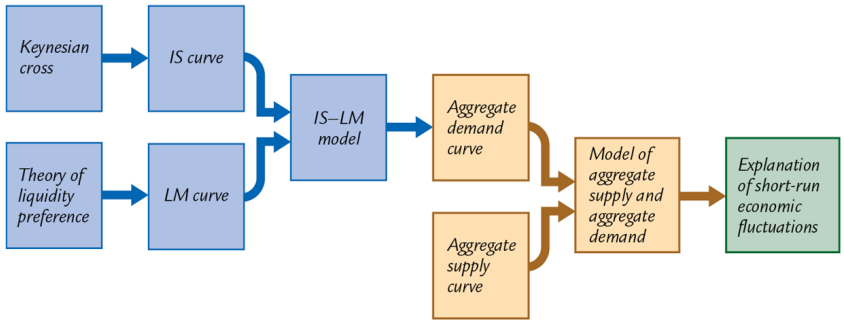
Money and Monetary Policy

Session 8 – Introduction to Macroeconomics

Francesco Chiocchio

ESCP Business School

The Overall Plan



Source: Mankiw, *Macroeconomics*, 11th ed.

Session 8: Outline

1. **Reconnect Money and LM**
   Money, inflation, liquidity preference, and the LM curve.
2. **How Central Banks Implement Policy**
   Policy rates, balance sheets, instruments, and transmission.
3. **Policy Rules and the Lower Bound**
   The Taylor rule, the Great Moderation, forward guidance, and QE.

1. Reconnect Money and LM

How do money and liquidity complete the demand side of the economy?

Money: Start with the Object

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- It serves as:
  - a medium of exchange,
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- In our teaching model:

$$M = C_u + D,$$

where C_u is currency held by the public and D is bank deposits.

The Agents and Their Balance Sheets

	Assets	**Liabilities and equity**
Households / firms	Deposits; currency; bonds	Bank loans; net worth
Commercial bank	Reserves; loans; bonds	Deposits; debt; equity
Central bank	Bonds; loans to banks	Currency; bank reserves

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- A loan of 100 creates both a bank loan asset and a deposit of 100. The borrower also owes 100.

The Monetary Base and the Money Supply

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Money held by the public

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Monetary base

$$B = C_u + R.$$

With $rr = R/D$ and $cr = C_u/D$:

$$M = mB, \qquad m = \frac{1 + cr}{rr + cr}.$$

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- For a given B, lower rr or cr permits more deposits and raises the simple multiplier m.
- The central bank influences B and reserve requirements; banks and the public influence actual rr and cr.

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- From growth rates to inflation, with velocity and long-run output fixed:

$$g_M + g_V = \pi + g_Y \quad \Longrightarrow \quad \pi = g_M.$$

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$$g_M \uparrow \implies \pi \uparrow \implies E\pi \uparrow \implies i \uparrow .$$

Fisher effect: sustained faster money growth ultimately raises the nominal interest rate.

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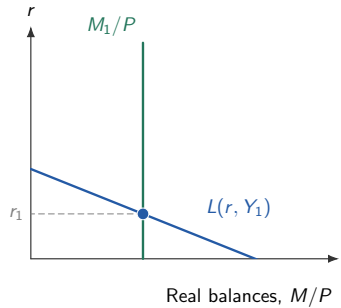
For the short-run diagrams, take $P = \bar{P}$ and $E\pi = 0$, so $i = r$.

Money-Market Equilibrium

At r_1:

- Desired real balances equal $\bar{M}/\bar{P}$; the money market clears.

What happens if $r > r_1$?



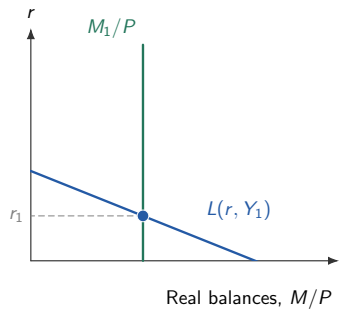
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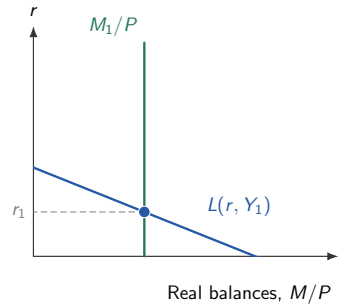
What happens if $r > r_1$?

1. People try to exchange excess money for bonds.
2. Bond prices rise and yields fall, reducing r.
3. Money demand rises until the market clears. The bond seller receives the money.



Expansionary Monetary Policy: Short Run and Long Run

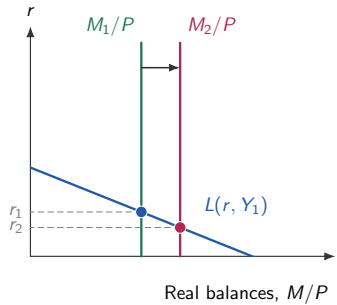
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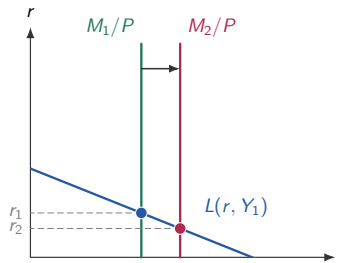


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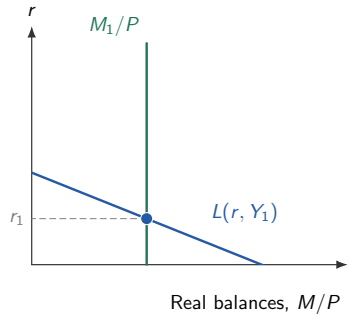
Long run: sustained faster money growth raises inflation and, through expected inflation, the nominal interest rate.



A one-time rise in M raises the long-run price level; sustained inflation requires sustained money growth in this benchmark.

Higher Income and the Money Market

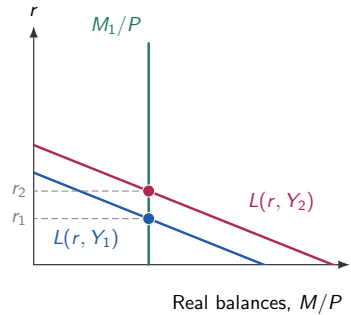
Income rises from Y_1 to Y_2. What shifts?



Higher Income and the Money Market

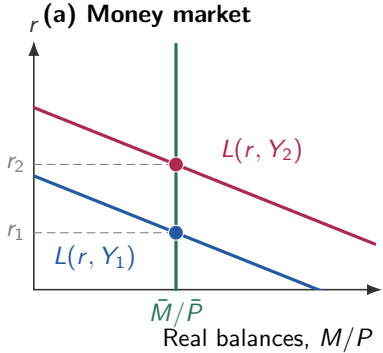
Income rises from Y_1 to Y_2. What shifts?

1. More transactions shift money demand to the right.
2. At the old rate, people sell bonds to obtain money.
3. Bond prices fall and yields rise; equilibrium moves to $r_2 > r_1$.



From the Money Market to LM

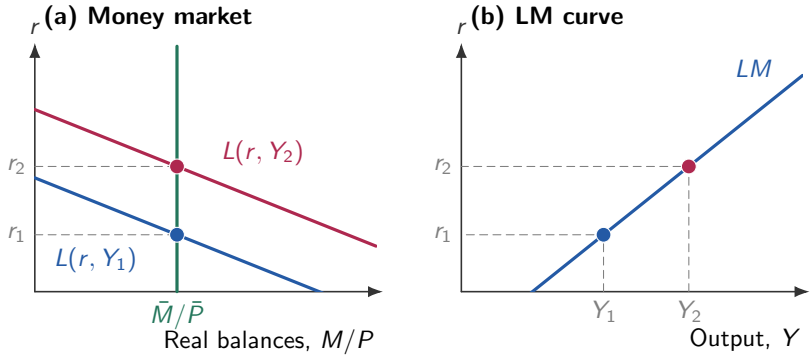
Raise income from Y_1 to Y_2, holding $\bar{M}/\bar{P}$ fixed.



Higher income raises money demand. With real balances fixed, the equilibrium interest rate rises.

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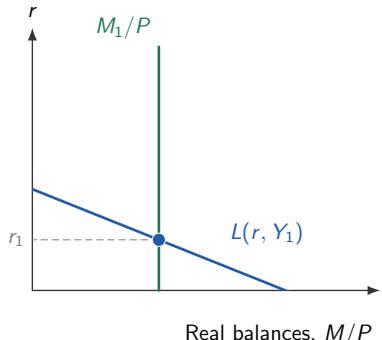
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The LM curve collects the (Y, r) combinations that clear the money market. It slopes upward.

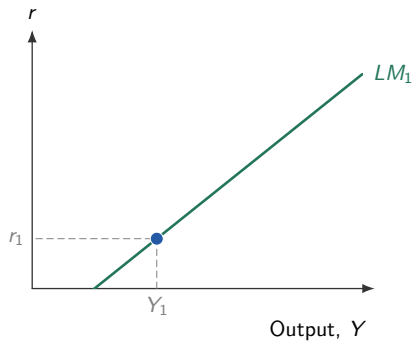
What Shifts the LM Curve?

The central bank increases M, holding P fixed. What happens to LM?

(a) Money market at Y_1



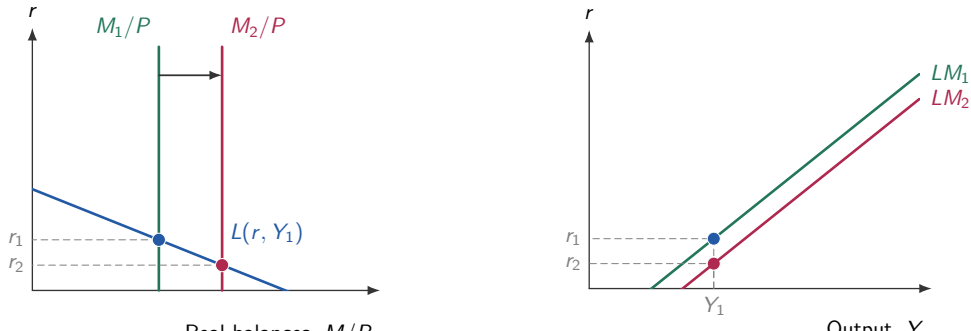
(b) LM curve



What Shifts the LM Curve?

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(a) Money market at Y_1 **(b) LM curve**



At the same income, higher real balances lower the equilibrium interest rate. At every income level, LM shifts **down and to the right**.

Short-Run Equilibrium in IS–LM

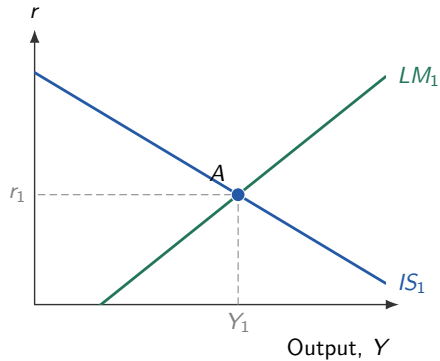
Goods market:

$$Y = C(Y - \bar{T}) + I(r) + \bar{G}.$$

Money market:

$$\frac{\bar{M}}{\bar{P}} = L(r, Y).$$

- IS and LM jointly determine output Y and the interest rate r.
- $\bar{G}$, $\bar{T}$, $\bar{M}$, and $\bar{P}$ are given; T is taxes net of transfers.
- Closed economy; expected inflation is zero.

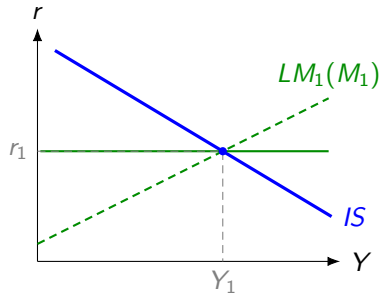


2. How Central Banks Implement Policy

How does a policy-rate decision reach spending and inflation?

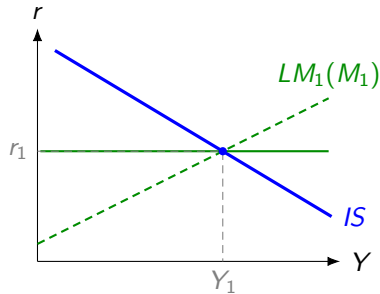
From a Money-Supply Target to a Policy Rate

- The ECB targets 2% inflation over the medium term and sets **policy rates**.



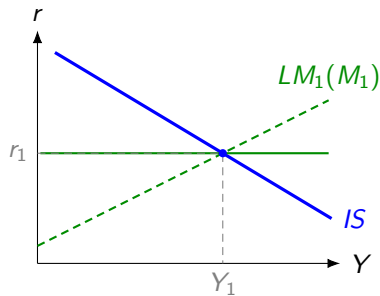
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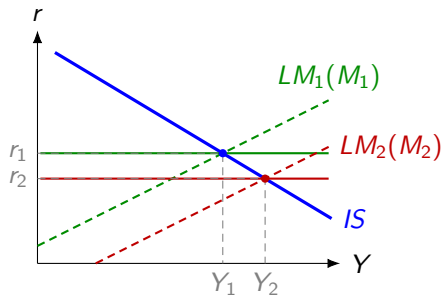
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- In the LM model, the central bank sets M and the interest rate clears the money market.
- Central banks typically **target a rate**. In IS–LM, we can illustrate the initial target r_1 with M_1 and LM_1.
- To lower the rate to r_2, use a higher money supply M_2 and LM_2.
- Expansion lowers the rate; contraction raises it.



The ECB's Monetary-Policy Instruments

Three families of instruments implement the chosen policy stance.

Standing facilities

- Deposit and marginal lending facilities

Open market operations

- Liquidity-providing operations

Minimum reserves

- Required reserves and their remuneration

Minimum Reserve Requirements

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Minimum Reserve Requirements

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- In the simple multiplier model, a higher required ratio can raise *rr* and reduce deposits for a given monetary base.
- Higher remuneration can encourage banks to hold reserves; lending also depends on capital, borrowers, and loan demand.
- In the euro area, the minimum is **1%** of specified liabilities, averaged over a maintenance period; required reserves earn **0%**.
- July–September 2026: required reserves averaged **EUR 174.7 billion**; banks held **EUR 338.0 billion** in reserve current accounts.
  - Current-account holdings were about 1.9 times the minimum. They exclude funds in the ECB deposit facility.
  - The 1% requirement applies to specified liabilities, not to all deposits or all bank liabilities.

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- The ECB offers both banks an alternative through its **standing facilities**.

Overnight Lending: An Illustrative Example

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- Now suppose the ECB offers A 2% on deposits and lends to B at 4% against collateral. What rates can A and B agree?
- In the simple corridor, a deal between **2% and 4%** benefits both relative to using the facilities.

Standing Facilities: The Overnight Corridor

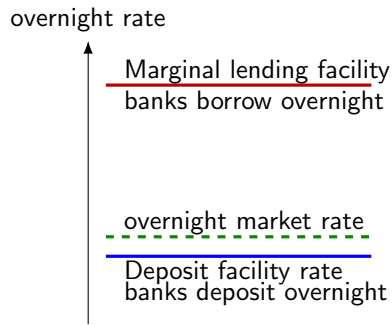
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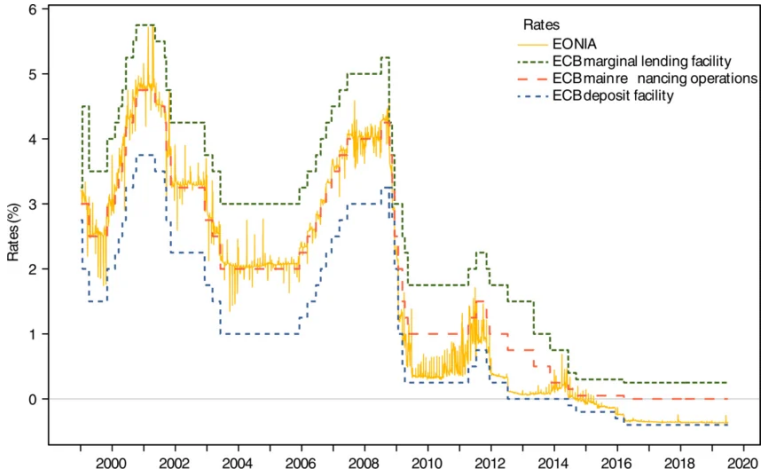
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- Why lend below the ECB deposit rate? Why borrow above the ECB lending rate?
- These alternatives form a **floor and ceiling** for overnight rates in the simple corridor.



The Overnight Corridor in the Data, 1999–2019



EONIA was a measure of the euro overnight interbank rate; the graph ends in June 2019.

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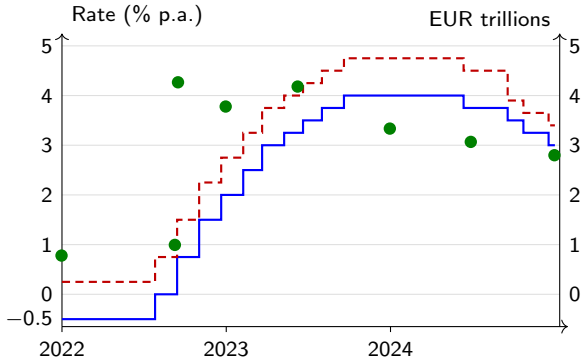
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- **Bank lending and money:** new loans to households or firms typically create deposits, which can increase $M = C_u + D$.
- The effect depends on loan demand, creditworthiness, and bank capital. Reserves transferred between banks stay in the banking system.

Inflation and the ECB's Standing Facilities

Euro-area inflation reached 10.6% in October 2022. What did the ECB do?



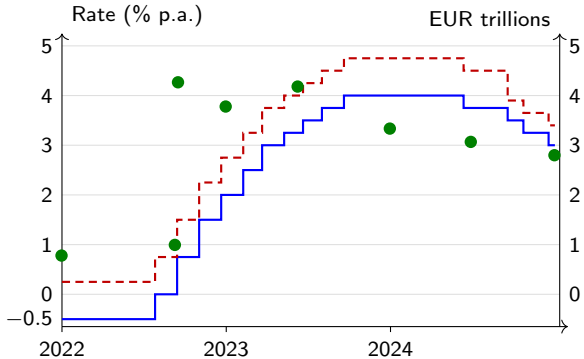
Blue: deposit rate; red dashed: marginal lending rate.

Green dots: deposit-facility balances on selected dates.

Source: ECB rates, ECB balance sheets (selected dates), and Eurostat inflation.

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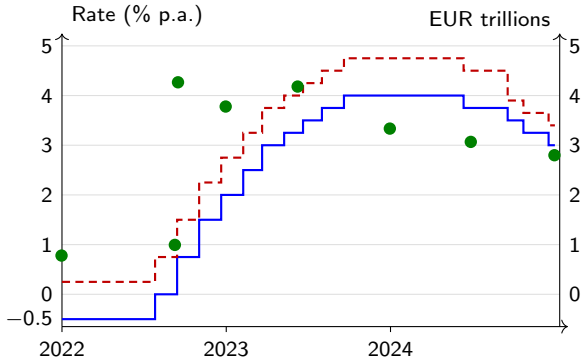
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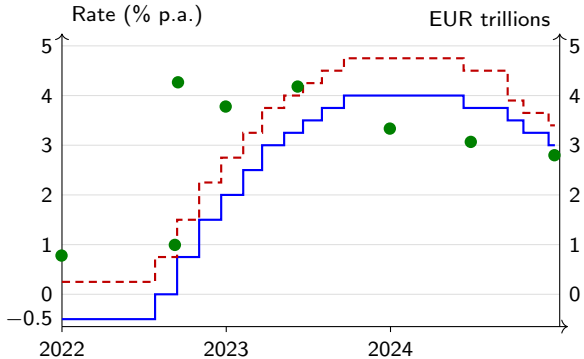
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- Higher borrowing costs can slow lending and spending; slower deposit creation can reduce money growth.
- The 2022 jump in facility balances mainly reflects a shift from ECB current accounts.

▸ Excess-reserves graph

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Open Market Operations: A Bond Purchase

To increase the money supply M, the central bank can **buy bonds** from commercial banks. It pays by adding reserves to their accounts.

For example, the central bank buys a bond worth 100:

	Assets	**Liabilities**
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- Bank reserves and the monetary base rise immediately. M can rise if deposits increase, for example through new lending.
- The commercial bank exchanges one asset for another; it is not required to make a new loan.
- If the seller is a non-bank customer, the customer's deposit and the bank's reserves also rise.

ECB Open Market Operations

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- The ECB also purchases securities, including under asset-purchase programmes; its regular refinancing operations are collateralized loans.

ECB and Federal Reserve: Operating Frameworks

	ECB / Eurosystem	**US Federal Reserve**
Policy signal	Deposit facility rate	Target range for the overnight federal funds rate
Rate control	Overnight deposit and lending facilities	Interest paid on bank reserves; other facilities support market rates
Reserve minimum	1% of specified liabilities	0% since March 2020
Liquidity to banks	Refinancing operations and marginal lending	Open market operations and lending facilities

Both use their instruments to keep short-term rates near the chosen policy stance.

▸ How the Federal Reserve implements policy

The Monetary-Policy Transmission Mechanism

Recall aggregate demand (AD) from Session 4; we derive the AD curve next session.
Example: a higher policy rate

$$\text{policy rate} \uparrow \Rightarrow \text{ borrowing costs} \uparrow \Rightarrow \text{ spending} \downarrow \Rightarrow \ AD \text{ shifts left.}$$

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1. Financial conditions, including bank rates, bond yields, exchange rates, and expectations, respond.
2. Consumption, investment, and net exports change; output and employment respond.
3. Inflation responds with a lag. The effects depend on banks, borrowers, expectations, and the shock.

3. Policy Rules and the Lower Bound

How should rates respond, and what happens when they cannot fall enough?

The Taylor Rule

A policy rule links a nominal policy rate to inflation and the output gap. For the ECB, policy rates include the main refinancing rate:

$$i_t = r^* + \pi_t + a_\pi(\pi_t - \pi^*) + a_y \tilde{y}_t.$$

- r^*: neutral real interest rate.
- π_t: inflation; π^*: inflation target.
- $\tilde{y}_t = 100(Y_t - \bar{Y}_t)/\bar{Y}_t$: output gap in percent.
- $a_\pi > 0$ and $a_y > 0$: strength of the policy response.

The rule is a benchmark for systematic policy, not a mechanical instruction that removes judgment.

Taylor Rule: A Numerical Example

Suppose $r^* = 2$, $\pi^* = 2$, and $a_\pi = a_y = 0.5$. Rates and gaps are in percent.

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- **Now inflation falls to 1%; the output gap stays at -2%. What is i?**
- $i = 2 + 1 + 0.5(1 - 2) + 0.5(-2) = 1.5\%$.

The Taylor Principle

- If inflation rises persistently by one percentage point, the nominal policy rate should rise by **more than one percentage point**.
- In the Taylor rule, the total response is $1 + a_\pi$ because inflation enters directly and through the inflation gap.

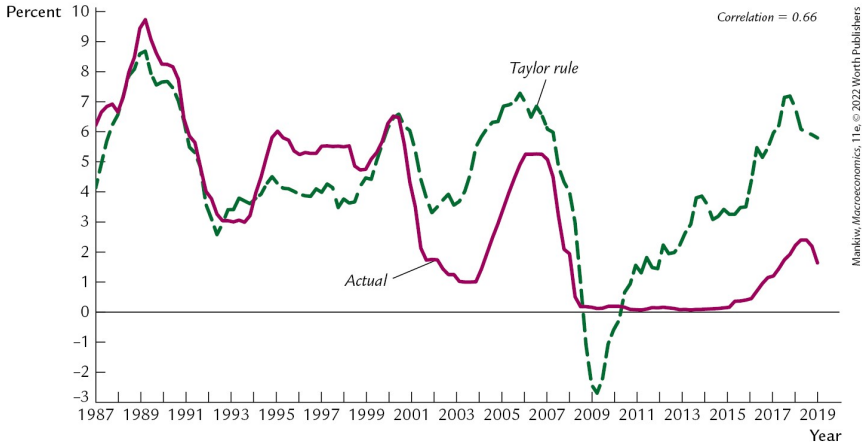
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$$\Delta i > \Delta E\pi \quad \Longrightarrow \quad \Delta r = \Delta i - \Delta E\pi > 0.$$

- A higher real rate restrains consumption and investment, reducing demand and inflation pressure.
- Raising the nominal rate less than inflation would lower the real rate and could stimulate demand.

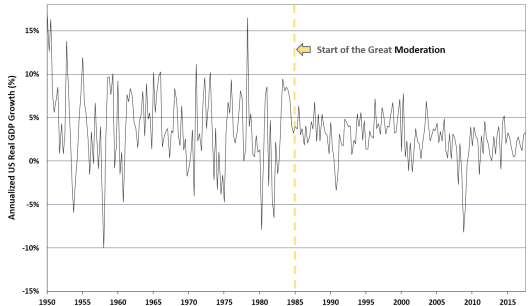
The Taylor Rule and the US Policy Rate, 1987–2019



Source: Mankiw, *Macroeconomics*, 11th ed. (2022), Worth Publishers.

The Great Moderation

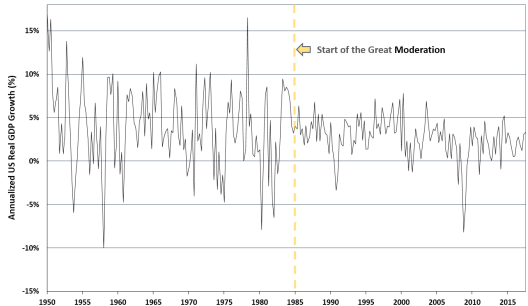
- From the mid-1980s to 2007, output growth and inflation became less volatile in many advanced economies.
- Possible explanations include monetary policy, structural changes, and smaller shocks.



US annualized quarterly real GDP growth, 1950–2016. Lawrencekhoo, Wikimedia Commons, CC0; data: FRED.

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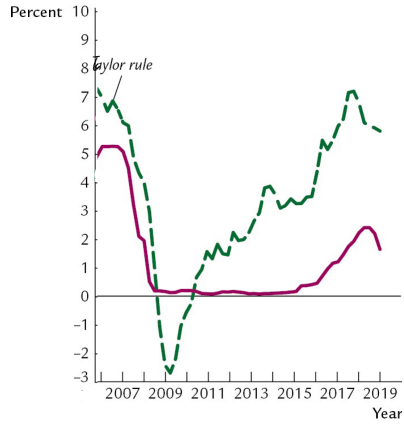
- From the mid-1980s to 2007, output growth and inflation became less volatile in many advanced economies.
- Possible explanations include monetary policy, structural changes, and smaller shocks.
- The 2008 crisis showed that major disruptions had not disappeared.



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The Effective Lower Bound

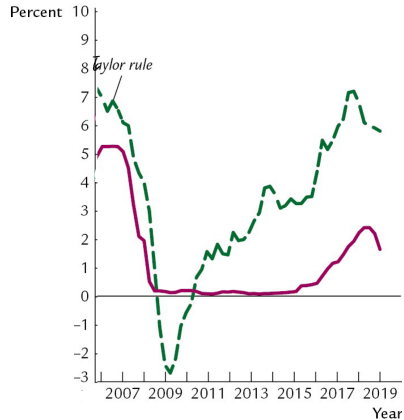
- A severe recession can make the Taylor-rule prescription negative.
  - With $\pi = 1$ and output gap $= -6\%$: $i = 2+1+0.5(1-2)+0.5(-6) = -\mathbf{0.5}\%$.



Mankiw, *Macroeconomics*, 11th ed. Dashed: Taylor rule; solid: actual US policy rate.

The Effective Lower Bound

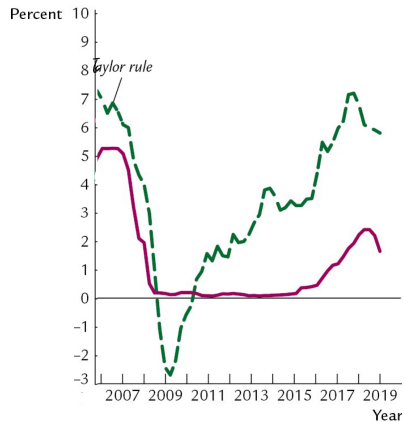
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- In December 2008 the Fed cut its target to **0–0.25%**; the figure shows the rule falling below zero in 2008–09.
- Cash limits how far nominal rates can fall: this is the **effective lower bound**.



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- Rate cuts may no longer provide enough stimulus; central banks can use **unconventional policies**.



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Unconventional Policy 1: Forward Guidance

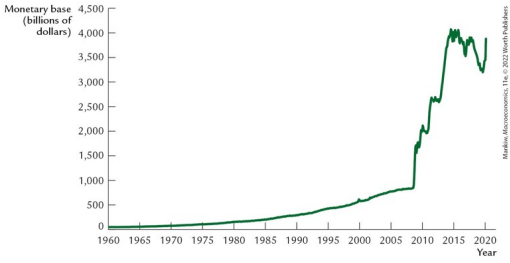
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- **Forward guidance** communicates the likely future path of policy.
- A credible promise to keep future short rates lower can reduce longer-term yields today.
- Lower longer-term borrowing costs can support current consumption and investment even when today's short rate is at its lower bound.
- Guidance works through expectations, so clarity and credibility matter.
- **Example:** in 2013, ECB President Mario Draghi expected rates to stay "at present or lower levels for an extended period", conditional on the outlook.

Unconventional Policy 2: Quantitative Easing

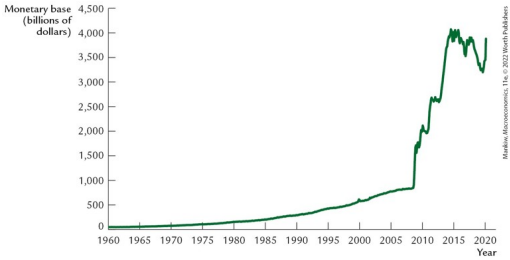
- **Quantitative easing (QE)** consists of large-scale purchases of longer-term government or private securities.
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- Purchases can raise bond prices and lower long-term yields, supporting spending and AD.
- Sellers also rebalance toward other assets, affecting wider financing conditions.



US monetary base, 1960–2020. Mankiw, *Macroeconomics*, 11th ed.

Quantitative Easing: Questions and Trade-offs

- **Mandate:** are large public-bond purchases consistent with the ECB's price-stability mandate and the prohibition on monetary financing?
- **Distribution:** higher asset prices can benefit wealthier asset owners; stronger employment and lower borrowing costs can benefit others.
- The overall effect on inequality depends on all these channels, not asset prices alone.

More Reserves Do Not Mechanically Become More Loans

$$M = \frac{1 + cr}{rr + cr} B.$$

- QE can increase the monetary base B sharply because bank reserves rise.
- Banks may choose to hold more reserves, raising rr and reducing the multiplier in the simple formula.
- Lending also requires capital, creditworthy borrowers, profitable opportunities, and demand for loans.

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- **Key message:** if banks do not lend and households or firms do not borrow and spend, the credit channel provides little stimulus. QE can also work through asset prices and other channels.

What to Remember

- **Money and LM.** At a given price level, money supply and demand determine the interest rate at each level of output.
- **IS and LM.** Goods- and money-market equilibrium jointly determine short-run output and the interest rate.
- **Monetary policy in practice.** Central banks use policy rates, lending operations, asset purchases, and standing facilities.
- **Policy rules.** The Taylor rule links the policy rate to inflation and the output gap.
- **The lower bound.** Forward guidance and quantitative easing can support policy when rates cannot fall much further.

Next session: policy in IS–LM, aggregate demand, and business cycles.

Appendix: How the Federal Reserve Sets Rates

- The Federal Open Market Committee chooses a **target range** for the federal funds rate: the overnight rate at which eligible institutions lend balances to each other.

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- The Fed pays banks **interest on reserve balances (IORB)**. This administered rate helps anchor short-term market rates.
- The **overnight reverse repurchase facility (ON RRP)** gives eligible money-market participants, including money-market funds, an alternative overnight investment at a Fed-set rate.
- With ample reserves, these administered rates help keep the federal funds rate within its target range.

▸ How the Fed supplies liquidity ◂ Return to comparison

Appendix: How the Federal Reserve Supplies Liquidity

- **Open market operations:** the Fed buys or sells securities, changing the quantity of reserves.
- **Standing repo facility:** the Fed supplies short-term cash against eligible securities, helping limit upward pressure on overnight rates.
- **Discount window:** the Fed lends directly to eligible banks against collateral, providing a liquidity backstop.

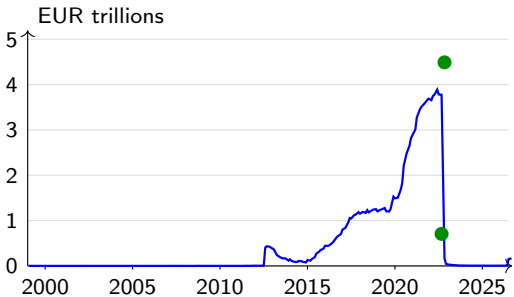
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- US reserve requirement ratios have been zero since March 2020; banks nevertheless hold reserves for payments, liquidity, and regulatory needs.

Federal Reserve rate control Return to comparison

Excess Reserves and the Deposit Facility

Why did excess reserves rise and then fall so sharply?



Blue: excess current-account reserves. Green: deposit facility (two averages).

Two reserve maintenance periods in 2022

	27 Jul–13 Sep	14 Sep–1 Nov
Excess reserves (EUR tn)	3.775	0.168
Deposit facility (EUR tn)	0.707	4.490
Rate on excess reserves	0%	0%
Deposit facility rate	0%	0.75%

Banks shifted funds to the better-paid deposit facility. The sharp fall in the blue series is mainly a change of account.

◂ Return to standing facilities