EFR summary

Macroeconomics, FEB11002X

2024-2025

Lectures 1 to 6

Weeks 1 to 2

Details

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Macroeconomics - IBEB
Lecture 1 - Week 1

What is macroeconomics?

Macroeconomics is the study of **aggregated behaviour**.
Macroeconomics focuses on **consumers, business, the government & foreign countries**. It also focuses on markets where demand and supply plays a role. These are markets of goods, markets of labour and financial markets.
In this course we are gonna look for an **macro-economic equilibrium.** The government always wants to move towards an equilibrium. They can do this with policy.

Government Policy:

- Demand Policy
  - Budgettair policy
  - Monetary policy
- Supply Policy

Gross Domestic Product

The gross domestic product (GDP) is the most common measure of an economies output/production and income.
This is an **indicator for all the final goods and services produced in 1 country in the timespan of 1 year.**
You can measure GDP in **nominal terms** (current prices) or **real terms** (constant prices, volume)

The observation for most countries of GDP is that:

1. There is constant growth of the real GDP in the long-run (rising trend)
2. There are significant and returning fluctuations of the real GDP around this trend.

Since big countries often have a higher GDP it is hard to compare smaller to bigger countries. Although there is a way: **Gross domestic product per capita**: This is the gross domestic product divided by the amount of residents in a country.

Unemployment

The **unemployment rate** is the ratio of the amount of unemployed on the labour force.

- Unemployment rate = $\frac{unemployed}{labour\ force}$

The labour force = working people + unemployed

Where unemployed people are people who are actively looking for a job. Therefore young people, retirees and people who don't want to work aren't part of the labour force.

A property of unemployment is that it is countercyclical. That means when economic activity (production) is rising, the inflation will decrease.

Production Factors

Output is the result of the combination of inputs.
In this course we only take two inputs into account: labour and capital. Other inputs (land, energy, …) are also relevant although out of the scope of this course.

Inflation

Inflation is the **growth rate of the general price level in the economy** (in %).
Deflation is in question when there is negative inflation
Hyperinflation is in question when the inflation is greater than 50% on a monthly basis.

A property of inflation is that it is procyclical. That means when economic activity (production) is rising, the inflation will also rise.

Financial markets vs. the real economy

Financial/monetary economy is a part of the economy where there is trade in financial or monetary assets like obligations, shares, valuta, etc...

Real economy is a part of the economy where there is production and consumption of goods and services and incomes out of productive activities.

The financial/monetary economy and the real economy intersect partly. For example physical investments by businesses and consumer expenditure of households are influenced by the financial markets.

Openness of the economy

The **openness of the economy** is measured via international trade. Which is export and import.

$$Openness\ ratio\ =\ \frac{import + export}{BBP}$$

Because of globalization the openness of countries has increased. Smaller countries are often more open than bigger countries.

Countries are influenced by events in other countries. This is called **contagion**.

Long run and short run

In order to understand how **key economic variables** (GDP, inflation...) evolve, we need to distinguish between **short-run changes** (cycles) versus **long-run evolution** (trend). Macroeconomics tries to explain deviations (a short-run pattern) from the trend value, and how to smooth these fluctuations.

Short run	Long run
Fixed prices	Flexible prices
Consists of business cycles	Consists of a trend line
Has bigger fluctuations	Is smooth

In case of a shock the supply side usually has to adjudge	The economy's capacity to supply enough for the population matters in the long run.

Macroeconomic accounts

There are a few accounts which need to be studied in order to move on to more complex subjects.

The three definitions of Gross Domestic Product

First we need to distinguish between stock and flow variables. Flow variables are variables which are constantly changing like a river. Stock variables are variables which are measured at a specific point of time.

The gross domestic product is a flow variable, so it is constantly changing.

1. GDP = Sum of final sales within a geographic location during a period of time, usually a year.
   Keep in mind that intermediate sales (resales) are not taken into account with this.
2. GDP = Sum of value added occurring within a given geographic location during a period of time.
3. GDP = Sum of incomes earned from economic activities within a geographic location during a period of time.

There are also a few problems with the gross domestic product:

- Comparison over time can be hard. The GDP can increase for different reasons:
    - More real economic activity
    - Higher prices for the same economic activity
- Comparison across countries
    - Exchange rates are quite volatile
- Small countries hyave small GDPs
    - Solution: GDP per capita.

Nominal GDP = $P^x Q^x + P^Y Q^Y$ in an economy with 2 products, x and y.
However prices change, therefore we also have the

Real GDP = $P_0^X Q_T^X + P_0^Y Q_T^Y$. So this takes account for price changes by comparing the GDP by setting constant prices to for example the time period where they started measuring.

Measuring price level: GDP deflator = $\frac{nominal\ GDP}{real\ GDP}$.

The circular flow diagram

The circular flow diagram illustrates how factors in an economy work together. In the book which is used in the course, macroeconomics, a European text eighth edition (Burda & Wyplosz), on page 39 (fig 2.3) there is a very good illustration of this flow diagram. It is very useful to study this illustration.

We can conclude a few basic assumptions out of this diagram:

- Y = GDP, C = consumption of households, I = investments of firms, G = government spending, X = export, Z = import
- **T = net taxes** = taxes - transfers
- **Private income (households and firms)** = Y - T
- **Net private saving** = S - I
- **Total domestic spending (absorption)** = C + I + G
- **Net exports** = X - Z
- **GDP** = Y = C + I + G +X - Z (See definition 1 of GDP)
- **GDP** = Y = C + S + T (See definition 3 of GDP)
- Out of this follows C + S + T = C + I + G + X - Z which can be rewritten as **(S-I)+(T-G)=(X-Z)**

The **Gross National Income (GNI)** is the total amount of money earned by a nation's people and businesses.
The **Net National Income** is obtained by adding the money earned by people of a country living abroad and subtracting the money earned in your country by residents of another country. (Adding the **primary international income)**
The **Gross Disposable National Income (GDNI)** is obtained by adding the secondary international income (for example money earned by shares or obligations) to the Net national income.
The **Net domestic product (NDP)** is obtained by subtracting depreciation from the GDP.
Current account balance = X - Z = Y - (C + I + G) = Y(GDP) - A(**Absorption)**
Absorption = C + I + G

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Lecture 2 - Week 1

Growth theory

There are four main growth factors in the economy. These are:

- Capital (K) (This follows out of savings, which are used for investments).
- Growth of the labour force (L)
- Technological progress (A)
- Other factors which are out of the scope of this course.

The first three of these factors (K, L, A) are in the **Solow model**.

Just like in the microeconomics course there is a production function. Although this one is for the entire economy. See the summary of the microeconomics course for the basic information on production functions.

The **general production function** is written as: $Y = F(K_+, L_+)$. The plus signs mean that output will grow when these inputs grow.
The **Cobb-Douglas function** is written as $Y = K^{a}L^{1-a}$ with a in $0<a<1$. a is the elasticity of capital.

Just like in microeconomics, we have **Marginal productivity of capital and labour** in macroeconomics. These are found by taking the partial derivative of the production function. This works for both the Cobb-Douglas function as the general production function.

The law of diminishing returns (See micro) is also in question for the production functions.

The Cobb-Douglas function has the property of **Constant Returns To Scale (CRTS**, See micro). Other functions might have increasing or decreasing returns to scale.

We can obtain the **intensive form of the production function** if the production function has constant returns to scale. Below i will illustrate how you will have to do it. Make sure that you see the difference between K, k, Y, and y.

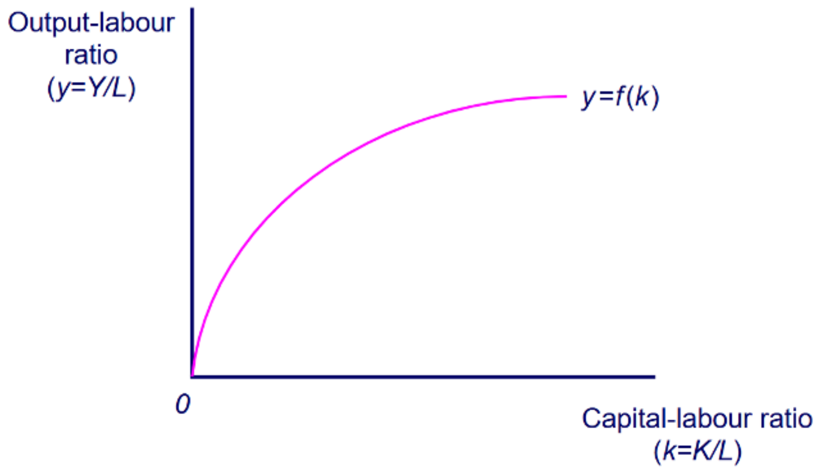
For constant returns to scale:

$cY = F(cK, cL)$ with $c = \frac{1}{L}$

$\frac{Y}{L} = F(\frac{K}{L}, 1)$

$y = f(k)$ with $y = \frac{Y}{L}, k = \frac{K}{L}$.

It is also possible to do this with the Cobb-Douglas function. I will challenge you to try it yourself. Below is illustrated how this works. It only works because we see L (labour) as a constant.



Kaldor's stylized facts

Kaldor's stylized facts are important features of long-term economic growth in reality. A theory therefore has to explain these facts.

1. Y/L and K/L keep increasing.
2. K/Y doesn't show a systematic trend
3. Y/L keeps rising, which means that labour becomes more productive and therefore the wages keep rising.
4. Y/K doesn't show any trend, which means that capital doesn't become more productive and profit doesn't have a trend.
5. The shares of labour and capital in the gross domestic product stay relatively constant.

Growth theory deals with where the long-term equilibrium lies. Even though it doesn't work the same as in microeconomics it is similar in some ways. We are looking for the **steady state** = state in which variables grow with constant rates or the variables are constant (growth rate = 0).

Solow's basic growth model

First we need to define all ingredients of this model:

- The production function is Y = F(K, L)
- K = capital, L = labour
- F(.,.) is a constant returns to scale function
- The endogenous variables are Y and K
- The exogenous variables are L
- The growth of L is the growth of the labour force which is for this lecture 0.
- Capital depreciates with a constant rate: δ.

Saving and investing

S = I, because this is a closed economy. Therefore all savings are invested by companies.

S = sY (in which s is fraction of the income)

I = sY

$\frac{I}{L} = s \cdot \frac{Y}{L} = s \cdot y$

Capital accumulation with depreciation:

$dK = I - \delta K$

$\frac{dK}{L} = \frac{I}{L} - \frac{\delta K}{L}$

$dk = \frac{I}{L} - \delta k$

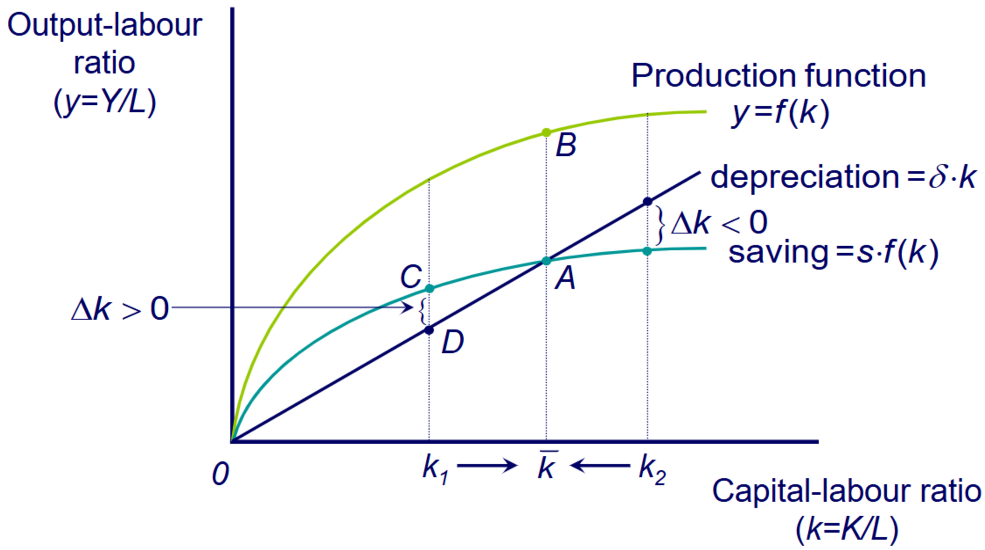
The full model can be summarised with 3 formulas:

- $y = f(k)$
- $\frac{I}{L} = s \cdot y$
- $dk = \frac{I}{L} - \delta k$

This can be summarised in the following function. $dk = sf(k) - \delta k.$

Now we want to know where this steady state is. This is where the quantity of capital doesn't change. In short where: $dk = 0 \Leftrightarrow sf(k) = \delta k$

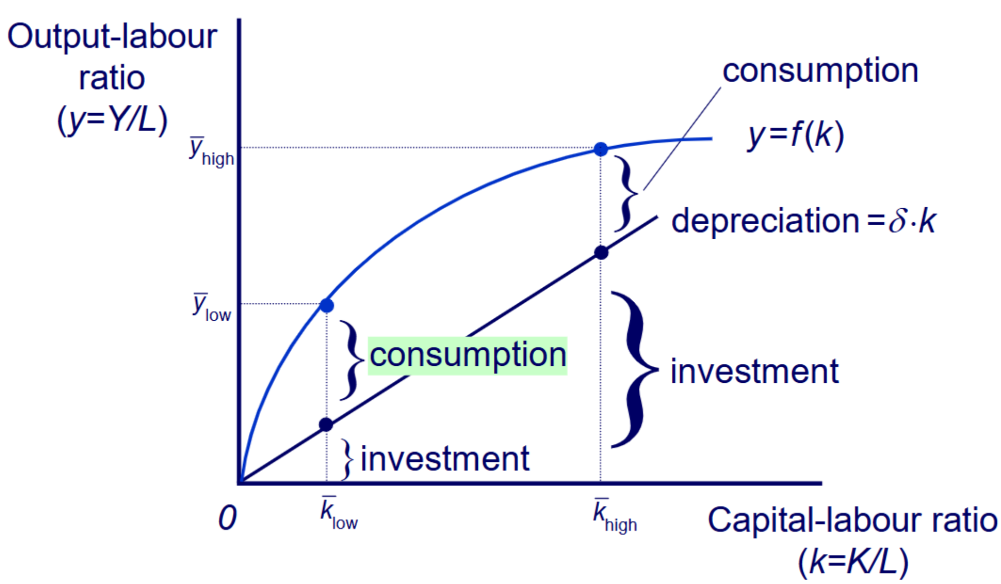
Below this steady state is illustrated with point A:



The "Golden Rule"

You might think that saving a lot might help for increasing the GDP. Although this isn't true. Saving money is a sacrifice, because you are delaying consumption. Consumption is essential for welfare.

The **Golden Rule** describes that maximising welfare is equal to maximising consumption per capita in the steady state. This can be mathematically written as: $c = y - sy = f(k) - \delta k$. When you maximise this formula you find the maximum of consumption - depreciation. This is illustrated below:



When you solve the maximising problem you will find that $MPK = \delta$. Where the slope coefficient of the production function is equal to the depreciation the income (Y/GDP) is at its maximum.

Below are a few exercises on the Solow model.
Give the intensive form of the production function:

$Y=K^{0,5}L^{0,5}$

A) Calculate the values for k, y and i in the steady state (use Question A):
   With $s = \delta = 0,1$ & $n = a = 0$
B) What is the golden rule value of S if:
   $Y=K^{0,5}L^{0,5}$
   $\delta = 0,1$
   $n = a = 0$

The solution are given below:

A) $\frac{Y}{L} = \frac{K^{0,5}}{L^{0,5}} \Leftrightarrow \frac{Y}{L} = (\frac{K}{L})^{0,5} \Leftrightarrow y = k^{0,5}$
B) $dk = sy - \delta k = 0$
   $sk^{0,5} = \delta k$
   $k = (\frac{s}{\delta})^2 = (0.1/0.1)^2 = 1$
   $y = k^{0,5} = 1$
   $i = sy = 0.1$
C) $MPK = \delta$
   $0.5k^{-0,5} = 0.1 \Rightarrow k = (0.5/0.1)^2 = 25$
   $y = 25^{0.5} = 5$
   $sy = \delta k \Rightarrow s = \frac{\delta k}{y} = 0.1 * 25/5 = 0.5$

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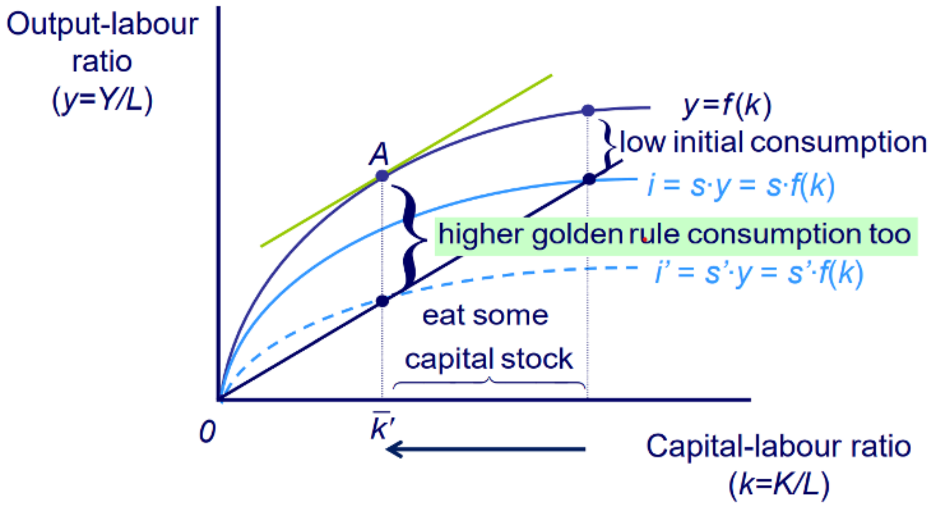
Lecture 3 - Week 1

The transition to the Golden Rule steady state

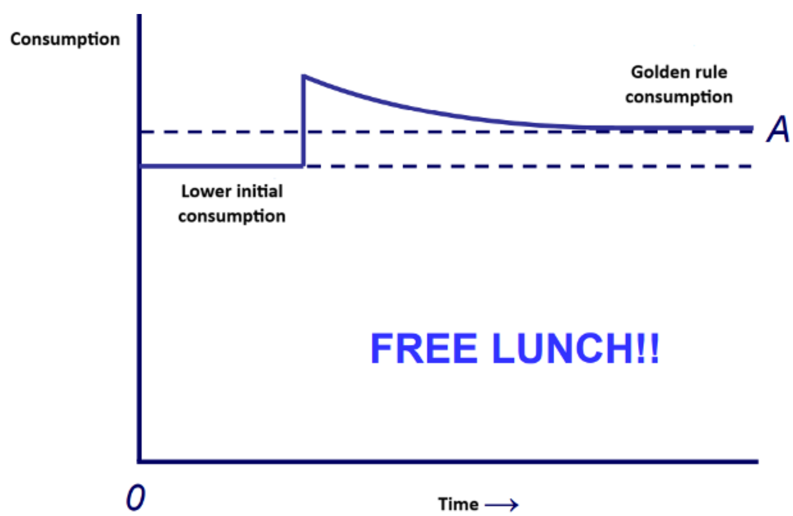
In the summary of the last lecture we have learned how to calculate the Golden Rule steady state savings growth rate. The economy won't move by itself to the Golden

Rule steady state. If the policymakers want to reach the Golden Rule steady state they shall have to change the savings growth rate. This change will lead to a new steady state with a higher consumption.

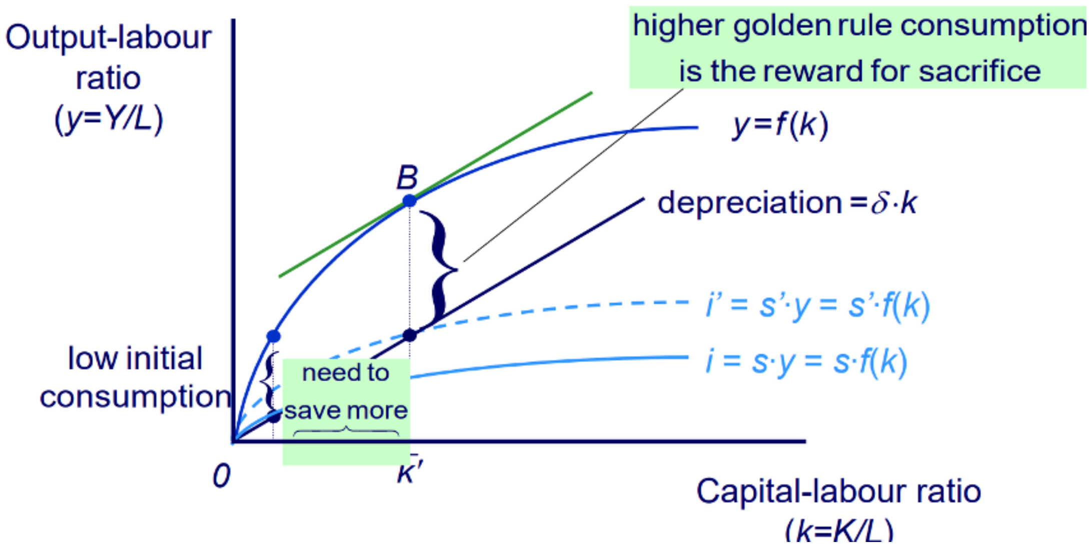
An economy is **dynamically inefficient** if it's possible to raise the consumption of all generations (possibly to the golden rule consumption) by lowering the savings. In short: there is too much capital.



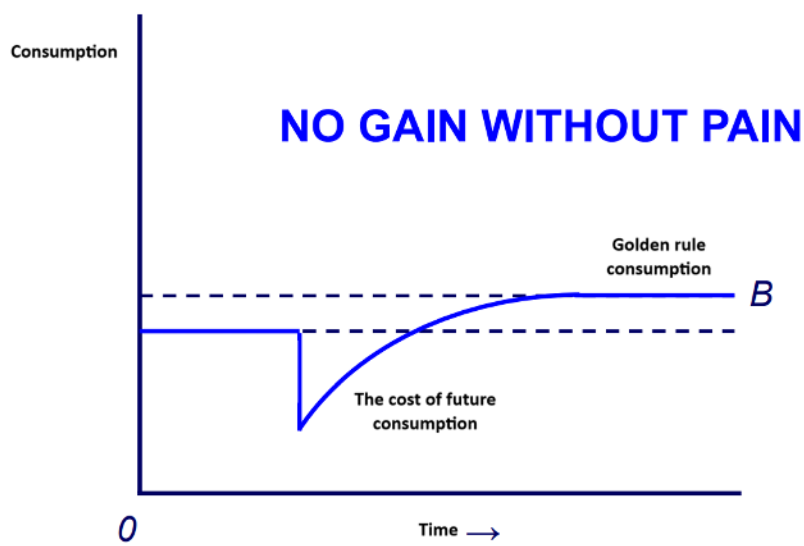
In the illustration above, we can see that by lowering the savings, which can be done by changing the investments to i' with savings growth rate of s', the golden rule consumption can be reached and it is also possible to first eat some capital stock. Which gives even more short-term consumption. In the end of course the amount produced isn't the goal but the amount of consumption is the goal. In the illustration below, you can see that by lowering the savings it will be possible to in the short-run get even more consumption, and in the long-run move to the golden rule amount of consumption.



An economy is **dynamically efficient** if it's possible to raise the consumption of future generations (possibly to the golden rule consumption) by raising the savings in the short-run. In short: Too little capital.



In the illustration above, we can see that by raising the savings, which can be done by changing the investments to i' with savings growth rate of s', the golden rule consumption can be reached. This comes at the cost of sacrifice of consumption in the short-run. In the long-run the golden rule of consumption will be reached. This is illustrated below.



The expansion of the basic Solow-model

A problem with the basic Solow-model is that with capital accumulation there isn't any permanent growth in the steady state of the base model. Therefore we will expand the model with **growth of population, =n, and technological progress, =a.**

First, we will look at the steady state with growth of population:
Let's say L grows with n, then we can conclude that:

- L_T=x*(1+n)^t

Let's say that capital-labour ratio and the output-labour ratio are constant and L grows with n, then the output Y and the capital goods stock K will also grow with n.

- $\Delta k = sf(k) - (\delta + n)k$

The capital accumulation has changed to the above formula. Let's look at the steady state:
$\Delta \bar{k} = 0 \Rightarrow sf(\bar{k}) = (\delta + n)\, \bar{k}$

So far k=K/L and y=Y/L are still constant. Although now L grows with factor n and therefore K and Y will also grow with factor n. ALthough the data shows that K/L and Y/L will keep growing on the long-run. The model doesn't explain that correctly at this point.

Therefore we will expand the Solow model with technological progress. Below is the new model illustrated:

- Y=F(K, AL) = F(K, E) [Cobb-Douglas: $Y = K^{\alpha}(AL)^{1-\alpha}$] Keep in mind that $a \neq \alpha$.
- A = The state of the technology
- $\frac{\Delta A}{A} = a$
- E=AL: Effective labour
- $y = \frac{Y}{AL}$, $k = \frac{K}{AL}$
- $\Delta K = sf(k) - (\delta + a + n)k$

In the steady state there are 3 kinds of variables:

1. Constant variables:
   $\frac{\Delta k}{k} = \frac{\Delta y}{y} = 0$
2. Variables with growth rate = a + n:
   $\frac{\Delta K}{K} = \frac{\Delta Y}{Y} = a + n$

3. Variables with growth rate = a:
$\frac{\Delta(Y/L)}{Y/L} = \frac{\Delta Y}{Y} - \frac{\Delta L}{L} = a, \frac{\Delta(K/L)}{K/L} = \frac{\Delta K}{K} - \frac{\Delta L}{L} = a$.

Keep in mind that Kaldor's stylized facts are still relevant and especially the continued growth of Y/L and K/L are explained better now.

The contribution of the three variables to the growth

How do we measure the contribution of the 3 variables (s, n, a) to the growth. In particular, technological growth is hard to measure. This is done as a residual factor: The **Solow residual**.

But first a few **rules with growth rates** to keep in mind!

- Definition of a growth rate: $\frac{\Delta X}{X}$
- The growth rate of a product: $\frac{\Delta(xy)}{xy} \approx \frac{\Delta x}{x} + \frac{\Delta y}{y}$
- The growth rate of a ratio: $\frac{\Delta(x/y)}{x/y} \approx \frac{\Delta x}{x} - \frac{\Delta y}{y}$
- The growth rate of a power: $\frac{\Delta(x^a)}{x^a} \approx a\frac{\Delta x}{x}$

Now let's see how to find the Solow residual out of the Cobb-Douglas function, keep in mind that $\alpha \neq a$(alpha isn't a):

$Y = AK^{\alpha}L^{1-\alpha}$

$\frac{\Delta Y}{Y} = \frac{\Delta A}{A} + \alpha\frac{\Delta K}{K} + (1 - \alpha)\frac{\Delta L}{L}$

Solow residual: $\frac{\Delta A}{A} = \frac{\Delta Y}{Y} - \alpha\frac{\Delta K}{K} - (1 - \alpha)\frac{\Delta L}{L}$

There is still some criticism on the Solow model. The Solow model sees technological progress as exogenous and the savings rate also. This does a poor job at reflecting reality because it doesn't explain why these variables are what they are.

Macroeconomics - IBEB
Lecture 4 - Week 2

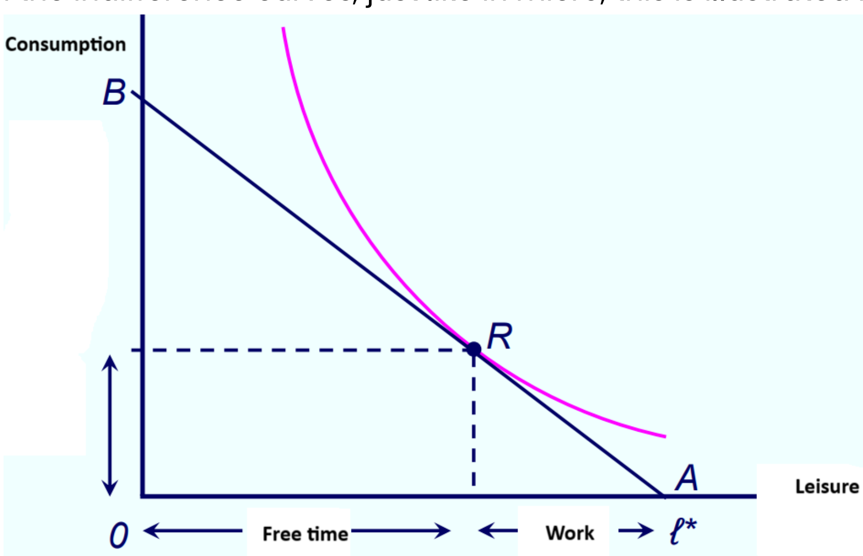
The labour market

The **supply of labour** is derived out of the utility maximization of employees. This works the same as in microeconomics. The employees consider the amount of consumption and free time they want. The **Marginal substitution ratio** between consumption and leisure is equal to the real wage rate.

The next part will be a lot like microeconomics. Therefore we use indifference curves and budget constraints. Let's first look at the supply of labour:

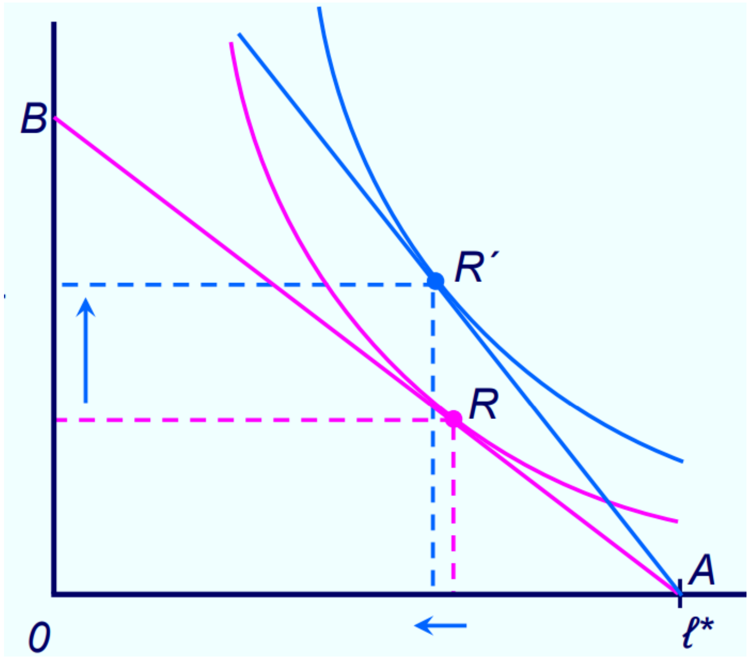
- **The budget constraint:** $C = al + b$
  With C being the real consumption. L is the free time in hours (leisure)
- The consumptive spendings being P(price) * C(consumption)
- The amount of available hours being: $l*$ and the hours worked being: $l * - l$
- The income being a function of the nominal hourly wage: W($l * - l$)
- The slope coefficient of the budget constraint = -w with w = W/P

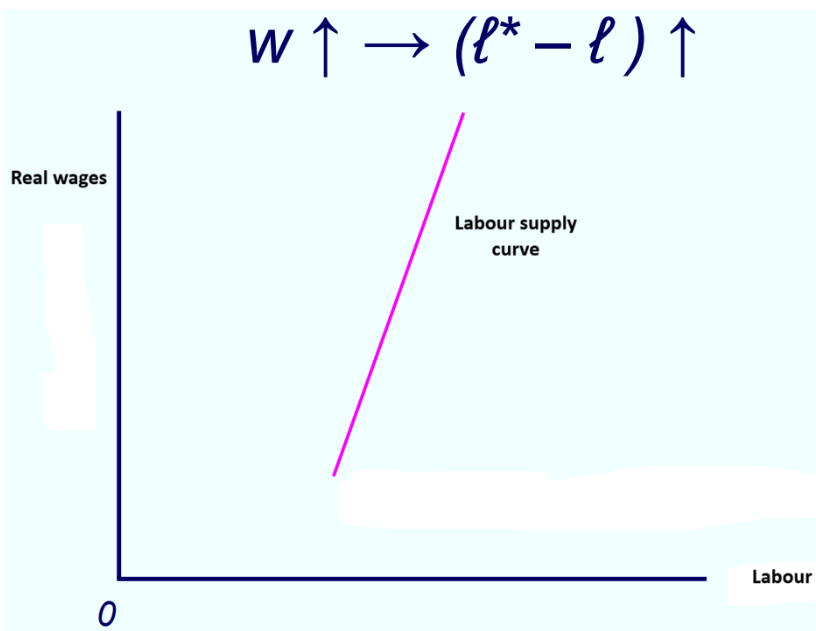
Together with the indifference curves, just like in micro, this is illustrated below:



The optimum of this scenario is where the MRS is equal to the budget constriction = -w. This is done by using the same utility maximization methods as in micro: max. U(C, l) while C = al + b.

Let’s say now that there is a real wage rise and therefore the optimum changes. If we do this for every possible wage and connect the points we get the **labour supply curve**. This is illustrated below in the 2 pictures:



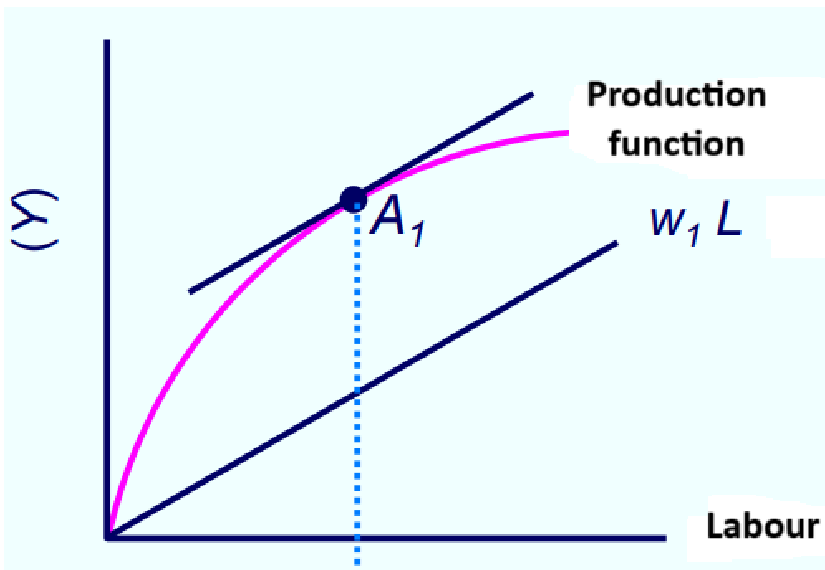


Labour demand

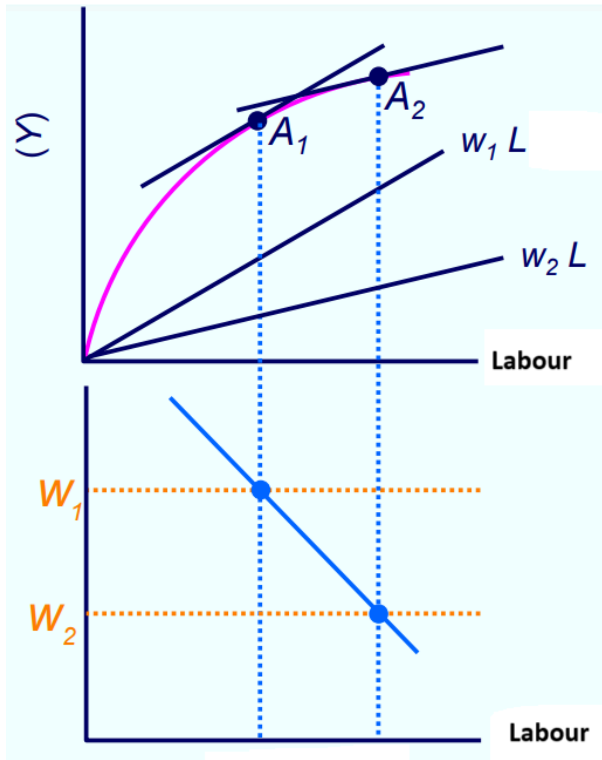
The demand of labour is derived from the winstmaximising of firms. This is at the point where marginal labour productivity equals the real wages.

The demand of labour decreases if the real wages rise and **rises because of increases in capital and technological progress.** This is a pitfall for lots of students. You might think demand for labour decreases because of technological progress, although technological progress makes labour more efficient. Therefore will the demand of labour rise.

In this case the labour will maximise the production (Y) minus the real wages (wL). This is illustrated below, and is done by taking the derivative of the production function minus the real wages and setting it to 0.



We now want to derive the **labour demand** curve. This is done by changing the wage rate (w) and taking the profit maximizing point for each rate. This is illustrated below, and can be illustrated in the demand curve.



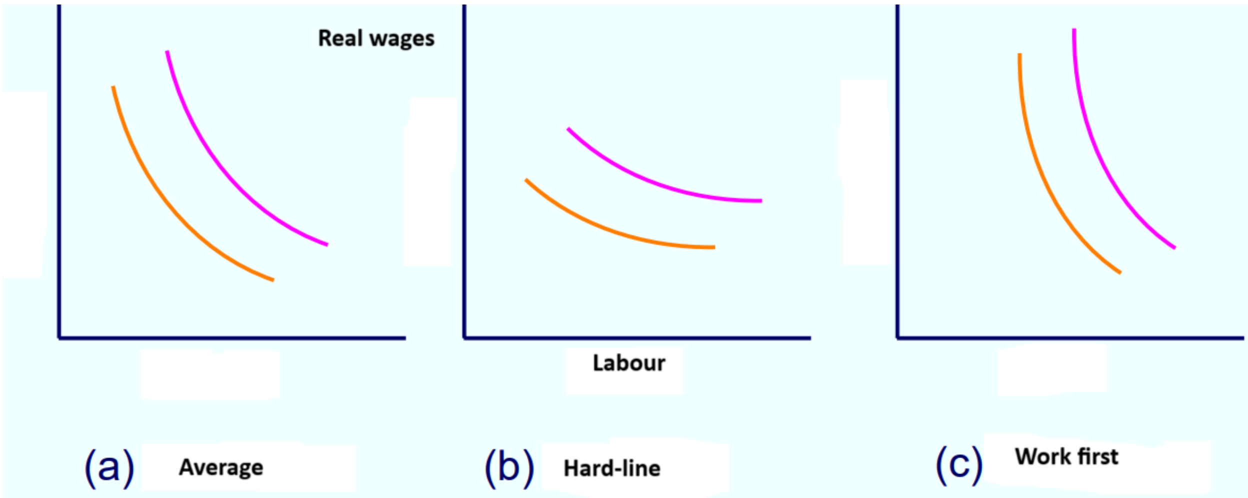
Types of unemployment

Voluntary unemployment is unemployment where people looking for work, can find it. They choose not to work however, because they find the wages too low.
Involuntary unemployment is unemployment where people are willing to do work for the prevailing wage, although that work isn't there for everyone. This unemployment is structural in its nature. This is explained by **downward real wage rigidity**. This lecture we will look at examples of this: minimum wages and labour unions.

A minimum wage is a wage higher than the equilibrium. This is regulated by law and prevents exploitation. However, firms don't hire employees with a lower labour productivity than the real wages. This leads to involuntary unemployment.
The difference between the labour force who is willing to work for the minimum wage and the labour demand at the minimum wage is the involuntary unemployment.

Labour unions represent employees and take over their indifference curves. They stand up for the interests of "**insiders":** the people who have work.
Because the labour unions represent a lot of people they can push the wages up.
This also makes for a higher unemployment rate ("outsiders").

Below the indifference curves of labour unions are illustrated:



The extra power a labour union has makes for it that the collective labour supply lies higher than the household labour supply. This makes for it that the real wages are higher, but there is more unemployment.

Equilibrium unemployment: This is long-term unemployment where there is absence of cyclical effects:

- **Structural unemployment:** because of downward real wage rigidity
- **Friction unemployment:** because of a temporarily "no match" between vacancy and job seeker (for example students who graduated looking for a
- job)

Cyclical unemployment: This is short-term unemployment caused by recessions.

The model of unemployment

The model of unemployment:

- $L^S = L + U$ with
- L^S = labour force
- L = The employed
- U = The unemployed
- $\Delta U = sL - fU$
- s = the fraction of the labour force losing its job
- f = the fraction of the unemployed gaining a job

- $\Delta U = 0 \Leftrightarrow sL = fU^E \Rightarrow s(L^S - U^E) = fU^E \Rightarrow sL^S = (s + f)U^E$
- If we want to express the unemployment in a fraction of the total labour force we can set: $u^E = \frac{U^E}{L^S} = \frac{s}{s+f}$.

Macroeconomics - IBEB
Lecture 5 - Week 2

Monetary neutrality

The supply of the total amount of money is decided by the monetary authority: the central bank. In the Eurozone, this is the European Central Bank (ECB).

The **neutrality principle:** Money only influences nominal variables in the long-run. Therefore nothing changes in the real economy. One important thing to note is that because of the neutrality principle, prices have to grow with the same rate as the amount of money.
$\pi = \frac{\Delta P}{P} = \frac{\Delta M}{M}$.

Transactions (T) are a primary motive for the money demanded (M). People keep a share (k) of their money to fulfill their purchases. The expenditure is equal to the amount of transactions times the average price per transaction (P*Y). Transactions (T) depend on the real GDP (Y).
From this the **Cambridge equation** of Pigou can be set up:
$M = kPT \Leftrightarrow M = kPY$

The **turnover rate**, so the amount of times M is spend per period is given by: $V = \frac{1}{k}$.

If the average prices rise it is possible to do less transactions with the given M. Therefore the real cash is relevant: $\frac{M}{P}$.
We can rewrite the to: $\frac{M}{P} = kY$.

The neutrality principle says money doesn't influence the long term growth of a country. Although the opposite isn't true. The growth of a country does influence the real cash demanded. We can see this be writing the cambridge equation in growth rates:
$\frac{\Delta M}{M} = \pi + \frac{\Delta Y}{Y}$. You can see that dY/Y, the growth rate of a country, does influence the growth rate of the money demanded. We can also rewrite this equation to get the inflation: $\pi = \frac{\Delta M}{M} - \frac{\Delta Y}{Y}$

Exchange rates

The nominal exchange rates can be written in two main ways:

1. The British definition: Amount of foreign valuta / 1 domestic valuta (S = 1,35$/1€)
2. The European definition: Amount of domestic valutas / 1 foreign valuta (X€/1$)

In this course and in the book we use the British definition. We'll define S as the nominal exchange rate. Therefore when S increases that leads to a nominal appreciation of the euro and a nominal depreciation of the dollar.

- S = nominal exchange rate british definition)
- P* = Prices of foreign goods (in $)
- P = Prices of domestic goods (in €)

The **real exchange rate** is given by: $\sigma = \frac{SP}{P*}$.
The real exchange rate measures the amount of foreign goods you can buy with 1 unit of domestic goods. Keep in mind that if the real exchange rate increases the domestic valuta depreciates. This is the opposite with the nominal exchange rate.

Purchasing power parity (PPP)

Relative purchasing power parity gives that the real exchange rate is constant in the long-run:
$\frac{\Delta\sigma}{\sigma} = \frac{\Delta S}{S} + \pi - \pi * = 0$
And therefore: $-\frac{\Delta S}{S} = \pi - \pi *$
Absolute purchasing power parity (Law of One Price) gives that the real exchange rate is constant in the long-run and the real exchange rate is equal to 1:

- $\frac{\Delta\sigma}{\sigma} = \frac{\Delta S}{S} + \pi - \pi * = 0$
- $\sigma = \frac{SP}{P*} = 1 \Rightarrow S^{PPP} = \frac{P*}{P}$

Macroeconomics - IBEB
Lecture 6 - Week 2

Intemporal budget constraint

Intemporal budget constraints are equations which connect the past, today and the future for different sectors.
We are gonna look different sectors:

- Consumers
- Producers
- Government
- Economies of countries as a whole

Consumers

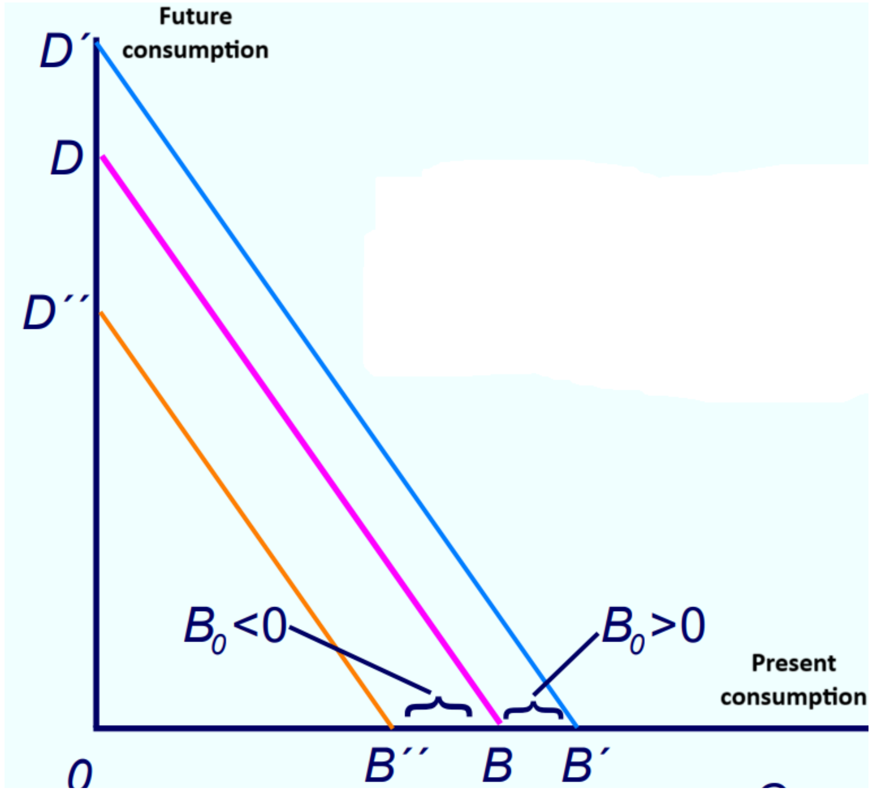
Let's start with the budget constraint for the consumer, in this case there are two periods: present and future.

- Income present/future: Y_1/Y_2
- Consumption present/future: C_1/C_2
- Real interest (debit&credit): r
- Vision from period 2: $C_1*(1+r) + C_2 = Y_1*(1+r) + Y_2$
- Vision from period 1: $C_1 + C_2 /(1+r) = Y_1 + Y_2/(1+r)$
- It is always possible to consume Y_1 in period 1 and Y_2 in period 2 (C_1=Y_1 & C_2=Y_2)

Now let's say you own a heritage since the start of period 1. We call this heritage B_0.
This changes the intemporal budget constraint to:

- $C_1*(1+r) + C_2 = (Y_1+B_0)*(1+r) + Y_2$

It is also possible that the heritage is a debt. Then B_0 will be negative.
Below is an illustration of this:



This subject is for big parts so if you find it challenging so far i suggest looking into the microeconomics summary of intertemporal budget constraints.

Producers

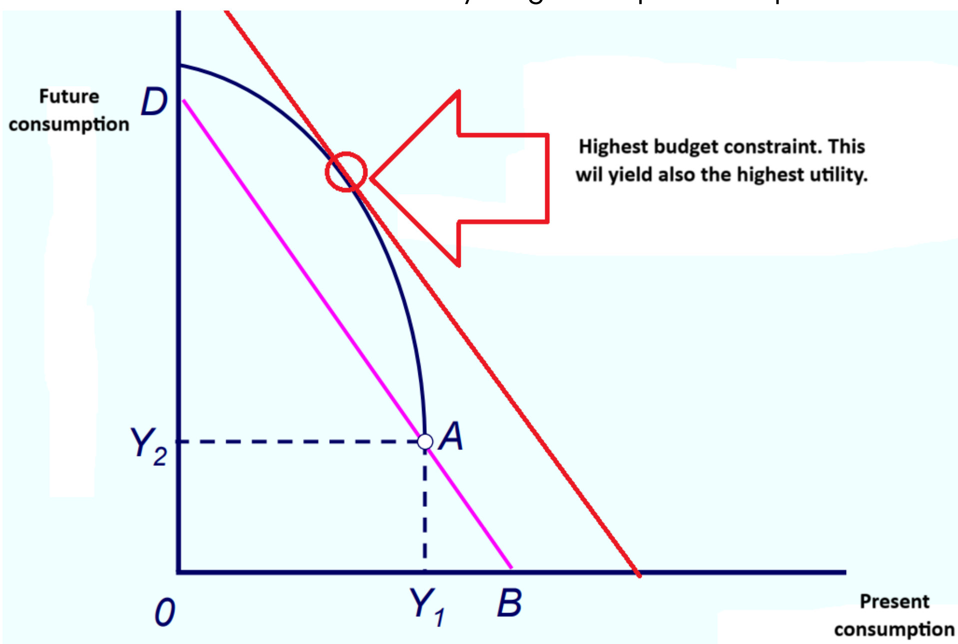
We know that the production-function is given by Y = F(L, K) although in lecture 2 & 3 of week 1 we learned how to write the production function in its intensive form: Y = F(K). We are interested in the capital because it's possible to invest in capital instead of saving money for interest.

We want to invest in physical capital if this yields more than a financial investment. Formally this is written as: F(K) > K(1+r) where the yields of a financial investment are given by K(1+r).
This can be rewritten as $\frac{F(K)-K}{K} > r$. Which translates to the net return on physical investment > return on financial investment. So as long as the production function line is above the opportunity cost line of investment (K(1+R)) profits are being made.

We know that consumers have a big influence on producers. They are the producers (CEO's, investors, etc). Therefore it's possible to rewrite the intertemporal budget constraint of consumers to include the production functions.

- From the vision of period 2: $C_1*(1+r) + C_2 = (Y_1-K)(1+r) + Y_2 + F(K)$
- From the vision of period 1: $C_1 + C_2/(1+r) = Y_1 - K + (Y_2+F(K))/(1+r)$

Below is illustrated how this is visualised. Note that the production function is mirrored because if we move to the left with present consumption, more is invested. Therefor because of diminishing returns, the production function will first increase a lot after which the increases diminish. Our goal is to reach the highest budget constraint with the production function. Therefore it isn't smart to invest everything in this particular production function.

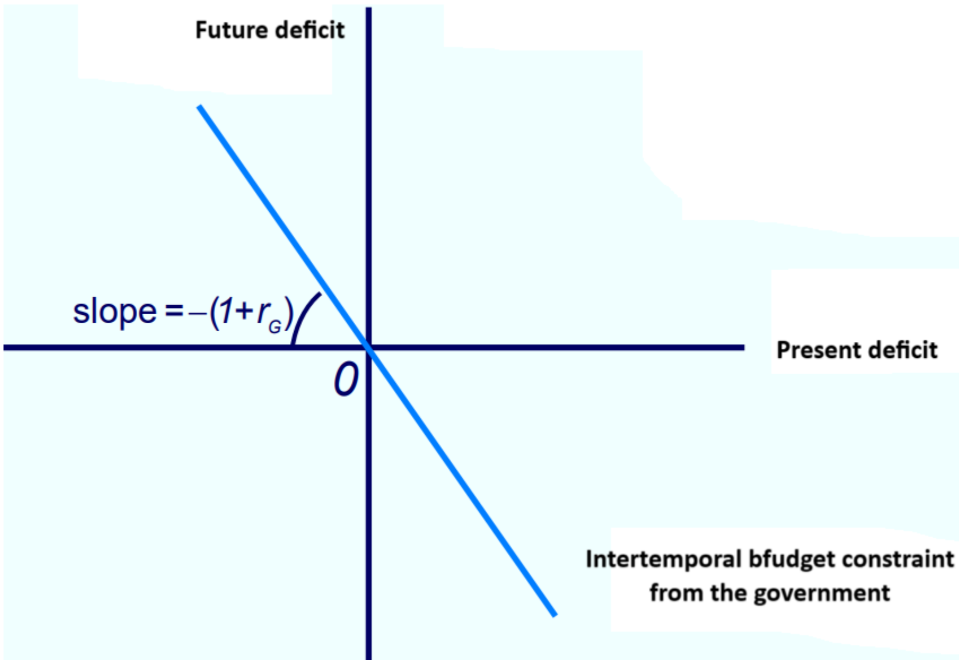


Government

The government's intertemporal budget constraint is also very relevant in macroeconomics. I will set the budget constraint up below.

- Old debt: G_1
- Government spendings in period 1/2: G_1/G_2
- Government income (tax) in period 1/2: T_1/T_2
- Government interest: r_G
- $(1+r_G)(D_1+(G_1-T_1))=T_2-G_2$

This budget constraint explains that the debts the government now makes has to be paid back in the future. Let's illustrate this without debt from the past: $D_1=0 \Rightarrow (1+r_G)(G_1-T_1)=T_2-G_2$



We can see that at points where there is a future deficit there is no present deficit and at points where there is a present deficit there is no future deficit.

Ricardian equivalence

Ricardian equivalence assumes consumers are very smart. They keep the government's budget constraint (less tax now is more future tax). We can illustrate how their budget constraint changes for Ricardian equivalence:

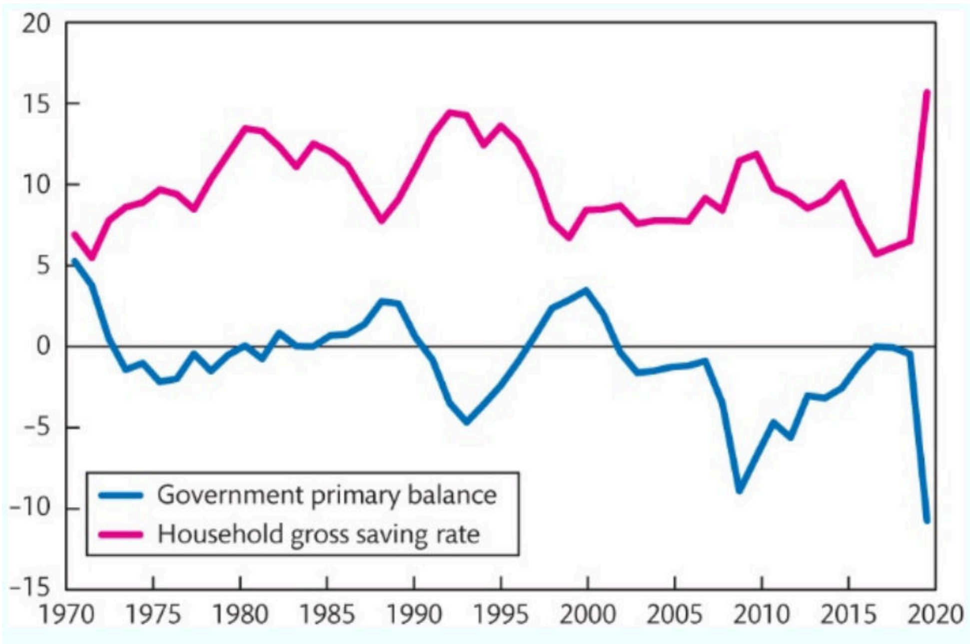
- $C_1 + C_2/(1+r)=(Y_1-T_1)+(Y_2-T_2)/(1+r)$
- $G_1 + G_2/(1+r_G)= T_1 + T_2/(1+r_G)$
- Ricardian equivalence assumes that $r_G = r$. Keep this in mind. If this isn't the case there isn't Ricardian equivalence.
- If we sum the first two equations we get: $C_1+C_2/(1+r) = (Y_1-G_1)+(Y_2-G_2)/(1+r)$

We see that in this ricardian budget constraint the consumer keep the government spending in mind. We can also see that taxing (T) has disappeared out of the constraint. Tax changes don't influence the consumption anymore.

There are a few reasons why ricardian equivalence doesn't apply:

- Keynes: "In the long run we are all dead". So basically the consumer doesn't care if there is a shortage for the government when he dies.
- The consumer doesn't get credit, for example a loan.
- The government pays a lower interest than the private sector: $r_G<r$

Below you can see an illustration in which it looks like Ricardian equivalence is relevant until 1995, because the government primary balance and household gross saving rate are inversely related.



Whole economy (country)

The current account (CA) in the balance of payments consist of:

- The primary current account (PCA = X - Z)
- + interest earnings/costs on the net assets compared to foreign countries (F)
- CA = PCA + rF
- In a model with two periods: $PCA_1+PCA_2/(1+r)>=-F_1$

Reference list

Burda, M. Wyplosz, C. (2022). Macroeconomics: A European Text[Book].

Pozzi, L (2024) Macroeconomics Lecture 1 PDF. Retrieved from: https://canvas.eur.nl/courses/47733/files/99955811?module_item_id=1321850

Pozzi, L (2024) Macroeconomics Lecture 2 PDF. Retrieved from: https://canvas.eur.nl/courses/47733/files/99972195

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