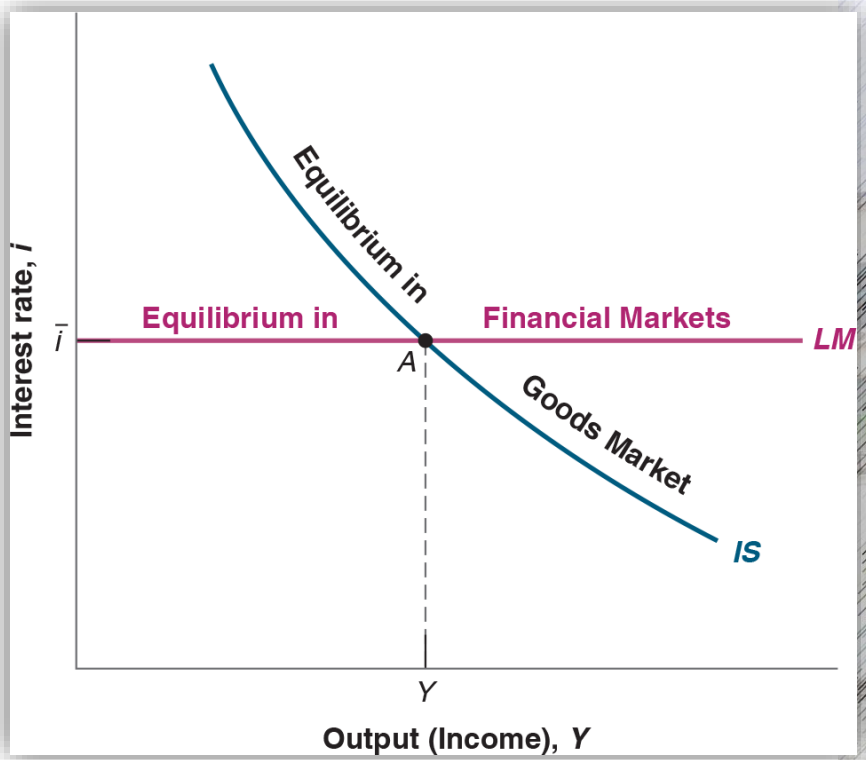
Putting the IS and LM relations together

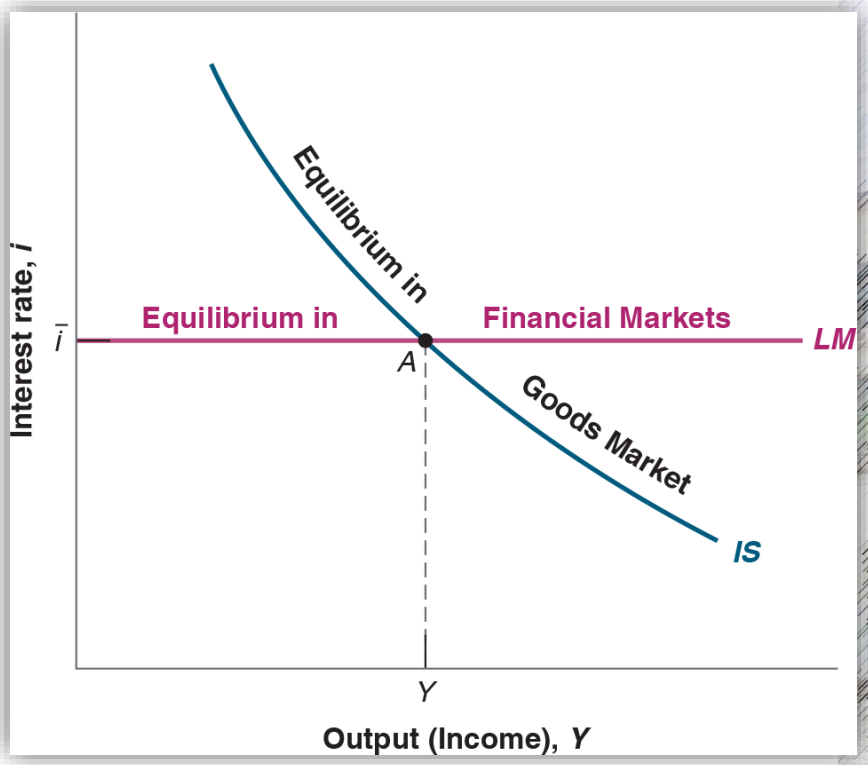
- Equilibrium in the goods market implies that an increase in the interest rate leads to a decrease in output.
  - This is represented by the IS curve. Any point of the IS curve is a combination of *i* and *Y* for which the goods market is in equilibrium
- Equilibrium in financial markets is represented by the horizontal LM line.
  - Any point on the LM line corresponds to equilibrium in financial markets.
- Only at point A, which is on both curves, are both goods and financial markets in equilibrium.



$$Y = C(Y - T) + I(Y, i) + G$$
$$(+) \quad (+ \ -)$$

$$\frac{M}{P} = YL(\bar{i}) \quad drawn\ as\ i = \bar{i}$$
$$(-)$$

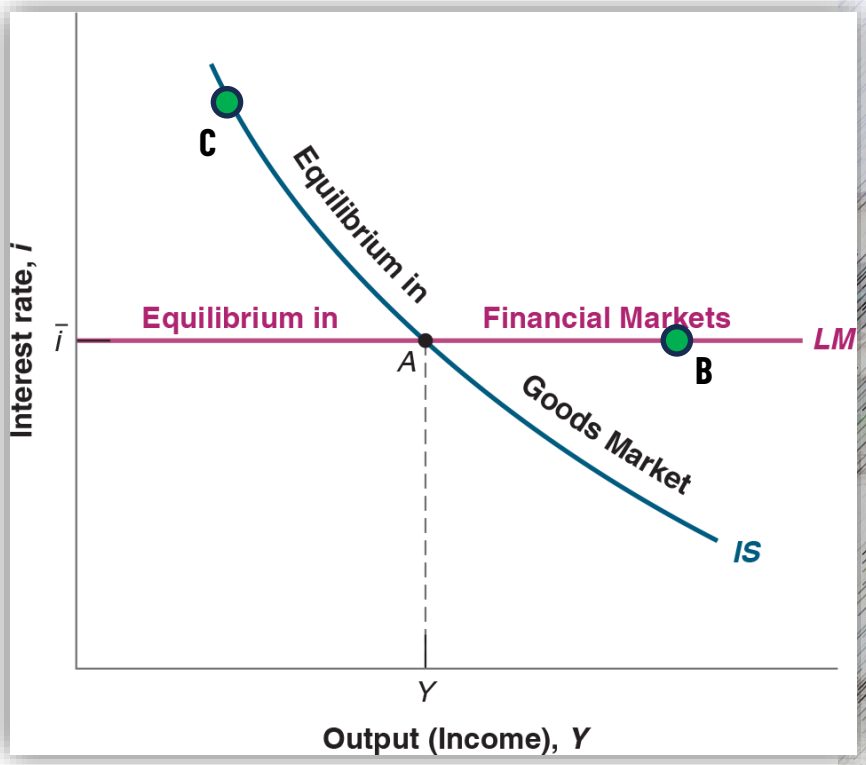
- Only at point A are both goods and financial markets in equilibrium.
- How is this useful for us to read world's events?
- This model holds the answer to many questions in macroeconomics.
  - what happens to output when the central bank decides to decrease the interest rate,
  - when the government decides to increase taxes
  - when consumers become more pessimistic about the future
  - …



$$Y = C(Y - T) + I(Y, i) + G$$
$$(+) \quad (+ \ -)$$

$$\frac{M}{P} = YL(\bar{i}) \quad drawn\ as\ i = \bar{i}$$
$$(-)$$

- How would you characterize an economy where GDP and interest rates are such as in point B?
- How would you characterize an economy where GDP and interest rates are such as in point C?



Economic policies and IS-LM equilibrium

- Fiscal policy
  - **fiscal contraction or a fiscal consolidation**: a reduction in the budget deficit (G-T), achieved either by increasing taxes, or by decreasing spending, or both
  - **fiscal expansion**: an increase in the budget deficit (G-T), achieved either by decreasing taxes, or by increasing spending, or both
- Monetary policy
  - **monetary expansion**: the central bank decreases the interest rate, achieved through an increase in the money supply
  - **monetary tightening**: an increase in the interest rate, achieved through a decrease in the money supply

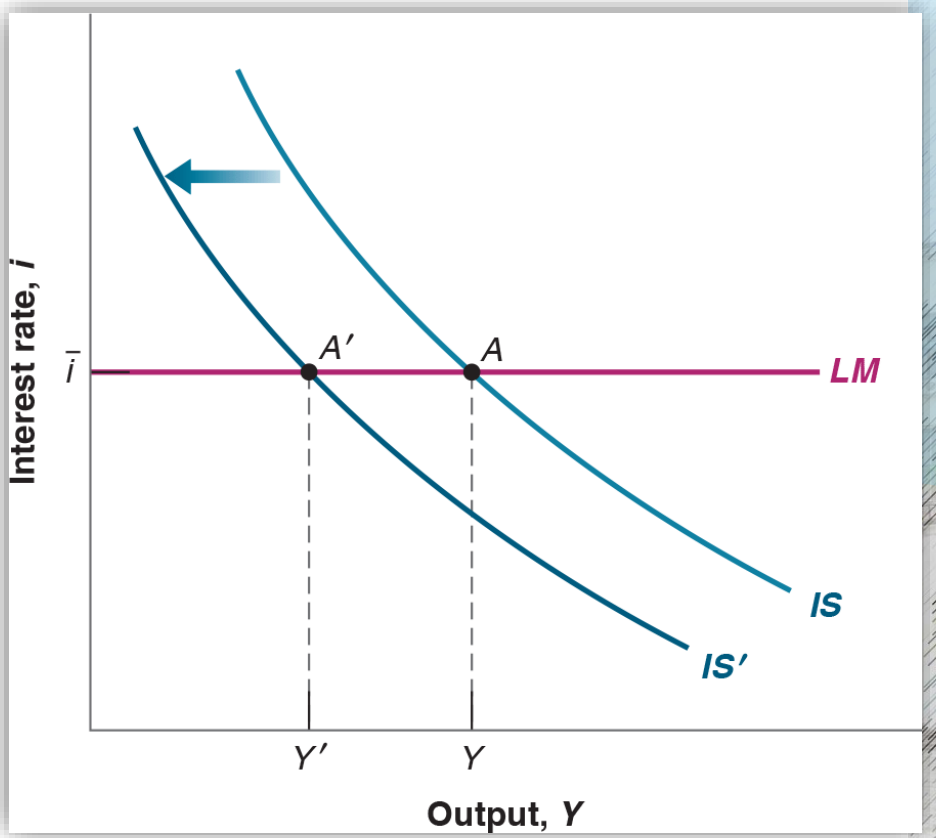
$$Y = C(Y - T) + I(Y, i) + G$$

(+ on Y in $C(Y - T)$; + on Y and − on i in $I(Y, i)$)

$$\frac{M}{P} = YL(i) \quad \text{drawn as } i = \bar{i}$$

(− on i in $L(i)$)

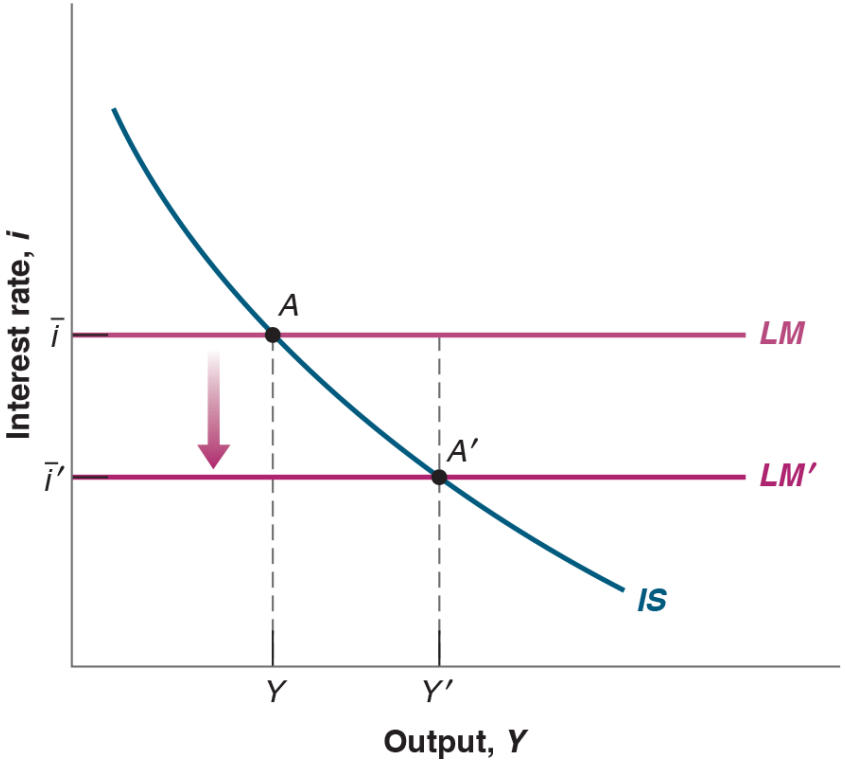
- Fiscal contraction (reduce the fiscal deficit) through higher T
- Higher T reduces Y, at any level of *i*
  - IS curve shifts to the left
- we are looking at a change only in fiscal policy, the central bank does not change the interest rate.
  - the LM curve does not shift
- The equilibrium shifts along the LM curve, from A to A'
- Increase in taxes → lower disposable income → people decrease consumption & investment→demand→output→ income.
- This lowers money demand (right hs of LM)
- The LM is not in equilibrium: money supply exceeds demand
- The central bank, to restore equilibrium while keeping the "*i*" fixed, reduces the money supply.



$$\uparrow Y = C(Y - T) + I(Y, \boxed{i}\downarrow) + G$$
(+ ; + −)

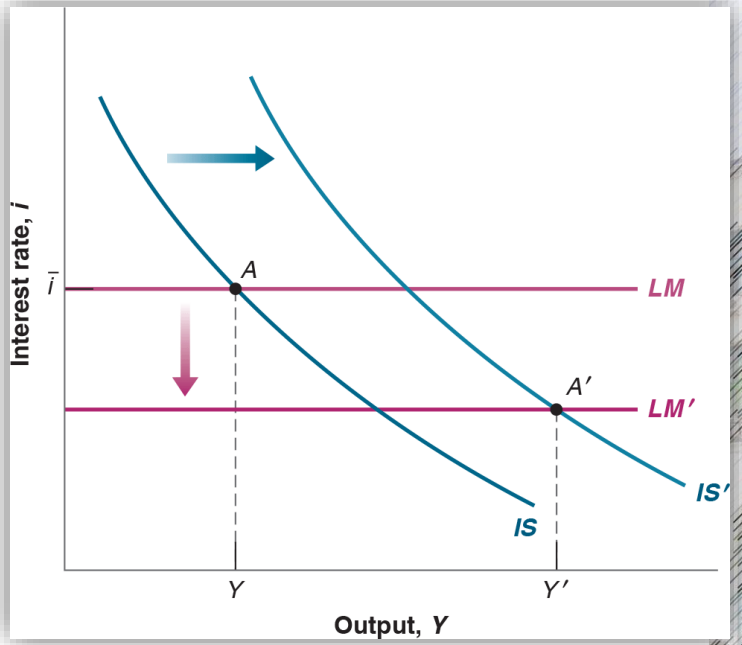
$$\uparrow \frac{M}{P} = YL(\boxed{\bar{i}}\downarrow) \quad drawn\ as\ i = \boxed{\bar{i}}\downarrow$$
(−)

- Monetary expansion (reduce interest rate by increasing monetary supply)
  - the central bank moves down *i* while increasing *M*, so that, at any level of output, *i* is lower
- What happens? Lower *i* → higher output
  - In the IS relationship, lower *i* → higher investment spending, hence output, hence consumption/investment…
- Graphically:
  - LM curve shifts down
  - IS does not move
  - New equilibrium shifts ALONGSIDE the IS curve (which does not move) from A to A'
- Even though the IS relationship (equation) shows changes in its components, the IS curve does NOT move. Why?



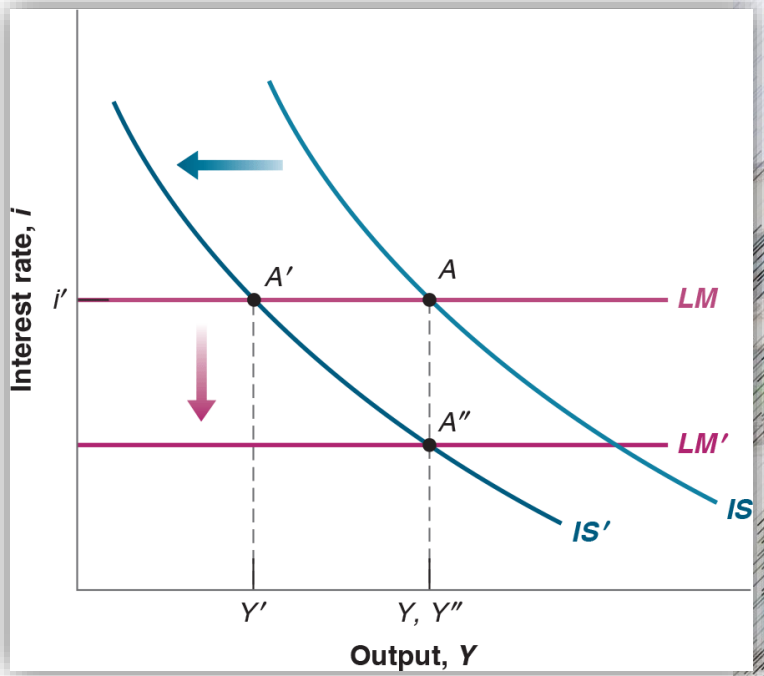
Using a policy mix

- **Monetary-fiscal** "policy mix" is the combination of monetary and fiscal policies.
- An example with convergent expansions
- Suppose that the economy is in a recession and output is too low.
- Both fiscal and monetary policies can be used to increase output.
  - Expansionary fiscal policy (IS shifts to IS′)
  - Expansionary monetary policy (LM → LM′)



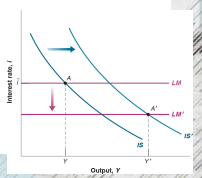
$$Y = \underset{+}{C}(Y - T) + \underset{+\ -}{I}(Y, i) + G \qquad \frac{M}{P} = YL(\underset{-}{i}) \ \ drawn\ as\ i = \bar{i}$$

- Example with diverging policies: fiscal consolidation + monetary expansion.
- Government aims at reducing the budget deficit: increase T and lower G. This would reduce output (recession) : equilibrium from A to A'
- If the central bank reduces the interest rate to i' the equilibrium is given by point A" with corresponding output Y".
- Reduced the deficit, avoided recession
  - Early '90s in the US: Clinton (in charge of fiscal policy) and Alan Greenspan (FED, in charge of monetary policy).
- In the late 2010s in euro area: would like to reduce debt through fiscal restrictions, and compensate with monetary expansions. BUT interest rates were already very low.
  - there was little room for monetary policy to offset the adverse effects of a fiscal contraction on output



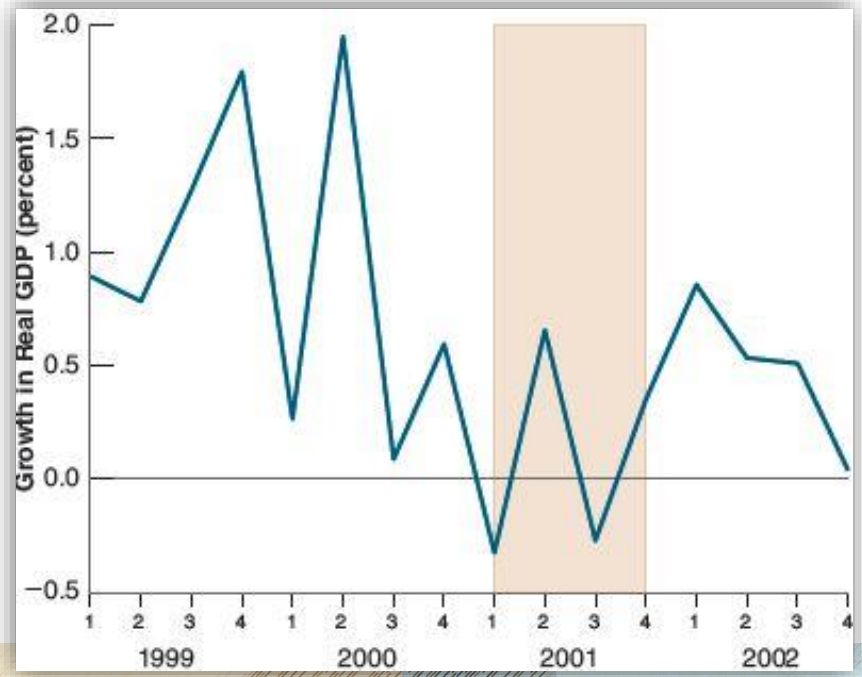
$$Y = \underset{+}{C}(Y - T) + \underset{+\ -}{I}(Y, i) + G \qquad \frac{M}{P} = YL(\underset{-}{\bar{i}}) \ \ drawn\ as\ i = \bar{i}$$

- **Monetary-fiscal** "policy mix" is the combination of monetary and fiscal policies.
- Why use both policies? Wouldn't one suffice?
  - Fiscal expansion: worse public budget (higher spending and/or lower , higher debt. This could be dangerous later.
  - Monetary expansion means a decrease in the interest rate. If reduced too much, then the room for monetary policy is limited. If the interest rate is equal to zero, fiscal policy has to do all the work, because of the **zero lower bound**.
  - Different effects on the composition of output. Changes in taxes tends to increase consumption more than investment spending.
    Changes in interest rate affects investment more than consumption.
    Depending on the context and the aims, policymakers choose the lever to use.
  - Neither policies work perfectly. A decrease in taxes may fail to increase consumption. A decrease in the interest rate may fail to increase investment. Thus, it is more prudent to use both



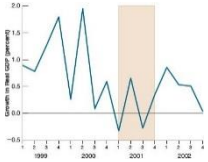
Focus: The U.S. Recession of 2001

- The U.S. economy was in a recession between March 2001 and December 2001, triggered by sharp declines in investment spending.



The U.S. Growth Rate, 1999 Q1 to 2002 Q4

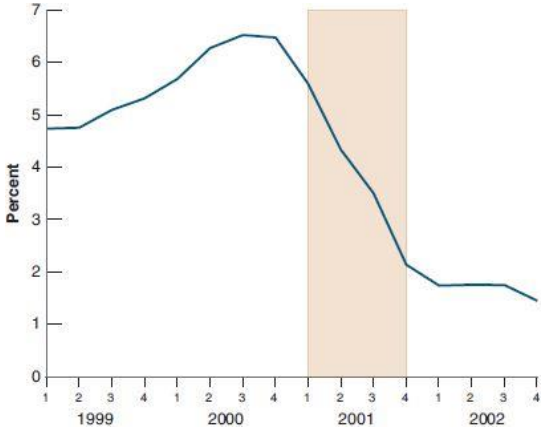
Source: Calculated using Series GDPC1, Federal Reserve Economic Data (FRED) http://research.stlouisfed.org/fred2/



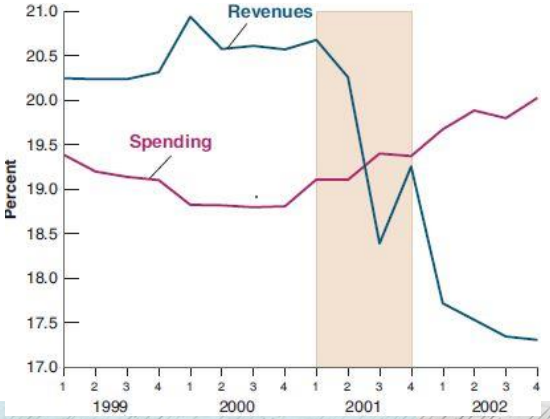
Focus: The U.S. Recession of 2001

- The U.S. economy was in a recession between March 2001 and December 2001, triggered by sharp declines in investment spending.
- The recession was met by strong macroeconomic policy response.
  - The Fed cut the federal funds rate from 6.5% in January to 2% at the end of 2001.
  - Government cut taxes in 2001 and 2002 budgets. 9/11 shock also led to an increase in spending on defense and homeland security.

The Federal Funds Rate, 1999 Q1 to 2002 Q4



Federal Government Revenues and Spending (% GDP)



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Introducing real interest rates and risk premiums in IS-LM (ch.6)

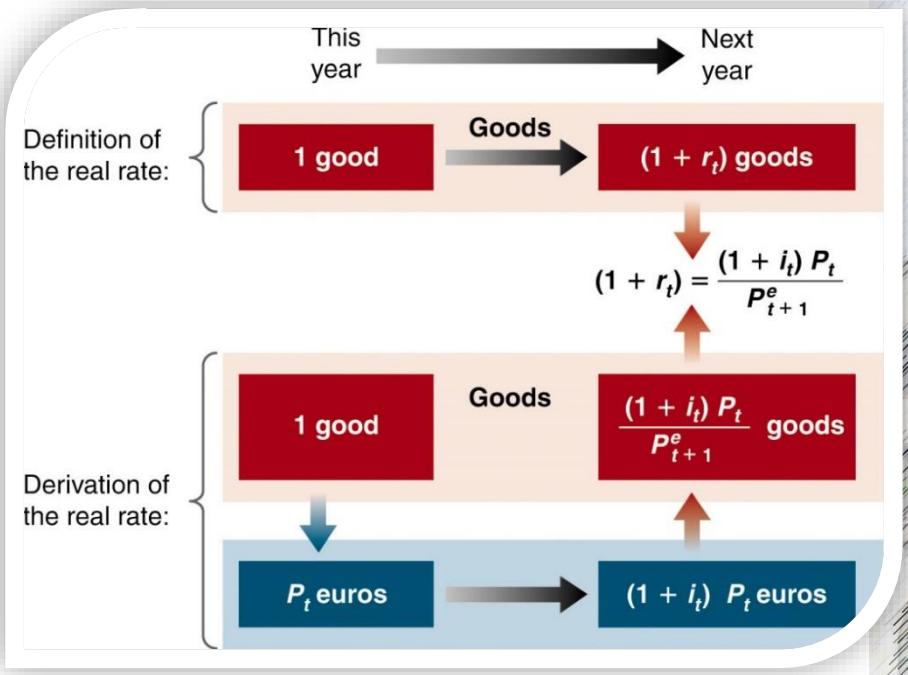
Real interest rate

- Nominal interest rate (i) is the interest rate in terms of dollars.
- Real interest rate (r) is the interest rate in terms of a basket of goods.
- We must adjust the nominal interest rate to take into account expected inflation π^e.

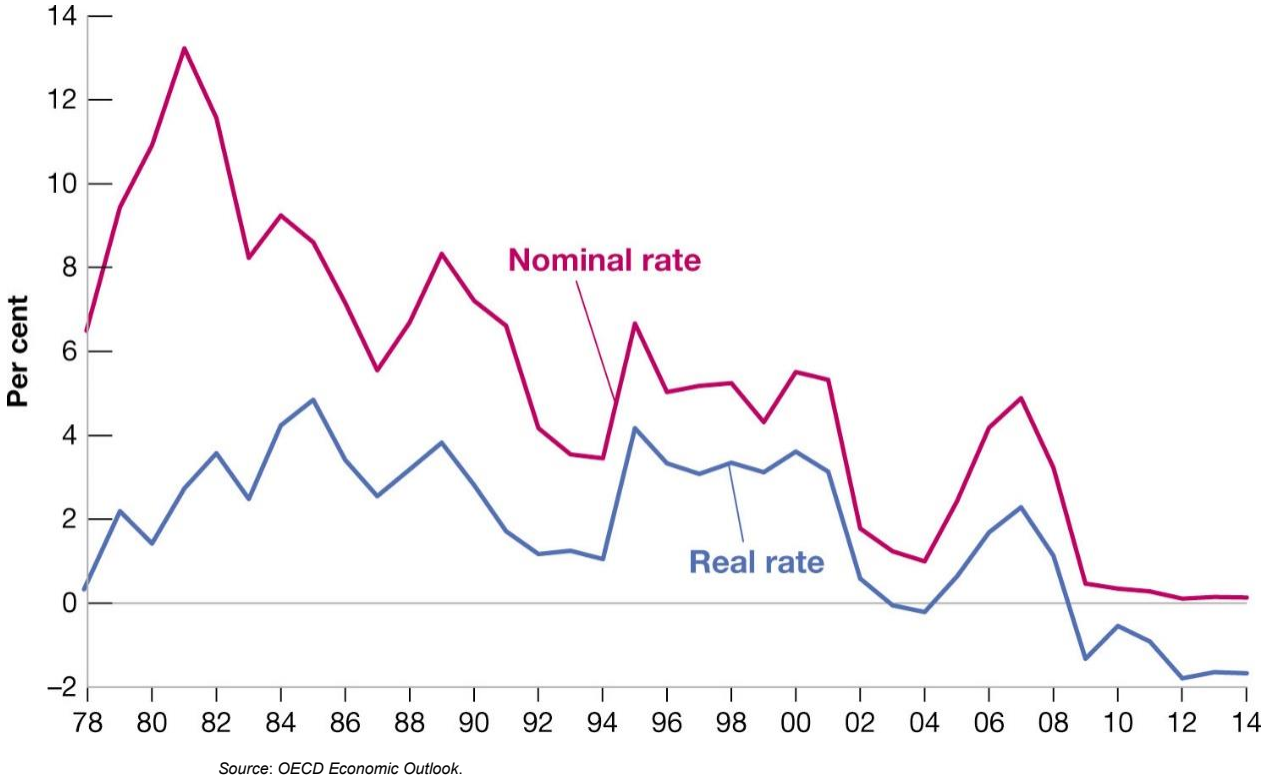
- Prices today: P_t
- Expected prices tomorrow: P^e_{t+1}

- Expected inflation: $\pi^e_{t+1} = \frac{P^e_{t+1} - P_t}{P_t} = \frac{P^e_{t+1}}{P_t} - 1$

- Real interest rate (approximation) $r_t = i_t - \pi^e_{t+1}$



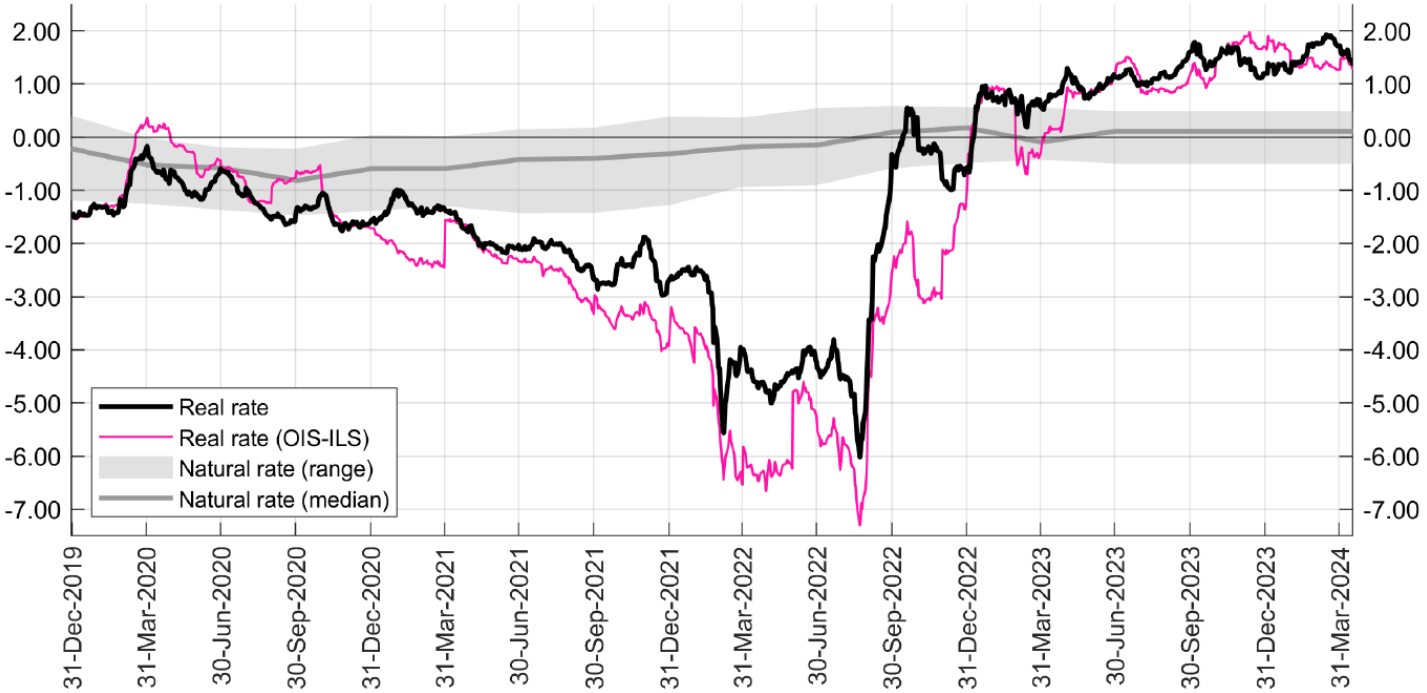
- Nominal and real one-year Treasury bill (T-bill) rates in the United Kingdom since 1980



Source: OECD Economic Outlook.

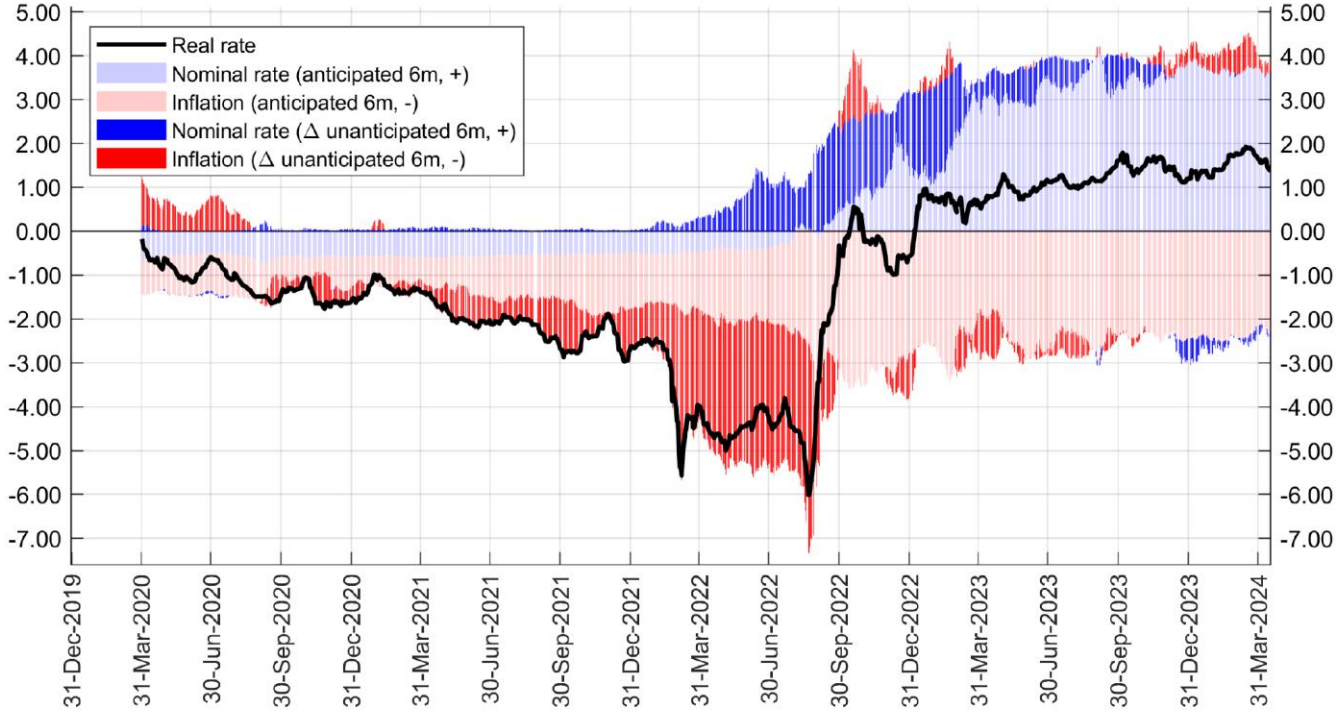
Figure 6. Evolution of the real rate gap since 2020

(*percent*)



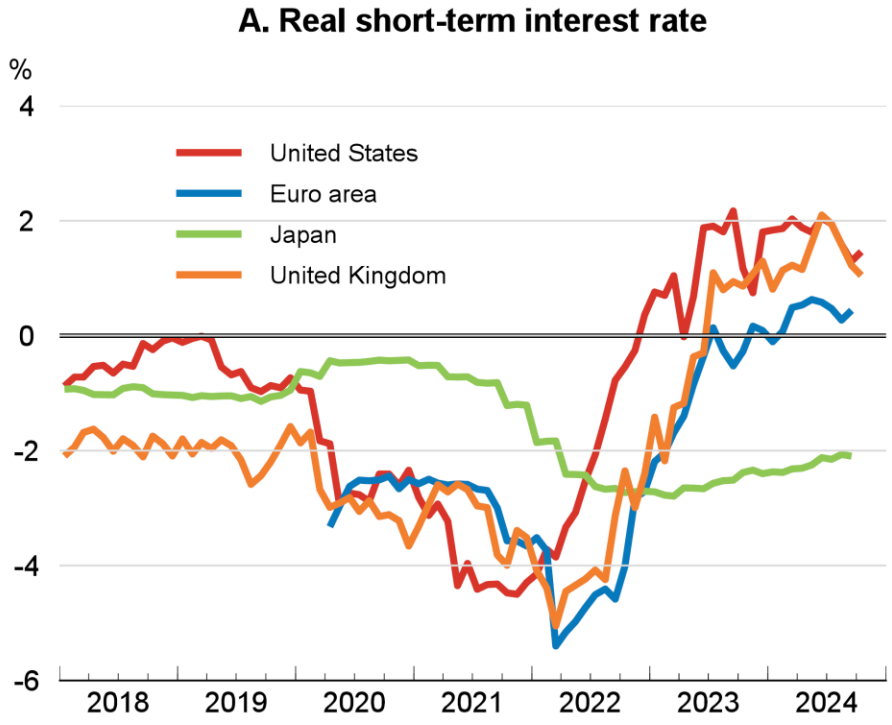
Source: authors' elaboration on Bloomberg and LSEG data. *Notes*: The chart shows (*i*) our measure of the *ex-ante* 1-year real interest rate based on the use of Inflation Fixing Swaps, (*ii*) the simple measure based on 1-year OIS-ILS difference and (*iii*) a range of estimates of r^* (10^{th} and 90^{th} percentiles). The range is available until 2023Q3 and kept constant afterwards. The solid grey line denotes the median of this range.

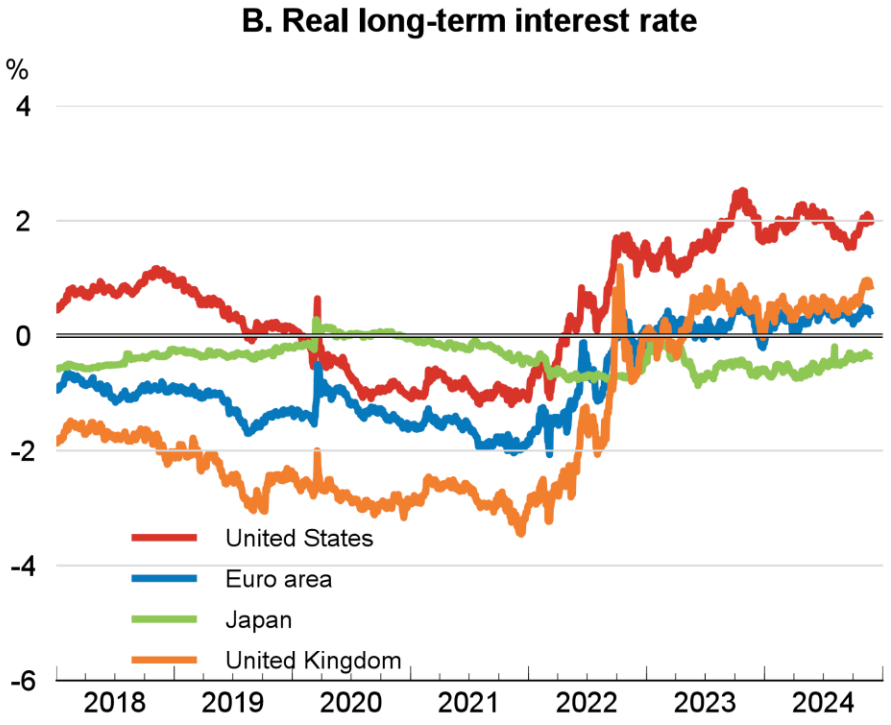
Figure 7. Decomposition of the real rate into expected and unexpected factors
(*percent*)

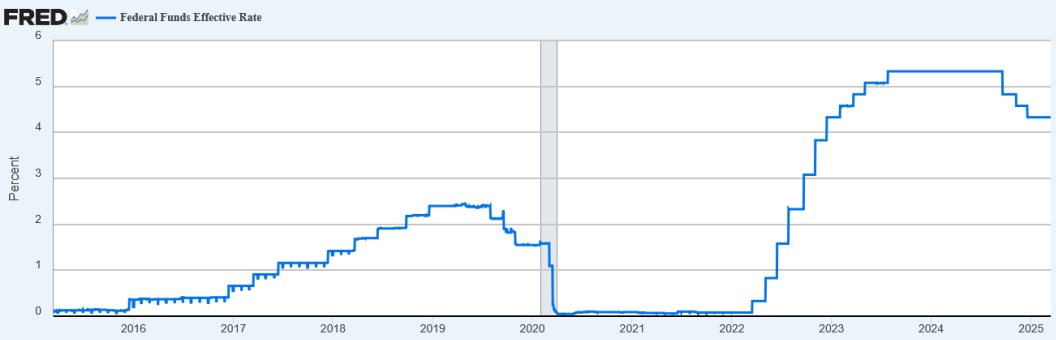


Source: authors' elaboration on Bloomberg and LSEG. *Notes*: The chart shows the decomposition of the *ex-ante* short term real interest rate (black solid line) in: *(i)* nominal rate anticipated 6-months behind (light blue bars), *(ii)* revision of nominal rate (dark blue bars), *(iii)* anticipated inflation 6-months behind (flipped sign, light red bars), *(iv)* revision of inflation outlook (flipped sign, dark red bars).

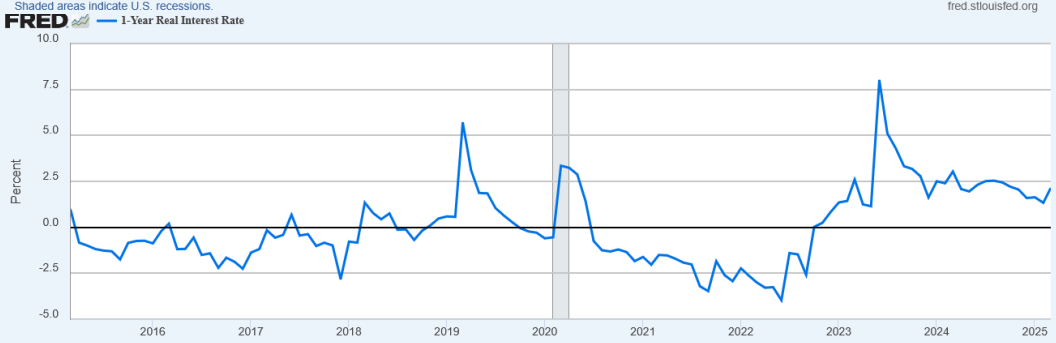
Figure 1.29. Forward-looking real interest rates remain above pre-pandemic levels in most advanced economies







Source: Federal Reserve Bank of Cleveland via FRED®
Shaded areas indicate U.S. recessions.
fred.stlouisfed.org



Source: Federal Reserve Bank of Cleveland via FRED®
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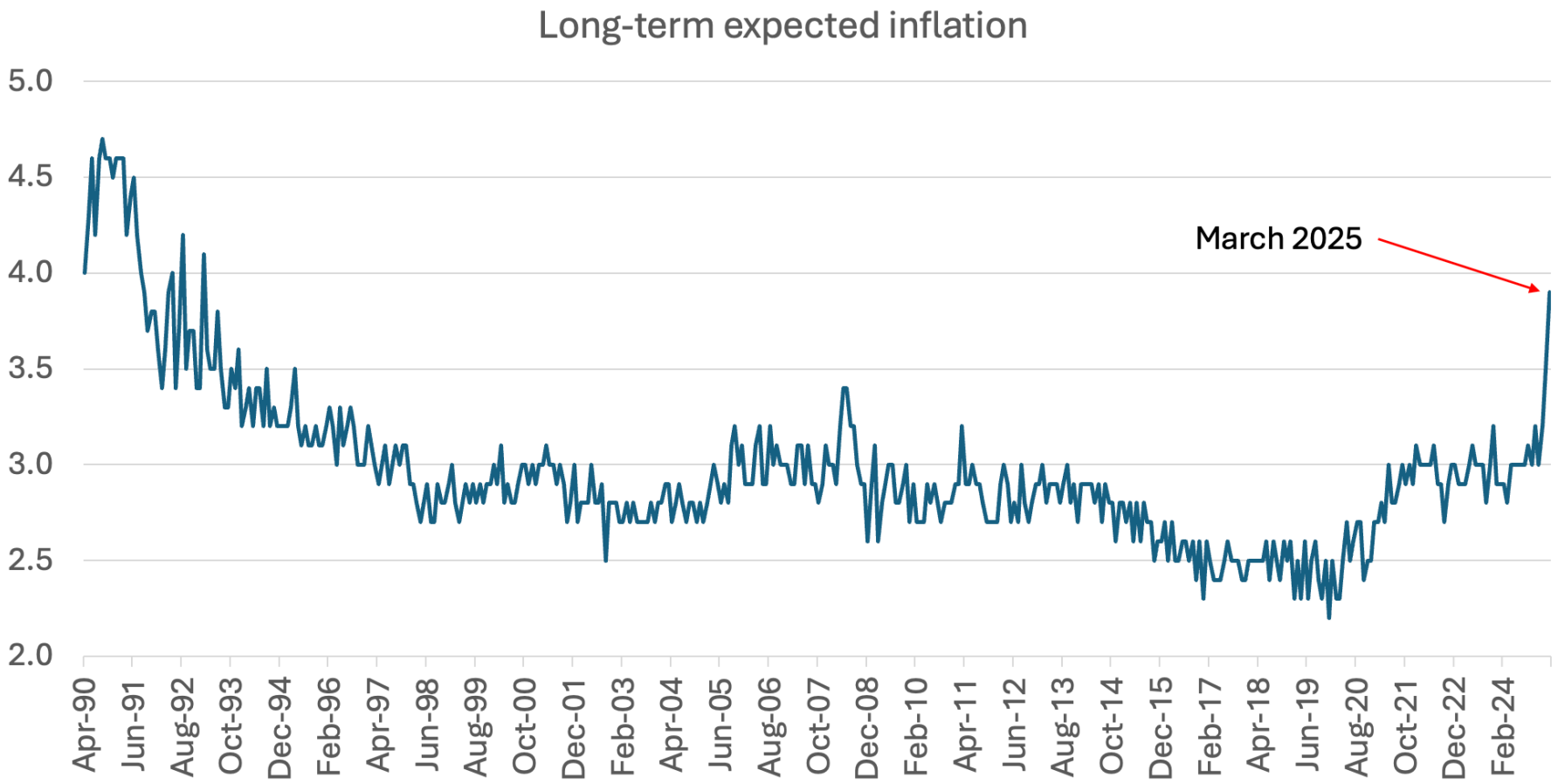

Long-term expected inflation
5.0
4.5
4.0
3.5
3.0
2.5
2.0
March 2025
Apr-90
Jun-91
Aug-92
Oct-93
Dec-94
Feb-96
Apr-97
Jun-98
Aug-99
Oct-00
Dec-01
Feb-03
Apr-04
Jun-05
Aug-06
Oct-07
Dec-08
Feb-10
Apr-11
Jun-12
Aug-13
Oct-14
Dec-15
Feb-17
Apr-18
Jun-19
Aug-20
Oct-21
Dec-22
Feb-24

Risk and Risk Premium

- Although we said that the central bank sets the interest rate, in the real world we do not pay exactly that interest rate if we purchase bonds.
  - We can borrow at the rate set by the central bank. Nor can we borrow at the same rate as the government. There is a good reason for this.
- Central bank rates do not account for risk of DEFAULT by the bond issuer.
- Markets do. Bonds are exchanged on markets.

Risk and Risk Premium

- Some bonds are risky, they **might not** get reimbursed
- Ideally, I would like to get the same return from a risky bond than I would get from a riskless bond. Otherwise no one would buy the risky bond.
- Riskless bond pays me *i* for sure → reimbursement rate will be (1+i) times what I have paid initially
- Risky bond
  - will pay me back ZERO with probability *p* (no interests, not even the initial money back)
  - Will pay me back the interest rate with probability (1-p)
- The expected return rate for the risky bond is lower than for the riskless bond
- Bond holders require a risk premium above and beyond the interest rate *i* if they perceive the bond is risky (and the more they are risk averse)

Return rate for riskless bond

$$(1 + i)$$

Return rate for risky bond

$$p(0) + (1 - p)(1 + i)$$

Risk and Risk Premium

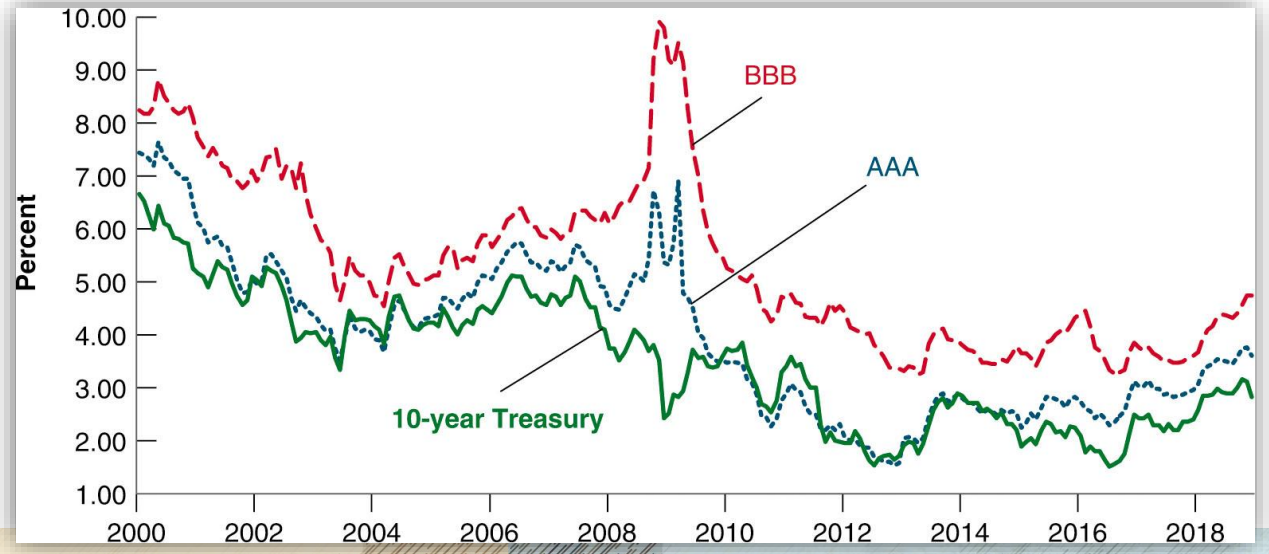
- Let *i* be the nominal interest rate on a riskless bond,
- x is the risk premium
- p is the probability of defaulting
- On a risky bond, I ask an additional premium *x* to get the same expected return on the risky bonds as on the riskless bond

$$(1+i) = p(0)+(1-p)(1+i+x)$$

$$x = \frac{(1+i)p}{1-p}$$

- if *i* on a riskless bond is 4% and *p* is 2%, then the risk premium for a risky bond *x* is 2.1%, to make the rate of returns equal
- A risk averse person will likely ask for an even higher *x*

- Rate of return (yields) on
  - 10-year Treasury Bond (almost riskless)
  - Corporate bonds rated as safe (AAA)
  - Corporate bonds rated as less safe (BBB)
- During the crisis, huge discrepancy between rates of returns of safest, safe and less safe bonds



Wrap up:

- Since some bonds are risky, bond holders require a risk premium to hold these bonds.
- Risk premia are determined by:
  - The probability of default
  - The degree of risk aversion of bond holders

Including risk in IS-LM Model

- Now we extend the I S-L M to reflect the distinction between:
  - the nominal interest rate *i* and the real interest rate $r = i - \pi^e$
  - the policy rate set by the central bank and the interest rates faced by borrowers

- Rewrite the *IS-LM*:

IS relation: $Y = C(\underbrace{Y - T}_{(+)}) + I(Y, \overbrace{i - \pi^e + x}^{r}) + G$ $\quad (+)\ (-)\ (+)$

LM relation: $\frac{M}{P} = YL(\overbrace{\bar{i} - \pi^e}^{r}) \qquad drawn\ as\ i = \bar{i}$

- Investment spending decisions depend now on the real interest rate r
  - **MAKE SENSE OF THIS: why is expected inflation positively related to investment spending?**
- The risk premium, x, captures, in a simple way, the factors we discussed previously: probability of default and level of risk aversion.
  - *x* may be high because lenders perceive a higher risk that borrowers will not repay or because they are more risk averse.

- The central bank formally chooses the nominal interest rate *i*.
- However, what happens is that it choose it in such a way as to achieve the real interest rate it wants (which affects the goods market, the IS equation)
- So we make a final simplification: let's assume that the central bank chooses *r* (**it only does so implicitly, by changing the underlying nominal interest rate**).

IS relation: $Y = C(\underbrace{Y - T}_{(+)}) + I(Y, \underbrace{r + x}_{(-)}) + G$ $(+)$

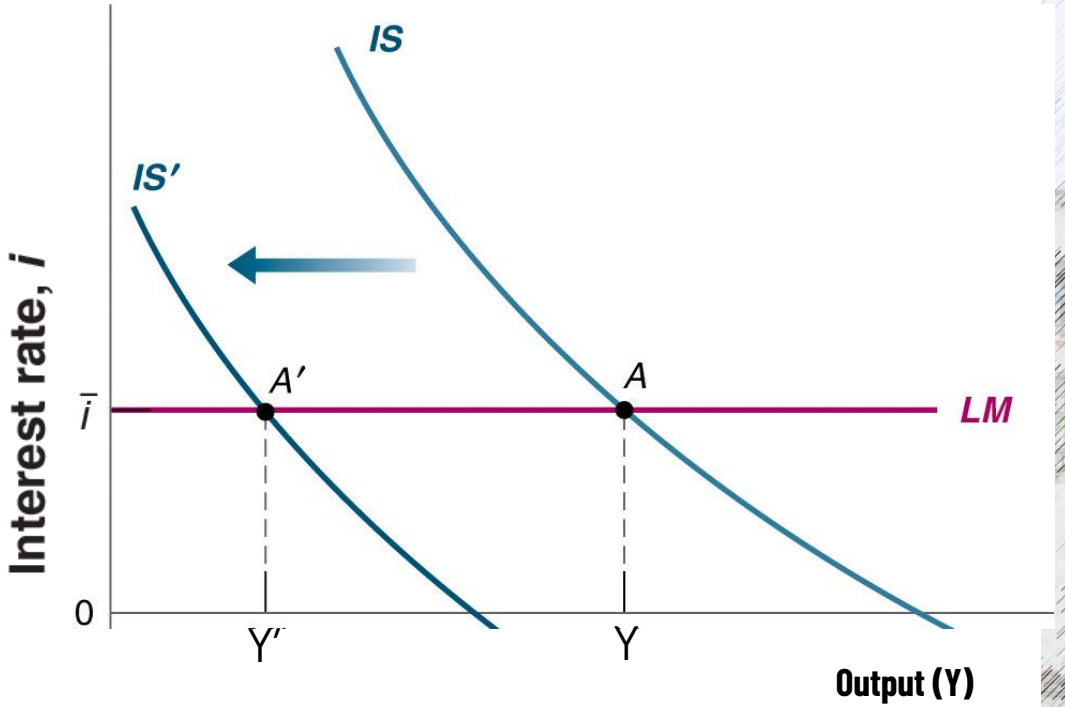
LM relation: $r = \overline{r}$

Book's choice we do not make (it's confusing: the central bank chooses *i*)

IS: $Y = C(Y - T) + I(Y, \underbrace{i - \pi^e + x}_{(-)}) + G$

LM: $\frac{M}{P} = YL(\underbrace{\bar{i} - \pi^e}_{-})$ $drawn\ as\ i = \bar{i}$

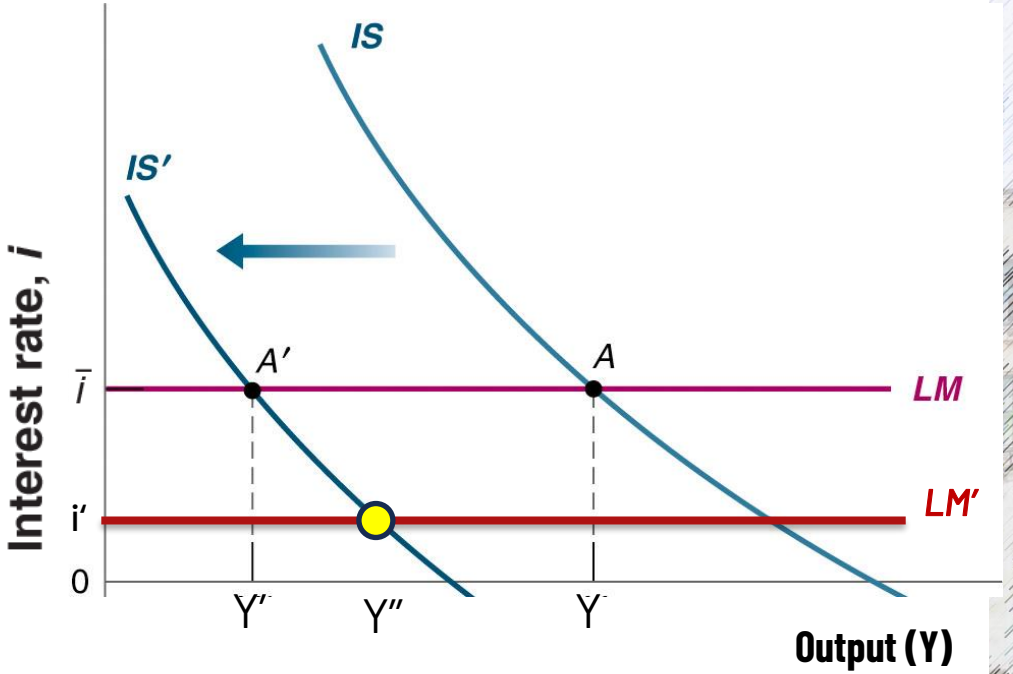
- Start from equilibrium point A
- Suppose that x increases: investors require a higher risk premium
- Effect on goods market? The IS curve shifts to the left. New equilibrium in A'
  - At the same policy rate $\bar{i}$, the borrowing rate, $(i - \pi^e + x)$, increases, leading to a decrease in demand and output.
- This is why problems in the financial system lead to a recession and a financial crisis becomes a macroeconomic crisis.



IS: $Y = C(Y - T) + I(Y, \underbrace{i - \pi^e + x}_{(-)}) + G$

LM: $\frac{M}{P} = YL(\underbrace{\bar{i} - \pi^e}_{-})$ $drawn\ as\ i = \bar{i}$

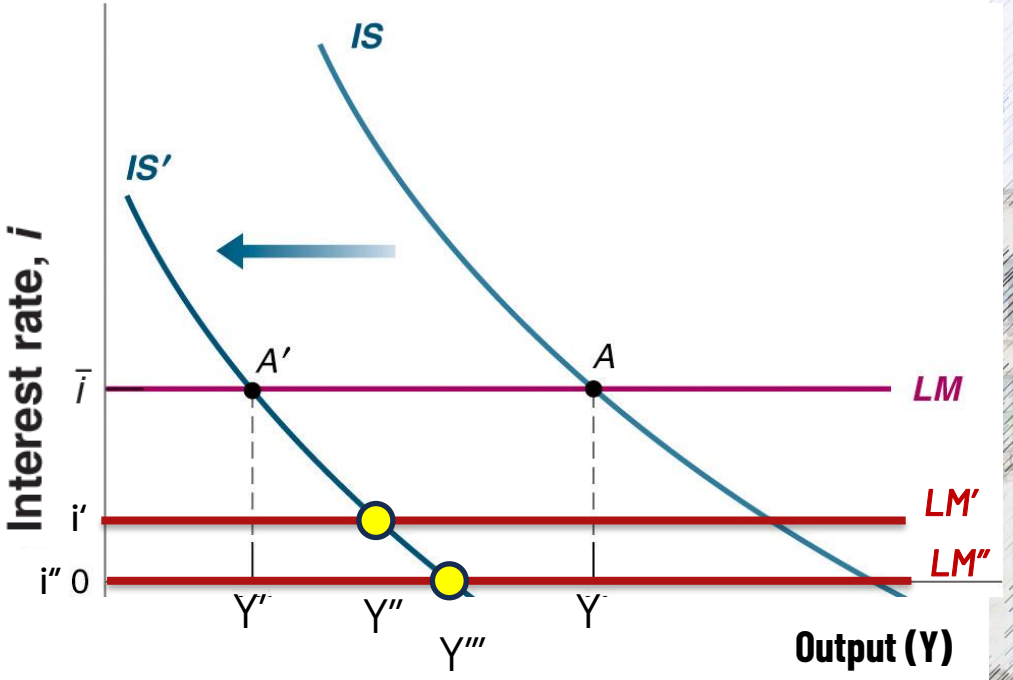
- What can policy do?
- Fiscal policy: an increase in G or a decrease in T can shift the IS curve to the right.
  - But an increase in the budget deficit might be problematic (too much debt already, trust, taxes already high…)
- Monetary policy: decrease the real interest rate, through a decrease of *i (e.g., to i")*
- Does the economy go back to original production level Y? It depends on how much can you lower the interest rate.



IS: $Y = C(Y - T) + I(Y, \underbrace{i - \pi^e + x}_{(-)}) + G$

LM: $\frac{M}{P} = YL(\underbrace{\bar{i} - \pi^e}_{-})$ $drawn\ as\ i = \bar{i}$

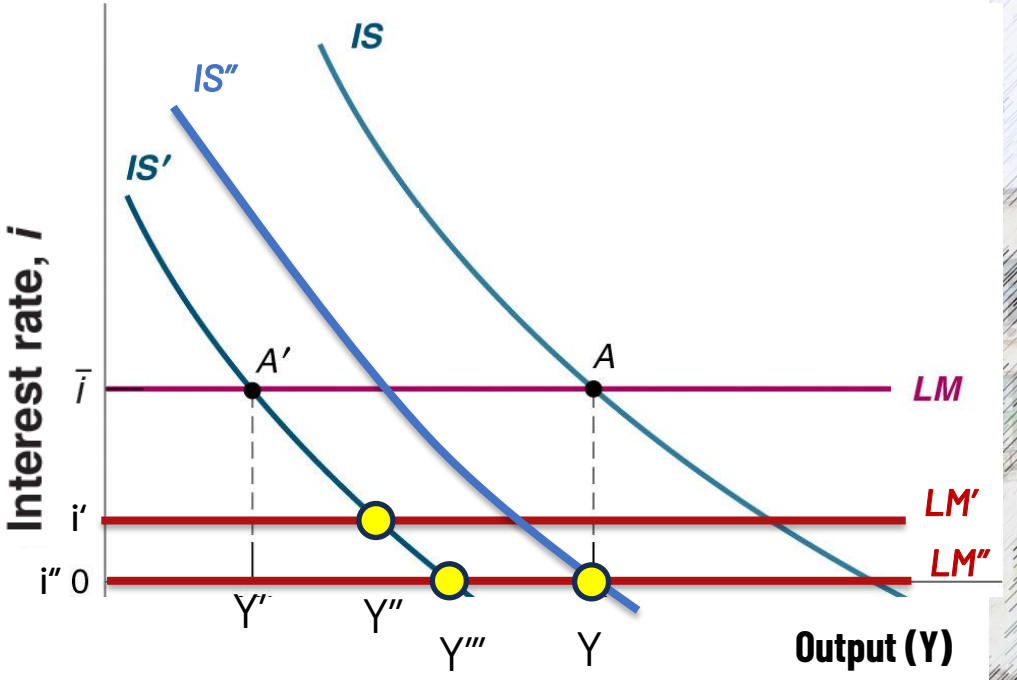
- Monetary policy: decrease the real interest rate, through lower *i*
- Does the economy go back to original production level Y? It depends on how much can you lower the interest rate.
- You might need to get to a negative real interest rate to increase demand sufficiently and return output to Y.
- Can the central bank achieve that level of real interest rate? It must decrease the nominal interest rate A LOT.
- BUT nominal interest rates CANNOT GO BELOW ZERO (e.g., i″).



IS: $Y = C(Y - T) + I(Y, \underbrace{i - \pi^e + x}_{(-)}) + G$

LM: $\frac{M}{P} = YL(\underbrace{\bar{i} - \pi^e}_{-})$ $drawn\ as\ i = \bar{i}$

- Because the nominal interest rate cannot be negative, the lowest real interest rate the central bank can achieve is the negative of inflation.
- If expected inflation increases, the IS curve would move to the right (IS″) and this would increase the equilibrium output (ideally, back to Y).
- Unless inflation is high, you cannot achieve very low real interest rates
- You might not be able to bring the economy back to the level of output Y IN THE SHORT TERM just by using monetary policy



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