Macroeconomics
Lecture 1 – Introduction & IS-TR

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Macroeconomics: objects

Main objects of study — *aggregate* measures of economic activity.

Interactions of various **markets**...

- Goods:
  - Consumption goods
  - Investment goods (capital)
- Services
- Labor
- Finance:
  - Banking
  - Market finance
- Currency

...and **policies**:

- Monetary
- Fiscal
- Regulation

One (even huge) market is not "macro" enough: e.g. real estate

Macroeconomics: motivation

Why care for the macro-economy?

- As **households**, we are all affected:
  - Crises $\Rightarrow$ unemployment: lives depend on business cycles
  - Need to check macro for big decisions: housing, retirement, own business...
- **Businesses**: cycles influence demand and supply chains, interest rates, exchange rates, inflation...
- **Policymakers**: macro policy is influential. In addition macro phenomena (over-)associate with politics $\Rightarrow$ accountability of politicians

Macroeconomics rules: Keynes

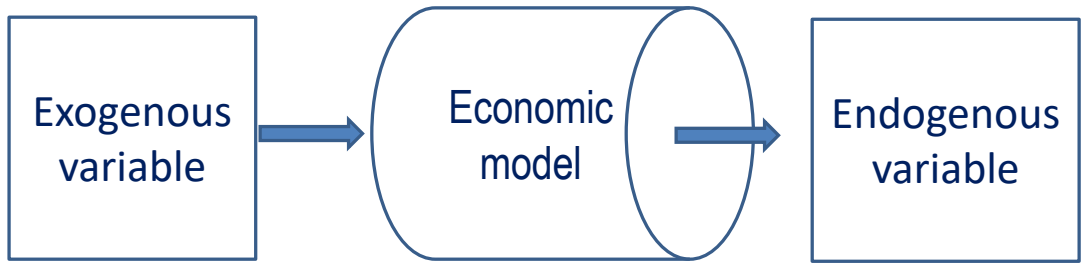
Practical men who believe themselves to be quite exempt from any intellectual influence, are usually the slaves of some defunct economist.

John Maynard Keynes

N. B.: Keynes **is** the most influential macroeconomist to date...

Methodology of Macroeconomics: Theory

- Macro deals with complex relationships of dynamic variables
- Theory with a good deal of *abstraction* necessary:
  - **exogenous** variables are taken as given, "out of nowhere"
    - their changes often called **shocks**
  - **endogenous** variables are explained by the model



Methodology of Macroeconomics: Data

- Unrealistic models are fine as long they:
  - give novel insights (M. Friedman)
  - are *falsifiable* i.e. can be proven wrong (K. Popper)
- Confronting macro theories with data is challenging:
  - aggregate indices: measurement problems
  - correlation vs. causality: experimental approach, as in applied micro, rarely applicable
  - tbexpectations are crucial, but never directly measurable
- Solutions:
  - vector autoregression (VAR) approach (Nobel prize of C. Sims) – estimate **impulse responses** to shocks with (almost) no model
  - estimate theoretical models, compare outputs to data

Macro dichotomies

Macroeconomics

Theoretical

- A zoo of models (see next slides)
- **Focus for this course**

Empirical

- Model estimation
  - introduction with practical implementation (coding) **in TD**
- Time series & VAR econometrics
  - Econometrics class (?)

Macro dichotomies

Macroeconomic models

Short-run

- Most of macroeconomists' job. Why?
  - Immediately applicable?
  - Most politicians' focus?
- **Focus of this course**

Long-run

- More substantial problems
- See Growth course (unless you are in financial track!)

Macro dichotomies

Macroeconomic models

Dynamic

- The modern approach

  Most of the course

Static

- Keynes-Hicks heritage (20th century)

  Beginning of course

Macro dichotomies

Macroeconomic models

Closed economy

- Wild simplification, but...
- ...most macro scholars based in the U.S. — large and independent enough $\Rightarrow$ closed economy is most studied model

around 70% of course

Open economy

- Small open economy models: country as *price-taker*

  around 30% of course
- Large open economy models: country influences prices

  rarely discussed in course

Macro dichotomies

Macroeconomic models

Flexible price (neoclassical)

- Usually result in optimal allocations
  - *laissez-faire* economics
- Useful to understand how a perfect world would work — normative approach

Most of the course

Sticky price (Keynesian)

- Associated with corrective interventions, such as Keynesian demand management

Beginning, then **second half** of course

Price rigidity

Central **Keynesian assumption:** Prices do not adjust immediately

- Price rigidity associated with time horizon:
  - very short term — fixed prices (extreme case)
  - short term — *sticky* prices (slow moving)
  - medium or long term — flexible prices
- Assuming demand is insufficient under current prices $\Rightarrow$ **demand-driven equilibrium**. Why? Recall micro equilibrium diagram
  - Keynes was inventing a remedy for the Great Depression $\Rightarrow$ natural to assume insufficient demand. Later, this assumption became an axiom for Keynesians

Desired demand for goods – closed economy

Assume a single good is used for consumption (C), investment (I) and government consumption/ investment (G).
Desired demand of the three sectors: $C + I + G$
Denote Y the supply of goods:

$$\underbrace{Y}_{\text{supply of goods}} = \underbrace{C + I + G}_{\text{desired demand}}$$

same formula as GDP decomposition in national accounts, **but**:

- It is a statement about a **demand driven equilibrium**: supply adjusts to demand
- OK, but what happens if demand suddenly changes?
  - classical price adjustment does not work (fixed prices assumption)
  - instead, firms accumulate and decumulate **inventories**

Desired demand for goods – open economy

The supply and demand must be adjusted for exports and imports:

$$Y + \underbrace{Im}_{\text{Imports}} = C + I + G + \underbrace{Ex}_{\text{Exports}}$$

or, using $TB = Ex - Im$,

$$Y = C + I + G + \underbrace{TB}_{\text{trade balance}}$$

- Desired demand in open economy includes **trade balance (TB)**
  - TB is a.k.a. net exports or **primary current account (PCA)**
  - Notation: PCA is used instead of TB in the Burda-Wyplosz textbook
  - We will define what is current account in 3 lectures

Desired demand – components

Consumption function

$$C = C(\underset{+}{\Omega}, \underset{+}{Y - T}) \tag{11.2}$$

- Ω is wealth
- Y is household income (since GDP is sum of incomes)
- T is (lump-sum) tax

$\Rightarrow$ $Y - T$ is **disposable income**

Investment function

$$I = I(\underset{+}{q}, \underset{-}{r}) \tag{11.3}$$

- Tobin's q $\left(q = \frac{\text{market value of installed capital}}{\text{replacement cost of capital}}\right)$
- real interest rate, (r)

Desired demands – components (cont'd)

Trade balance function

$$TB = TB(Y - T, \sigma)$$

Goods market equilibrium

Desired demand function

$$DD = C(\underset{+}{\Omega}, \underset{+}{Y - T}) + I(\underset{+}{q}, \underset{-}{r}) + G \qquad (1)$$

- Assumptions:
- (1) r and G exogenous
- (2) goods market is in **equilibrium** (supply=demand)

$$Y = DD(Y, r...)$$

- $Y \equiv$ 'equilibrium GDP'
- This need not be the case!
- What if exogenous variables change?

Goods market equilibrium

Example 1: excess supply

How does a change in Y affect DD?

- What happens if Y' increases by 1 EUR, such that $Y' > Y$?
  - $C \uparrow$
  - The effect on C dominates
  - $\rightarrow$ an increase in DD by less then 1 EUR
  - $\Rightarrow$ $Y' > DD'$ **(excess supply)**
- **Dynamic adjustment mechanism**: goods will be stored (*inventories*), future production will be reduced
- ... reductions in income until $Y = DD$ holds again

Discussion

- So far, a number of variables exogenous: P, G, T, Ω, q, Y^*
- Intended reduction in complexity, can be *endogenized* later.

Goods market equilibrium

Example 2: Keynesian multiplier

Consider: **Increase in public pending, ΔG**

- $DD \uparrow$, firms will produce more, ..., $Y \uparrow$
- **"Multiplier"**: *By how much does output change, ΔY?*
  - firms will increase production by ΔG
  - this generates new income, thus $C \uparrow$ (I too, if $Y \uparrow \Rightarrow q \uparrow$)

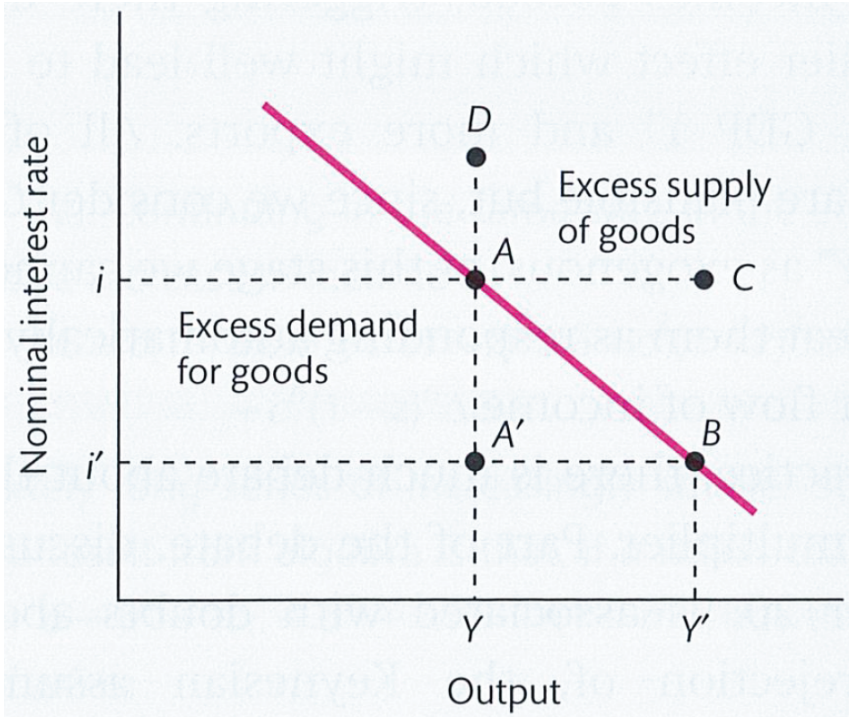
  $\rightarrow$ $Y \uparrow, C \uparrow, Y \uparrow$
  - additional spending ΔC is smaller due to *leakages*, so $\Delta Y_2 < \Delta Y_1$
  - leakages (closed economy): *savings, taxes (if proportional)*
    - **marginal propensity to consume**, $0 < c < 1$

$$\begin{aligned}\Delta Y &= \Delta G + c\Delta G + c^2\Delta G + ... + c^n\Delta G \\ &= \underbrace{\frac{1}{1-c}}_{\text{multiplier}>1}\Delta G\end{aligned}$$

using $1 + a + a^2 + ... + a^n + ... = 1/(1-a)$.

The *IS* curve

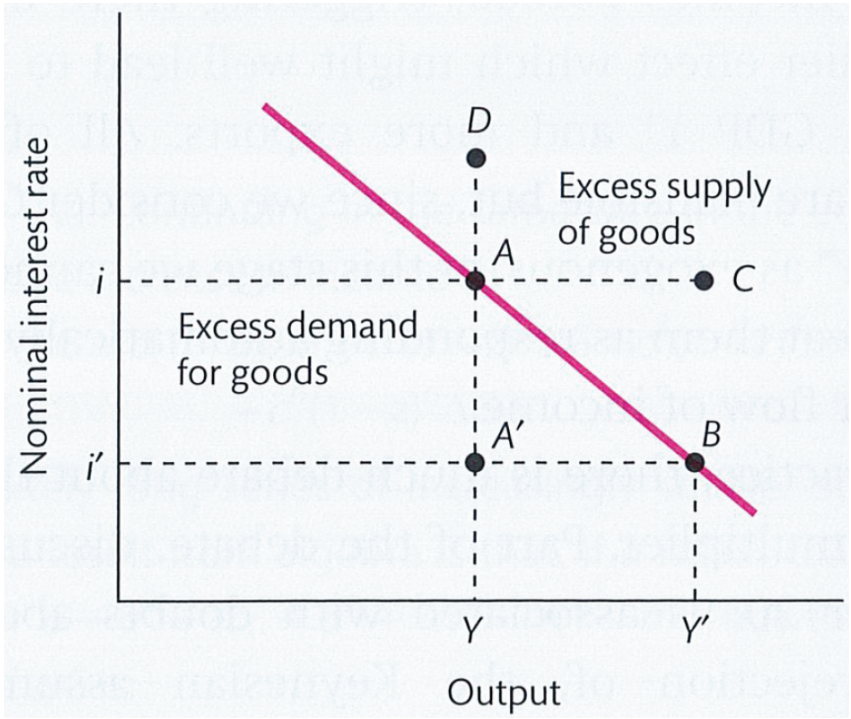
- IS stands for Investment=Saving
- Equivalent relationship to $Y = DD$
  - check it with $S = (Y - T - C) + (T - G)$
- assume $i \downarrow \Rightarrow I \downarrow$
- Also, wealth responds indirectly via q and stock prices
- $\Rightarrow$ **IS-curve**: **downward-sloping**, i.e. negative relationship between output and interest rates (given T, G)



Source. Burda and Wyplosz (2017), Figure 11.3.

Off the IS curve

- *IS* curve describes the **goods market equilibrium**
- Off the *IS* curve:
  - *excess supply* (point C, D)
  - *excess demand* (point A')
- Temporary deviations from the *IS* curve are possible
- Adjustment will bring output back to **equilibrium level** $Y = DD$
- *more in a couple of slides...*



Taylor rule and the TR curve

Nominal interest rates are set by the central bank as a function of the **inflation gap** and the **output gap** (**Taylor rule**):

$$i = \bar{i} + a(\pi - \bar{\pi}) + b\left(\frac{Y - \bar{Y}}{\bar{Y}}\right)$$

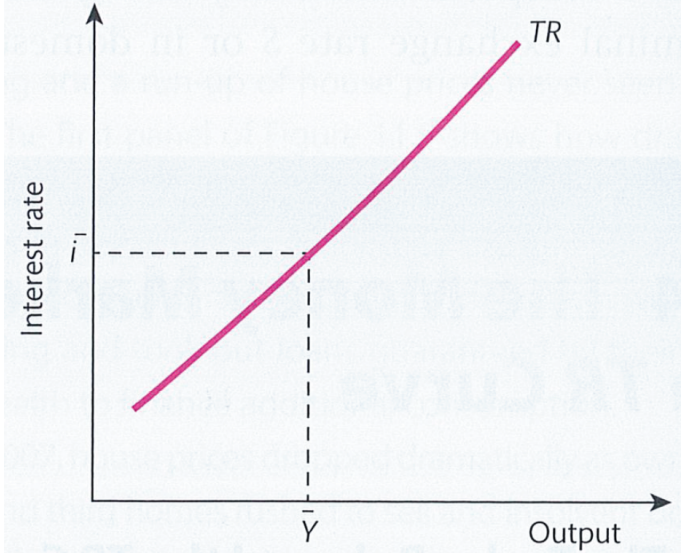
Assuming inflation at its target (for simplicity), this yields

$$i = \bar{i} + b\left(\frac{Y - \bar{Y}}{\bar{Y}}\right)$$

TR curve

- Monetary policy centered around the **natural rate of interest**, $\bar{i}$, i.e. the nominal interest rate the central bank sets when the economy is on trend output (no demand deficiency).
- (Simplified) Taylor rule: Describing pairs $\{Y, i\}$ consistent with monetary policy

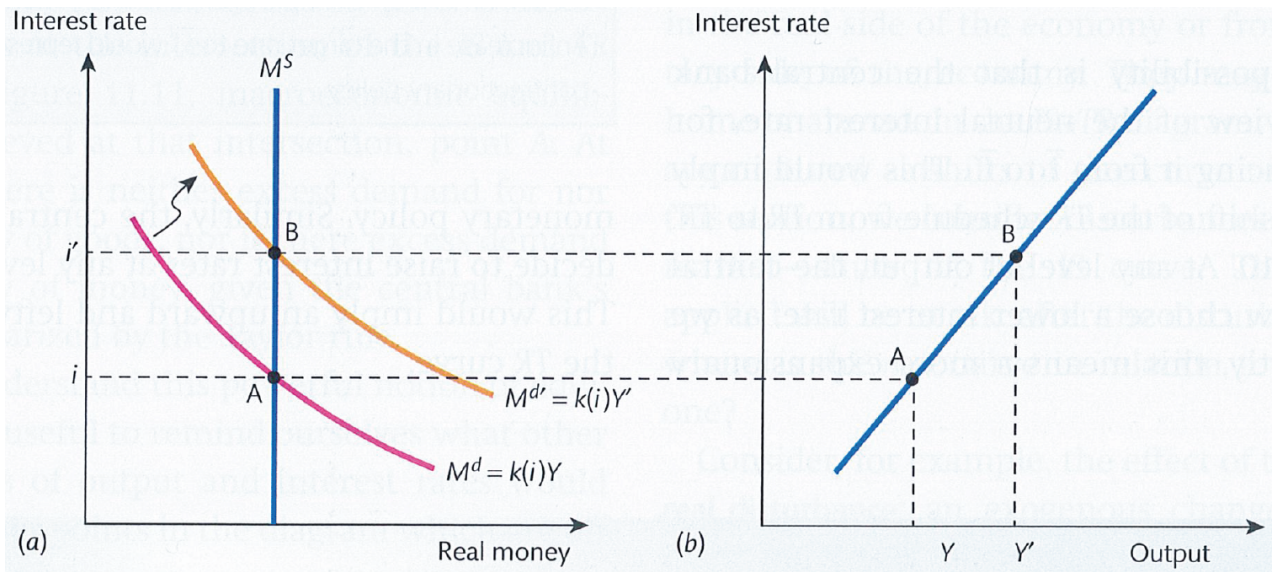
$\Rightarrow$ economy always on the TR curve as long as the central bank does its job



Source. Burda and Wyplosz (2017), Figure 11.6.

Alternative assumption: Targeting Money Supply (LM)

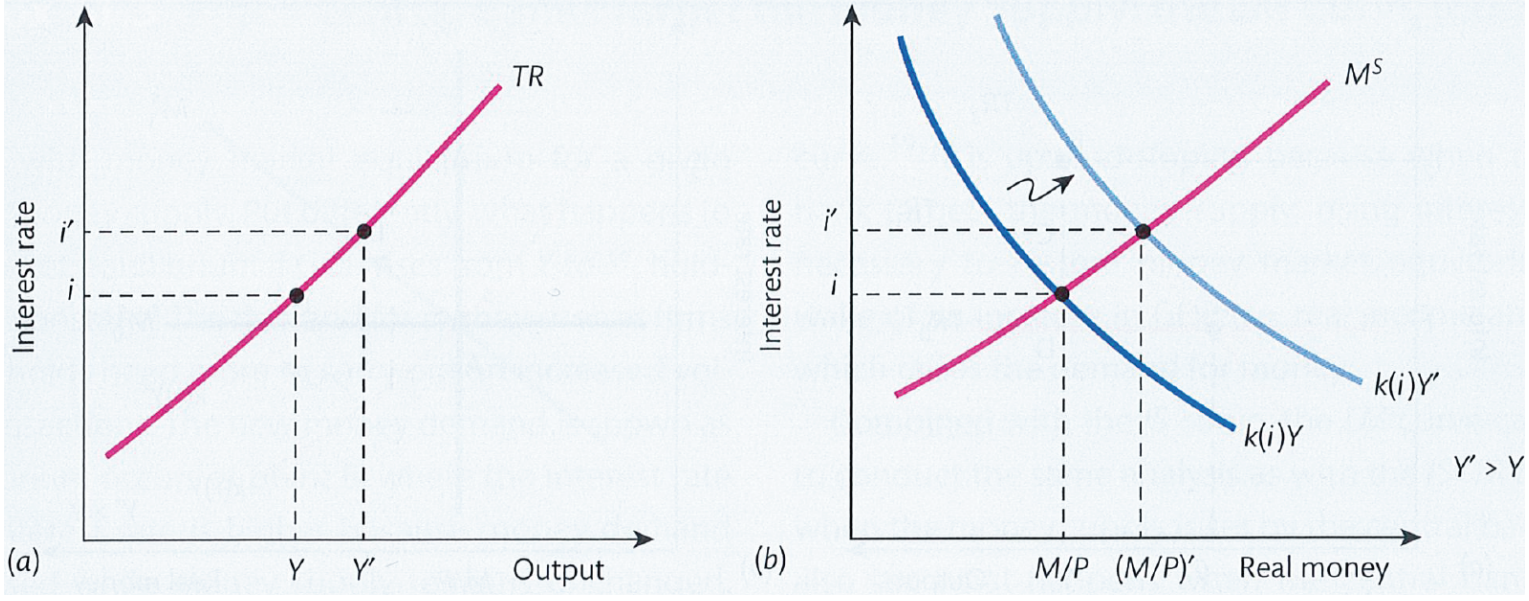
- During the 1980s, monetary targeting as main policy tool (M. Friedman)
- Gives rise to the **LM curve** (Panel b) ($\Rightarrow$ IS-LM model of J.R. Hicks)
- LM curve (Panel b) upward sloping: pairs $\{i, Y\}$ for fixed supply of money M^S



Note. Panel (a) denotes the money market, the vertical M^S line describes the central bank decision. Each money demand curve M^d corresponds to a level of output. Panel (b) **Source.** Burda and Wyplosz (2017), Figure 11.9.

Money market equilibrium with the TR curve

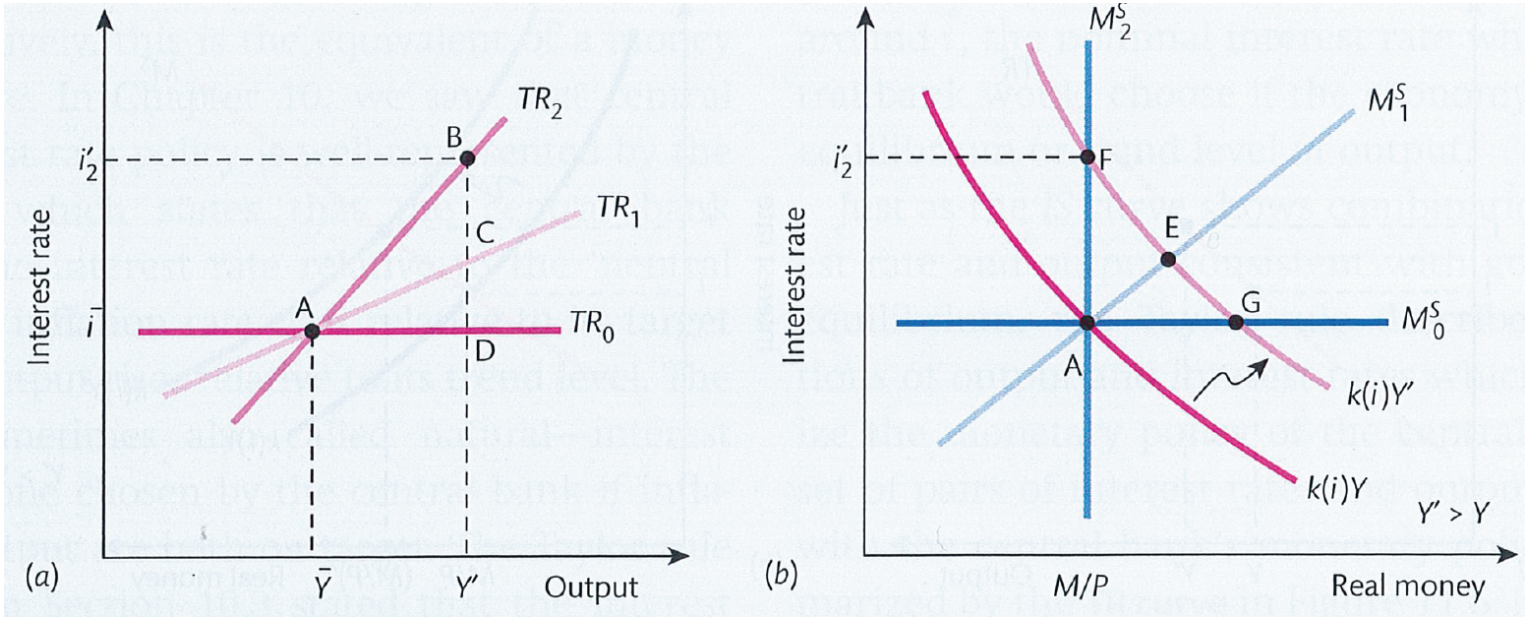
- Expansion in GDP leads to higher interest rates (panel a) and higher demand for real money balances $(M/P)'$ (panel b).
- **Money market equilibrium** implies that the central bank provides this additional money in the form of reserves, which is consistent with i given by the Taylor rule (M^S).



Source. Burda and Wyplosz (2017), Figure 11.7.

Slope of the TR curve

- *How strongly does a central bank react to the output gap?*
- The coefficient b in the Taylor rule captures the response.
  - TR_1: standard case
  - TR_0: perfectly elastic supply of money
  - TR_2: extreme case, implying strong fluctuations in i (equivalent to fixing the money supply M/P)

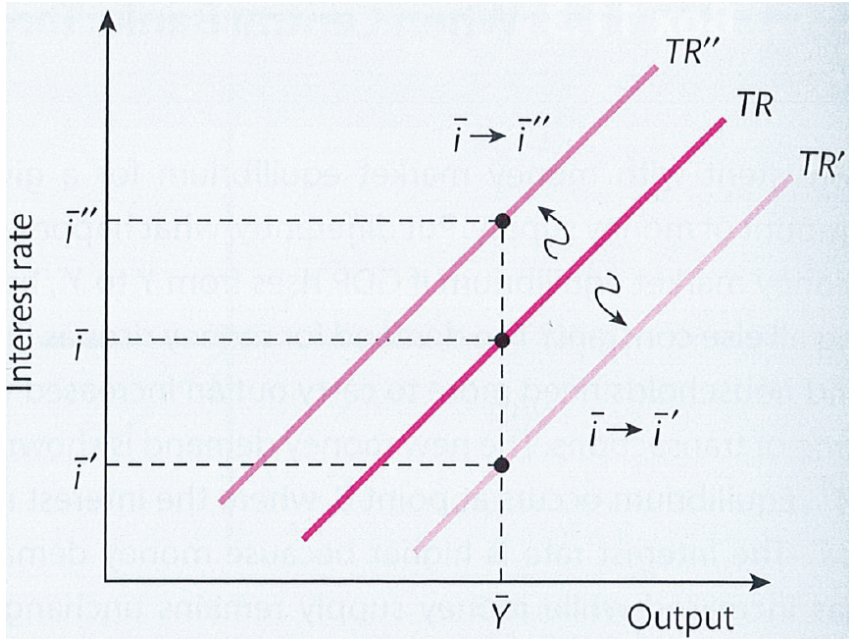


Source. Burda and Wyplosz (2017), Figure 11.8.

Shift of the TR curve

Interest rate given by the simplified Taylor rule
$i = \bar{i} + b\left(Y - \bar{Y}\right)/\bar{Y}$

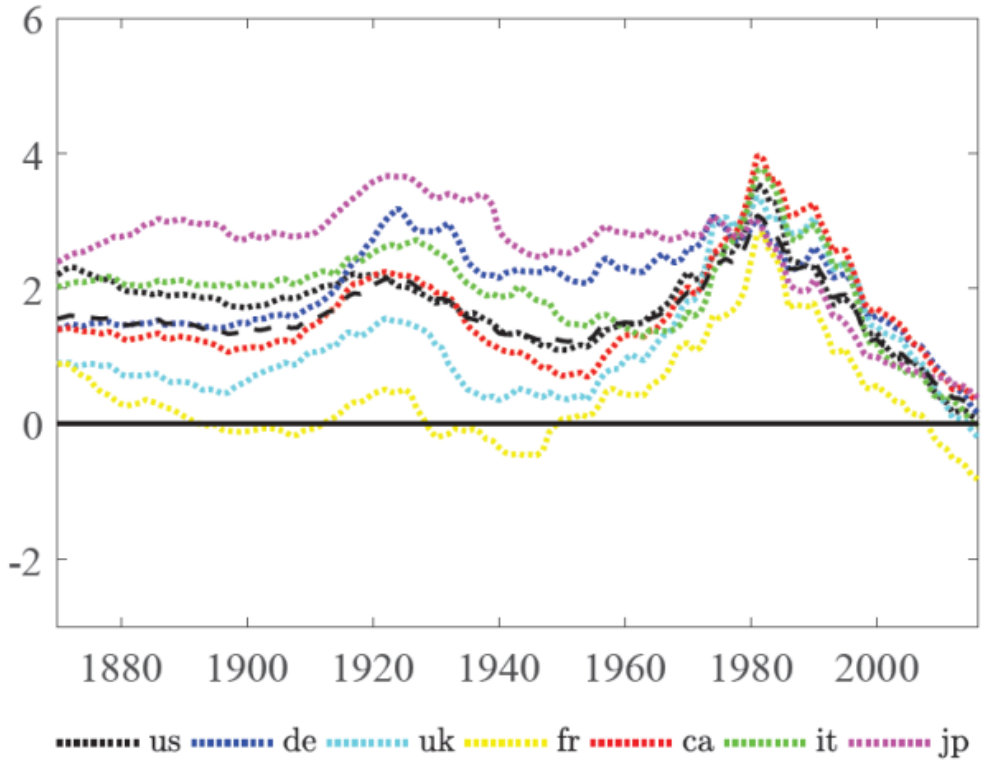
- Changes in output lead to **movements along the TR curve**
- Changes in the degree of 'leaning against the wind' (coef. b) lead to a **rotation** of the TR curve (cf. Fig. 11.8)
- Changes in the natural rate of interest lead to a **shift in the TR curve** ($\bar{i} = \bar{r} + \bar{\pi}$), $\bar{r}$, natural real rate and $\bar{\pi}$ inflation target



Source. Burda and Wyplosz (2017), Figure 11.10.

Context: real natural rates of interest in developed countries

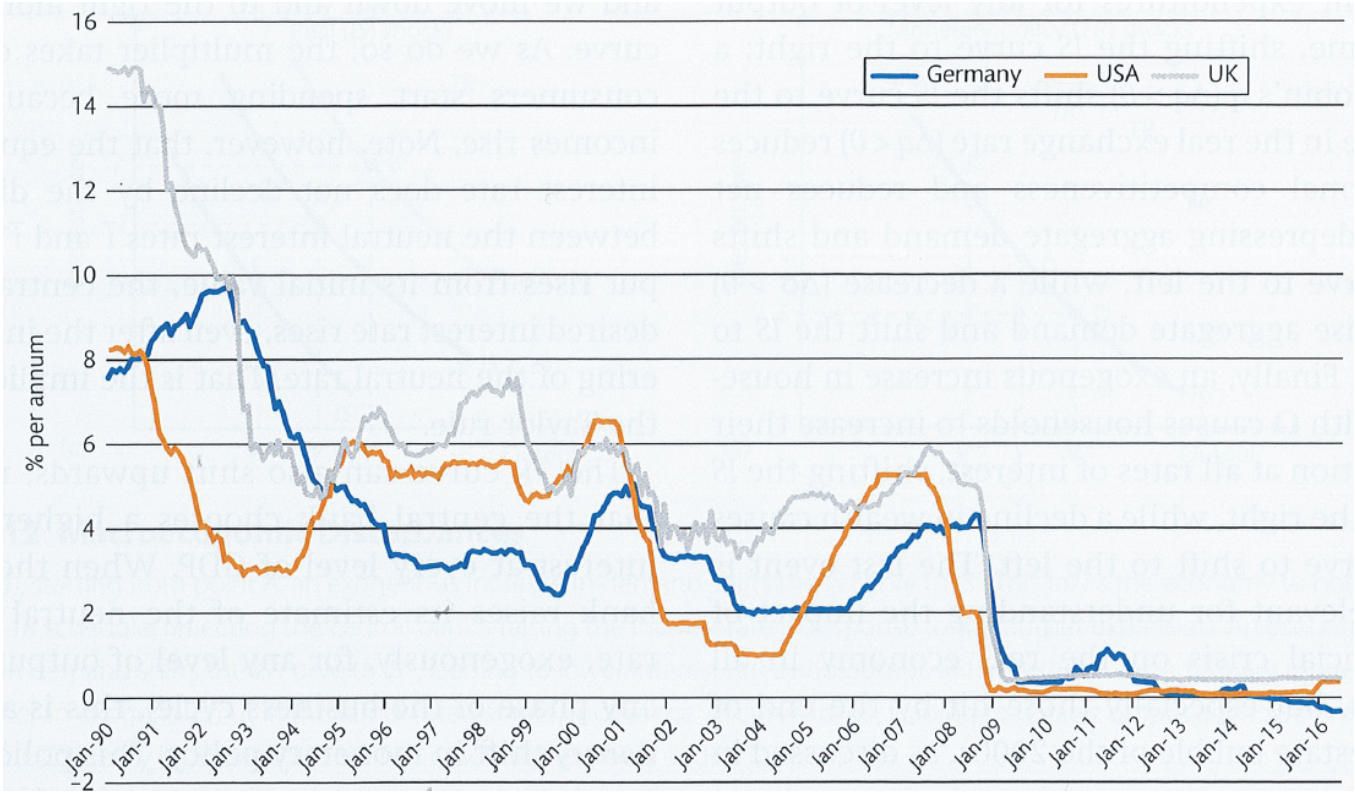
- Low frequency changes in the natural rate of interest $\bar{r}$, often denoted r^* (read as 'r-star')
- **Common trends** across countries, strong **convergence** over the last years
- Recently, very low levels
  - $\rightarrow$ **Implication:** Lower and lower levels of i for same level of output growth
  - $\rightarrow$ **challenges for mon. pol.** in the presence of a zero lower bound (ZLB)



Note. Estimates from a Bayesian factor model with country-specific and global trend for the real natural rate of interest, r_i^*. **Source.** Del Negro, Giannone, Giannoni and Tambalotti (2019), 'Global trends in interest rates', Figure 3.

Context: zero lower bound on central bank interest rate

Figure. Nominal short-term interest rates in the US, Germany and UK



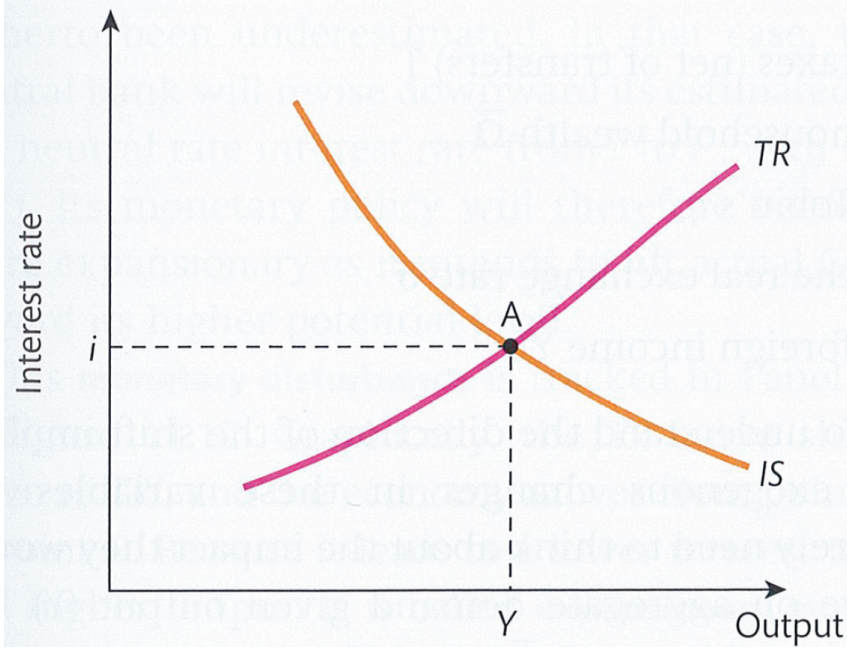
Source. Burda and Wyplosz (2017), Figure 11.13.

Macroeconomic equilibrium in the IS-TR model

- Under which conditions are **goods markets** and **money markets** in equilibrium *at the same time*?
- What are the effects of changes in **exogenous influences** on output and interest rates?

Macroeconomic equilibrium

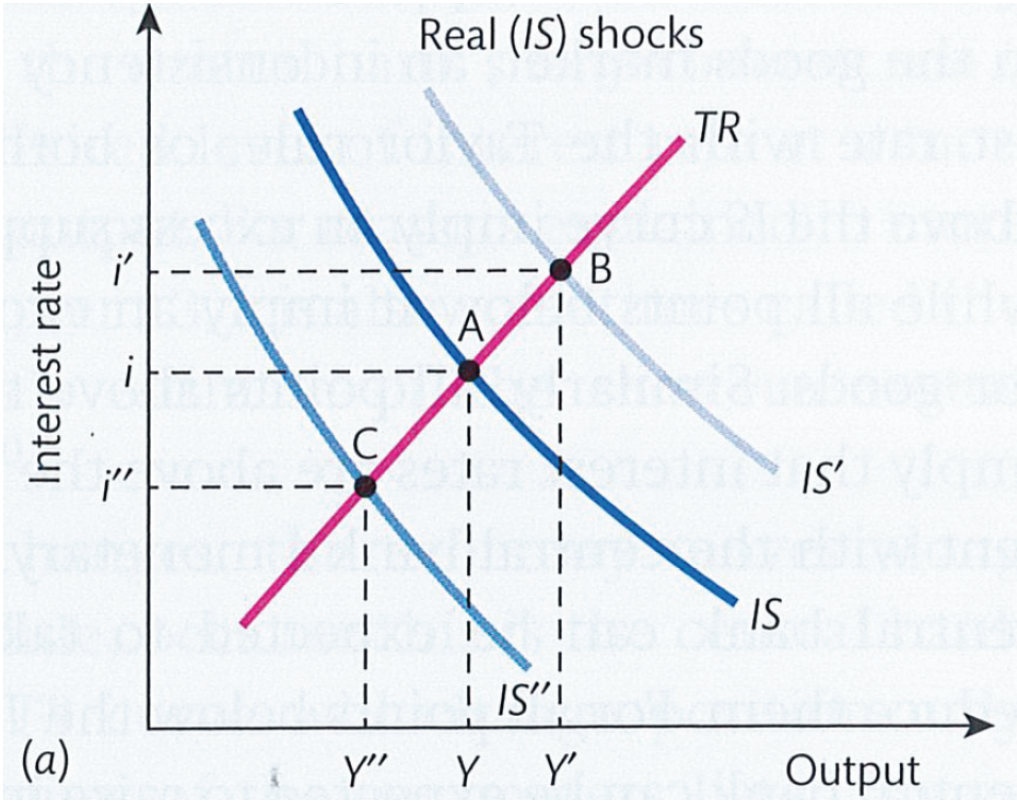
- For goods and money markets to be in equilibrium, economy should be at the **intersection** of the IS and the TR curves, (point A)
- $\rightarrow$ no excess supply or demand for goods or money!



Source. Burda and Wyplosz (2017), Figure 11.11.

Real disturbances: Shifts of the IS curve

- Central question: after a disturbance, where is the *new curve* in relation to the *original one*?
- Consider an increase in government spending, $G < G'$,
- New equilibrium: IS', point B



Source. Burda and Wyplosz (2017), Figure 11.12.

Real disturbances: Propagation of the 'shock'

Thinking of cycles in this simple framework:

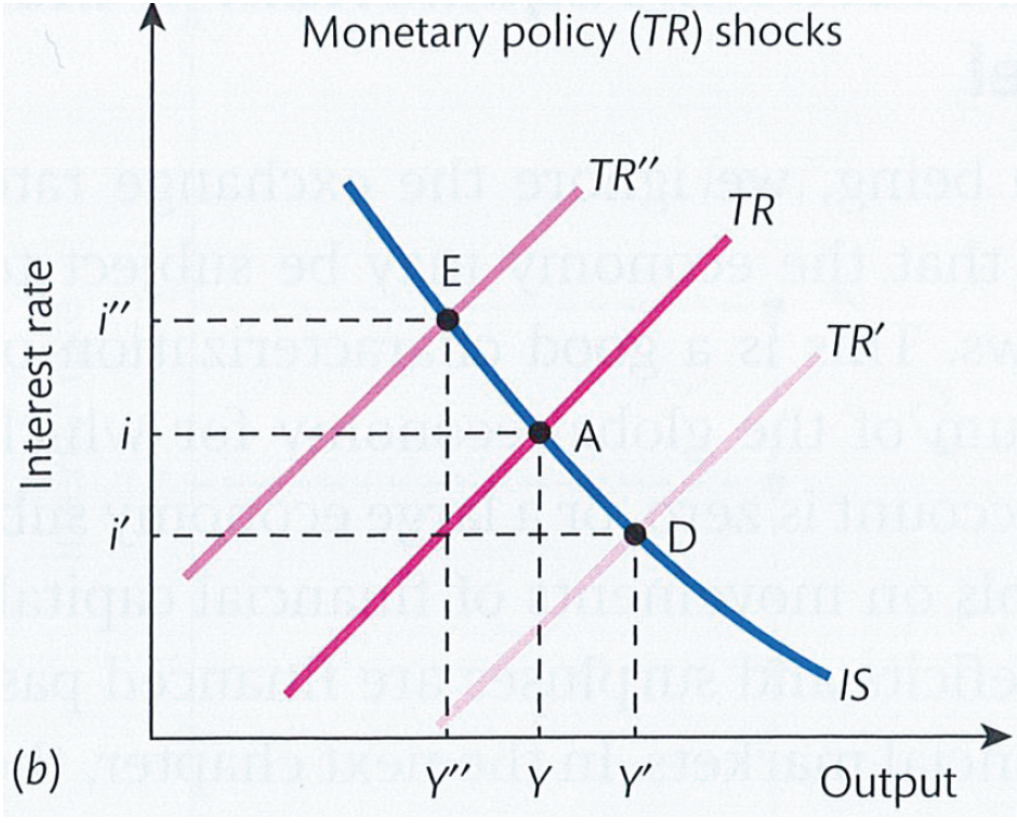
- Assume a positive income shock
- Higher demand leads to higher output
- Keynesian multiplier: higher output $=$ higher income
- Additional income leads to higher demand, thus higher output (leakages):
- $output \rightarrow income \rightarrow demand \rightarrow output \rightarrow ...$
- Where does it end?
  - Leakages: saving, (proportional) taxes...
  - Monetary policy: interest rate i moves along the TR curve upward, dampening demand and output

Sources of "shocks":

- lump-sum taxes T
- household wealth $\bar{\Omega}$
- Tobin's q

Monetary policy disturbances: Shifts of the TR curve

- Assume a downward revision of $\bar{i}$
  - $\Rightarrow$ downward shift of the TR curve
- New position: TR', equilibrium at point D
  - $\Rightarrow$ **expansionary** monetary policy



Source. Burda and Wyplosz (2017), Figure 11.12.

Monetary policy disturbances: Propagation of the 'shock'

- Lower interest rates lead to higher demand (e.g. Tobin's q)
- higher investment spending leads to more output and higher income
- Keynesian multiplier (net of leakages):
- $output \rightarrow income \rightarrow demand \rightarrow output \rightarrow ...$
- The nominal rate will change by less than the revision of the natural rate, i.e. $i - i' < \bar{i} - \bar{i}' > 0$, due to the **endogenous output response** ($Y \uparrow$) which leads to a muted response in the nominal rate due to the **Taylor rule**.

Summary: How to use the IS-TR framework

- Sometimes, policymakers might ask several questions at the same time:
  - a boost in public spending and a **tax cut**
  - **fall in natural rate** and an **increase in stock prices**
- The **joint effect** has ambiguous sign!
- Follow the steps:
  - **Which curve** is affected by the disturbance?
  - What is the **equilibrium of the new IS and TR curves**

A linear closed economy model

Consumption function

$$\begin{aligned} C =& a_0 + a_1\Omega + b(Y - T) \\ =& a + b(Y - T), \end{aligned}$$

where $a = a_0 + a_1\Omega$ sometimes called **autonomous** part of C, and $b \leq 1$ is the **marginal propensity to consume**

Investment function

$$I = c + dY - ei,$$

with $c, d, e > 0$

Simplified Taylor rule (no inflation)

$$i = \bar{i} + \beta(Y - \bar{Y})$$

Home task: solve for the macro equilibrium before first TD.

Summary: Macroeconomic equilibrium

- **General equilibrium**: all markets clear simultaneously
- Keynesian assumption: **prices are rigid/sticky**
- **Multiplier** in response to an exogenous increase in demand
- *IS* curve: GDP levels and interest rates compatible with equilibrium in the goods and services market
- *TR* curve: Description of central bank setting of i to stabilize inflation around target and output around potential.
- **Macroeconomic equilibrium:** intersection of *IS* with *TR* curve