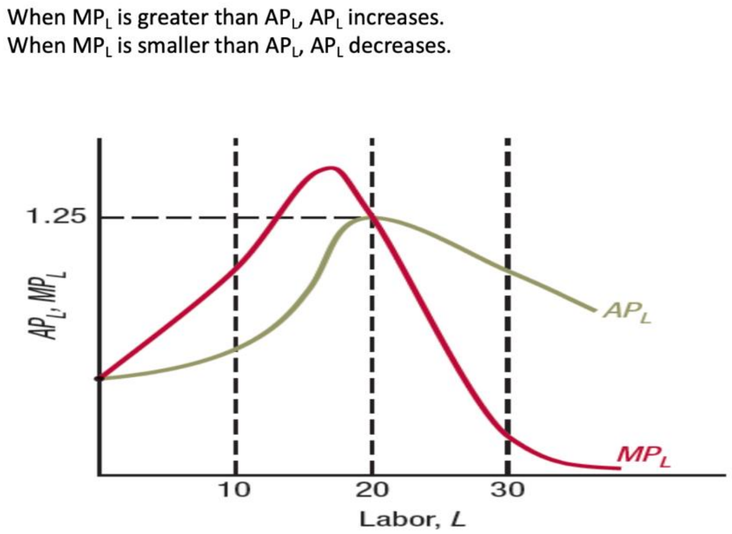
➢MP captures the additional output we can get for each additional unit of input when we increase the input by the smallest possible amount, holding the other fixed.

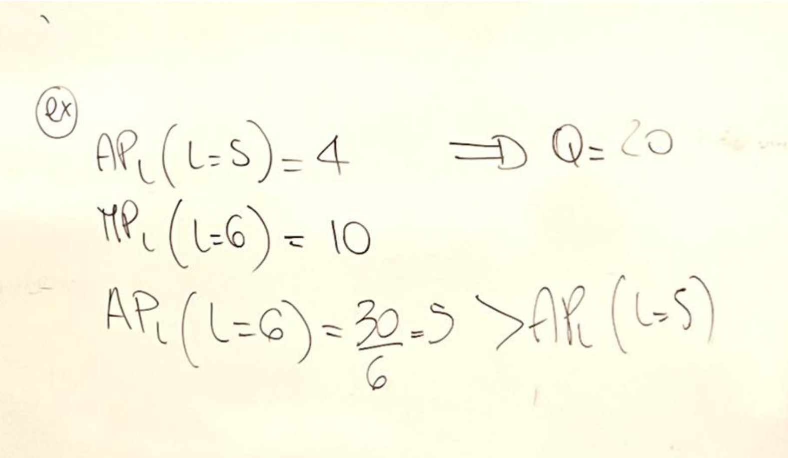
$$MP_L = \frac{\Delta Q}{\Delta L} = \frac{F(L,K) - F(L-\Delta L, K)}{\Delta L}$$
$$or$$
$$MP_L = \partial Q / \partial L$$

$$MP_K = \frac{\Delta Q}{\Delta K} = \frac{F(L,K) - F(L, K-\Delta K)}{\Delta K}$$
$$or$$
$$MP_K = \partial Q / \partial K$$

➢Example Q=KL
➢MP_L=dKL/dL=K for a given K
➢MP_K=dKL/dK=L for a given L

Average product and marginal product





Cioè se ho 5 lavoratori che producono mediamente 4 (e dunque avrò quantità 20), e poi aggiungo un lavoratore (quindi L=6) che produce da SOLO 10→ la mia average aumenterà →(APL precedente+produttività del nuovo lavoratore (20+10) diviso il nuovo numero di lavoratori

Productive Inputs Principle

➢**Assumption 1:** Firm can freely dispose of any unwanted inputs

> ➢ production company cannot produce less output when the amount of any input is increased

➢**(A2) Productive Inputs Principle**: We assume that increasing the amounts of all inputs strictly increases the amount of output the firm can produce (if I hire a worker and he starts to destroy things, I tell him to stay home

Law of diminishing marginal returns

➢**(A3)Law of Diminishing Returns**:

Holding other inputs fixed, MP of an input will eventually decline as more of that input is used

Isoquants

➢**Isoquant**: set of all the input combinations (L,K) a firm can use to efficiently produce the same amount of output

➢For Q=KL: (L=1,K=2) and (L=2, K=1) are on the same isoquant

➢**Family of isoquants**: consists of the isoquants corresponding to all possible output levels

- Isoquants are thin
- Isoquants do not slope upward
- Isoquants for the same technology do not cross

Substitution Between Inputs

- Rate at which one input can be substituted for another is an important factor for firms in choosing best mix of inputs
- Shape of isoquant captures information about inputs' substitution
- ***Marginal Rate of Technical Substitution for input X with input Y (***MRTSLK)***:*** the rate at which a firm must replace units of *X* with units of *Y* to keep output unchanged, for a small change in X.
- MRTS is the absolute value of the slope of an isoquant in a given point

MRTS and Marginal Product
➢Note the similarity between MRTS and MRS for a consumer's preferences
➢Recall the relationship between MRS and marginal utility
➢Parallel relationship exists between MRTS and marginal product

$$MRTS_{LK} = \frac{MP_L}{MP_K}$$

The Cobb-Douglas Production Function

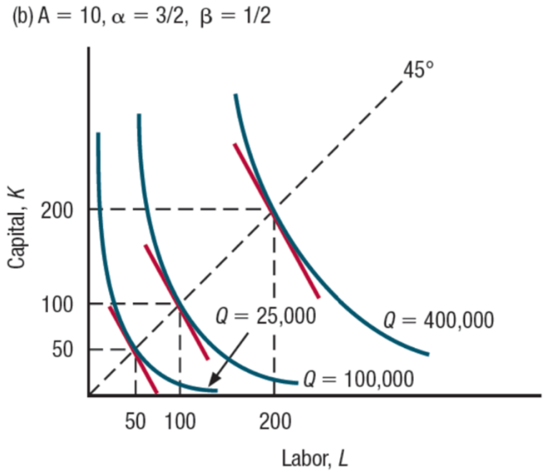
$$Q = F(L, K) = AL^{\alpha}K^{\beta}$$

Where a,b and A are specific parameters that measure a firm's productivity.

- Isoquant:

$$K = \left(\frac{Q}{AL^{\alpha}}\right)^{\frac{1}{\beta}}$$

$$MRTS_{LK} = \left(\frac{\alpha}{\beta}\right)\left(\frac{K}{L}\right)$$



Returns to Scale

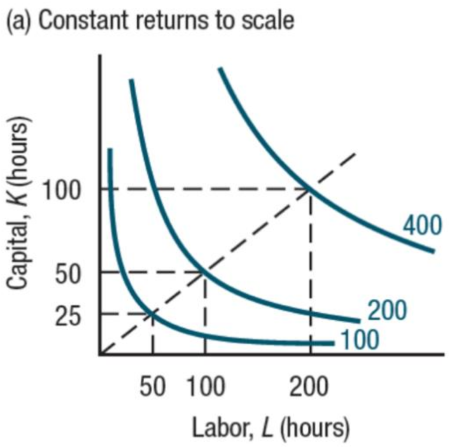
➢Some markets are served by many small companies, small by few very large ones
➢E.g. drugstores, flower shops
➢E.g. airplane manufacturing, pharmaceuticals
➢Economists use the concept of returns to scale to judge if larger producers produce more effectively than smaller ones, or vice versa
➢What would happen to output if the firm increased the amounts of all its inputs by the same proportion?

Based on what happens to output if the firm increased the amounts of all its inputs by the same proportion, a firm can have:

➢**Constant returns to scale**

A proportional change in all inputs produces the same proportional change in output

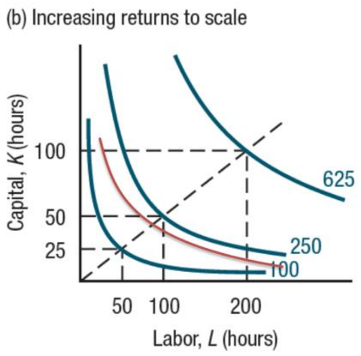
- If the firm doubles K and L, it will double its output Q=F(K, L)



➢**Increasing returns to scale**

A proportional change in all inputs produces a more than proportional change in output

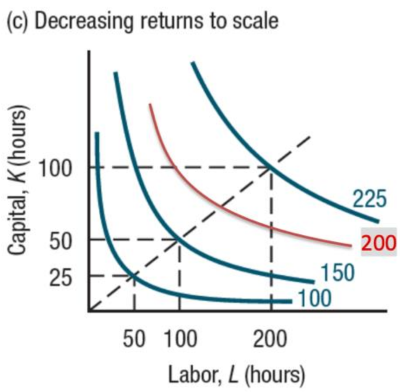
- If the firm doubles K and L, it will more than double its output Q=F(K,L)
- Red isoquant at Q=200, closer to the isoquant Q=100 than in constant returns to scale



➢**Decreasing returns to scale**

A proportional change in all inputs produces a less than proportional change in output

- If the firm doubles K and L, it will less than double its output F(K, L)
- Red isoquant at Q=200, farther from the isoquant Q=100 than in constant returns to scale



TO SEE WHICH RETURN TO SCALE IS, COMPARE F(2K,2L) WITH 2F(L,K)

➢**If F(2K,2L)=2F(K,L), then CRS**

➢When you double the inputs, output is doubled

➢**If F(2K,2L)>2F(K,L), then IRS**

➢When you double the inputs, output is more than doubled

➢**If F(2K,2L)<2F(K,L), then DRS**

➢When you double the inputs, output is less than doubled

Reasons for Increasing and Decreasing returns

➢Factors for increasing returns: ➢Specialization of tasks as scale increases
➢Factors for decreasing returns: ➢Limited managerial capacity

LECTURE 13

COST FUNCTION

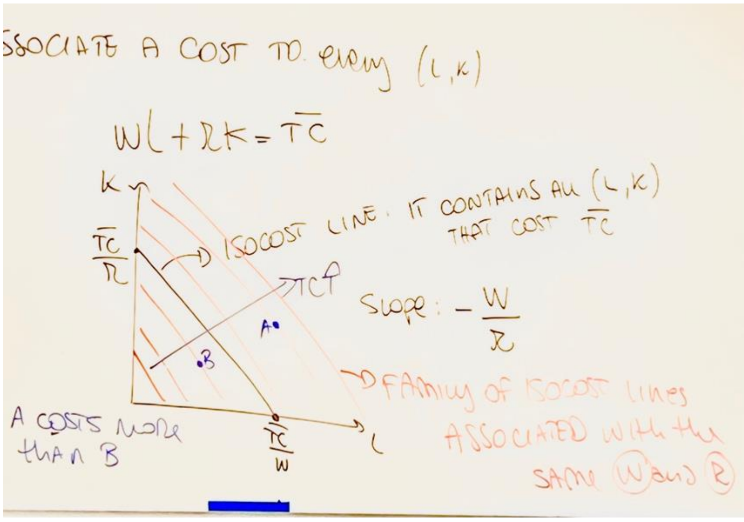
- w→ cost of labor
- r→cost of capital (K)
- (L, K)→wL+rK

1. Q fixed→for every (L, K) on the isoquant Qfixed compute the cost wL+rK
   a. Take (L, K) that cost less: min wL+rK, given Qfixed→(L*, K*)
   b. TC(Qfixed)=wL*+rK*
2. TC(Q) for every Q→min(L,K) wL+rK, for every Q→
   a. L*(Q)
   b. K*(Q)→
   c. TC(Q)=wL*(Q)+rK*(Q)

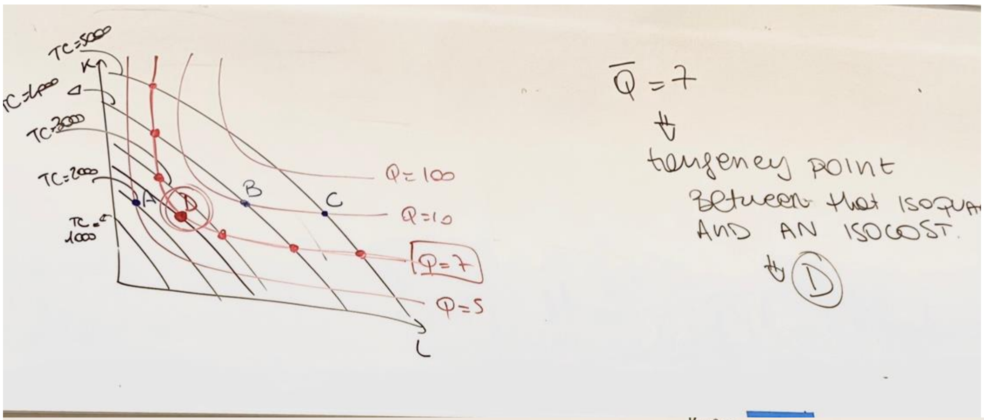
I. SHORT RUN (K Fixed)
   a. F(L)=Qfixed→L=f^-1(Qfixed)
   b. TC(Qfixed)=wf^-1(Qfixed)+rKfixed
   c. Eg
      i. Q=4L^2
      ii. W=15
      iii. R=25
      iv. Kfixed=4
      v. TC(Qfixed=1)
      vi. L=?
      vii. 1=4L^2→L=1/2

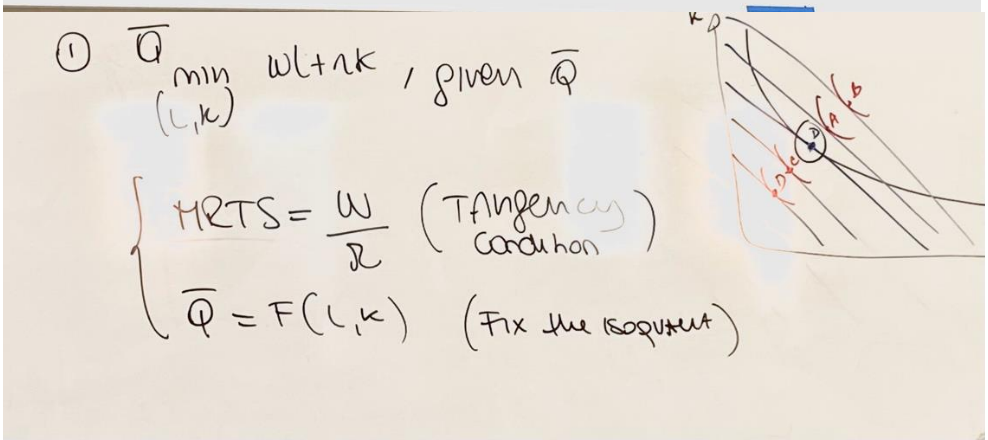
II. SHORT RUN TC(Q) for every Q
   a. F(L)=Q
      L=f^-1(Q)
   b. TC(Q)=wf^-1(Q)+rKfixed

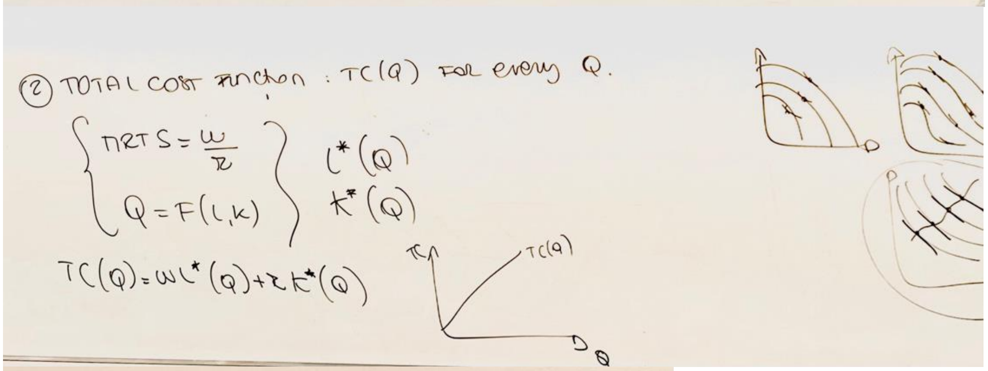
III. LONG RUN
   a. Associate a cost to every (L, K)
   b. wL+rK=TCfixed
   c. ISOCOST (like budget line): it contains all (L, K) that cost TCfixed
   d. Slope=-W/r

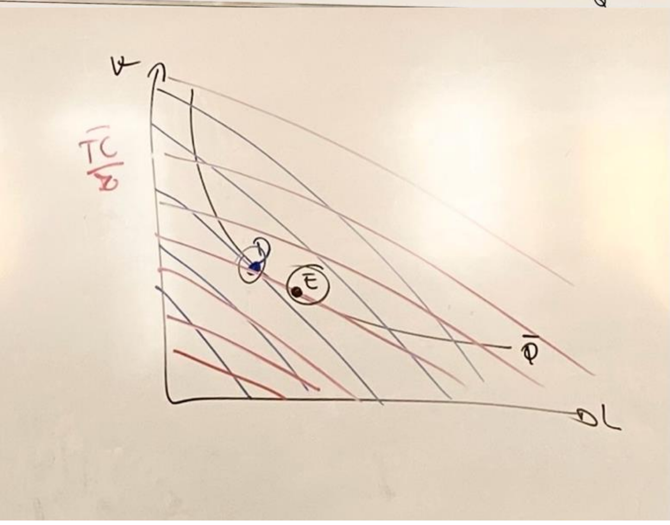


THE OPTIMAL POINT D IS THE TANGENCY POINT BETWEEN THE ISOQUANT AND AN ISOCOST

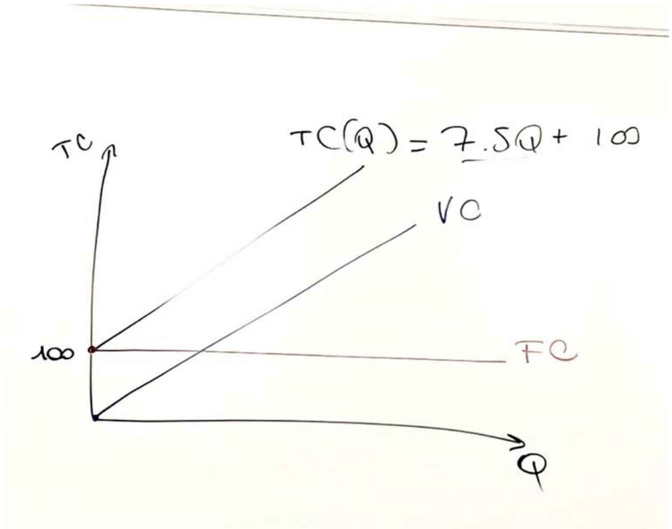








LECTURE 14

- TC(Q) short run (K fixed)
  - TC(Q)= VC(Q) (variable cost, associated with variable inputs)+FC (fixed cost, assoc. with fixed input)
    - VC(Q all costs that depend on Q
    - FC: constant term
    - 

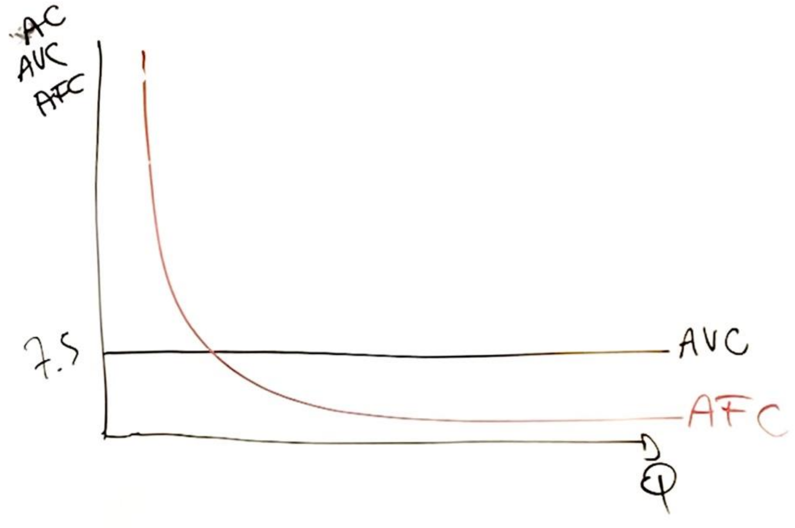
- TC(Q) long run (K variable)
  - TC(Q)=VC(Q)

AVERAGE COST (AC(Q)): how much does it cost on average every unit the firm produces

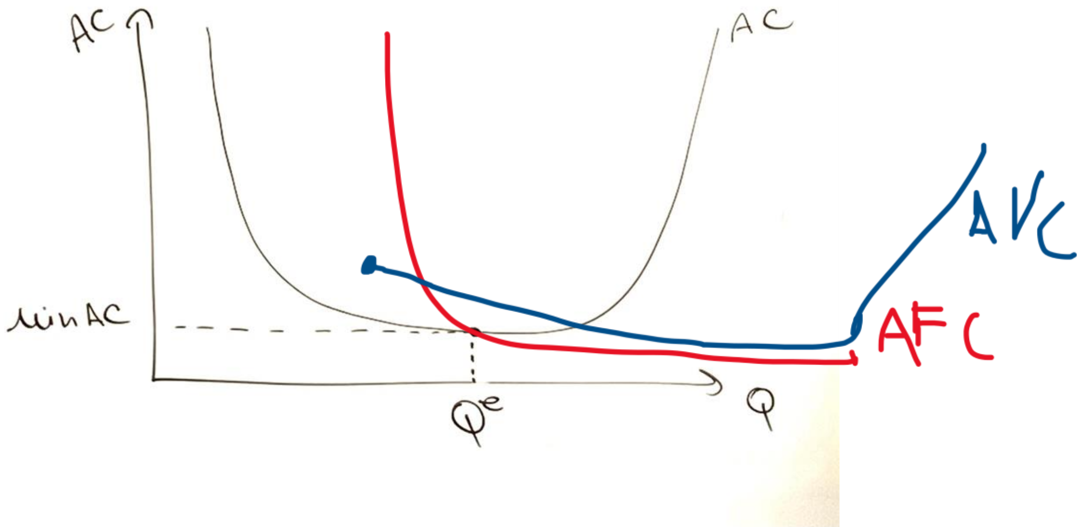
$$AC(Q) = \frac{TC(Q)}{Q} = AVC + AFC$$

AVC = Average variable cost: $\frac{VC(Q)}{Q}$

AFC = Average fixed cost: $\frac{FC}{Q}$



Q^e→efficient scale of production (the Q at which AC is at its minimum)



AC=AVC+AFC

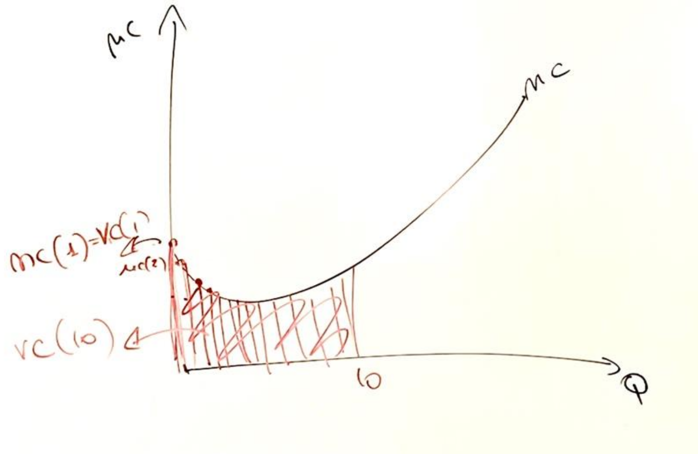
AC goes down→AFC goes down
AC goes up→MPL goes down

MARGINAL COST (MC(Q)): tells by how much TC increases when we increase Q by 1 u

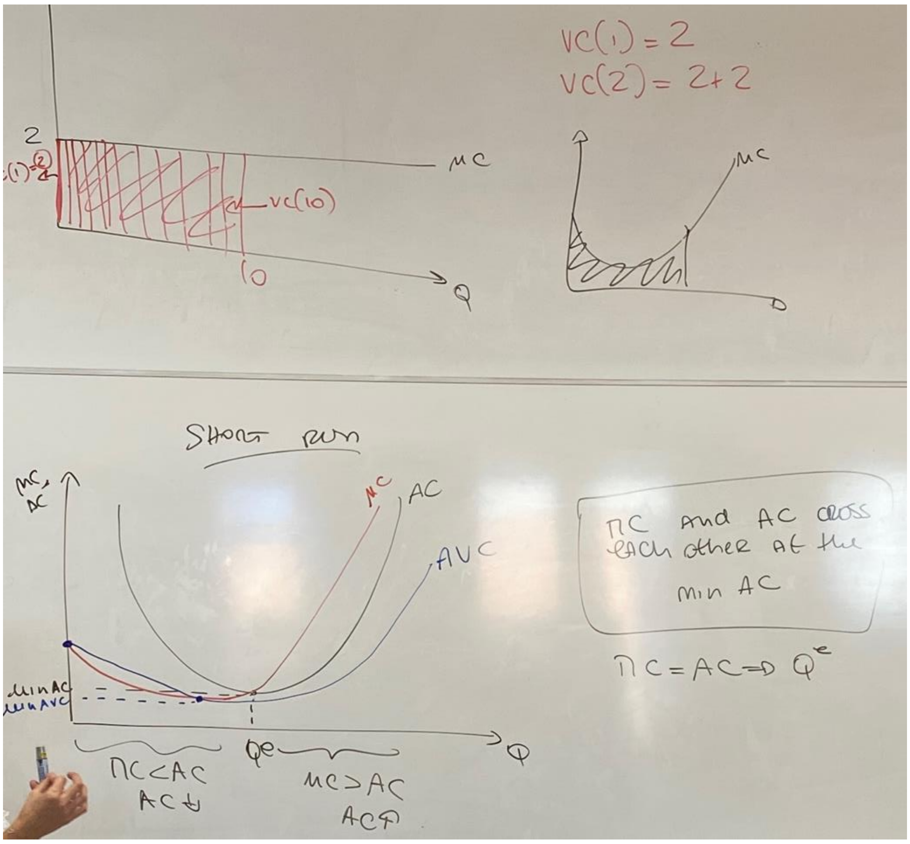
$$MC = \frac{\partial TC}{\partial Q}$$

(ex) $TC(Q) = Q^3 + Q + 2$
$MC(Q) = 3Q^2 + 1$
→ MARGINAL COST DOES NOT depend ON FC: $MC = \frac{\partial VC}{\partial Q}$

(ex) $TC(Q) = Q^2 + Q$
$MC(Q) = 2Q + 1$



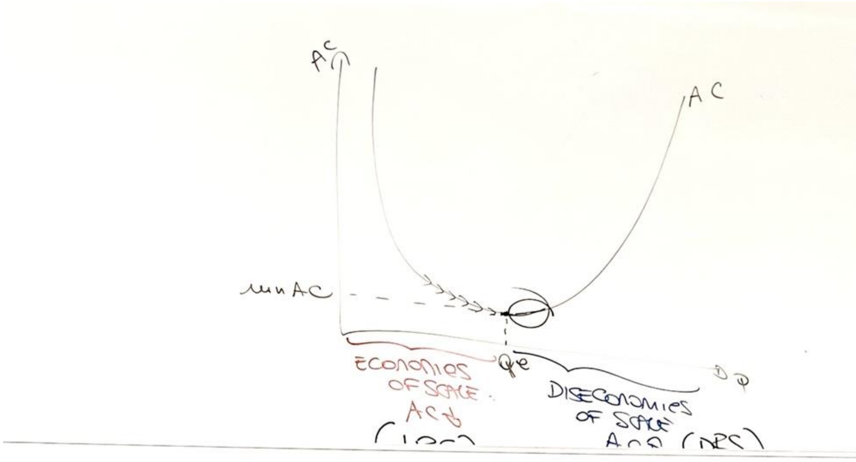
VC(2)= VC(1)+MC(2)
MC(2)= VC(2)-VC(1)
If Q discrete
MC(Q)= VC(Q)-VC(Q-1)→TC(Q)-TC(Q-1)ff

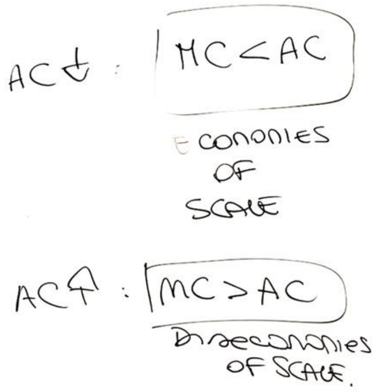


THE MC CROSSES THE AVC AT the min AVC AND CROSSES the AC at the min AC
MANCA QUALCOSA

ECONOMIES AND DISECONOMIES OF SCALE

- Economies of scale: if when Q increseas, AC(Q) decreseas
  - ie. If Q2>Q1→AC(Q2)<AC(Q1)
- Diseconomies of scale: if when Q increseas, AC(Q) increseas
  - ie. If Q2>Q1→AC(Q2)>AC(Q1)





SUPPLY CURVE:

- MAX Pi Greco(Qi) for given P fixed→Qi
- MAX PiGreco(Qi) for every price→Qi(P)
- PigrecoiQi=Tr-Tc

LECTURE 15

TO MAXIMIZE PROFITS→ MR=MC

Perfect competition:

- Assumption: consumers and firms are price takers. Since a firm is small relative to the market→ if it changes the quantity that it offers, this will not affect the Market Price
- Pi Greco=PQ-Pi Greco (Q)
- In perfect competition, from the point of view of single firm→D is horizontal
- D is negatively sloped
- If firm P up→D=0
- If firm P down→D>Q fixed
- $\Pi = P_{market} \cdot Q - TC(Q)$
- Max MR=MC→MR=P(derivative→in perfect competition.

1. Optimality→Pfixed=MC
2. $\Pi(Q^*) \geq \Pi(0)$
3. $\Pi(Q*)$ =(Q*)
2. Mancano cose

SUPPLY CURVE (for every price)

1. P=MC→Q*(P)
2. P≥min AVC

Short run: p=mc if p≥minAVC
Long run: p=mc if p≥minAC
LAW OF SUPPLY
If price increases the firm doesn't offer less units than before

LECTURE 16

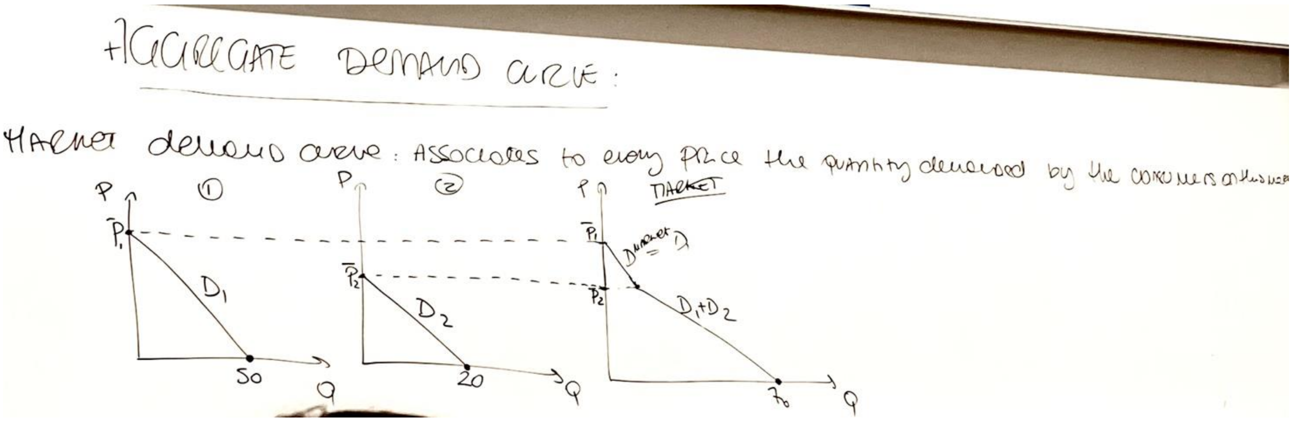
1. Aggregate demand and supply→Market D, Market S
2. Competitive equilibrium: D=S (→short run, long run)
3. Social Welfare

In perfectly competitive markets firms and consumers are <u>price-takers</u>

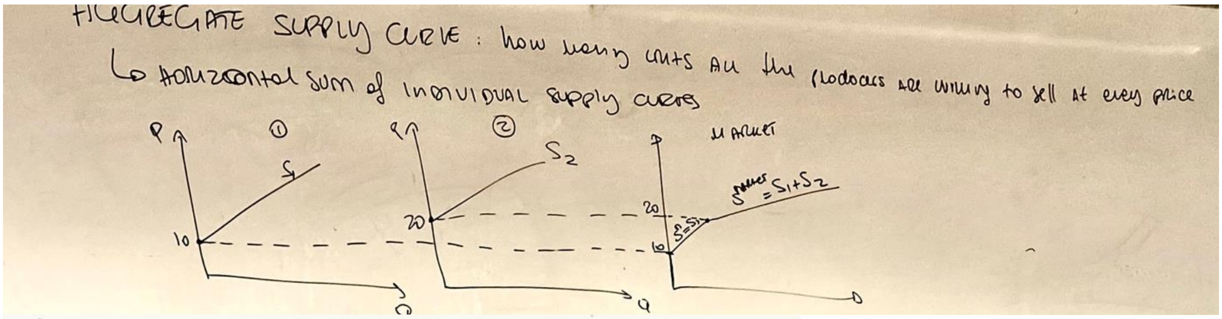
1. No transaction costs: no cost in switching from one producer to another, both in terms of real costs and time spent checking prices (in reality it's impossible to have 0 transaction costs)
2. Homogeneous goods: goods exchanged on this market must be identical
3. There are (infinitely) many producers and consumers→ quantity provided by a firm is small compared to the quantity of the market

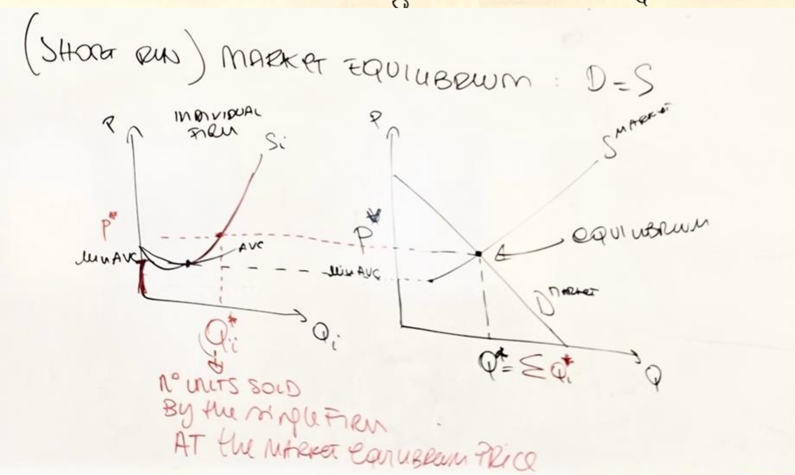
→in reality there are no perfect competitive markets, only highly competitive markets that behave similarly to the perfectly ones (eg: commodities)→ perfectly comp. equilibrium is a benchmark for efficiency (→to justify market intervention on non competitive markets)

AGGREGATE DEMAND CURVE



AGGREGATE SUPPLY CRUVE





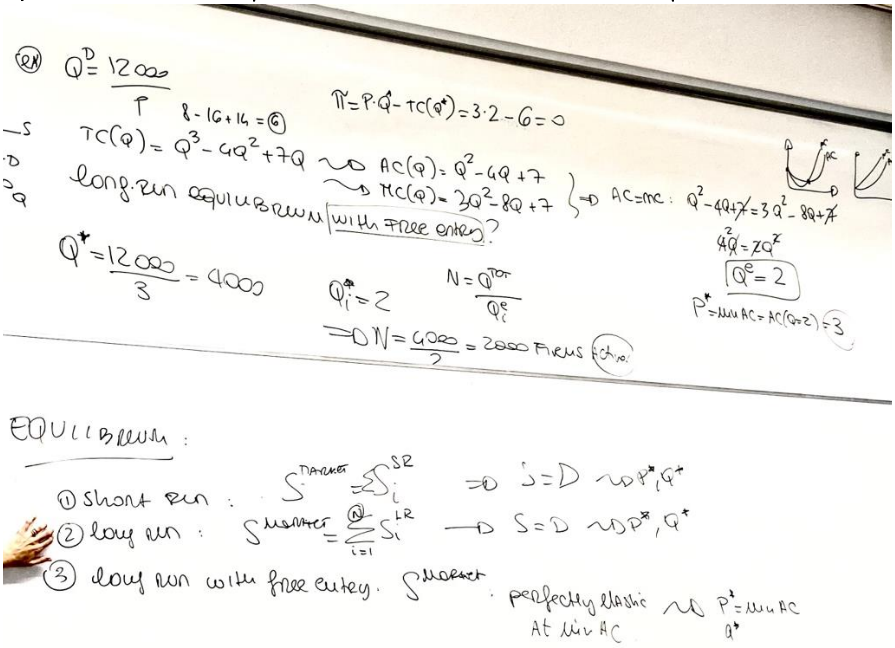
EQUILIBRIUM IN THE LONG RUN:

1. a. In long run MC lr different than MC sr→supply curves are different in the long and short run
   b. Si in short run starts at min AVC; Si in long run shorts at min AC
2. a. In the short run the number of firms is the one of Active firms in the market
   b. In the long run we tale the number of POTENTIAL FIRMS ON MARKET

If we assume free entry: everyone can potentially enter this market because there are not high initial investment

Long-run equilibrium with free entry (very long run): with free entry, the supply curve is horizontal at the level of AVC_{min}. Free entry has **3 implications** for the equilibrium:

1) the equilibrium price equals the minimum average cost: $P^{eq} = AVC_{min}$
2) firms earn zero profit: $\pi_i = 0$
3) each active firm produces at its efficient scale of production MC = AC

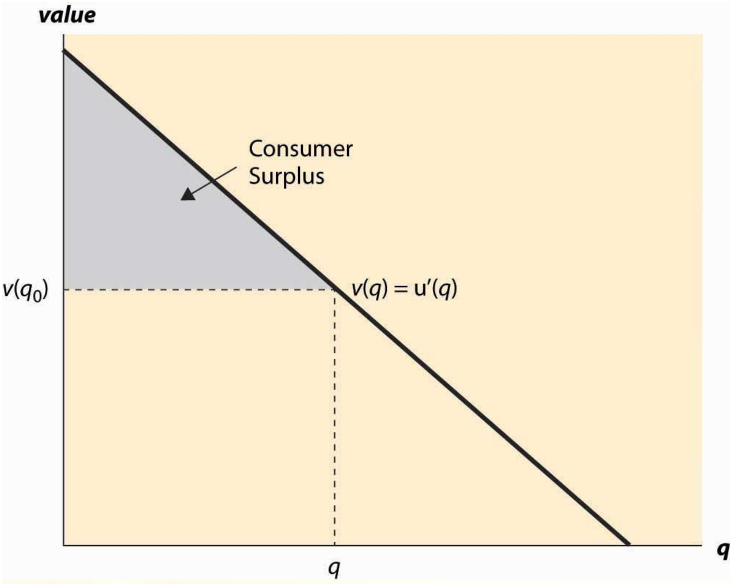


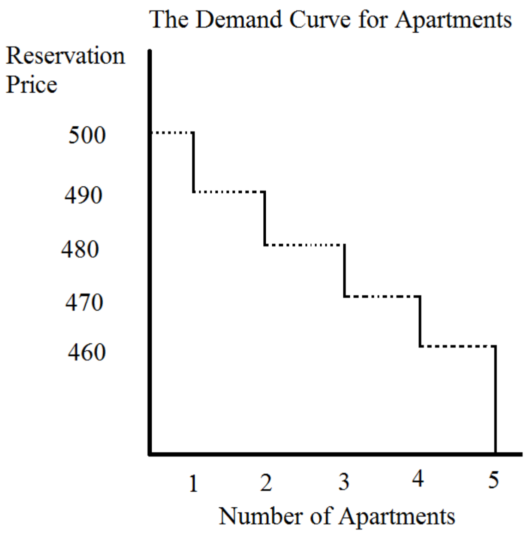
LECTURE 17

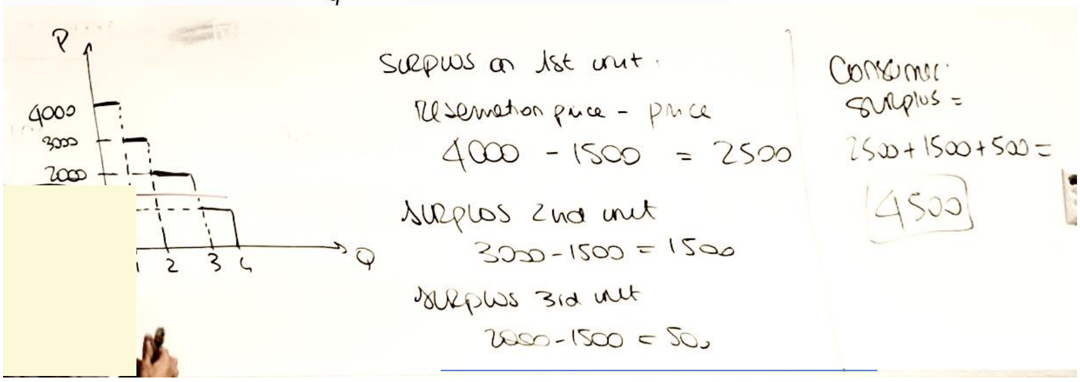
SOCIAL WELFARE: well being of the agents on Q markets

- Consumers + producers welfare
- Consumes + producers + government welfare if there is a policy in act
- CONSUMER'S WELFARE: well being of the consumer from participating to a market→measured with consumer surplus : it is a measure of consumer well being in MONETARY TERMS
- CONSUMER SURPLUS: net benefit from buying a good on the market→sum of net benefit of each unit bought
- NET BENEFIT OF A UNIT=Benefit (see demand) + cost (price) of this unit

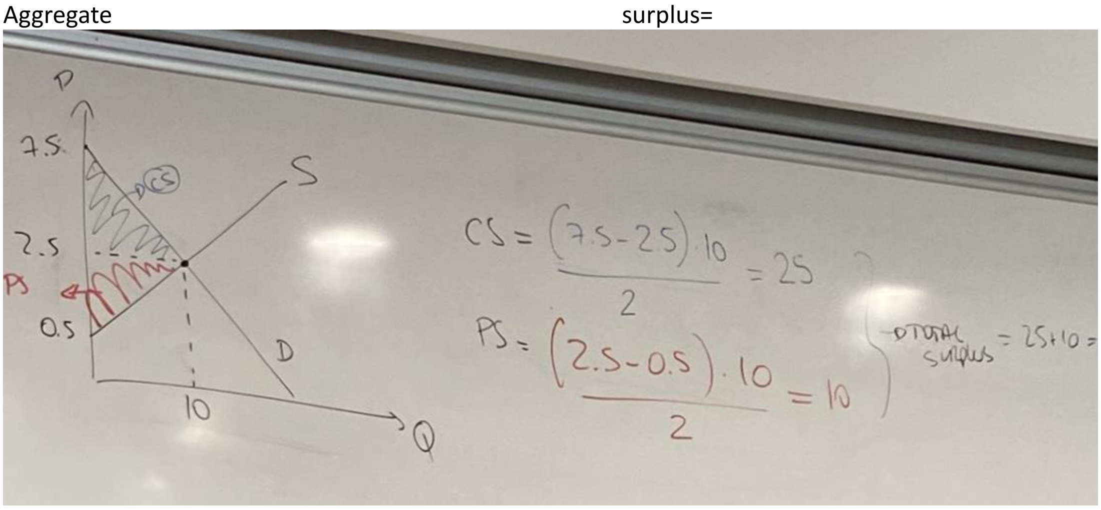
- Benefit: reservation price: maximum willingness to pay for that unity (a point on the demand curve)

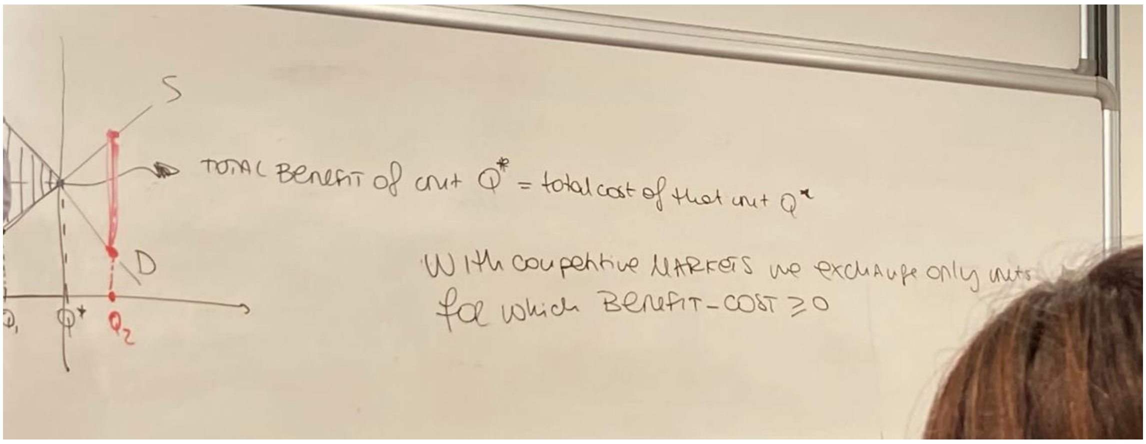






Consumer surplus = (½) x Qd x ΔP (P fixed- P market)
PRODUCER'S SURPLUS: measure of producer's well being in monetary terms from participating to that market
PRODUCER SURPLUS= TOTAL REVENUES – VARIABLE COSTS
Consumer surplus = (½) x Qd x ΔP (P market- P fixed)
AGGREGATE SURPLUS: measure of total welfare on a market. It is the sum of the surplus of all agents on the market
Aggregate surplus= CS+PS





EFFICIENCY→Pareto (efficiency): an equilibrium is pareto efficient if there is no way to make someone better off without making someone else worse off→ you cannot increase total welfare

An efficient equilibrium maximizes total welfare
Equilibrium is efficient only if Q*competitive market) units are exchanged
DEADWEIGHT LOSS: by how much total surplus is smaller than the maximum one

LECTURE 1 2ND PART OF SEMESTER

Government intervention

Why?

- Equity (up)
- Raise funds to cover public expenditure
- Penalize certain markets (decrease quantity exchanged)
- Incentivize some markets (increase quantity exchanged)

How?

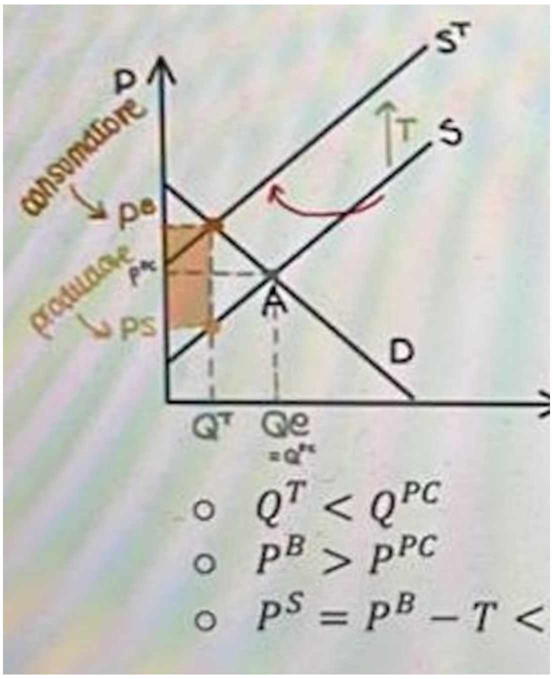
- Taxes
- Subsidies

Tax

- Change equilibrium (P and Q)
- Inefficiency (decreased efficiency)

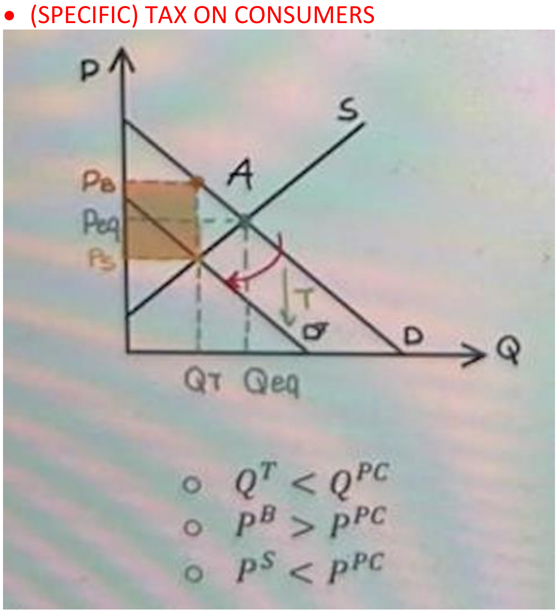
Specific tax (T): a constant tax on each unit exchanged on the market (sold or bought) -> ex. T=5 euro per unit emitted (variable cost)

- Increase in variable cost
- (SPECIFIC) TAX ON PRODUCERS



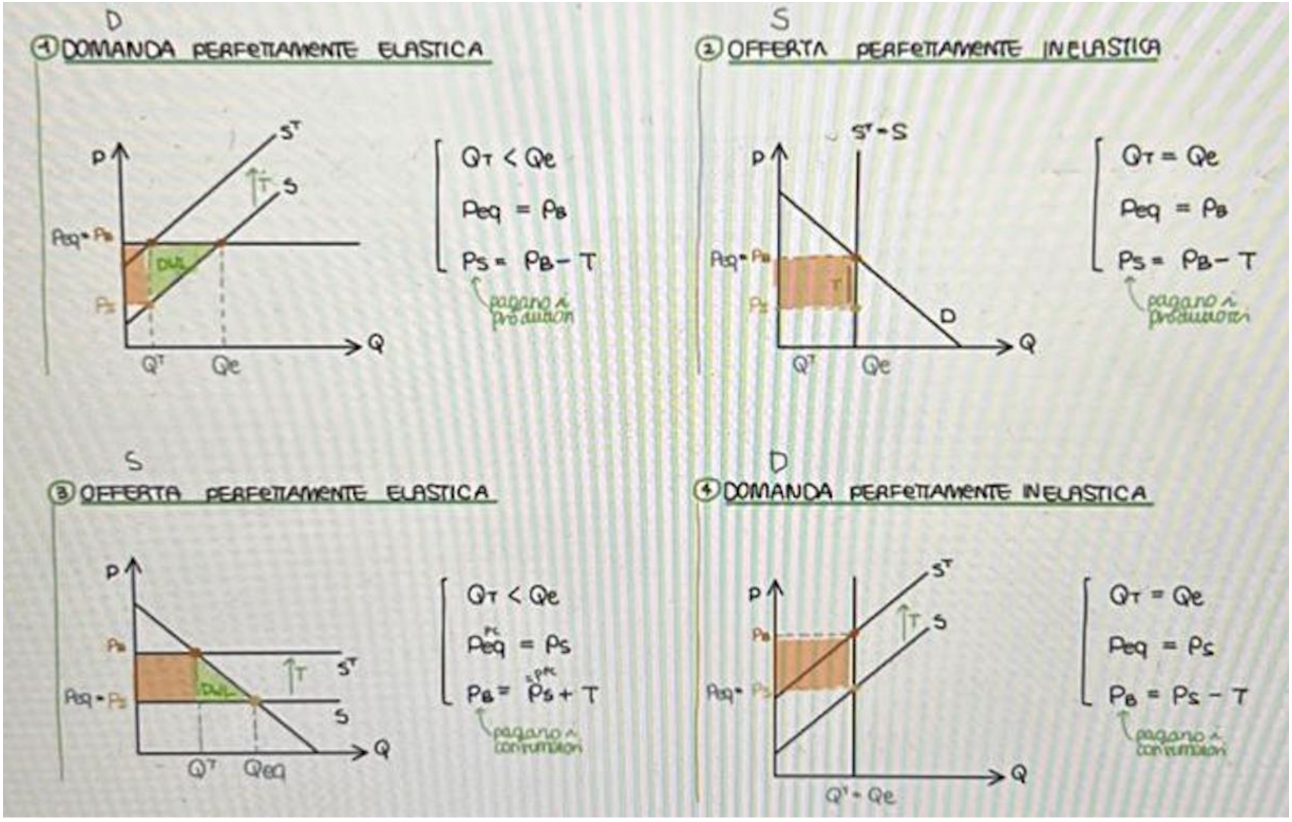
- A= equilibrium without tax
- Left shift in supply curve = T (tax) → <u>new equilibrium</u>: quantity decreases, price (that buyers pay) increases, price
- for sellers (Ps = Pb - T) (marginal revenue) is smaller than initial price
- Even if T tax is on producers, effect also on consumers (meaning they pay part of tax)
- Government revenues: T x Q^T

- (SPECIFIC) TAX ON CONSUMERS



- A= initial equilibrium
- Size of shift = T -> left shift -> consumer will want to buy less
- New equilibrium quantity decreases, price decreases
- (consumer gets) -> buyers will get higher price (Pb = Ps +T)
- Again, effect of tax on consumers but also part of tax paid by producers
- Government revenues: T x Q^T

- Independently of who is taxed, we get the same equilibrium, where T is paid both by consumers and producers
- **How do we know how the tax is split?** Elasticity of D and S (less elastics pay more)
  - S perfectly elastic, D negatively sloped→consumers D will pay
  - S positive sloped, D perfectly elastic→ consumer D will pay
  - S perfectly inelastic, D negatively sloped→producers S will pay
  - S positively sloped, D perfectly inelastic →producers S will pay
- Graphically starting always taxing the consumers
-



Pb=price buyers pay Ps=price sellers pay
*if we tax producers and consumers we get same result

- Profits will decrease based on Q and P
  - if Q doesn't change then reduction will be equal to government revenues (all profits lost become government profit)
  - otherwise it will depend both on quantity and price = creating deadweight loss (thus surplus that is not created)
- when D is more inelastic than S, the tax is mainly paid by consumers (for S perf. Elastic and D perf inelastic)
- when S is more inelastic than D, the tax is mainly aid by producers (for D perf elastic and S perf inelastic)

incident of tax on consumers: percentage of tax that is paid by consumers→ <u>depend only on relative elasticity</u>

- Small tax: incidence on consumers =$\frac{E^S}{E^S - E^D}$
  - Elasticity of demand is negative, thus with minus in front becomes positive
  - If E^s = -E^d→$\frac{E^S}{E^S + E^S}$→$\frac{1}{2}$→50%

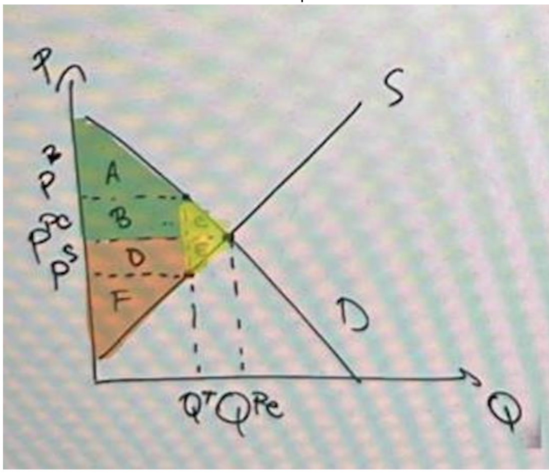
Ex

- Qd = 10 - P
- Qs = P
- T = 2 on producers
- Initial eq = 10 - P = P→P *= 5→ Q *= 5
- Adding tax= two prices
  - Qd = 10 - Pb
  - Qs = Ps
  - Ps = Pb – T→plug in second equation = Qs = Pb - T
  - $\begin{cases} Qd = 10 - P \\ Qs = Pb - T \end{cases}$
  - Pb=&, Ps=4, Qt=4
  - equally split tax of 2$ between sellers and buyers

Welfare

- Adding government revenues

- Total surplus will be PS+CS+G



	PC	TAX
CS	A+B+C	A
PS	D+E+F	F
GVT revenues	/	B+D
Total surplus	A+B+C+D+E+F	A+B+D+F
DWL		-C-E

CS ↑
PS ↓
>0

- The introduction of a tax creates inefficiency (more as tax increases)
  - Given by the fact that same units are not exchanged
  - DWL= QPC-QT
- The more inelastic supply is, the less dul will be created = improve efficiency→actually reduce equity bes tax paid mainly on inelastic side on market (consumers)
- You cannot have both equity and efficiency

LECTURE 2.2

NON COMPETITIVE MARKET

- MONOPOLY:
  - 1 producer
  - Many consumers
- OLIGOPOLY:
  - Few Firms
  - Many consumers

Profit function

1. Perfect competition: P given: firms do no not influence each other profits
2. Monopoly: the firm does not have competitors who could influence the market price
3. Oligopoly: profits of one firm are influenced by other firms quantity decision because this will influence P and thus the Profit.

GAME THEORY: studies those situations where agents gains/loses depend not only on their choices but also on those who are the agents→situation of strategic interaction

In econ, we use game theory when:

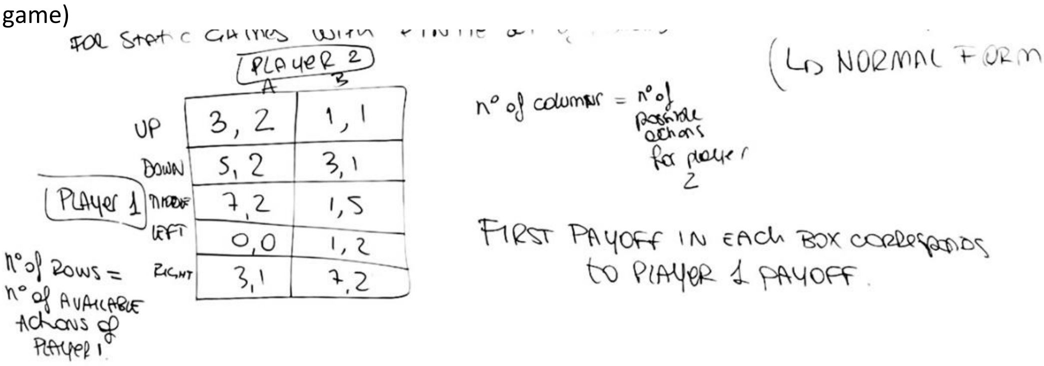
1. Utility of a consumer depends not only on his action but also on the opponent's action
2. Profits of a firm depend not only on the action chosen by that firm but also by other firms (Oligopoly)→ competition on quantities, competition of prices

STRATEGIC INTERACTION→Strategic thinking: an agent must reason on the opponent's actions before taking his decision

A Game is the representation of a situation of strategic interaction→

- STATIC GAMES: represent those situations in which every player must choose his actions without seeing the action taken by the opponents→Simultaneous moves game (rock-paper-scissors)
  - Rules:

1. Set of players: i=1,…N
2. Set of available actions: (finite or infinite set)
3. Payoffs for every possible outcome and for every player: how much every players gain in each possible outcome
   - For static games with finite set of actions: use a matrix to represent the game (→ normal form of the game)



   -
   - Assumption: each player knows each other's payoffs
   - Psychological traits are included in payoffs

1. Dominant actions→ we can say for sure what players will play
2. Dominated actions→we can say what players will not choose
3. Nash equilibrium→give us a prediction of the game
   - An action is a best response to an opponent's action if for that given action of the opponent, this action is the one that provides the player with the highest payoff

- DYNAMIC GAMES: represent those situations where players play one at the time and those playing second can see the history of previous actions (multiple stages games)
- SOLUTION in DOMINANT ACTIONS:
  - If every player has a dominant actions he will pick that action
  - If one player has a dominant action, he will choose that action. The second player (being rational and believing in the opponent's action) picks the best response to the opponent's dominant action

LECTURE 2.3

A dominant action is an action that is never a best response for every opponent's action, there is an action for this player that provides him a higher payoff→a rational player never chooses a dominated action→opponent, then, never chooses a best response to a dominated action

1. Find all the best responses
2. Find dominated actions

→the first player never take a BR to a BR to a dominated action

1. Inspect the game and delete dominated actions
2. Now we have smaller game, now the BR to DA become the new DA
3. In the even smaller game delete the newly DA
4. Stop when there are no new DA

NASH EQUILIBRIUM

Solution concept→ a NE is a pair of actions, one for each player, such that each action is a best response to action player by the opponent

Assumptions:

1. Every player correctly predicts the action played by the opponent
2. A player picks the best response to his correct belief on the opponent

NE IS STABLE: once the game is played and players see opponent's action, they don't want to change their action

PRISONER'S DILEMMA

Eg- for each player SQUEAL is dominant action. This is also the Nash equilibrium for the game

COORDINATION GAME: all those situations in which agents want to coordinate, but one agent prefers 1 outcome and the other prefers another outcome→ multiple equilibriums

ZERO SUM GAMES: opposite interests. NE play each action with probability 0.5

LECTURE 2.4

1. A dominant action is always played in a Nash equilibrium
2. A dominated action cannot be part of a Nash equilibrium
3. If there is a unique solution in dominant actions or with iterative deletion of dominated actions→this solution is a Nash equilibrium

NE predicts correctly reality when:

1. Repeated games→learning on how to play and how are opponents play→converge to NE
2. NE are the only Self enforcing agreement (does not need a signed contract)

STATIC GAME with INFINITE set of actions (oligopolies)

1. Best response function: tells what is the best action of a player, for every possible action of the opponent
2. NE: crossing of the best response function (solve system of equations)

FREE RIDING GAME:

Us(X, Y)=40(X+Y)-(X+Y)^2→

- PAYOFF X: 40(X+Y) – (X+Y)^2 -x^2/2
- PAYOFF Y: 40(X+Y) – (X+Y)^2 -Y^2/2

DYNAMIC (or sequential) games

With perfect information: every player chooses his action sequentially, and those who play second see the history of the previous moves

RULES:

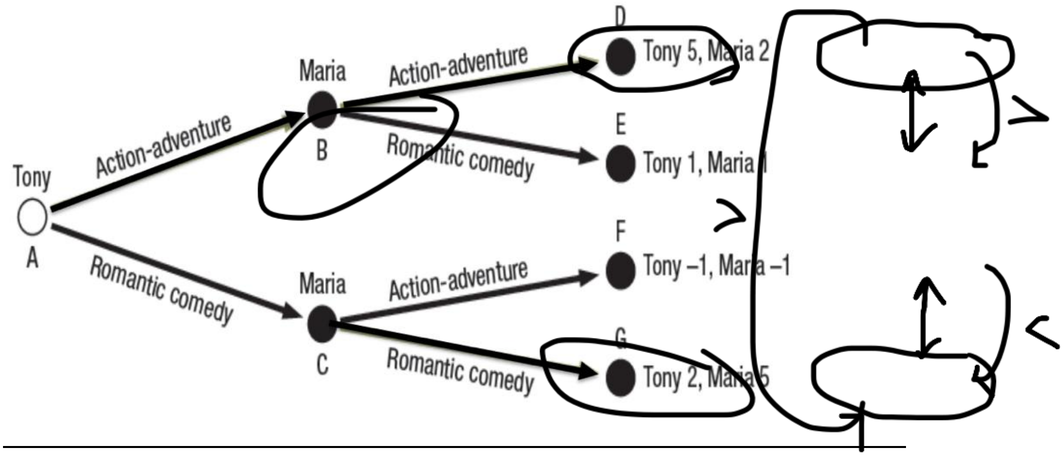
- Set of Players
- Set of possible actions for every player (infinite or finite)
- Set of payoffs for every possible outcome and for every player
- Set of strategies (for every player)

Strategy and optimality are NOT related in game theory

→ Strategy: plan of action that specifies what the player will do in every situation he might face

LECTURE 2.5

DIAGRAM TREE



A strategy describes an action for every possible decisional node of that player

→ Tony's strategies: AA, RC
→ Maria's strategies:
- RC if Tony RC, AA if Tony AA
- RC if Tony AA, AA if Tony RC
- RC if Tony RC, RC if Tony AA
- AA if Tony RC, AA if Tony AA

Tony can predict how Maria would play in each subgame
→ backward induction: process of solving the game starting from the end and going back to the beginning

A Nash Equilibrium in a sequential game is a pair of strategies, one for each player, such that every strategy is a best response to the strategy played by the opponent.

1. SPNE is credible while NE are not credible
2. The part of the strategy of the second player that is not played is still important in order to justify the optimal strategy of the first strategy
3. First/second mover advantage depends on incentives of the game but not on information

LECTURE 2.6

Non-competitive markets: firms have market power→ P>MC (in competitive markets P=MC)
If P>MC→ Q(n-c markets)<Q (P.C.)→ DWL>0→Inefficiency

- MONOPOLY: 1 firm, many consumers
- OLIGOPOLY: few firms, many consumers
- (MONOPSONY: 1 consumer, many firms)
- ➔ Equilibrium (P and Q)
- ➔ Efficiency analysis
- ➔ Market intervention

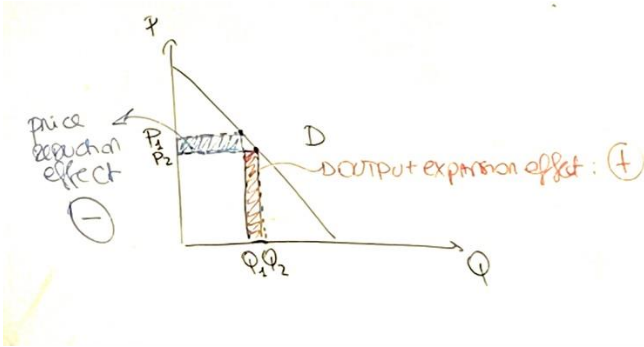
Characteristics of non-competitive:

- Economies of scale
- High initial investments→barriers to entry
- R and D
- Patents/trademarks (brevetto)
- Few substitutes

MONOPOLY

Profits: insert formula from slides
dP/dQ=0
MR=MC→optimality condition

- In competitive markets, by assumption→MR=P
- In Monopoly MR NOT EQUAL TO P→ because the monopolist can influence the price→ we need to study MR
- Marginal revenue: tells how TR changes when we increase Q by a small amount (MR=dTR/dQ)
- When Q increases (by 1 unit)
  - TR increases because we sell 1 extra unit (Output expansion effect) +
  - TR decreases because we sell all the previous units at a lower price (price reduction effect) –
- Depending on which of the previous effects prevails, we have either increasing or decreasing



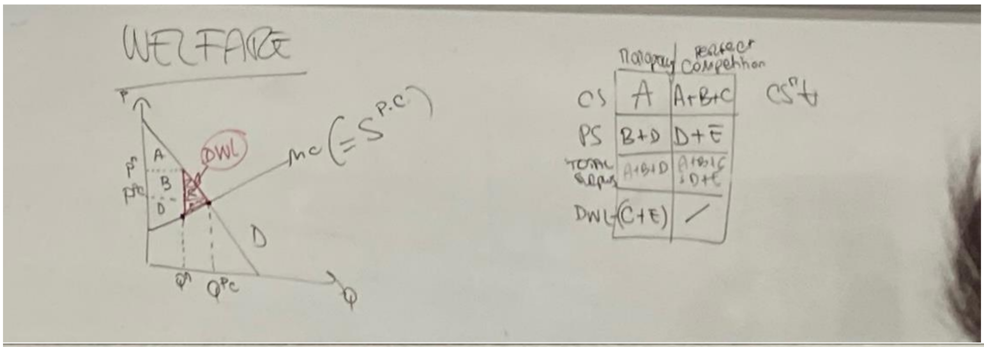
TR=P(Q)Q→ inverse demand function
MR=dTR/dQ→P(Q)+dP(Q)/dQ x Q
(in perfect competition, the price reduction effect= 0)
In Monopoly: MR<P

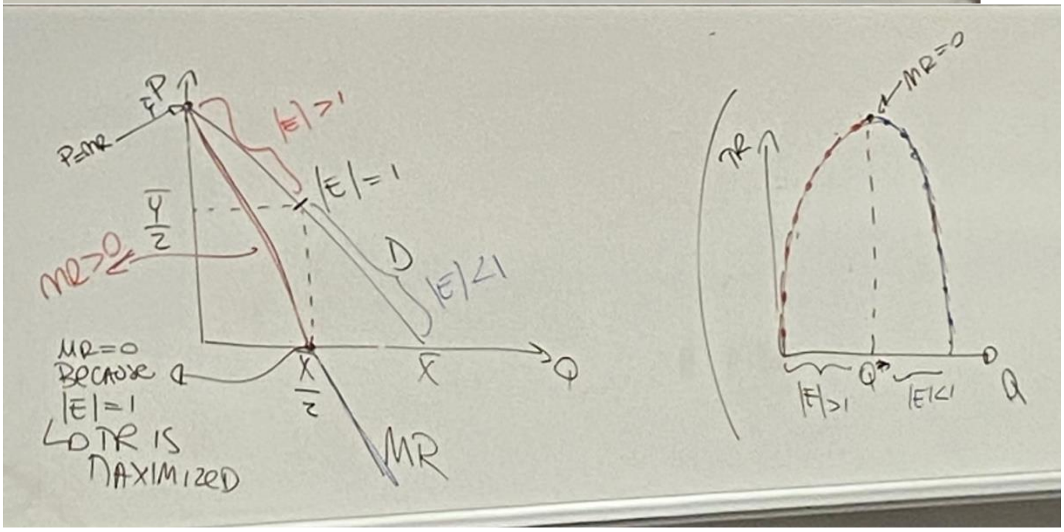
To find optimal Q

1. MR=MC→Q^M
2. P> or equal to AC(Q^M)=AVC(Q^M)→no fixed cost

EQUILIBRIUM:

- Monopoly would never choose a price that is in the inelastic portion of the demand→min price always P/2 (equal to p when E=1)
- Relation AVC and MC→ if AVC up, MC greater→ MC (and AVC) cannot decrease and be negative

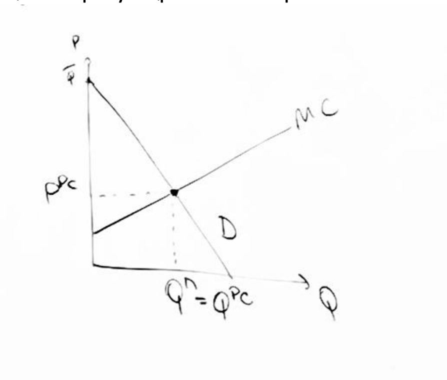




MARKET POWER MEASURED WITH LERNER INDEX or MARKUP→P-MC/P
Higher markup means P>>>MC→greater inefficiency→justify market intervention
LECTURE 2.7
MARKET POWER→ usually set different pricing strategies for different consumers (museum tickets for adults, kids, old etc)

PRICE DISCRIMINATION
A firm price discriminates if it charges different prices for differently units of the same good to different consumers (or the same consumer)
When does this happen?
1. The firm has market power (P>MC)
2. The firm must be able to understand willingness to pay based on an observable characteristics (Age, sec, other…)
3. No arbitrage opportunity (io e fede all'open wine) (no resell)

3 PRICING STRATEGIES
1. 1st degree price discrimination (or perfect price discrimination)
   a. When the firm is able to sell each unit exactly at the maximum price a consumer is willing to pay for that unit.
   b. Pi= reservation price
   c. Qmonopoly=Qperfectcompetition→to find Qm: set P=MC→Q
   d.



2. 2-parts tariff
    a. The monopolist charges an initial fee (fixed and independent of how many units the consumer will use) and the a per-usage price (entrance in club + cocktails)
    b. Initial fee+Punit→max profit
    c. Optimal Punit=MC in order to get DWL=0
3. 3rd degree price discrimination (imperfect)
    a. Monopolist can charge different prices of different groups (museum→old, adult, kids etc)
    b. Each group a "different market"
    c. To max profits: consider different groups and different markets
        i. Group with more inelastic demand is charged the highest price→(P-MC)/P=-1/Edp
        ii. Increasing the number of groups will make this pricing strategy closer to 1
    d. Welfare considerations:
        i. Consumer surplus positive, but smaller than with no price discrimination
        ii. Profit smaller than profit with 1 and 2 but greater than w/o price discrimination
        iii. DWL>0 (inefficiency) but smaller than 2/o price discrimination

LECTURE 2.8

- Oligopoly: situation with few sellers and many buyers
- In an oligopoly, each firm's profit depends on the choices (P or Q) of the other firms: strategic interaction
- Economists determine the outcome of oligopolistic competition by applying game theory
- As we saw, in game theory a firm's most profitable choice given the actions of its rivals is called its best response
- In a Nash equilibrium of an oligopoly, each firm is making a profit-maximizing choice given the choices of its rivals→NE in oligopoly is a pair of best responses to each other's strategy!

Bertrand model of oligopoly: few firms produce homogeneous (i.e identical) or differentiated products and set their prices simultaneously

- To keep things simple we study a Bertrand duopoly (Bertrand model with only two firms)
- Assumption: firms have constant marginal cost and no fixed costs
- Once firms have set their prices simultaneously, buyers observe prices and decide how much to purchase from each firm
- They purchase from firm with lower price
- Each firm's most profitable choice depends on what the other does:
    - If the other firm has set a lower price, noone will buy from the first
    - If they pick the same price, demand is split in two
    - If the other firm has set a higher price, everyone will buy from the first

__Nash Equilibrium__ ➢ Look at firms' best responses:

- ➢ If firms have same MC:
- ➢$P_1=P_2=MC$ is the only stable outcome!
- ➢Graphically $P_1=P_2=MC$ is the only point where the best responses cross!
- ➢They split the demand in 2 ♏♊ NE: (MC,MC)
- ➢ If $MC_1>MC_2$:

  ➢ $P_1=MC_1$ and $P_2=MC_1-0.01\$$ is the only stable outcome ➢ all the demand would go to firm 2! ♏♊NE: (MC_1, $MC_1-0.01\$$)

LECTURE 2.9

COURNOT OLIGOPOLY: few firms sell a homogeneous good and each chooses simultaneously the quantity to offer on the market→situation of strategic interaction→Qi→influence P→Profit

- NE set of quantities, one for each firm, such that Qi is a best response to Qi
- Since Qi belongs to (0, Q capacity limit)→infinite set of actions:
  1. Best response action
  2. Find point when BR functions cross eachother→NE

(DUOPOLY)

1. Profits for firm 1:
   a. Profit(Q)=PQ-TC(Q)

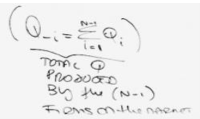
      F^-1(Q) inverse demand function where Q=Q1+Q2
      - Profit(Q1,Q2)=f^-1(Q1+Q2)Q1-TC(Q1)
      - Profit for firm 2: Profit(Q1,Q2)=f^-1(Q1+Q2)Q2-TC(Q2)

   b. A BR Function Q1=f(Q2): associates to each Q2, the Q1 that maximizes Profit, given that Q2
      i. Best response function for firm 1: derivativeProfit1/derivativeQuantitive1→Q=f(Q2)
      ii. Best response function for firm 1: derivativeProfit2/derivativeQuantitive2→Q=f(Q1)
2. $\begin{cases} Q1 = f(Q2) \\ Q2 = f(Q1) \end{cases}$→ NE: (Q1, Q2)→Qtot=Q1+Q2
3. If the firms have the same cost structure→best response functions are symmetric: you can find the best response function for firm 1 (derivativeProf/derivQ=0) and then find the BR function for firm 2 inverting Q1 with Q2 in BR1.

COURNOT WITH N FIRMS:

BR function firm i

Qi=3000-Q-I (all firms opposing)/2

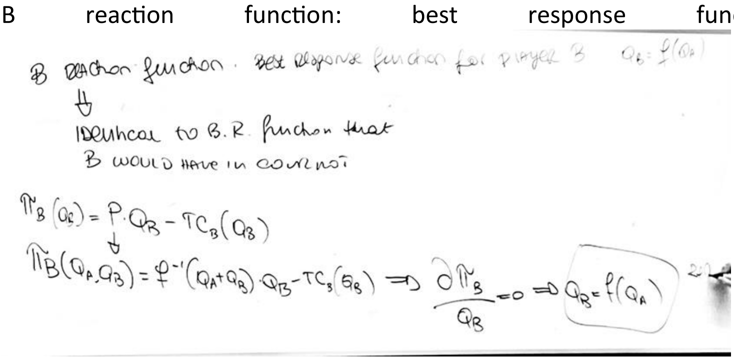


STACKELBERG MODEL: firm A chooses quantity first, and then firm B, after seeing Qa, chooses Qb

Backward induction to solve the game to find SPNE

1. Solve for optimal Qb for every possible Qa
2. Find Qa

B reaction function: best response function for player B: Qb=f(Qa)



LECTURE 2.10

CHOICE UNDER UNCERTAINTY

Choice influenced by

- Value of each possible consequence
- Preferences toward risk (differ from individual to individual and over time)

RISK when the agent doesn't know what consequence will prevail→agents choose among risky option (risky bundles)

1. Set of all the outcomes
2. Set of all of the payoffs
3. Probability distribution

An outcome is one of the possible consequences of a risky option
→set of outcomes: set of all the possible consequences associated with a risky option (FINITE and known to the agent)

→A probability of an outcome measures the likelihood of that outcome

- It's a number between 0 and 1
  - Pr (outcome)=0 : that outcome does NOT happen
  - Pr (outcome)=1: that outcome happens FOR SURE
- The sum of all the probabilities associated with a risky option is 1→1 and only 1 outcome will prevail
- A probability distribution specifies the probability of each possible outcome
- When there's uncertainty, agents choose among lotteries (while with certainty they choose among bundles)
- A riskless bundle can be seen as
- Expected value of a lottery (EV) is the weighted average of all the possible values (v) of the outcomes using probabilities as weights
- EV(lottery)=P1V1+P2V2… →ex ante value
- V1 or V2 or V3… → ex post value REAL MONETARY VALUE

To understand choice we need to take into consideration also preferences for risk→utility function
Expected utility (EU) is the weighted average of all the utilities associated with all the possible outcomes, using probabilities as weights.
EU(lottery)=P1U(V2)+P2U(V2)… ←Von Neumann.Morngenstern utili function,
P is probability of outcome; V is associated with that outcome. (Ex ante). Exc post U(V1) or U(V2)

3 categories:

1. Risk-averse agents
2. Risk-loving agents
3. Risk-neutral agents

CERTAINTY EQUIVALENT (CE) of a lottery is the amount of money that if provided with certainty, makes the agent indifferent between the lottery and this money

RISK PREMIUM (RP) → RP=EV-CE
Is the subjective price for risk. It tells how much an average the lottery must pay (more or less) compared to the sure amount given by CE.

LECTURE 2.11

RISK-AVERSION

An agent is risk averse if comparing a riskless bundle with a lottery with the same EV, he prefers the riskless one:

$$V_{riskless\ bundle} = EV_{lottery}$$
$$U(V_{riskless\ bundle}) > EU_{lottery}$$

- CE<EV
- RP=EV-CE>0
- CONCAVE UTILITY FUNCTiON

RISK-LOVING AGENTS:

An agent is risk loving if comparing a riskless bundle with a lottery with the same EV, he prefers the lottery:

$$V_{riskless\ bundle} = EV_{lottery}$$
$$U(V_{riskless\ bundle}) < EU_{lottery}$$

- CE>EV
- RP=EV-CE>0
- CONvex UTILITY FUNCTiON

RISK NEUTRALITY:

An agent is risk neutral if comparing a riskless bundle with a lottery with the same EV, he's indifferent:

$$V_{riskless\ bundle} = EV_{lottery}$$
$$U(V_{riskless\ bundle}) = EU_{lottery}$$

- CE=EV
- RP=0
- Utility function linear

→he always picks the lottery (or degenerate lottery) with the highest EV

Every agent will pay a max price for a lottery ticket equal to its CE

→for a risk averse age t: would never pay more than the EV to buy a lottery ticket (because CE<EV)

→For a risk loving agent: would pay more than the EV to buy a lottery ticket (because CE>EV)

→For a risk neutral agent:

LECTURE 2.12

Asymmetric information cause by hidden characteristics:

The characteristics of the good exchanged is hidden to one of 2 sides of the market (no buyers)

Ex: buyers in second hand market

- Car insurance companies do not know the ability of the insured driver
- Employer does not know skills/productivity of newly hired workers

PROBLEM: ADVERSE SELECTION: only low quality goods or low ability workers are exchanged on the market.

There is no market for good quality goods→inefficiency + failure of the market→remedies?

- With symmetric info: we would have 2 different markets: one for high quality and another for low quality goods, with Ph and Pl<Ph
- With asymmetric info: 1 market and 1 price for all the goods (low and high), with Pe=equilibrium<Ph and >Pl
    - **If Pe is too low**→good quality sellers find not profitable to sell their good on this market
      → only low quality goods are sold on the market
  - ADVERDSE SELECTION? Low quality goods are driving out of the market good quality items
    - **Pe is high enough that both high and low quality goods are sold**
    - Pe<Ph→H sellers get lower profits than symmetric info and transfer part of their profits to L sellers (because Pl<Pe)
      - H sellers will start selling items to make higher profits
      - Only low quality goods will survive in this market (adv sele in long run)
      - Failure of market for H

ASTRA
BOCCONI