

Macroeconomics

Lecture 1 – Introduction & IS-TR

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1 What is Macro? Why Macro?

2 Old Keynesian macro: IS-TR

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 ⇒ 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 ⇒ accountability of politicians

Macroeconomics rules: Keynes

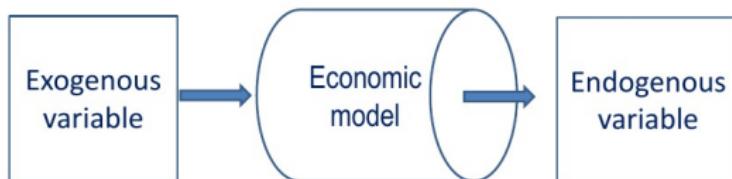
Practical men who believe themselves to be quite exempt from any intellectual influence, are usually the slaves of some defunct economist.

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
 - ▷ expectations 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
⇒ 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

- 1** What is Macro? Why Macro?
- 2** Old Keynesian macro: IS-TR
 - The Goods Market
 - The Goods Market and the IS Curve
 - The Money Market, Monetary Policy and the TR Curve
 - Macroeconomic Equilibrium

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 (slow moving) prices
 - ▷ medium or long term — flexible prices
- ▷ If demand is insufficient under current (fixed) prices ⇒
demand-driven equilibrium. Why? Recall micro equilibrium diagram
- ▷ Keynes' context was the Great Depression ⇒ 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

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 includes **trade balance (TB)**
 - ▷ TB also known as net exports or **primary current account (PCA)**
 - ▷ Notation: PCA is used instead of TB in BW textbook

Consumption function

$$C = C(\underbrace{Y - T}_{+}, \Omega)$$

- ▷ Y is household income (since GDP is sum of incomes)
 - ▷ T is tax (assumed lump-sum, i.e. independent of any household characteristics)
- ⇒ $Y - T$ is **disposable income**
- ▷ Ω is wealth

How to measure the reaction of consumption to a change in disposable income?

Take a derivative:

$$mpc = \frac{\partial C}{\partial(Y - T)}$$

is the **marginal propensity to consume**. Assumption
 $0 < mpc < 1$ central to Keynesian analysis

Investment function

$$I = I(q, \underline{r})$$

Tobin's q is the ratio of **market value of installed capital** and **replacement cost of capital**

- ▷ For now, think of “investor sentiment” that encourages investment. We will formalize Tobin's q in the RBC model

Real interest rate r is defined as:

$$r = \underbrace{i}_{\text{nominal interest}} - \underbrace{\pi^e}_{\text{expected inflation}}$$

A rise in the real interest discourages investment: borrowing becomes more expensive, future incomes are valued less (r is used in **discounting**)

Trade balance function

Trade balance function

$$TB = Ex(Y^*, \sigma) - Im(Y, \sigma) = TB(Y, Y^*, \sigma)$$

- ▷ Y^* is output/incomes of rest of the world
- ▷ Y^* as argument of $Ex(\cdot)$ and Y as argument of $Im(\cdot)$ are shortcuts: all determinants of foreign demand $C^* + I^* + G^*$ might be relevant for Ex and all local demand might be relevant for Im
- ▷ σ is **real exchange rate**: how expensive are domestic goods relative to foreign goods (**more on this next week**)

Desired demand (DD) function

$$\begin{aligned} DD &= C(Y_+ - T_+, \Omega) + I_+(q, r) + TB(Y_-, Y^*_+, \sigma) + G_- \\ &= DD(Y, r, \dots) \end{aligned}$$

where “...” regroups exogenous variables: $T, G, \Omega, q, Y^*, \sigma$.

What is the influence of Y on DD? Depends on two derivatives:
 $\frac{\partial C}{\partial Y} = \frac{\partial C}{\partial (Y-T)} (= mpc)$ and $\frac{\partial TB}{\partial Y} (= -\frac{\partial Im}{\partial Y})$, which is the negative of
marginal propensity to import (mpm).

Assume reaction of domestic consumption to income is stronger than reaction of imports.

Then, DD increases in domestic income, with derivative
 $\frac{\partial C}{\partial Y} - \frac{\partial Im}{\partial Y} = mpc - mpm$, assumed positive, but **below 1 (why?)**

Goods market equilibrium: comparative statics

Equilibrium condition can be written as $Y = DD(Y, r, \dots)$.

Assume an increase in DD by 1 unit, e.g. because of G :

- ▷ Y must increase in response by the same amount. Is $Y = DD(Y, r, \dots)$ verified? No, because DD increases again:
 - ▷ $C \uparrow, TB \downarrow$
 - ▷ The effect on C dominates
 - ▷ DD increases by $mpc - mpm$
- ▷ Y rises by $mpc - mpm$ in response
- ▷ the cycle repeats until equilibrium restored

The model is not dynamic, so the adjustment assumed to happen immediately. What is the ultimate increase in Y ?

Answer: $1/(1 - mpc + mpm)$ – a sum of geometric series with coefficient $mpc - mpm$.

The Keynesian Multiplier

The ratio of increase in GDP and the increase of government spending is called the **Keynesian multiplier** of government spending.

For small changes (shocks) of government spending dG , the increase in GDP is $\frac{1}{1 - mpc + mpm} dG$. The multiplier is then

$$\frac{dY}{dG} = \frac{1}{1 - mpc + mpm}$$

so it is a derivative of **equilibrium** GDP with respect to government expenditure.

The multiplier is the same for large shocks if the model is linear
this will be seen in TD

Goods market equilibrium: the 45° diagram

$$DD(0, r, \dots) > 0$$

because $C(0, \underline{r}) > 0$
 (assumption)

$$I > 0 ; G \geq 0$$

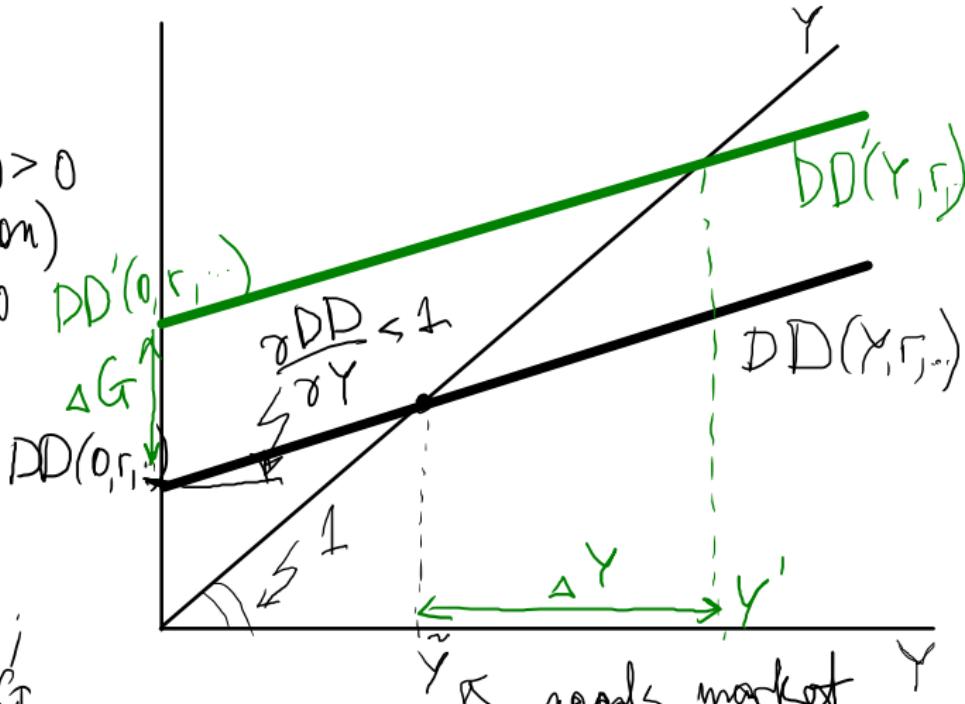
$$TB(0, Y^*, \beta)$$

not too
 negative
 (assumption)

$$\text{Consider } \Delta G > 0 ;$$

$$DD' = DD + \Delta G$$

$$\Delta Y / \Delta G > 1 \text{ (the multiplier)}$$



$\Delta Y / \Delta G > 1$ goods market equilibrium

Investment = Saving: IS

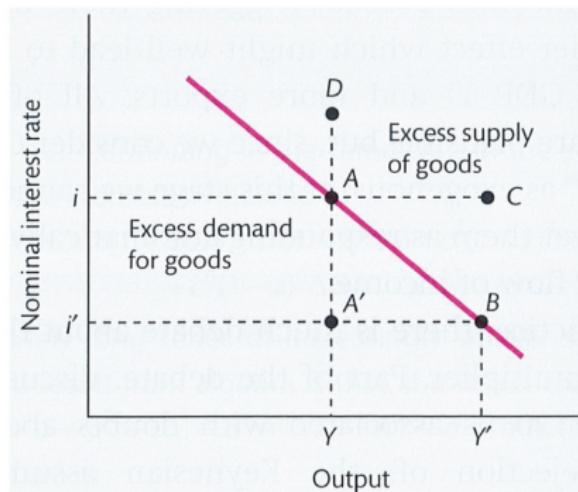
The equilibrium condition $Y = DD (= C + I + G + TB)$ is equivalent to investment being equal to the sum of saving of all sectors of the economy:

$$\begin{aligned}C + I + G + TB &= Y \\Y - C - G - TB &= I \\ \underbrace{Y - T - C}_{\text{HH saving}} + \underbrace{T - G}_{\text{government saving}} + \underbrace{Im - Ex}_{\text{rest of world saving}} &= I\end{aligned}$$

It is also called the **IS condition** when the focus is on GDP and real interest rate

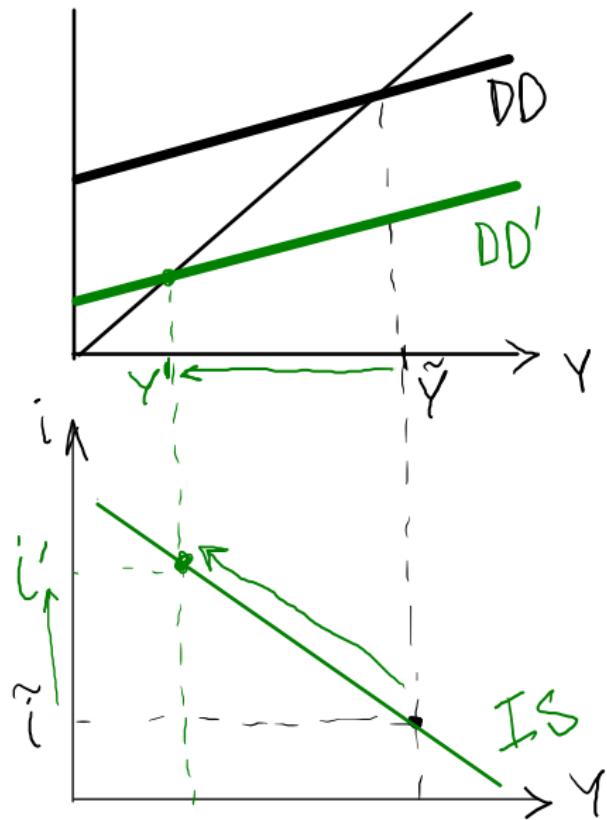
The IS curve

- ▷ Recall that DD decreases when r increases (**why?**)
- ▷ consider an increase in nominal interest rate i (same as changes in r under constant π^e)
 - ▷ $I \downarrow \Rightarrow DD \downarrow$
 - ▷ with the multiplier mechanism at work, $Y \downarrow$
- ▷ the IS condition (goods market equilibrium) then gives a **negative** relationship between i and Y – the **IS curve**



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

The 45° graph and the IS curve



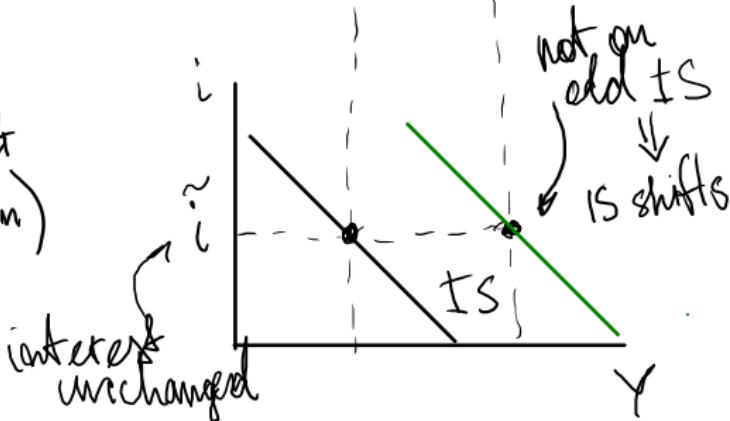
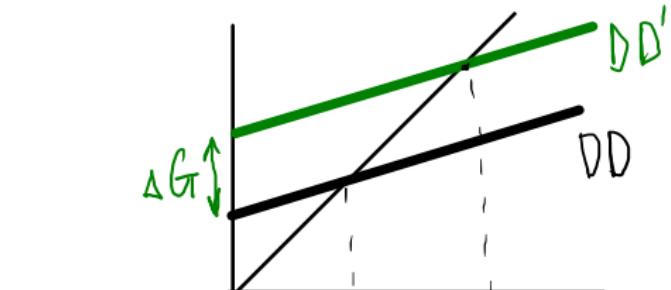
Now DD becomes DD'
because of it
(and $r \uparrow$)

Moving along IS vs. shifting IS

Changes in i and resulting changes of Y – **movement along IS**

Change of any other determinant of DD – **shift** of IS

example : change in G (again)



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Taylor rule and the TR curve

Nominal interest rates are endogenous in the model.

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

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

Where \bar{Y} is **target output** of the central bank and $\bar{\pi}$ its **target inflation**.

Assuming for now that inflation is always at its target:

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

Coefficient β measures how **active** the policy is

Trend, cycle, and central bank's target GDP

GDP data can be decomposed
in **trend** and **cycles**:

$$Y^{actual} = Y^{trend} + Y^{cycle}$$

Assumption: GDP would
always be on smooth trend if
prices were **flexible**

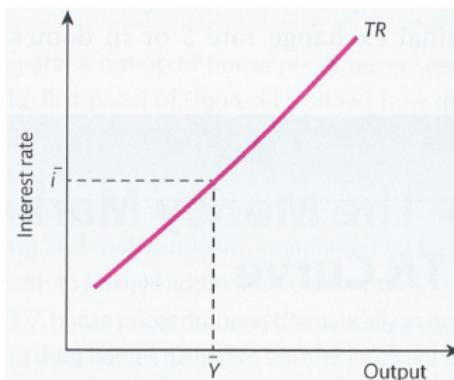
The goal of central bank is to
smoothen the cycles, i.e.
get closer to the trend GDP:

$$\bar{Y} = Y^{trend}$$

TR curve

Taylor Rule (TR) equation is $i = \bar{i} + b \left(\frac{Y - \bar{Y}}{\bar{Y}} \right)$

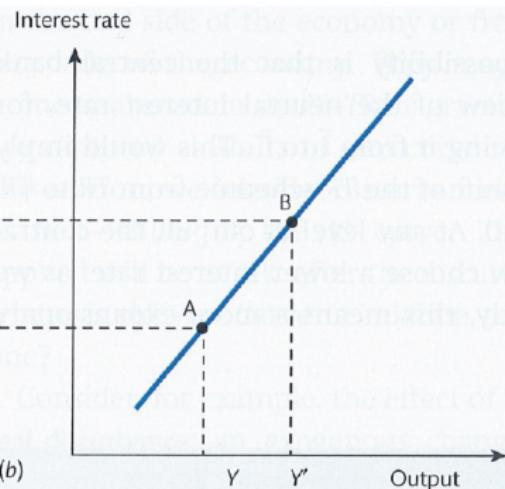
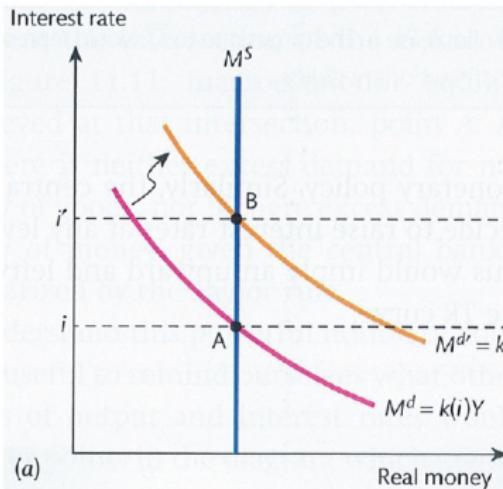
- ▷ its graph in (i, Y) space is an upward-sloping line
- ▷ When $Y = \bar{Y}$, i.e. economy on trend, central bank sets $i = \bar{i}$: the **natural interest rate**
- ▷ the economy is always on the TR curve as long as the central bank follows the Taylor Rule



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

Alternative assumption: Targeting Money Supply (LM)

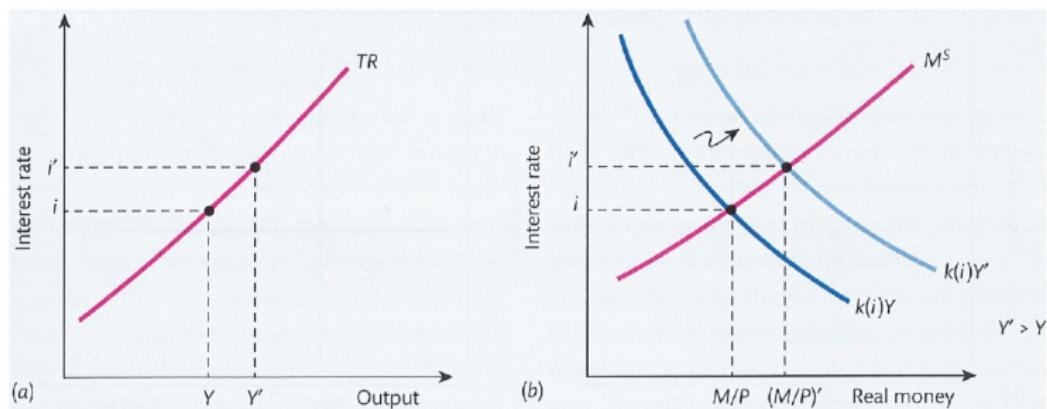
- ▷ During the 1980s, monetary targeting as main policy tool (M. Friedman)
- ▷ Gives rise to the **LM curve** (right graph) (\Rightarrow IS-LM model of J.R. Hicks)
- ▷ LM curve upward sloping: pairs (Y, i) for fixed supply of money M^S



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.

Movement along vs. shift of TR

For the simplified Taylor rule

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

Changes in output & the response of i according to Taylor Rule \Rightarrow **movement along** the TR line

A more active policy (larger b) means a more **steep** TR line

Change in the natural interest rate \bar{i} \Rightarrow **shift** of the TR line

Macroeconomic equilibrium in the IS-TR model

We first study equilibrium in an economy where $TB = 0$ constantly
(does it mean the economy is closed?)

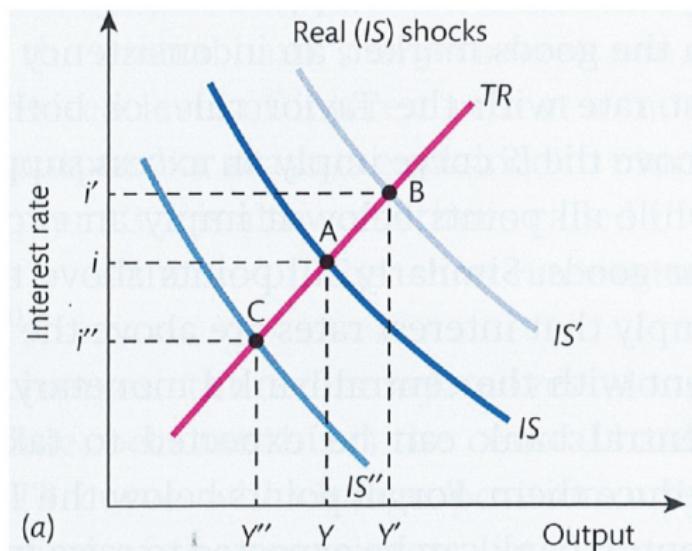
Definition of equilibrium: a pair of values (Y, i) such that:

1. The goods market is in equilibrium (IS holds). This means
 $Y = DD$
2. The Taylor Rule holds. This means the money market is also
in equilibrium

Geometrically, the point on the (Y, i) plane where IS and TR lines intersect.

Goods market shocks: shifts of IS

Classic example: a shock of G . Note that i changes in new equilibrium – what are the implications for new equilibrium?



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

Consider $G \uparrow \Rightarrow IS$ shifts to the right. Central Bank responds $\Rightarrow i \uparrow$. In the new equilibrium (point B), $C \uparrow$ and $G \uparrow$, but $I \downarrow$. Total effect on output is positive: $Y' > Y$.

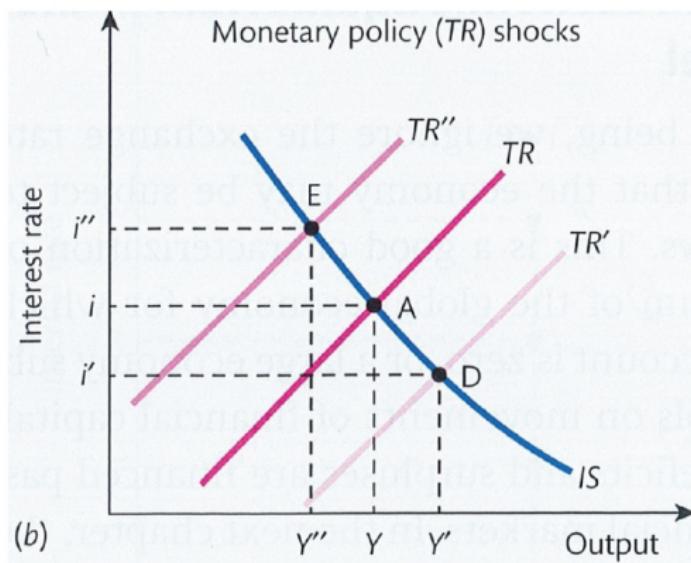
Goods market shocks: mechanisms

Additional details on the “shock propagation”:

- ▷ How far does IS shift? Depends on the Keynesian multiplier
- ▷ Other sources of goods market shocks:
 - ▷ lump-sum taxes T – effect opposite to G , with a different multiplier (can you calculate it?)
 - ▷ household wealth Ω – same effect as G , multiplier depends on form of $C(\cdot)$
 - ▷ Tobin's q – same effect as G
- ▷ Rest of the world shocks considered next week (remember, $TB = 0$ assumed for now)

Monetary policy shocks

Assume the Central Bank revises its \bar{i} (which can happen because the natural interest rate is not measured directly):



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

Consider $\bar{i} \downarrow \Rightarrow$ TR shifts down $\Rightarrow r \downarrow, I \uparrow, Y \uparrow \Rightarrow$ **expansionary** monetary policy

How to use the IS-TR framework

Be able to answer two main questions:

1. Which line (IS or TR) is affected by shock(s)?
2. In what direction do IS and TR move?
3. Find new equilibrium geometrically, then think about mechanisms – the always involve i and I

Shocks tend to happen simultaneously:

- ▷ A boost in public spending and a tax raise
- ▷ A fall in natural rate of the Central Bank and a rise in investors' optimism

In the first case, the joint effect on both Y and i is ambiguous, in the second $Y \uparrow$, but the final change in i unclear (verify that)

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 $a = a_0 + a_1 \Omega$ is the autonomous part of C (does not depend on income), and $b < 1$ is the **mpc**

Investment function

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

with $c, d > 0$, $e < 0$

Simplified Taylor rule

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

Output gap not normalized by \bar{Y}

Solve for the macro equilibrium before first TD

Summary: IS-TR

- ▷ We studied a **demand-driven** equilibrium with **fixed prices**
- ▷ A Keynesian **Multiplier** measures how much the GDP consistent with goods market equilibrium changes after shock
- ▷ **IS** curve: GDP levels and interest rates compatible with equilibrium in the goods market
- ▷ **TR** curve: central bank setting of i to smoothen business cycles
- ▷ Macroeconomic equilibrium in an economy with $TB = 0$ intersection IS and TR