EFR summary

Microeconomics, FEB11001

2024-2025

Lectures 1 to 10

Weeks 1 to 4

Details

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Microeconomics - IBEB
Lecture 1, week 1

What is (micro)economics

Economics is a science that studies how people, firms, and organisations behave and make choices when there is scarcity.
Microeconomics in particular is the study of individual choices and the study of group behaviour in individual markets.
Macroeconomics is the study of broader aggregations of markets.
Economists study **how** and **why** people make choices. Therefore economics is better at explaining individual markets than the entire economy.

The Cost-Benefit approach to decisions

Economists assume that choices are made based on the cost-benefit analysis.
The main question of the cost-benefit analysis is if you should do a particular activity:
Should I do activity X?
$B(x)$ = Benefit of activity X
$C(x)$ = Cost of activity X
If $B(x) > C(x)$ you **should** do activity X.
If $B(x) < C(x)$ you **shouldn't** do activity X.

The reservation price of activity x = the price at which a person would be indifferent about doing x and not doing x.

- If $B(x) = C(x)$ you are indifferent.
- If $B(x) - C(x) > B(y) - C(y)$
  $B(x) - C(x) = B(y) - C(y) + r$ (reservation price)
  So there is a reservation price for which you are indifferent about doing activities x and y.

The Cost-Benefit approach to decisions

Pitfall 1. Ignoring implicit costs

Implicit costs are costs that are not explicit. This is the loss of alternatives when one alternative is chosen.

An example of this is: if you spend 3 hours watching TikTok each day, you aren't able to do anything else. For example, go to work or hang out with your friends. You might have been able to earn 50€ in those 3 hours. This way something free like Tiktok will cost you money in the form of implicit costs.
Costs and benefits are reciprocal. It doesn't matter if you subtract those 50€ from the benefits or treat them as costs. Just make sure you don't count them twice!

Pitfall 2. Failing to ignore sunk costs.

Sunk costs are costs that are beyond recovery at the time a decision is made and so should be ignored. Because these costs are beyond recovery they are irrelevant.

An example of this is: Imagine you bought a concert ticket for 50€ and it isn't possible to resell this ticket. At the night of the concert you get invited to a free party which you would enjoy more than the concert. Should you go to the party or not?
In this case, you should definitely go to the party because the 50€ for the concert is beyond recovery and therefore should be ignored. This way you should go to the party.

Pitfall 3. Measuring costs and benefits as proportions rather than absolute monetary amounts

In your decision making you should only measure costs as absolute monetary amounts and not as proportions. So it shouldn't matter if you save 10€ on a TV of 500€, or 10€ on a shirt of 20€.

Pitfall 4. Failure to understand average vs. marginal distinctions

Marginal costs = Increase in total cost resulting from carrying out one additional unit of an activity.
Marginal benefit = Increase in total benefit that results from carrying out an additional unit of an activity.
You should increase your level of activity as long as **mar. B(x) >= mar.C(x)**

Average cost = Average cost of undertaking n units activity = **Total cost / n**
Average benefit undertaking n units of activity = **Total benefit / n**
The optimal amount of a continuously variable activity is when **MC = MB** (Marginal cost is equal to Marginal benefit).

Different approaches to choice behaviour

Positive approach: What do people choose, and how do we declare what they choose?
Normative approach: What ought or what should people choose?

The positive approach emphasizes declaring and understanding.
This is used in Science, advertising, and managing people.

The normative approach helps people to make good decisions. It is important that it's good for those people.

Not all choices are good in the Cost-Benefit analysis

Economics assumes that people are rational. That doesn't mean that all the decisions are "good". People make mistakes.
The Homo-Economicus: Stereotypical decision maker in self-interest model.
Economic agent: Individual or group making choices. A group can also be a single agent. For example, if Apple increases their iPhone prices. In this case, Apple is a single agent.

Three principles of economists

1. People make choices by **optimising**: They try to make the best choices.
2. Lots of attention goes to the **equilibrium**: a situation where no one wants to change their choices.
3. **Empirical analysis**: Economists use data to test and prove their theories.

Causality: What causes what?
Observation: a statement based on something one has seen, heard or noticed.
For example: When the sun shines, there are a lot of people on the beach.

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Lecture 2, week 1

The market

Definition: A market exists of all the buyers and suppliers of a good or service.
Markets come in all forms and sizes. Place, anonymity and time are all important factors of defining the market.
Economists are among others interested in:
1. Explaining the price of a good (P)
2. Explaining the quantity traded (Q)

The **demand curve** describes the relation between the quantity of a good that demanders want to buy and the price of that good.
Law of demand: Empirical observation that if the price of a product falls, the quantity demanded increases.
$Q = f(P)$
=> $\frac{dQ}{dP} = f'(P) < 0$

Two explanations for the law of demand:
1. Increase in price: which makes people look for alternatives: substitution-effect

2. Increase in price: something has to change: income-effect

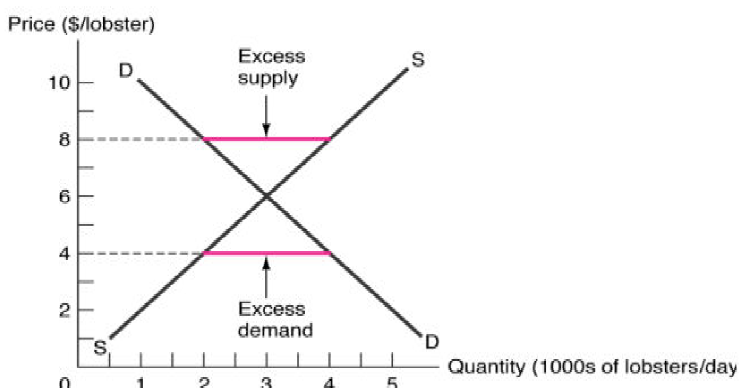
The **supply curve** describes the relation between quantity of a good that suppliers want to sell and the price.
Law of supply: empirical observation that suppliers want to sell more if the price rises.
$Q = f(P)$
$\frac{dQ}{dP} = f'(P) > 0$

Two ways of reading the supply and demand curves:
Horizontal interpretation: The quantity that is offered/demanded at a certain price.
Vertical interpretation: The price that the market will move towards at a certain quantity offered/demanded.

The equilibrium

The equilibrium quantity and price is the intersection of the supply & demand curves. This is the point where all the participants are 'satisfied'. 'Satisfied' in this case means that buyers and sellers are buying/selling the amount they want to at that price.
So: $Qs(P) = Qd(P)$

If the price-quantity pair is above the equilibrium: excess supply
If the price-quantity pair is above the equilibrium: excess demand



Determinants of demand/supply

Determinants of demand:
- Incomes

    - **Normal goods**: If income increases, quantity demanded increases.
    - **Inferior goods**: if income increases, quantity demanded decreases.
- Tastes
- Price of substitutes and complements
- Expectations
- Populations

Determinants of demand:
- Technology
- Factor prices (production prices)
- Expectations
- Weather

Government intervention

Government intervention with good intentions who ignore the laws of supply and demand are doomed to fail.

An example is rental policy. In lots of cities the rent prices are too high for the poor. A reaction from politicians on this is the point system. The renting price is based on objective criteria instead of supply and demand. This results in excess demand. Another problem with this is that the poor people might prefer to use the extra money on something else, so the government would be better off giving the money to the people instead of cheaper houses.

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Lecture 2/3, week 1

Rational choice model

A **model** is a simplified description of reality.

Structure of an economic model:

1. Description of possibilities of economic agent
2. Description of his goals.

A combination of both leads to an explanation of his behaviour.

Structure of an economic model in math:
$max\ U(x,\ y)\ gegeven\ y\ =\ f(x)$

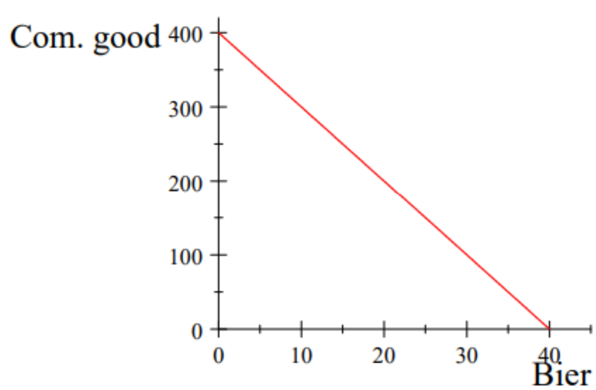
An example of this is how Charly spent his income on pizza and beer:
A few assumptions need to be made for now to decide:

1. Complete information
2. One period
3. Other people don't matter

The budget curve (opportunity set)

The options of Charlie are depending on the price of beer, the price of pizza and his **monthly income**. Which makes: $M\ =\ PbB\ +\ PzZ$
Which can be rewritten as a line by writing $B\ =\ \frac{M-PzZ}{Pb}$
It's slope coëfficiënt = -(Pp/Pb) and can be interpreted as that if Charly wants to buy one extra pizza he should sacrifice Pp/Pb beers.

In reality instead of the choice being between two goods the choice might be between millions of goods. This can be written as:
$M\ =\ \sum_{i=1}^{N} PiGi$
Imagine instead of wanting to be looking at all goods we want to look at one good, and another good which consists of all other goods. This is the '**Composite good**'. The price of the composite good = 1.



Description of his goals

We describe what an agent wants with help of preference orders: A scheme by which a person organises alternatives based on desirability.
For the preference orders there are a few assumptions:

1. **Complete**: $A > B \, v \, B > A \, v \, A = B$
2. **More is better**: Let $A = (Bx, Zx) \; and \; C = (By, Zx) \; and \; Bx > By. \; Then \; A > C$
3. **Transitivity**: Let A>C, and C>D -> A>D
4. **Continuïty**: If one part of the budget option A is slightly bigger than that part of budget option B and the other part is equal -> A is slightly better than B.
5. **Convexity**: A=C -> He prefers all the points on the line between A and C.

A few exceptions on transitivity:

- Football games: if Feyenoord wins from Ajax, And Ajax wins from PSV it doesn't necessarily mean Feyenoord will win from PSV.
- Collective preference orders based on majority (votes)

The indifference curve

An indifference curve is a set of bundles between which a consumer is indifferent.

Marginal rate of substitution (MRS) is the slope coëfficient of the indifference curve: Which means how much of product A you are willing to give up for an extra product B.

Indifference map:

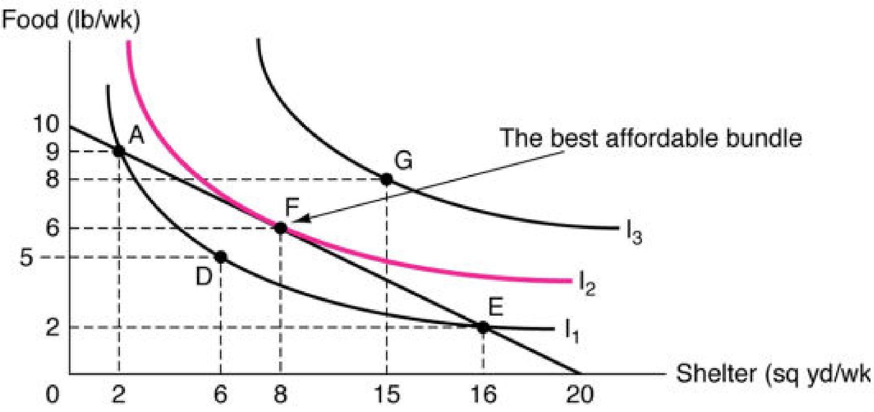
- Unlimited amounts of indifference curve
- The higher the curve, the higher the utility
- Different persons have different indifference curves and therefore also different indifference maps
- Indifference curves cannot cross each other.

Two ways to learn about indifference curves:

1. Asking questions about all sorts of bundles.
2. Statistics (How do income & prizes affect a choice)

How to maximise utility

The goal of the consumer is to maximise its utility (trying to reach the highest indifference curve)
The highest indifference curve is reached when the MRS (slope coëfficient of indifference curve) is equal to the slope coëfficient of the budget constraint.
So when: $MRS = \frac{Px}{Py}$



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Lecture 4, week 2

Rational choice model into mathematics

The structure of the economic model can be written as:
max. U (x, y) s. t. y = f(x)
U (x, y) describes the indifference map (all the indifference curves)
y = f(x) describes the budget constraint.
Maximising this will make sure all the resources are used optimally.

The utility function is described as U = U(x, y) where U stands for utility.
Utility is something positive, so therefore we want to maximise our utility.
More-is-better implies:

$\frac{\partial U}{\partial Y} = UY > 0; \frac{\partial U}{\partial F} = UF > 0$
Which makes sure the marginal utility is greater than zero.

If you write the differential of U(F, S) it can be written as: $MRS = \frac{dF}{dS} = -\frac{Us}{Uf}$

Ordinal vs. marginal utility

Ordinal utility: People can say bundle A is better than bundle B but the number U (utility) has no meaning in itself.
Cardinal utility: The number in itself has meaning because you can compare people's utility number against each other.

Economics of happiness makes use of cardinal utility:
People from different countries were asked how happy they are on a scale of 4. An interpretation of this scale of 4 is that they were asking on which utility scale people are.
The answers got used to decide how happy people were, and it concluded that richer countries reported a higher utility than poorer countries.
So what is **important for utility**:

- Relative income position
- Marital status: A divorce is compensated by 100.000 Euros higher income.
- Work versus no work
- Security: Risk aversion
- Children makes you deeply unhappy

Solving the optimisation problem

We solve the optimisation problem with two methods:

1. The **Lagrange method**
2. The **substitution method**

The lagrange method:

1. Set up the lagrange function: $L(x, y) = U(x, y) - \lambda(ax + by - m)$
2. Set up the first order conditions:
    a. $Ux(x, y) - \lambda a = 0$
    b. $Uy(x, y) - \lambda b = 0$
    c. $ax + by = m$

3. Divide 2a and 2b: $\frac{Ux(x,y)}{Uy(x,y)} = \frac{a}{b}$
4. Solve the rest of the variables with this answer.

The substitution method:

1. Rewrite: $ax + by = m$ into for example: $y = \frac{m-ax}{b}$
2. Substitute y into U(x, y) so that makes $U(x, \frac{m-ax}{b})$
3. Take the derivative of U.
4. Optimise the derivative of U.

You can also solve problems with even more variables by setting up the first-order derivatives by putting all the first partial derivatives and the budget constraint together.

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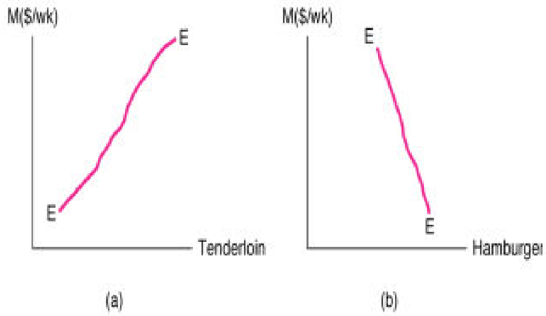
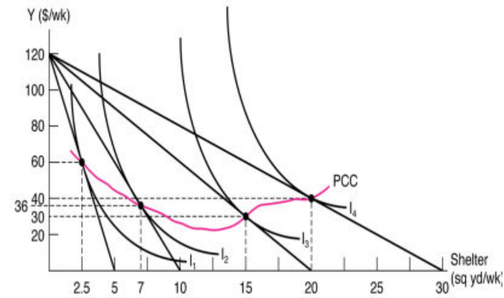
Lecture 5, week 2

Analysing the demand curve

Individual demand curve: how does the quantity demanded of a person change when prices differ?
Another name for the individual demand curve is the **price-consumption curve**(PCC). It shows for every price the best bundle (in relation to the different budget constraints and the indifference map).
A price increase will always make a person worse off, because he will reach a lower indifference curve.

Engel curve, Q = f(M), shows the relation between income and the quantity demanded.
With normal goods: f'(M) > 0
With inferior goods: f'(M) < 0



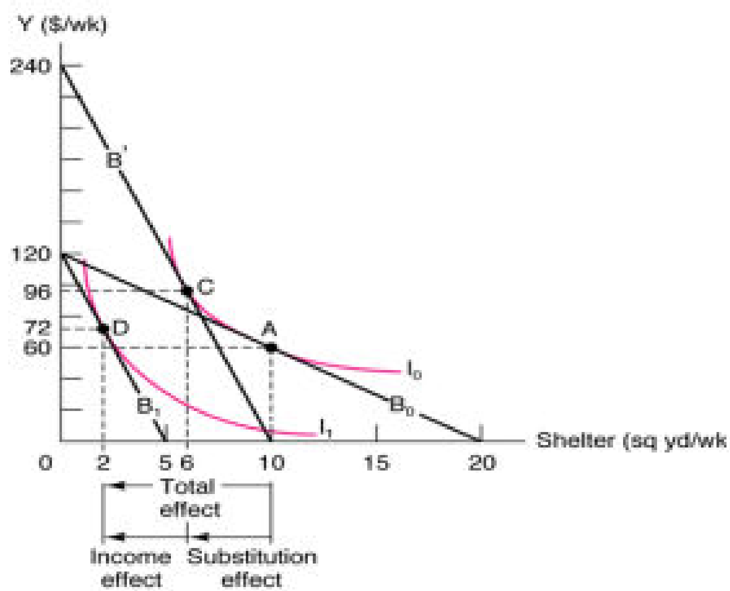


Effect when the price changes

There are two reasons why the quantity demanded changes when the price increases:

1. The **income-effect**: Lower real income (Engel curve)
2. **Substitution-effect**: Looking for alternatives.

Distinguish between income and substitution effect:
To distinguish substitution effect and income effect: shift new budget equation to the point where the initial utility can be achieved.

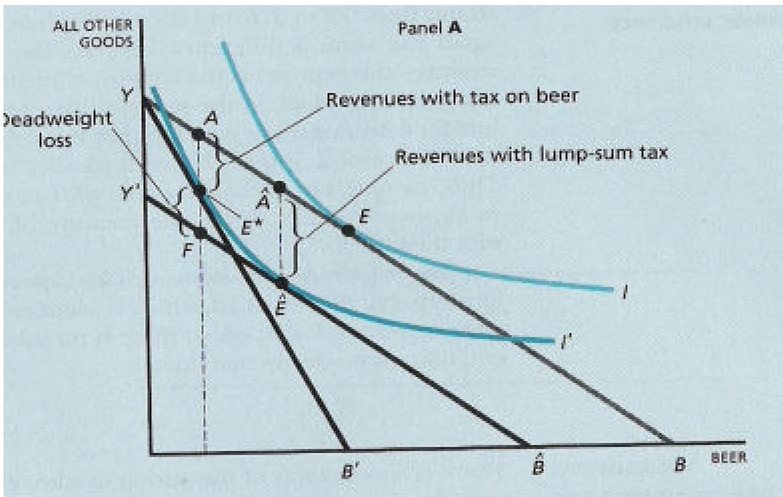


The difference between C and D in shelter is the income effect.
The difference between A and C in shelter is the substitution effect.

Government taxing

When the government set a tax on a product there will be changes in the budget curve of the consumer and will therefore change the utility the consumer is reaching.
We want to make the tax as efficient as possible:
A situation is inefficient if it is possible for the government to
achieve higher returns while the consumer receives the same utility.

When putting a tax on a product the budget curve will change:
PxX + PyY = M -> (Px + t) +PyY = M
When putting a tax on income the budget curve will change:
PxX + PyY = M -> PxX + PyY = M - T



Income tax will reach higher returns while the consumer receives the same utility. Therefore not changing the VAT rate on a product and taxing income is more efficient. The tax on for example alcohol can be justified for other reasons, like health.

Individual curve to market curve

The market demand curve is the sum of the individual demand curves.
Summing the individual demand curves will give the market demand curve.
An example:

$P = 16 - 2Qa \; -> \; Qa = 8 - \frac{1}{2}p$

$P = 8 - 2Qb \; -> \; Qb = 4 - \frac{1}{2}p$

$P <= 8 \; -> \; \Sigma Qi = Q = 12 - P \; -> \; P = 12 - Q$

$P > 8 \; -> \; P = 16 - 2Q$

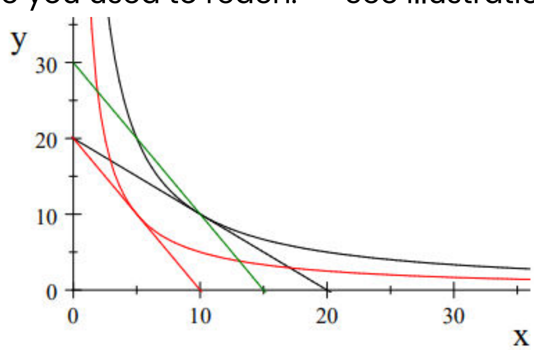
Price Elasticity (ε)

Managers would like to know how strong the demand reacts to the price.
Price elasticity = the resulting percentage change in quantity of a percent change in price.
$\varepsilon = \frac{dQ}{dP} * \frac{P}{Q}$
There are three possibilities for **price elasticity**:
$\varepsilon < -1$: **Elastic demand**, demand decreases more than one percent when price increases one percent.
$\varepsilon = -1$: **Unit-Elastic demand**, demand decreases one percent when price increases one percent.
$\varepsilon > -1$: **Elastic demand**, demand decreases less than one percent when price increases one percent.

Income elasticity = the resulting percentage change in quantity of a percent change in income.
$\eta = \frac{dQ}{dM} * \frac{M}{Q}$
Three possibilities for income elasticity:
$\eta < 0$ -> **inferior goods**
$0 <= \eta <= 1$ -> **Normal goods**
$\eta > 0$ -> **Luxury goods**

Price compensation

Price compensation means that you have so much more income that you can buy the same bundle you used to buy when prices were lower.
Price compensation will lead into higher utility, because the budget curve will go over the old indifference curve you used to reach. -> See illustration



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Lecture 6 & 7, week 2

Uncertainty in economics

In the previous notations we assumed that the consumer knows all prices, his income and the features of all products. In reality, people are uncertain about prices, their taste, the quality of products and much more.

Uncertainty will raises two questions:
1. How and to what extent do people collect information
2. How do people decide under uncertainty.

When people collect information they look at what is known, what isn't known and after this they start collecting. That raises the question how much information needs to be collected. Therefore we always use the cost-benefit analysis:
- Benefit: The amount of information raises your changes of making a good decision.
- Cost: Collecting information doesn't come without a cost.

B = Benefit of a good decision (instead of a bad one)
P(I) = Change of a good decision as a function of the amount of information.
I>=0
C(I)= The cost of collecting information
Therefore we want to:
Max: P(I)B-C(I) -> $\frac{\partial P(I)}{\partial I}B = \frac{\partial C(I)}{\partial I}$

Rational ignorance

Research shows however that voters are "dumb" (ignorant)
Economics call that "**rational ignorance**"
Take for example collecting information for the American elections:
- Benefit: Increases your vote the chance that the best candidate wins
  - B = Difference in utility per candidat = 0(U(Trump)-U(Clinton))
  - P(I) = The chance that your vote will be decisive = 0

- Cost: C = Collecting information about all sorts of political issues.

A way of winning information is “**Communication”**
The amount of information depends on:
- The sender of information
- The message
- Circumstances

“Communication”

A way of collecting information is “**Communication**”
The degree in which statements contain information depends on:
- The sender of the information
- The message
- The circumstances

Every producer will say they have the best product if there is no way for the consumer to find out which is the best.
That’s when **balance thinking** comes into play.
For example: Producer A offers a 10 year warranty because he makes amazing products. Producer A will be able to demand a higher price. Although there will be no balance yet, because all the other producers will all be seen on the same level. That’s why producer B also offers a warranty of 5 years, even though it is worse than the warranty of producer A. This will continue until everyone offers a warranty of different duration and so will the consumer find out about all the products which are best

- **Relevation principle:** some information is given voluntarily, because if no information is given, people fear the worst.

Decision-making under uncertainty

The two main questions about uncertainty are:
- Collecting information
- How to decide under uncertainty

Economists see decision making under uncertainty just like a lottery.

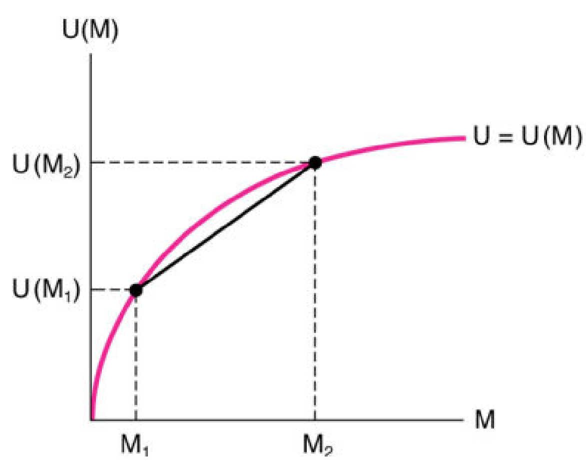
The expected value = The sum of all possible outcomes weighted by its respective probability of occurrence.
For example: If i can invest 100 euros and i have a 50% chance of tripling my money and a 50% chance of losing all my money, the EV = ½ * (300-100) + ½ * (0-100)=50

In economics people make decisions based on expected utility (and not expected money)! This is very important to keep in mind. (This is called the Von Neumann-Morgenstern expected utility model)
That's why people make choices based on the expected utility.
The expected utility = The sum of all possible outcomes measured in utility weighted by its respective probability of occurrence.

A **fair gamble** = A lottery with an expected value = 0.
A **risk-averse person** prefers security above a fair gamble. His preferences are described by a utility function with declining marginal utility.

Declining marginal utility is seen in the illustration below. You can see that the line of expected utility is always below the utility function and therefore a risk-averse person prefers security above a fair gamble.

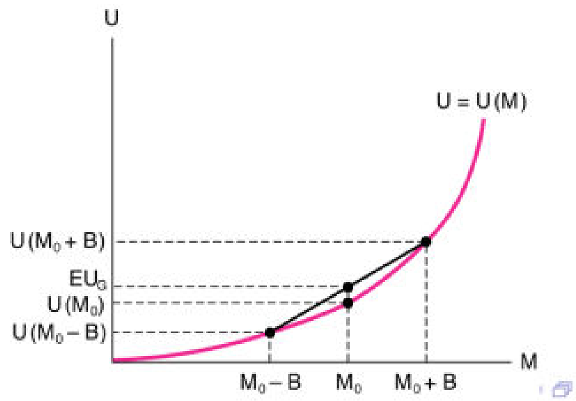
$$U'(M) > 0; U'' < 0.$$



A **risk-seeking person** prefers a fair gamble above security. The preferences of a risk-seeking person will be described by a utility function with a declining marginal utility.

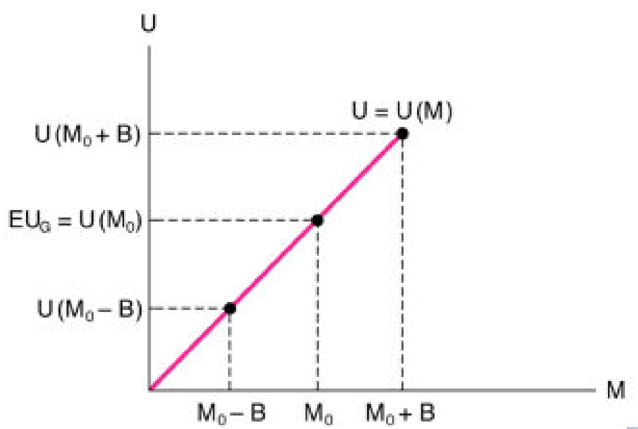
See the illustration below for the utility function of a risk-seeking person:

$$U'(M) > 0; U''(M) > 0$$



A **risk-neutral person** is indifferent between accepting and rejecting a fair gamble. He has a utility function with a constant marginal utility.
See the illustration below for the utility function of a risk-seeking person:

$$U'(M) > 0; U''(M) = 0$$



People are willing to pay a lot for insurance!

A **full insurance**, is an insurance where income, M, is independent of the factor you are insuring.
An example of what you could be insuring is your health. Let's say there's a ⅔ Change you stay healthy and a ⅓ change you get sick. Your expected utility will be EU=⅔ x 600+ ⅓ x 150 = 500. We are also assuming you are risk averse. The amount you are willing to pay for insurance = M, if you stay healthy, - M corresponding to the expected utility which lies on the same indifference curve.

Moral hazard is the incentive to take greater risk because the cost of that risk is borne by others. So if you're insured of something you might take greater risk, for example not putting your bike on a lock.

Example of a question of decision making under uncertainty

Imagine that Sarah has two options. One option is becoming a teacher where she is certain of M=5. The other option is becoming an actrice with a 1% chance to earn M=400 and a 99% change to earn M=2.
Her utility function is described as U(M)=1 - 1/M
^Side note on the utility function: U'(M)= 1/M^2 -> U"(M)=-2/M^2. Because U'(M)>0^&U"(M)<0 is she risk averse.

Her expected utility for becoming a teacher is $1 - \frac{1}{5} = 0.8$
Her expected utility for becoming an actress is $\frac{1}{100}(1 - \frac{1}{400}) + \frac{99}{100}(1 - \frac{1}{2}) = 0.505$
Therefore she will become a teacher because EVteaching>EVacting

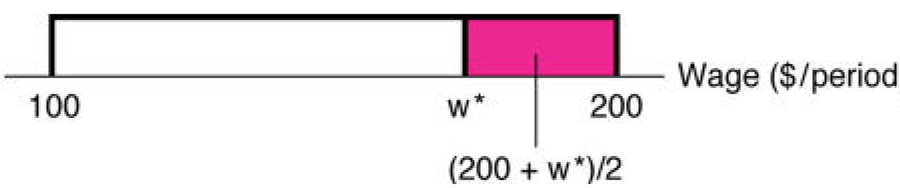
Now imagine sarah can buy advice. Someone can predict perfectly if she will become a topactress. How much will Sarah at most pay for this advice.
$U(T)\ without\ advice\ = U(t - p)\ with\ advice$
$0.99(1 - \frac{1}{5-p}) + 0.01(1 - \frac{1}{400-p}) = \frac{4}{5}$from which will follow p=0.05. So sarah will pay at most p=0.05 for the advice.

Microeconomics - IBEB
Lecture 8, week 3

Search Theory

A crucial question in search theory is when do you stop looking and when do you go into action.

Imagine you are looking for a job and every job pays between 100 and 200 euros. Looking for another job costs you 10 euros each time, and the salary is uniform divided. So 1 euro extra from 100 euros is worth as much as 1 euro extra from 199 euros.



The benefit of looking for a new job is: $Pr(W > W*)[E(W|W > W*) - W*]$. Where Pr(W>W*) stands for the chance that W* > W, so the chance that you find a higher result by searching.

The expected gain in the case if W* > W is: [E(W|W > W*)-W*).
If you are looking for the amount where you should stop searching is: $\frac{200-W*}{2} * \frac{200-W*}{200-100} = 10(price\ of\ looking)$. A more general formula can be written as $\frac{max-W*}{2} * \frac{max-W*}{max-min} = price$

Hawk and dove model

Hawk and doves are fighting for food (12 calories)
There are three possibilities:

- Two hawks: fight for food. Both lose for (-)4 calories.
- Two doves: Coöporate together. Both gain 6 calories

- Hawk and a dove: Dove flies away. The hawk gains 12 calories.

Let the percentage of hawks be ‘h’, then the percentage of doves is ‘1-h’.
The equilibrium will be reached when Ch=Cd
$Cd = (1 - h)6 + 0h = 6 - 6h$
$Ch = (1 - h)12 - 4h = 12 - 16h$
The equilibrium can be calculated which will equal to $h = \frac{3}{5}$and $d = 1 - \frac{3}{5} = \frac{2}{5}$
The equilibrium doesn’t have to be a ‘social optimum’.

Intemporal choice model

Up till now we made the assumption that the consumer spends his entire income. In reality consumers also save money and get loans. Therefore the question rises: how does a consumer distribute his consumption over time?

Therefore we make use of two periods: today and the future.
We also assume that there are no initial assets and no inheritances.

Notation:

- Ct is the consumption in period t.
- Mt is the income in period t.
- $St = Mt - Ct$ are the savings in period t
- i is the interest to which you can save and loan

How much you can spend at most in period 2: (1+i)M1+M2
How much you can spend at most in period 1: M1+$\frac{M2}{1+i}$
If you spend in period 2 x amount of money you have to pay back x(1+i). Therefore the maximum amount you can loan is: M2=x(1+i) => $x = \frac{M2}{1+i}$
Discounted value of M2 in period 1 = $\frac{M2}{1+i}$

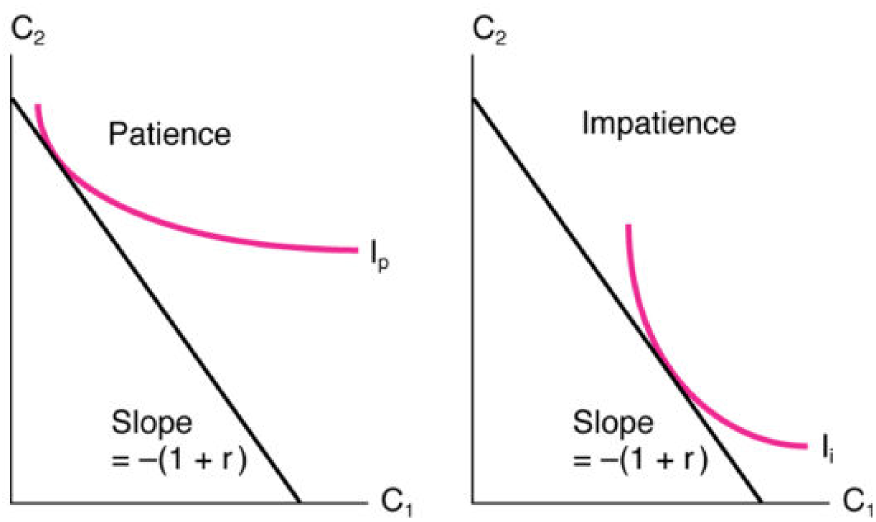
The **temporal budget comparison** shows the opportunity set of the consumer.
The budget comparison in period 1: $M1 = C1 + S1 \; -> \; S1 = M1 - C1$
The budget comparison in period 2: $C2 = (1 + i)(M1 - C1) + M2$
The price of one extra unit of C1 is C1(1+i)
The slope of the budget comparison therefore is -(1+i)

The **endowment point** (M1, M2) is the point that the consumer, regardless of i can always choose. That's spending all your income now and all your future income in the future.

Intemporal indifference map

The indifference curves have the same properties as before: completeness, more-is-better, transivity, continuity, convexity.
The Marginal rate of time preference (MRTP) = $\frac{dC2}{dC1}$= The slope coefficient of the indifference curve.

The shape of the indifference curve says something about the patience of a person. If someone is patient they will trade a lot of money right now for a bit more money in the future, and if someone is impatient they will trade a lot of money in the future for a bit of money now.



Deciding on the optimal choice is the same as with the normal rational choice model. You gotta find the point where the temporal budget comparison hits the indifference curve => $mrtp =-\ (1\ +\ r)$

Who should pay for taxes?

A big question in economics is who should pay for taxes: Consumers or suppliers. Jurists have a different opinion on who pays taxes as the economist. If a jurists put a tax on a supplier the economist asks the question who really pays for the tax. If all the costs of the tax get transferred to the consumer by the supplier the consumer really pays for the tax.

There are **two ways to levy taxes**. Via:

- The **consumer** (**changes** the **demand curve**).
  Initial demand curve: P = Qd, after taxes P + T = Qd (In the case of a subsidy -> P - S = Qd)
- The **supplier** (**changes** the **supply curve**)
  Initial supply curve: P = Qs, after taxes P - T = Qd (In the case of a subsidy -> P + S = Qs)

If the tax gets put on the consumer, and you want to calculate how much the consumer is actually paying you should fill in P = Qd and if you want to calculate how much suppliers receive of that price you should fill in P = Qd - T.

Shortly said, if you want to calculate how much the consumer is actually paying you should fill in the Q calculated with the new functions in the original demand function.

The group (consumers or suppliers) who pay economically for the tax is independent of who legally pays.

The **transfer rate** is the percentage of how much consumers or suppliers pay of the tax. For example, if the old price used to be 16 and is now increased to 17 and the tax is 3 the consumers have a transfer rate of the tax of ⅓ ((17-16)/3).

Microeconomics - IBEB

Lecture 9, week 4

Producer theory

The definition of **products** is anything which supplies utility, now or in the future. (not only physical goods).

Definitions of **production** are: a process that creates utility, now or in the future. Or a process that production factors (**inputs**) turns into products (**outputs**)

Examples of inputs are: labor, capital, land, energy, raw materials, entrepreneurship, and knowledge. Output is anything that supplies utility, now or in the future.

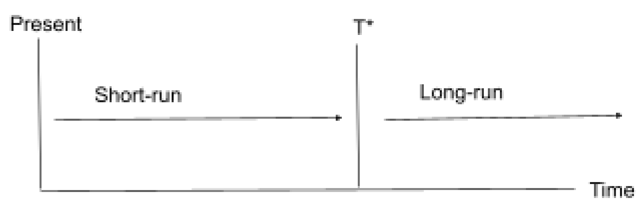
The **production function:** Input -> Business/production function -> output
In this course the only inputs (production factors) we are gonna use are **labour**, which we describe as **L**, and **capital**, which we describe as **K**.

We can write the production function as **Q = F(K, L)**, where Q is the amount of products we produce. Function F is the production technology.
An example of a production function is the Cobb-Douglas production function: $Q = mK^a L^b$ with $a,\ b \in [0,\ 1)$ and $m > 0$

Long vs. short run

The producer chooses the production factors (inputs). Some choices are able to be changed quickly, these are **variable inputs**, other choices aren't possible to change quickly, these are **fixed inputs**.

T* is the time it takes to change all production factors (see illustration)

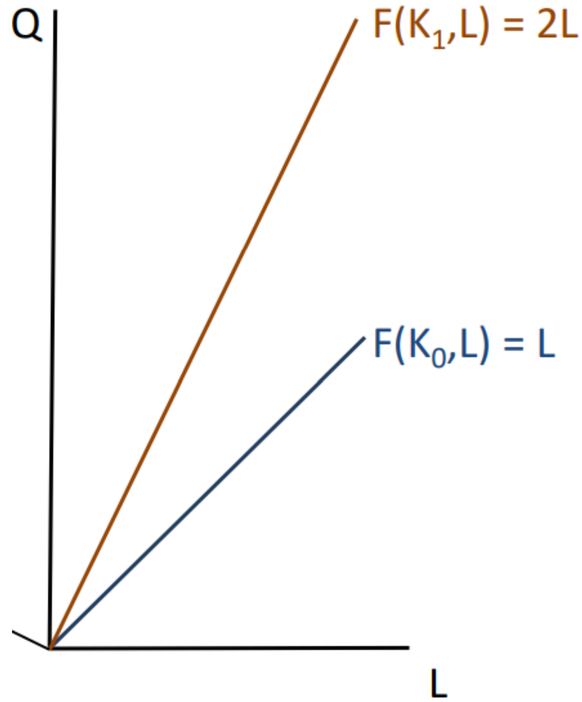


In the **short-run** there is at least 1 productionfactor 'fixed'.
In the **long-run** are all production factors 'variable'.

In this course Labor 'L' is always variable and Capital 'K' is fixed.

Production in the short-run

If we have a production function F(K, L)=KL and capital is fixed in the short run to $K = K_0 = 1$ we can illustrate that (see illustration). Later we change $K = K_1 = 2$, therefore the production function also changes.



The short-run production function always goes through the origin.

Total, average and marginal product

Total product (TP):

- How much gets produced: Q (production function)

Average product (AP):

- Output per unit variable input
- The average product of labour: $AP_L = \frac{Q}{L} = \frac{F(K,L)}{L}$

Marginal product (MP):

- How much changes the output with the change of 1 unit of an input.
- The marginal product of labour: $MP_L = \frac{dQ}{dL} = \frac{\partial F(K,L)}{\partial L}$

Effects of labour in the short-run:
If there is one person he will do everything. If there are multiple people there will be specialisation (Adam Smith), and if there are too many people they get in each other's way. This effect is called the **law of diminishing returns**.

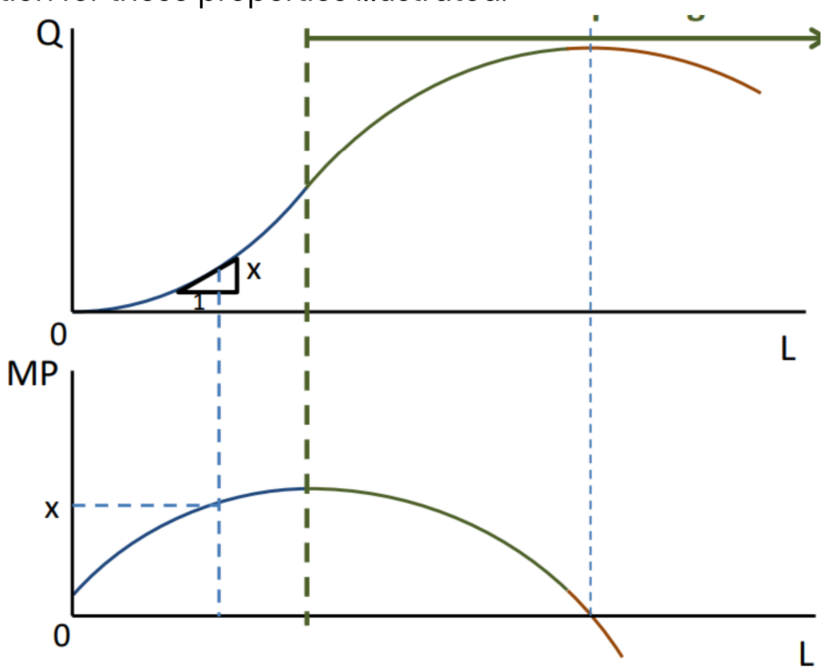
A more formal definition of the **law of diminishing returns** is: a principle stating that profits or benefits gained from something will represent a proportionally smaller gain as more money or energy is invested in it.

The law of diminishing returns, works for every short-run input although it doesn't work in the long-run. For example if we multiply our restaurant (long-run because it also affects fixed costs) and place it on the other side of town it won't necessarily give less returns than the first restaurant.

Properties of the marginal product of labour (MP_L):

- Slope coefficient of the total product (TP)
- Rises for L if L is small (specialisation)
- Decreases if L is bigger (law of diminishing returns)
- TP: The inflection point is at the start of diminishing returns
- The MP can be negative for L if L is big (people get in each other's way)
- The start of negative returns is when $MP_L = 0$

See the illustration for these properties illustrated.



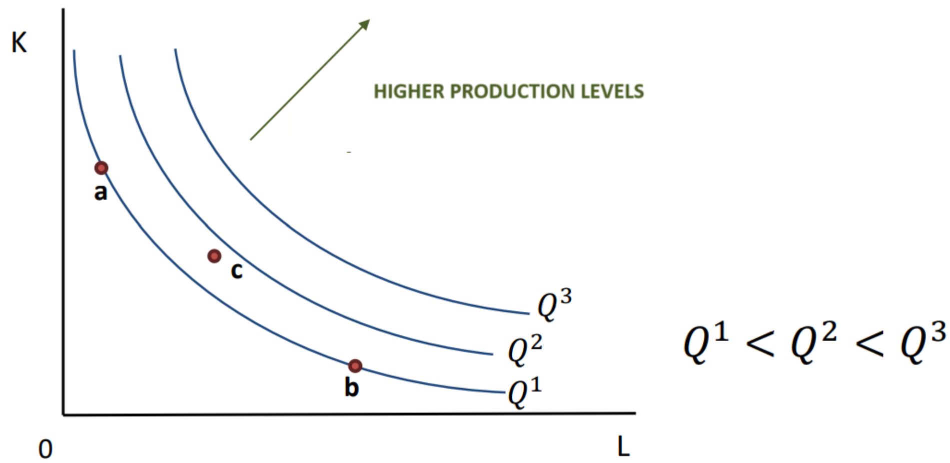
Properties of the average product:

- The coefficient of the origin to a point on the production curve
- When L -> 0: $AP_L = MP_L$
- MP > AP => AP increases
- Maximum AP_L : $AP_L = MP_L$ (not the point in the origin)
- MP < AP => AP decreases

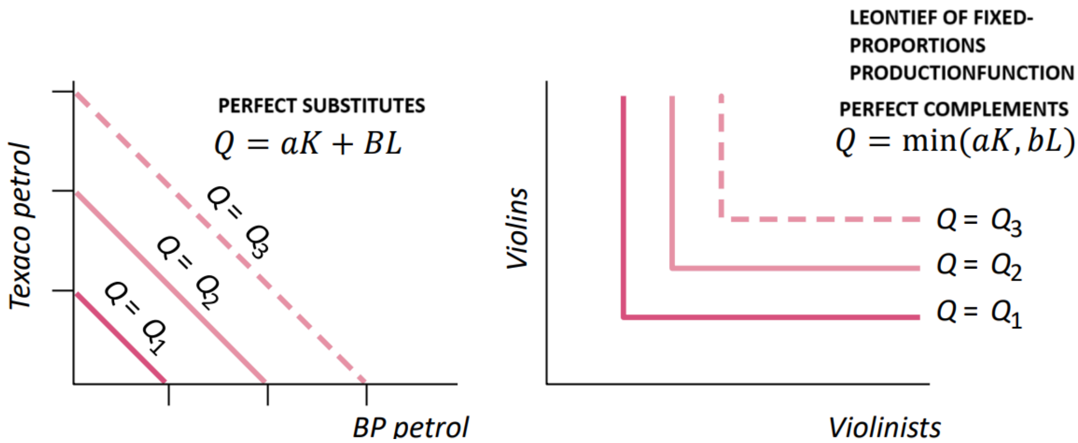
If we want to maximise production in the short-run with certain amounts of labours we should make sure $MP_{L1} = MP_{L2}$

Production in the long-run

In the long-run all production factors are variable. The production function will be described as Q = F(K, L). We can show this graphically with an isoquant map. This isoquant map consists of unlimited amounts of isoquant curves for which the amount of production is the same, regardless of the distribution of the production factors.



Perfect substitutes and complements also work the same for the isoquant map. These types of functions are illustrated below:



The marginal rate of technical substitution (MRTS): is the absolute value of the slope coefficient of the isoquant.

MRTS = $|\frac{dK}{dL}|$

The economic interpretation of the MRTS is the ratio to which capital can be exchanged for labour without changing the production quantity

Returns to scale

Returns to scale is about what happens with the production when you increase the production factors (inputs) proportionally. So both with the same proportion

- Increasing returns to scale
  F (cK, cL) > cF(K, L)
  This can happen because of specialisation, or the law of big numbers.
- Constant returns to scale
  F(cK, cL) = cF(K, L)
- Decreasing returns to scale
  F(cK, cL) < cF(K, L)
  This can happen when people for example get in each other's way while working. This is not the same as the law of diminishing returns.

Example exercise: Decide if the production function $F(K, L) = K^{1/4}L^{1/2}$ has increasing, constant or decreasing returns to scale.
Solution: F(cK, cL) = $c^{1/4}K^{1/4}c^{1/2}L^{1/2} = c^{3/4}K^{1/4}L^{1/2} < cF(K,\ L)$ so this function has decreasing returns to scale.

Microeconomics - IBEB

Lecture 10, week 4

Economic vs. accounting profit

Accounting profit is all revenue - all normal costs.

Economic profit is the accounting profit - the opportunity costs. So we want to look at opportunity costs also. For example if you invest 10 million in your business you could have also invested it and gained 10% per year. That would make for 1 million of opportunity costs.

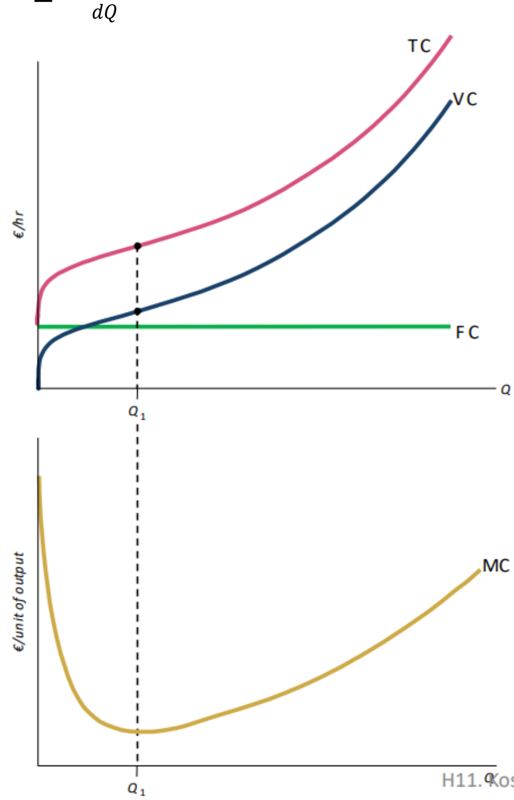
Short-run costs

In the short term we have:

- **Fixed costs (FC)**, a synonym for this is overhead costs.
  Where the cost of capital is defined as 'r' and fixed capital defined as K_0: FC = rK_0. You pay fixed costs even if you produce nothing.
- **Variable costs (VC)**, depends on how much you produce. The hourly wage we define as 'w', the hours worked we define as L_1 , and the output is defined as Q_1.
  $VC_{Q1} = wL_1$
- **Total costs (TC)**, this is the sum of fixed and variable costs
  $TC_{Q1} = rK_0 + wL_1$

How do we calculate the fixed costs. Let's say we have $F(K,\ L)\ =\ K^{1/2}L^{1/2}$, K_0 = 4, r = 2
The fixed costs are FC = rK = 4*2 = 8.
The quantity of labour: $Q(L)\ =\ K^{1/2}L^{1/2}\ =\ 2L^{1/2}\ <=>\ L(Q)\ =\ (Q/2)^2$
$TC_Q = FC + VC_Q = 8 + Q^2$

Marginal costs is the slope coefficient of the total costs.
$MC(Q)\ =\frac{dTC(Q)}{dQ}=\frac{d(FC+VC(Q))}{dQ}=\frac{dVC(Q)}{dQ}$



So we see that the MC is also the slope coefficient of the variable costs. If we want to illustrate this in a picture we can see that the inflection point of the TC and VC is the minimum point of the MC.

We can rewrite the marginal cost function also as $MC(Q) = \frac{w}{MPL}$. Here we can see that the slope of the TC and VC is inversely proportional with the slope of the TP. The inflection point of the functions will be the same, although the TP will diminishingly increase and the total cost will increase more than before. This works with the rules of diminishing returns. Which we talked about in the previous lecture.

Average costs:

- **Average Total Costs (ATC)**: $ATC(Q) = \frac{TC(Q)}{Q}$
- **Average Variable Costs (AVC)**: $AVC(Q) = \frac{VC(Q)}{Q}$
- **Average Fixed Costs (AFC)**: $AFC(Q) = \frac{FC}{Q}$

The relation between marginal/average costs:

$MC < ATC$: $ATC\ decreases$

$MC > ATC$: $ATC\ increases$

$MC\ hits\ ATC\ in\ its\ minimum$

$MC < AVC$: $AVC\ decreases$

$MC > AVC$: $AVC\ increases$

$MC\ hits\ AVC\ in\ its\ minimum$

Optimal allocation of short-term costs:

The optimum for short-term cost allocation is when $\mathbf{MC_1=MC_2}$

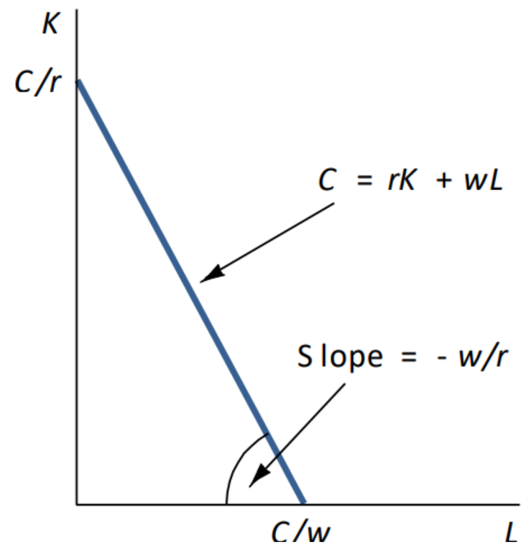
I will illustrate this with an example: imagine you have two factories with two total cost functions. $TC_1(Q_1)=10(Q_1)^2 + 10$, $TC_2(Q_2)=5(Q_2)^2 + 20Q_2 + 3$, $Q_1 + Q_2 = 31$

We can rewrite the last function as: $Q_1 = 31 - Q_2$

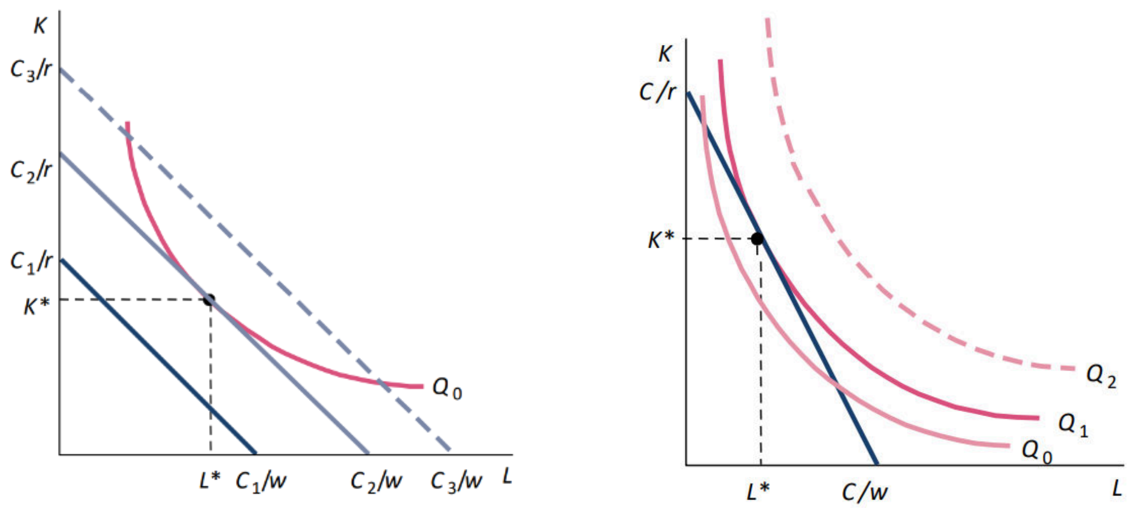
If we solve $TC_1(31-Q_2)=TC_2(Q_2)$ we will reach our answer. You can try this for yourself at home. The answer will be $Q_1 = 11$ and $Q_2 = 20$

Long-run costs

Isocost lines are like the budget curves of firms. In the long-term all production-factors are variabel. Therefore we define the isocost line as C = rK + wL. The slope coefficient of the line will be -w/r. It works almost the same as the consumer's budget curve, see the illustration for more.

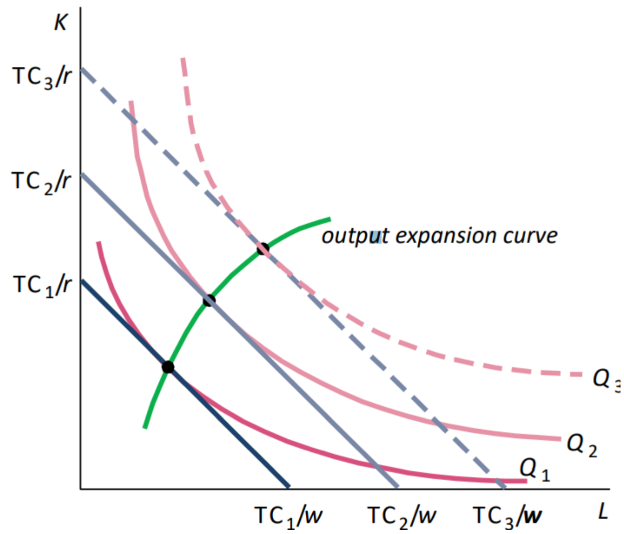


The **maximum output for a certain costs** is where $MRTS = \frac{w}{r}$. (We talked about the MRTS in previous lecture.) This equation can be rewritten as $\frac{MPl}{MPk} = \frac{w}{r}$. This works exactly the same when we are looking for the **minimum cost for a certain output**. See the difference in the illustration below.



The left illustration is the minimum cost for a certain output and the right illustration is the maximum output for a certain cost. Keep in mind that solving this works the same as solving for example the consumer problem. If you struggle with this I recommend looking back to that part of the summary.

The **output expansion curve** is the curve which measures the optimal cost allocation (most Q, quantity) for each amount of total costs.



- The **long-term total costs** will always go through the origin because in the long-term all the costs are variable.
- The **long-term marginal costs**: $LMC = \frac{dLTC}{dQ}$
- The **long-term average costs**: $LAC = \frac{dLTC}{dQ}$

Market structure and curves

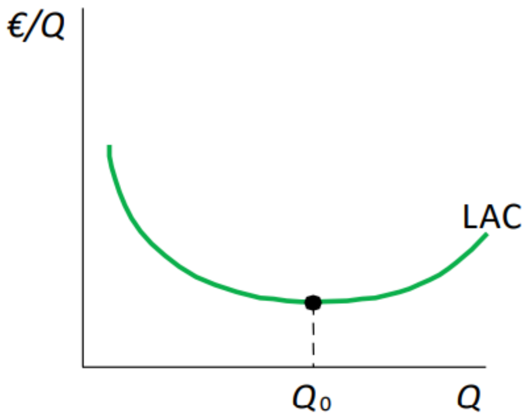
For constant returns to scale [F(cK, cL) = cF(K, L)], when output doubles the costs double, the LTC curve will be a straight line through the origin. The Long-run marginal costs will also be equal to the long-run average costs.

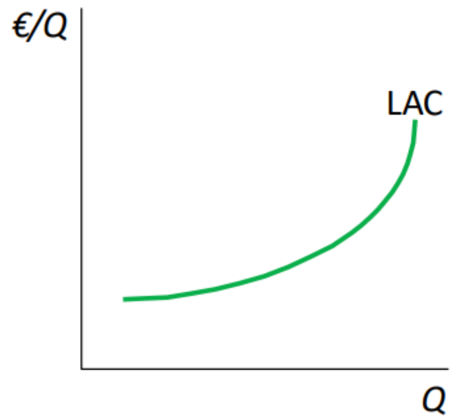
For decreasing returns to scale [F(cK, cL) < cF(K, L)], when output doubles the costs will increase more than double, the LTC curve will be a convex line through the origin. The long-run marginal costs and the long-run average costs will increase.

For decreasing returns to scale [F(cK, cL) > cF(K, L)], when output doubles the costs will increase less than double, the LTC curve will be a concave line through the origin. The long-run marginal costs and the long-run average costs will decrease.

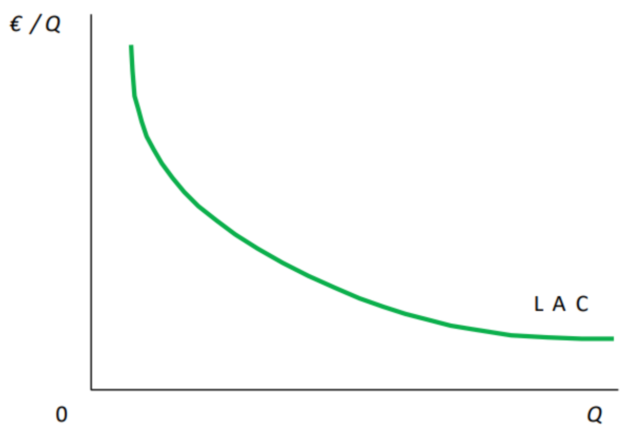
The shape of the LAC curve is decisive for the market structure.

In a competitive market you want to produce at the lowest costs. Therefore you will see that the LAC curves are increasing or U-shaped. This indicates a market with lots of small firms.





When there are increasing returns to scale the LAC will be decreasing. A firm that grows faster will produce cheaper. This firm will push other firms out of the market. This is called a natural monopoly:



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