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

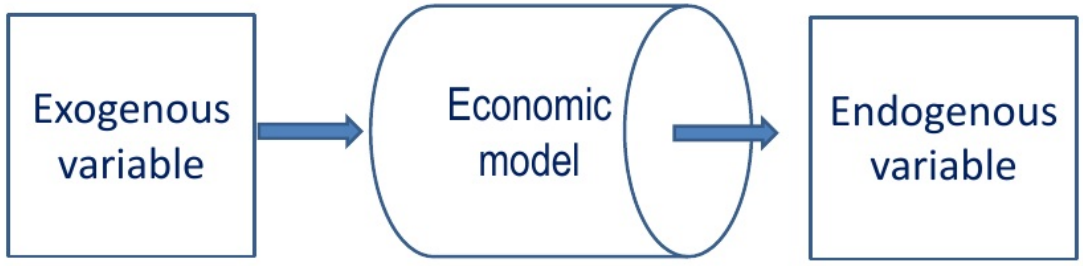
Practical men who believe themselves to be quite exempt from any intellectual influence, are usually the slaves of some defunct economist.

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

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 $\Rightarrow$ **demand-driven equilibrium**. Why? Recall micro equilibrium diagram
  - Keynes' context was 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

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

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

- Y is household income (since GDP is sum of incomes)
- T is tax (assumed lump-sum, i.e. independent of any household characteristics)

$\Rightarrow$ $Y - T$ 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

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

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

$$TB = Ex(\underset{+}{Y^*}, \underset{-}{\sigma}) - Im(\underset{+}{Y}, \underset{+}{\sigma}) = TB(\underset{-}{Y}, \underset{+}{Y^*}, \underset{-}{\sigma})$$

- 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

$$DD = C(Y - T, \Omega) + I(q, r) + TB(Y, Y^*, \sigma) + G$$
$$= DD(Y, r, \dots)$$

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

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

because $C(0, \Omega) > 0$ (assumption)

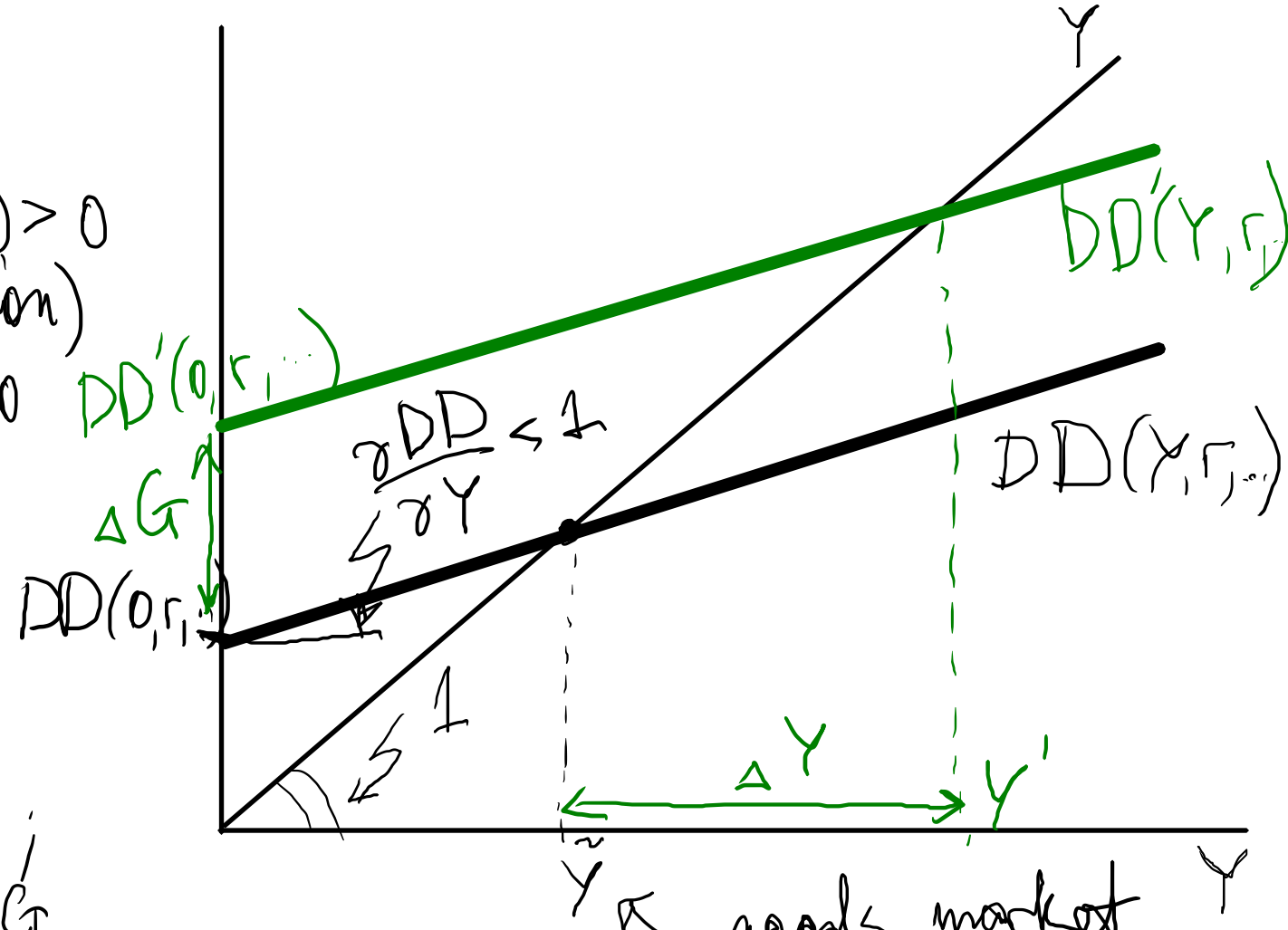
$I > 0$; $G \geq 0$

$TB(0, Y^*, \delta)$ not too negative (assumption)

Consider $\Delta G > 0$;

$DD' = DD + \Delta G$

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



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:

$$C + I + G + TB = Y$$

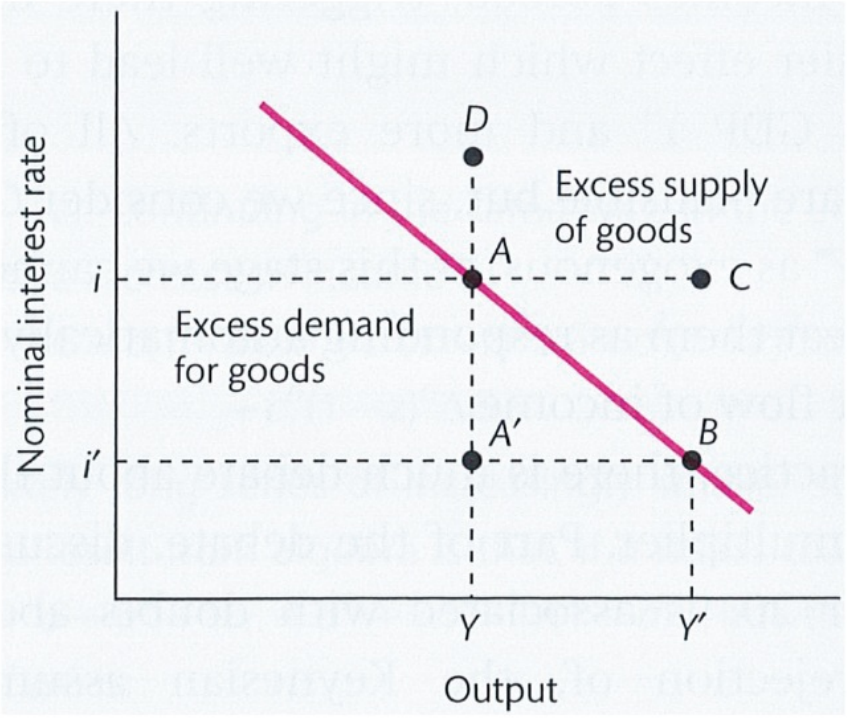
$$Y - C - G - TB = I$$

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

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

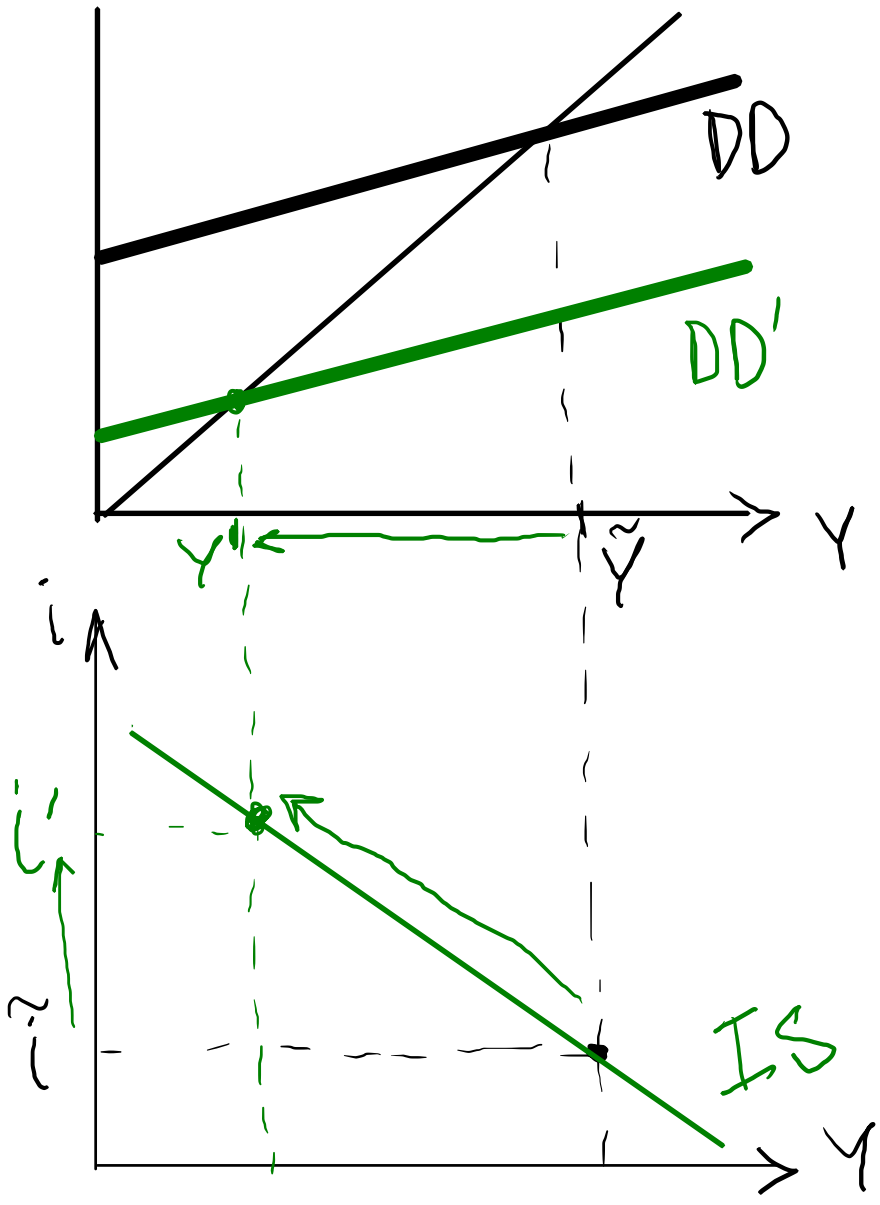
The IS curve

- 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



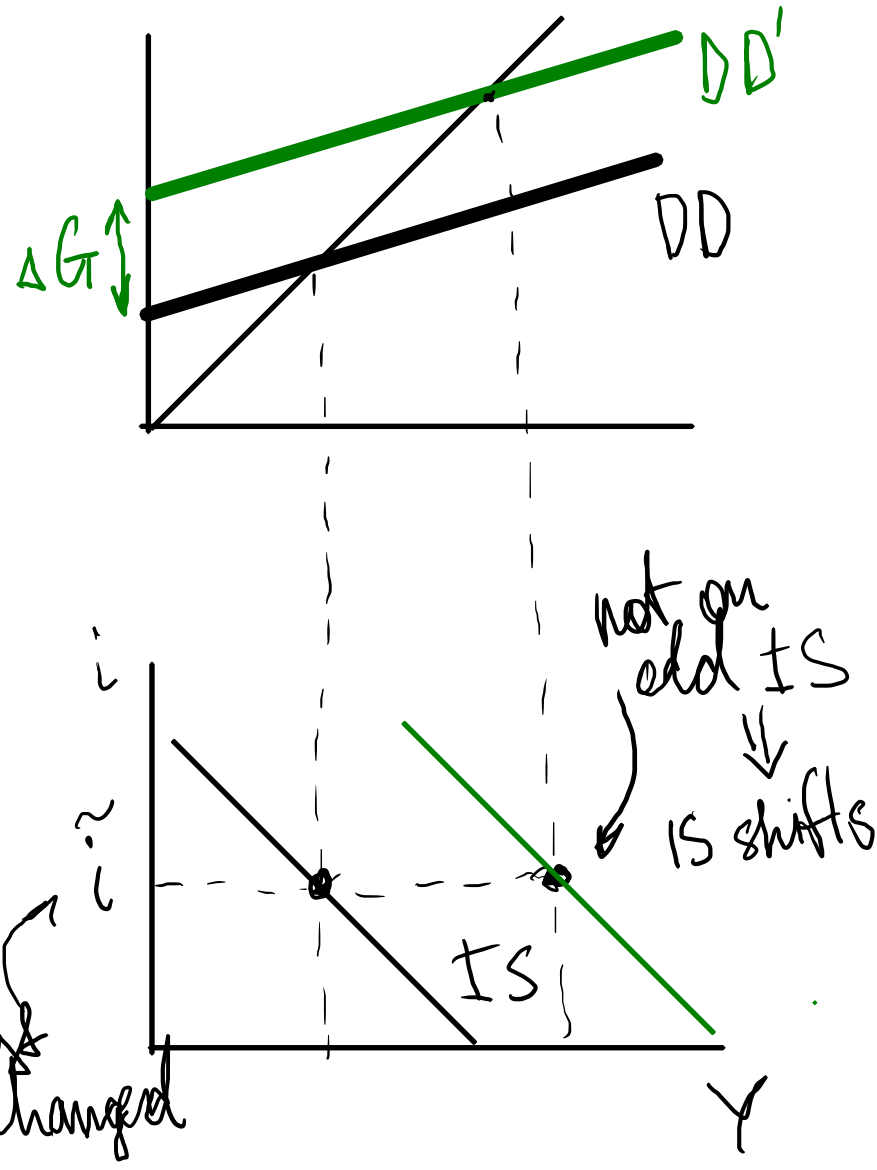
Now DD becomes DD' because of $i\uparrow$ (and $r\uparrow$)

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)



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:

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

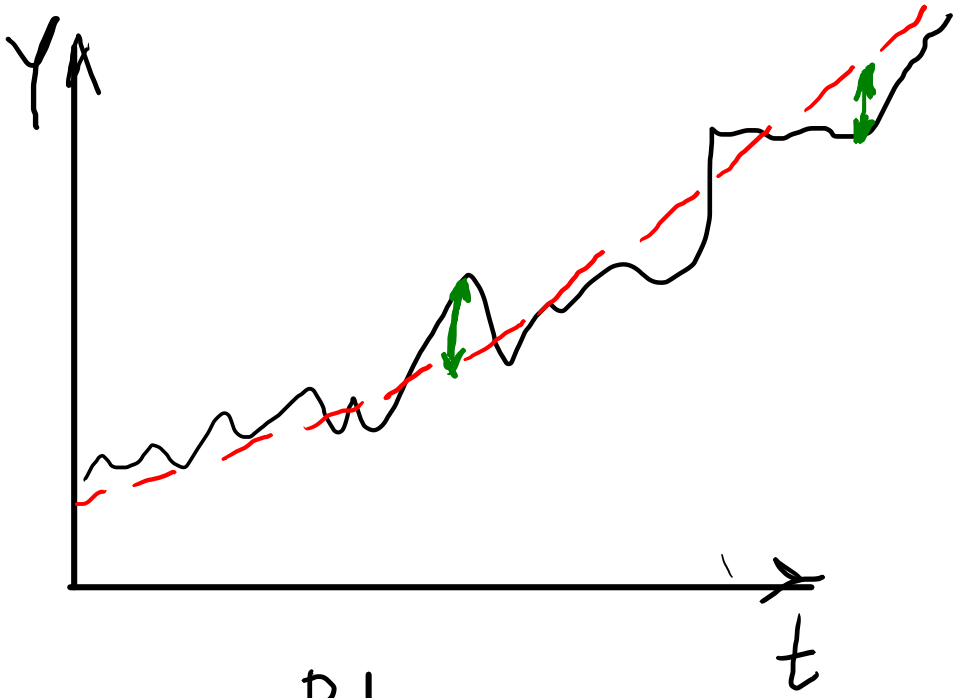
Coefficient b measures how **active** the policy is

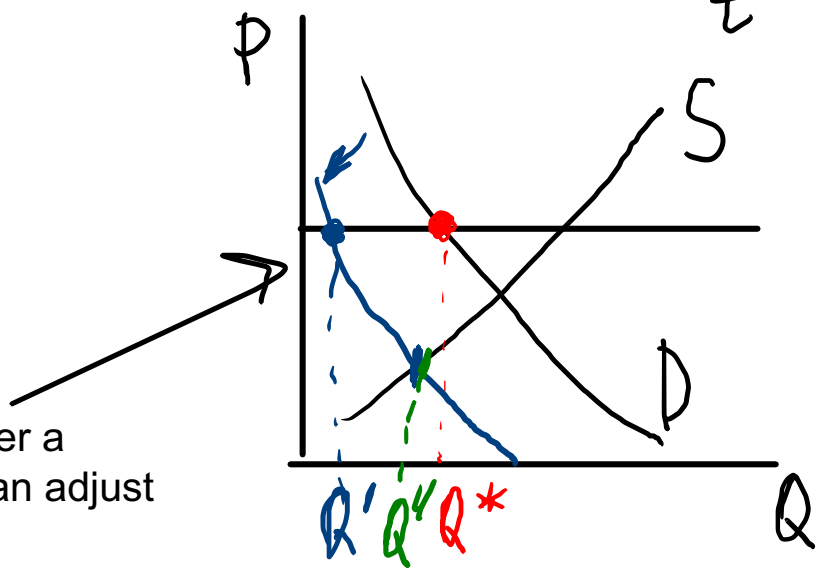
Trend, cycle, and central bank's target GDP

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



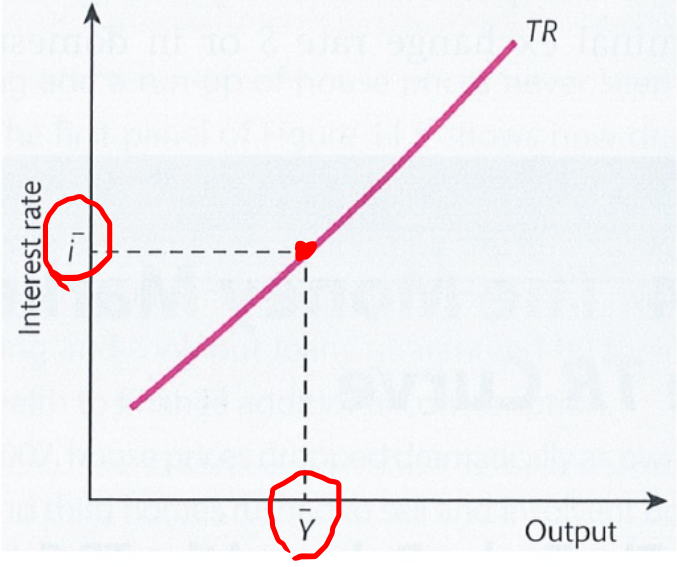


less output movement after a demand shock if prices can adjust

TR curve

Taylor Rule (TR) equation is $i = \bar{i} + b\left(\frac{Y - \bar{Y}}{\bar{Y}}\right)$ — 0 when $Y = \bar{Y}$

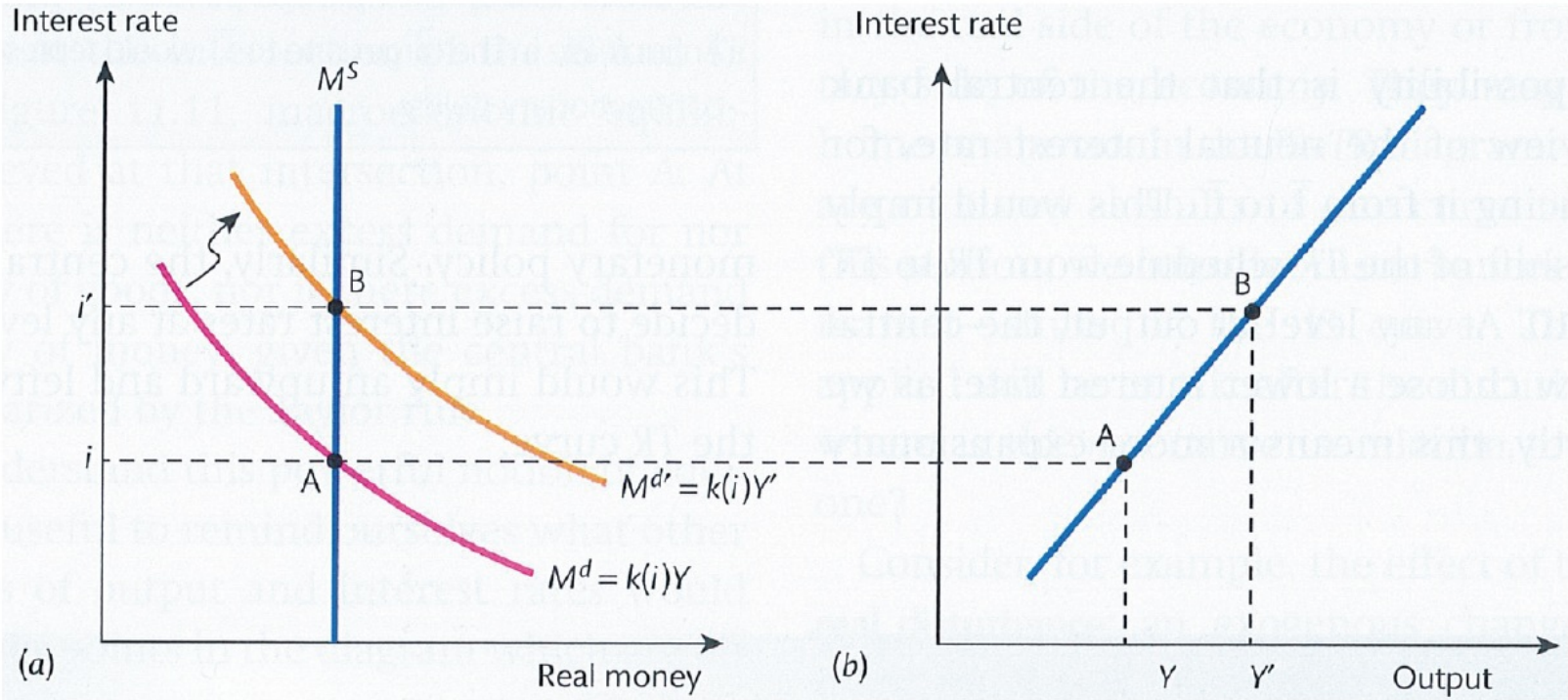
- its graph in (i, Y) space is an upward-sloping line
- When $Y = \bar{Y}$, i.e. economy on trend, central bank sets $i = \bar{i}$: the **natural interest rate**
- the economy is always on the TR curve as long as the central bank follows the Taylor Rule



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

Alternative assumption: Targeting Money Supply (LM)

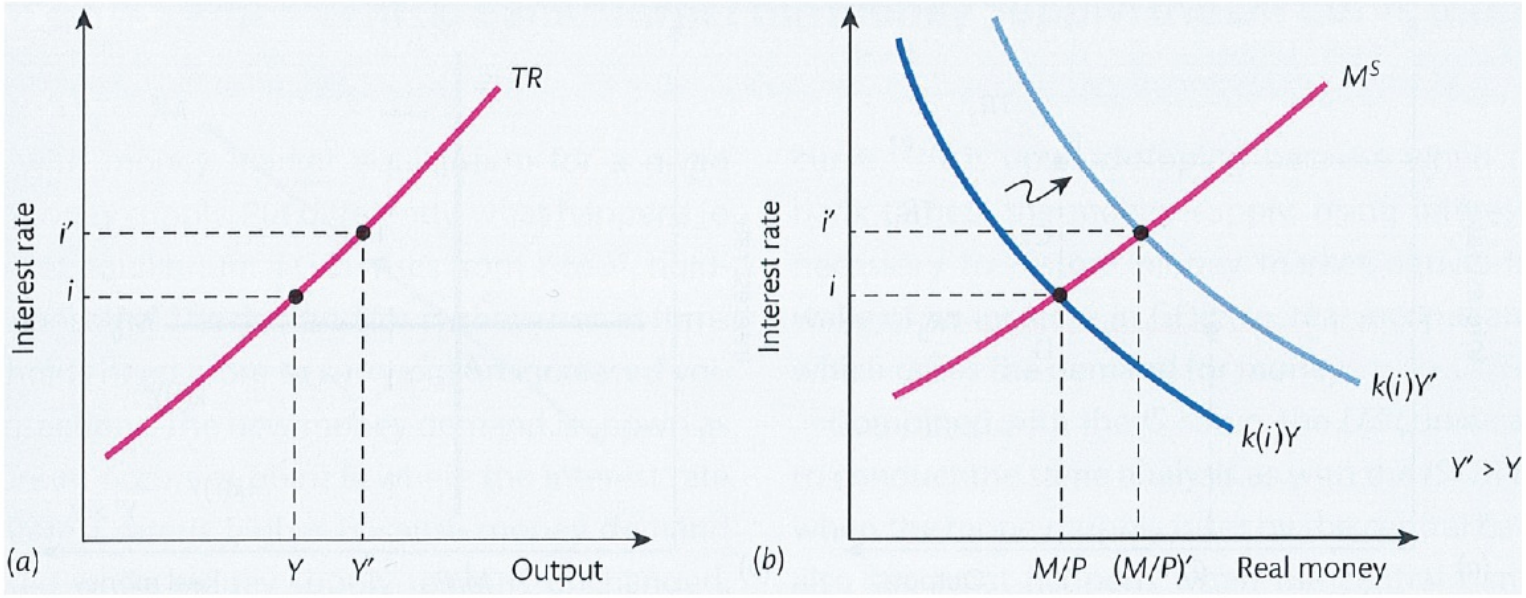
- During the 1980s, monetary targeting as main policy tool (M. Friedman)
- Gives rise to the **LM curve** (right graph) ($\Rightarrow$ IS-LM model of J.R. Hicks)
- LM curve upward sloping: pairs (Y, i) for fixed supply of money M^S



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.

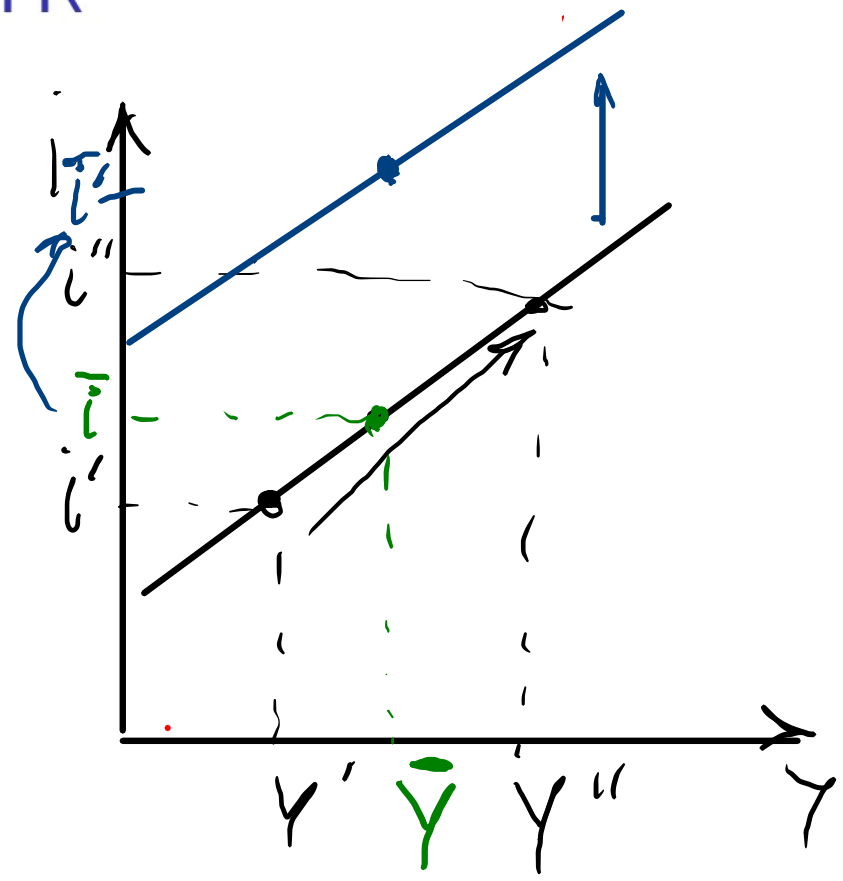
Movement along vs. shift of TR

For the simplified Taylor rule $i = \bar{i} + b\left(Y - \bar{Y}\right)/\bar{Y}$:

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:

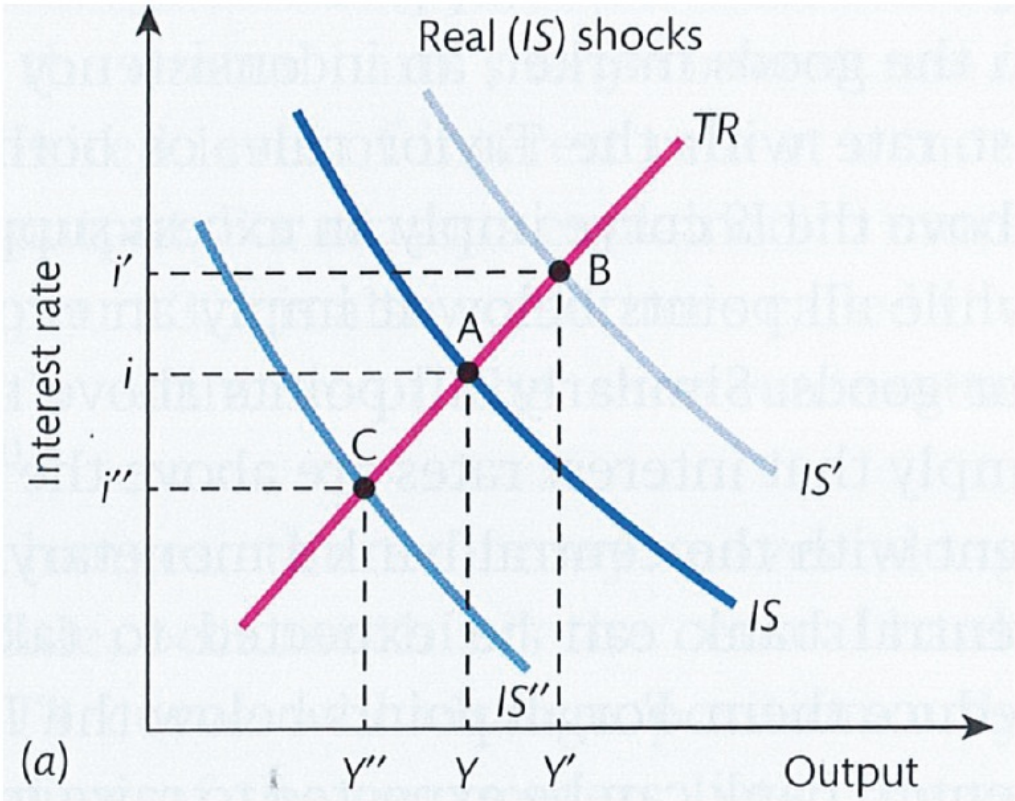
1. The goods market is in equilibrium (IS holds). This means $Y = DD$

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: $Y' > Y$.

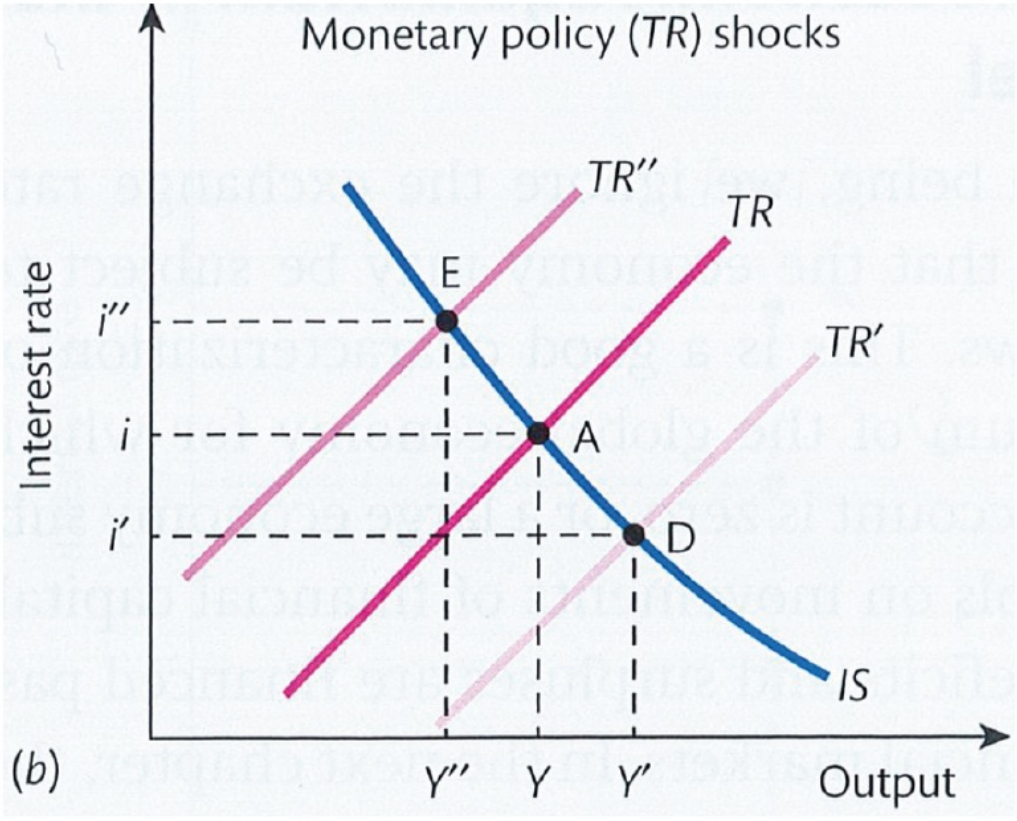
Goods market shocks: mechanisms

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