Recapitulation of the last lecture

We defined GDP as the sum of all domestic consumption expenditures (private consumption, investment and government consumption) plus exports minus imports

Using this, Austria’s GDP in 2007 can be decomposed as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Billons of €</th>
<th>% of GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Consumption (C)</td>
<td>173.65</td>
<td>64.12%</td>
</tr>
<tr>
<td>Investment (I)</td>
<td>60.88</td>
<td>22.48%</td>
</tr>
<tr>
<td>Government consumption (G)</td>
<td>19.58</td>
<td>7.23%</td>
</tr>
<tr>
<td>Inventory changes</td>
<td>0.88</td>
<td>0.32%</td>
</tr>
<tr>
<td>Exports (X)</td>
<td>161.42</td>
<td>59.60%</td>
</tr>
<tr>
<td>Imports (Q)</td>
<td>-145.45</td>
<td>-53.70%</td>
</tr>
<tr>
<td>GDP (Y)</td>
<td>270.84</td>
<td>100%</td>
</tr>
</tbody>
</table>
Recapitulation of the last lecture

IMPORTANT

A decomposition does however not explain how GDP will respond to sudden changes in one of its components.

In the following sessions we try to explain GDP.

In other words, we will try to understand the effect people’s consumption decision, firms’ investment decisions and government’s consumption decisions have on aggregate output using a simple model inspired by John Maynard Keynes.
The first step towards the IS-LM model

- The IS-LM model was first presented informally by John Maynard Keynes in "The General Theory of Employment, Interest, and Money" (published in 1936)
- John Hicks presented the IS-LM model as we discuss it in 1936
- The IS-LM model studies the **simultaneous equilibrium** on a goods and a financial market
- The IS-LM model is a **static** model, i.e. adjustments to the equilibrium occur instantaneously
- The **endogenous variables** of the IS-LM model are output (production/income, Y) and the interest rate (endogenous variables are determined in equilibrium (or explained by the model), whereas exogenous variables are taken as given)
The first step towards the IS-LM model

- As a first step, we will discuss the equilibrium on an isolated goods market where the level of real GDP will be determined by the equality of supply (or production) and aggregate demand.
- After that, we will discuss the equilibrium on an isolated financial market where the interest rate will be determined by the equality of money supply and money demand.
- Finally, we will connect the two markets by assuming that investment demand depends on the interest rate and by assuming that money demand depends on the level of real GDP. An equilibrium is then defined as a situation in which production and demand are equal on the goods market and in which money demand equals money supply at the same time.
Assumptions of our Model

1. We are only concerned with the **short run**: prices are constant
2. There is **only one good** in the economy. This good is used for private consumption, for investment and for government consumption.
3. Firms are willing to supply any amount of the good at the given price ⇒ in equilibrium supply will equal demand
4. The economy is **closed**, i.e. there are no exports or imports (and no other relationships with foreign countries such as people working abroad, …)
Discussion of Assumptions

- Empirically, prices are indeed constant in the short run. This can be explained by:
  - menu costs: changing prices is associated with costs ("printing new menus") and will take some time
  - Therefore, firms will not immediately respond to changes in demand with changing the price they charge but instead simply change their production (working overtime, ...)
- Actually, people consume more than just one good. But we can think of the single good in the model as a whole consumer basket. Assumption 2 is only made for simplicity!
- There are (almost) no closed economies. Assumption 4 is wrong, but a simplification! We will start discussing the model with an open economy at the end of the course.
Decompositions of GDP show that private consumption is by far the most important part of demand.

Households base their demand decisions on their disposable income $Y_D$.

We can define the consumption function of households as:

$$ C = C(Y_D) \text{ with } C' > 0 $$

Disposable income of households is given by their income $Y$ minus the taxes they pay and plus the subsidies they receive, i.e. by

$$ Y_D = Y - T $$

where $T$ captures net taxes (taxes minus subsidies).
A linear Consumption Function

For simplicity, we assume that private consumption is a linear function, i.e. if households receive an additional unit of disposable income they increase their consumption by the same amount regardless of their prior income:

\[ C = c_0 + c_1 Y_D \]
A linear Consumption Function

A linear consumption function can be fully described by two exogenously given parameters:

- **the intercept $c_0$**
  - is referred to as *autonomous consumption*, i.e. consumption without any disposable income
  - captures the level of consumption necessary for survival (so $c_0 > 0$)
  - is financed by dissaving (selling assets or borrowing)

- **the slope $c_1$**
  - is referred to as the *marginal propensity to consume*
  - captures by how much households increase their consumption if their disposable income increases marginally
  - $0 < c_1 < 1$
For now, we will take investments as exogenously given, i.e. we assume that

\[ I = \bar{I} \]

for some fixed value \( \bar{I} \).

In order to establish the link with the financial market we will change this assumption later on by assuming that investments depend negatively on the interest rate and positively on production.
Government Consumption (G)

- Government consumption and taxes are **exogenous parameters** of the model, i.e. $G = \bar{G}$ for some fixed value $\bar{G}$ and $T = \bar{T}$ for some fixed value $\bar{T}$.

- This assumption allows us to analyze questions such as ”What happens when the government suddenly increases its consumption or taxation?”

- We will also be able to compare the effects of fiscal policy under different regimes, e.g. with a government that wants to maintain a balanced budget or with a government that doesn’t care about running a budget deficit.
Assuming that the government only collects lump sum taxes (taxes which do not depend on households’ income, but are the same for each income level) is again a simplification.

Instead we can assume that government uses a linear tax scale, i.e.

\[ T = t_0 + t_1 Y \]

with \(0 < t_1 < 1\)
The goods market is in equilibrium if demand \((Z)\) and supply are equal.

Using the definition of demand \((Z \equiv C + I + G)\) and the assumptions we have made on \(C\), \(I\) and \(G\) we get:

\[
Z = c_0 + c_1 (Y - T) + I + G
\]

Supply in the economy is given by \(Y\) (recall that GDP can also be defined as the value of the produced output in the economy).

The **equilibrium condition** for the goods market is therefore:

\[
Y = Z
\]

or equivalently

\[
Y = c_0 + c_1 (Y - T) + I + G \tag{1}
\]
In order to find the equilibrium level for $Y$ we can use a graphical analysis:

1. we plot demand $Z$ as a function of income $\Rightarrow$ the line $ZZ$ in the diagram

2. we plot supply/production $Y$ as a function of income $\Rightarrow$ 45° line ($Y = Y$)

3. we look for the intersection of the two lines (setting demand equal to supply)
3-3  The Determination of Equilibrium Output

Let's consider the following equation:

\[ Z = cI + G + cTcY \]

First, plot production as a function of income. Second, plot demand as a function of income. In Equilibrium, production equals demand. Equilibrium output is determined by the condition that production be equal to demand.

Equilibrium in the Goods Market

Figure 3 - 2
Using a Graph
Equilibrium on the Goods Market - Algebraic Solution

However, for a precise analysis we also want to calculate the equilibrium level of $Y$ algebraically:
This can be done by reformulating the equilibrium condition (1):

\[(1 - c_1) Y = c_0 + I + G - c_1 T\]

\[Y = \frac{1}{1 - c_1} \left( c_0 + I + G - c_1 T \right) \quad (2)\]
Equilibrium on the Goods Market - Interpretation of the Solution

From (2) we see that equilibrium output $Y$ is a multiple of **autonomous spending** $c_0 + \bar{l} + \bar{G} - c_1 \bar{T}$:

- Goods market equilibrium output is positive provided that autonomous spending is positive. This case is very likely since it only requires that the surplus of the government $T - G$ is not too large.
- If autonomous spending were negative, there would be no equilibrium output level (for all positive $Y$ there would be excess supply on the goods market) $\Rightarrow$ we rule this case out by assuming that autonomous spending is positive.
- The factor $\frac{1}{1-c_1}$ is referred to as the **multiplier** and is larger than 1 $\Rightarrow$ if autonomous spending (e.g. $\bar{G}$) is increased by €1, the value of equilibrium output will increase by more than €1.
The Multiplier - A Graphical Analysis

Suppose that autonomous consumption increases by $\Delta = 1$ billion, in the diagram this corresponds to a parallel upward shift of the ZZ curve:
The initial increase in autonomous spending by $\Delta$ has the following effects:

1. If demand increases by $\Delta$ ($A \rightarrow B$), production ($Y$) must also increase by $\Delta$ in order to maintain the equilibrium on the goods market ($B \rightarrow C$).

2. Since production has increased by $\Delta$, the disposable income of households will also increase by $\Delta$ and households will increase their consumption further by $c_1 \Delta$ ($C \rightarrow D$).

3. In order to maintain the equilibrium on the goods market, production ($Y$) must also increase by $c_1 \Delta$ ($D \rightarrow E$).

4. Because of this increase in production, incomes increase by $c_1 \Delta$ and households will increase their consumption by $c_1 (c_1 \Delta)$ and so on.
The Multiplier

The Multiplier Effect

The total effect of an increase in autonomous spending by \( \Delta \) on equilibrium output is therefore given by:

\[
\Delta + c_1 \Delta + c_1^2 \Delta + \ldots = \Delta \sum_{j=0}^{\infty} c_1^j = \Delta \frac{1}{1 - c_1}
\]

where we have used that \( 0 < c_1 < 1 \).

If \( c_1 \) were larger than one, output would diverge to infinity (increase forever).
How long does the Adjustment Process take?

- The adjustment to the new goods market equilibrium \( A' \) occurs instantaneously.
- Thinking that the adjustment occurs in successive rounds as we have done before is only a tool to understand the process.
- Actually, production will respond immediately to increased demand and demand will respond immediately to increased income \( \Rightarrow \) all steps described above occur at once.
An Increase in Taxes

Suppose that government increases the taxation by one unit

Then we see from (2) that the level of $Y$ clearing the goods market will decrease by $\frac{c_1}{1-c_1}$, i.e. the effect of changing taxes is smaller than the effect of changing for example $G$

To see this, note the following:

- an increase in taxes by one unit only affects demand because it decreases disposable income by one unit
- since only a fraction ($c_1$) of disposable income is spent on private consumption, demand initially decreases only by this fraction
- if however $G$, $c_0$ or $I$ change by one unit, demand will initially change by one unit as well
A Different Way of Defining Goods Market Equilibrium

- When Keynes formulated the IS-LM model he focused not on supply and demand, but on saving and investment.
- In order to do so, note that the equilibrium condition on the goods market \( Y = C + I + G \) can be rearranged to yield:

\[
Y - T - C = I + G - T
\]

- Now note that the part of households’ disposable income that is not used for consumption must be used for private saving \( S \), i.e.

\[
S = Y_D - C = Y - T - C
\]

- Inserting this definition of private saving into the rearranged goods market equilibrium condition yields:

\[
S = I + G - T \iff S + T - G = I
\]
A Different Way of Defining Goods Market Equilibrium

- Since $S$ captures private saving and $T - G$ constitutes public saving, this equilibrium condition says that in a goods market equilibrium $Y$ is such that investment equals total saving in the economy.
- This is also why the goods market equilibrium will be represented by the IS-curve in the full model.
The two definitions of the goods market equilibrium are equivalent, i.e. the equilibrium output level calculated using the equilibrium condition "Supply = Demand" is the same as the output level calculated using the condition "Investment = total Saving":

\[
\begin{align*}
\bar{I} &= Y - \bar{T} - [c_0 + c_1 (Y - \bar{T})] + \bar{T} - \bar{G} \\
(1 - c_1) Y &= c_0 - c_1 \bar{T} + \bar{I} + \bar{G} \\
Y &= \frac{1}{1 - c_1} \left( c_0 - c_1 \bar{T} + \bar{I} + \bar{G} \right)
\end{align*}
\]
The Paradox of Saving/Thrift

- In general people think that an increase in private saving stimulates the economy as it leads to capital accumulation.
- In order to see what happens in our model if households try to increase their saving, suppose for example that $c_0$ decreases.
- Initially, private saving will increase since 
  \[ S = Y - T - C = -c_0 + (1 - c_1)(Y - T) \]
- However, recall that reduced autonomous consumption also implies that production and thus income declines which reduces saving again.
- Using the equilibrium condition $I = S + T - G$ we see that in the new equilibrium this decline in saving due to the decreased income must exactly offset the initial increase in saving since neither $I$, $T$ nor $G$ changed.
The Paradox of Saving/Thrift

Conclusion
In the short run, an attempt to increase private saving only results in decreased output or income but leaves private saving in the new equilibrium at its initial level.
Remarks

- Demand and supply on the goods market are **real** variables (we are concerned with quantities!).
- Hence, we must assume that e.g. the consumption decision (i.e. how many goods to buy) also depends on **real** income (i.e. how many goods can be bought with the given nominal income) \( \Rightarrow \) the variable \( Y \) refers to real GDP rather than to nominal GDP.