Monetary Policy

Macroeconomics - EF01

Year 2022-2023

Sessions Program

- Session 1: introduction / reminders on macro
- Session 2: aggregate demand
- Session 3: aggregate supply
- Session 4: macroeconomic fluctuations
- Session 5: monetary policy
- ~~Session 6: unconventional monetary policies~~

Main question

How does the Central Bank set interest rates?

Tools of Monetary Policy

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What are the main tools of monetary policy?

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- Open market operations
  - CB exchanges liquidities (cash) in exchange for more illiquid assets (gvt bonds)
  - CB lends in the interbank market
- Reserve requirement ratios
- Interest rates on reserves held by banks at the CB
  - Discount rate in the US
  - Main Refinancing Operations (MRO) in EZ
- Many other unconventional tools (not covered here)

Money Aggregates

Central Bank Money

The Central Bank has the monopoly to create **Central Bank Money**

- Coins, banknotes, digital euros...

Central Bank Money is also called **Monetary Base**. How is it *injected* in the economy?

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In principle, Central Bank *could* distribute it

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But in practice the central banks exchanges central bank money for less liquid assets.

- which enables money creation by private bank.

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Who owns Central Bank Money?

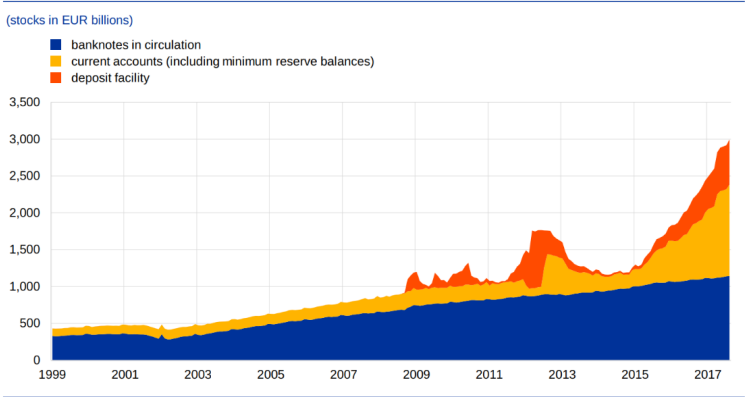

Figure 1: Base Money (ECB stats)

[2]This money remains virtual in the sense that it is never printed. It is effectively digital currency.

Who owns Central Bank Money?

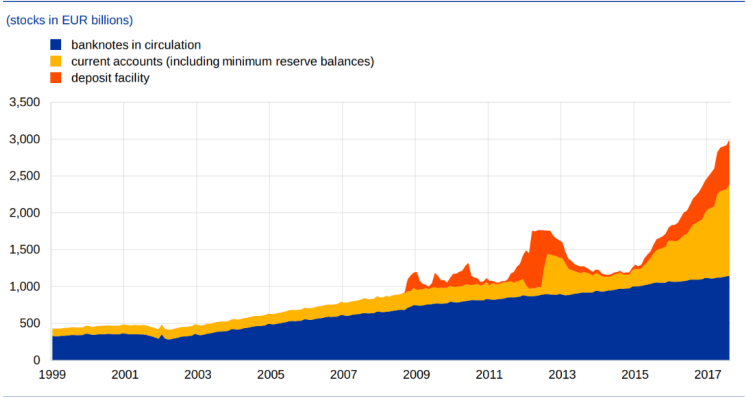

Figure 1: Base Money (ECB stats)

Most of the money created by the central bank since 2009 is owned by private financial institutions who keep reserves (current accounts) at the central bank.[2]

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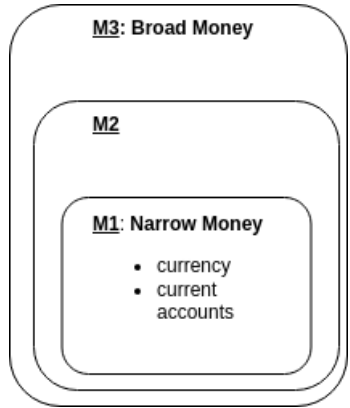
Narrow Money / Broad Money

Money circulating in the economy

ECB lists several monetary aggregates:

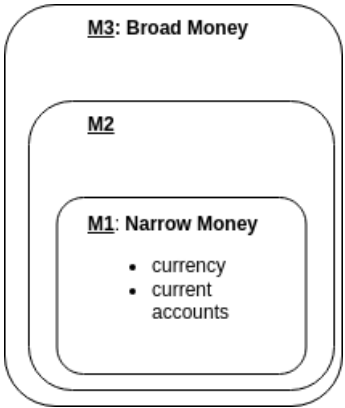
- M1: **narrow money**
  - currency (coins, banknotes) in circulation and overnight deposits (e.g. consumer checking accounts)
- M2:
  - M1 + deposits with an agreed maturity of up to two years and deposits redeemable at notice of up to three months
- M3: **broad money**
  - M2 + repurchase agreements, money market fund shares/units and debt securities with maturity of up to two years



Narrow Money / Broad Money

Money circulating in the economy

Monetary aggregates contain financial assets of decreasing liquidity.
Note that in these monetary aggregates, only currency is created by the central bank. All the other assets are created by the private sector.



Wait? Private banks create money?

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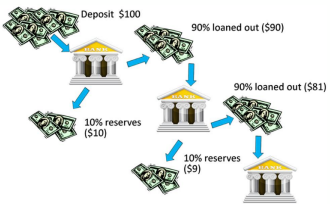
Yes, most of it. Let's explain how.

Controlling M1

Reminder: Fractional Reserve system

- When a commercial bank makes a loan it creates money directly!!!
- Credit from private banks is limited by the reserve requirement ratio
  - commercial banks must keep a fraction λ of outstanding loans in reserves
  - for 1 unit of central bank money they receive (e.g as deposits), they can lend $1 - \lambda$
- The total amount of narrow money the financial system can create from a 1 deposit is called the money multiplier: $\mu = \frac{1}{\lambda} - 1$



Changing reserve ratio is a potential policy tool to control money creation by the private sector[3].

[3] the calculations to obtain the money multiplier are very similar to the fiscal multiplier. One euro of deposits leads to total lending $(1-\lambda) + (1-\lambda)^2 + \cdots = (1-\lambda)\frac{1}{1-(1-\lambda)}$

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Let's check the data...

Controlling M1

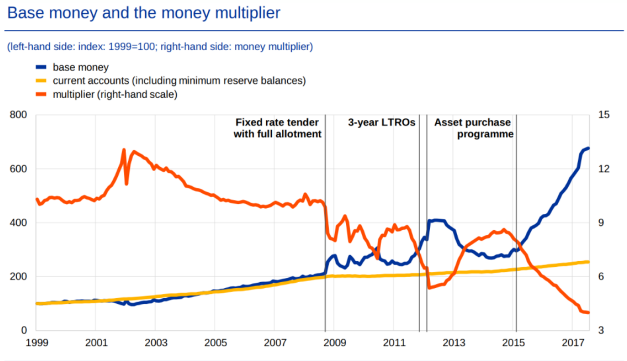
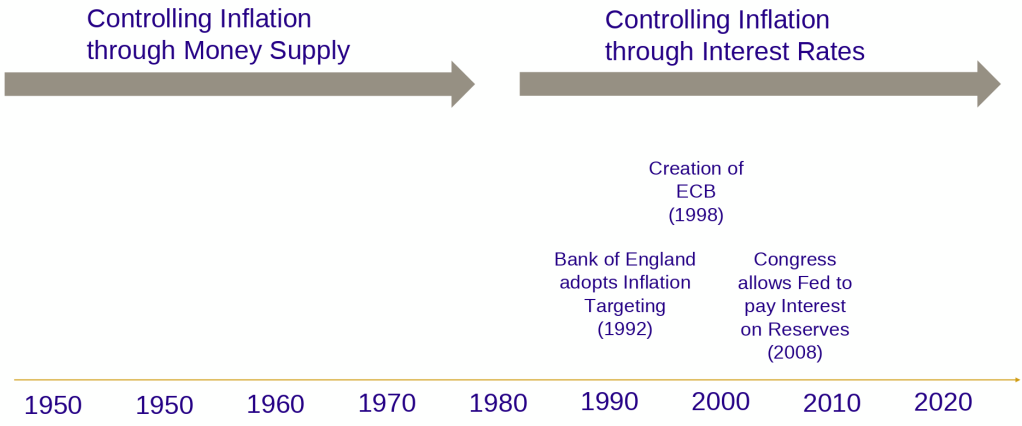


Figure 2: Base money and the money multiplier (ECB)

Since 2009, base money has increased tremendously, but not credit. Money multiplier is far from its maximum. Reserve requirements are not binding.

Inflation Targeting

Evolution of Standard Policy Practices



Inflation Targeting

Most CBs have now switched to some form of "inflation targeting"

- the central bank tries to achieve a given inflation target (e.g. 2% in EZ)

It reaches the target, by manipulating nominal interest rates:

- either by controlling the money supply
- or by setting interest rates directly

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Important message

Since 2009s **main instrument for monetary policy is interest rate setting**

- the amount of money creation is determined by he private sector

The Taylor Rule

Inflation targeting and the Taylor Rule

What economic variables does the CB mostly look at to stabilize inflation?

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John Taylor, discovered empirically (in 1993) that actual interest rates decisions were well approximated (even before inflation targeting was adopted) by a *simple rule* of the form:

$$i_t = i^\star + 0.5(\pi_t - \pi^\star) + 0.5(y_t - y_t^{nt})$$

It depends on

- the deviation of inflation from its target
- the deviation of output from its natural level (output gap)

Taylor Rule vs Effective Rate

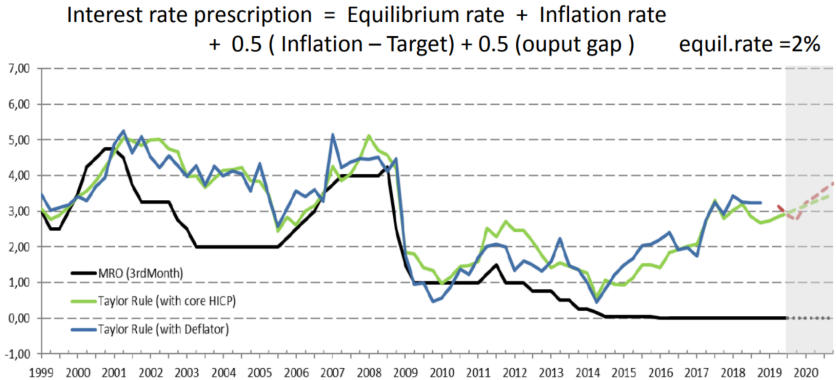


Figure 3: Original Taylor Rule against Actual Decisions (US Data)

Since 1999, the Taylor Rule is still broadly relevant but completely misses the target after 2014 (when i.r. were at 0).

Improved Taylor RuleOriginal Taylor Rule is too simple

A version based on inflation expectations describes well CB decisions:

$$i_t = i^\star + 0.5 \underbrace{\left(E_t\left[\pi_{t+1}\right] - \pi^\star\right)}_{\text{expected excess inflation}} + 0.5 \underbrace{E_t\left[y_t - y_t^{nt}\right]}_{\text{expected output gap}}$$

This version is a good reference point to understand central bank's communication.

Improved Taylor Rule vs Effective Rate

Policy rate change = 0.5 (Inflation forecast – target)
+ 0.5 (GDP growth forecast – Potential growth rate)

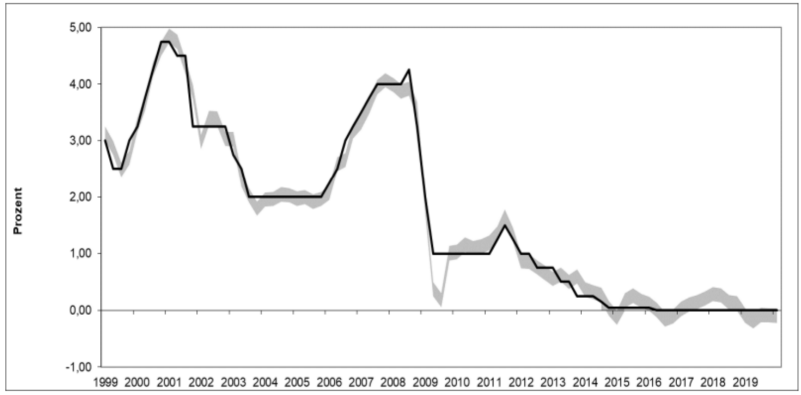


Figure 4: Improved Taylor Rule

Source: Orphanides and Wieland

Operational Summary

Evolution of Central Banking

- since the 90s and inflation targeting, the main central banks have switched to inflation targeting

The central bank raises interest rate

- when (expected) production is above its natural level
  - to prevent inflationary pressures, economy overheating
- when (expected) inflation is too high
  - the bank tries to *anchor* expectations around its target

The fact that central bank reacts to and manipulate *expectations*, is the central key of modern central banking.[4]

[4] Blogger Matt O'Brian notes that «Central Banks have a strong influence on market expectations» and likens its activities to «jedi mind tricks».

Monetary Policy Implementation

Interest Rate Term Structure

Fisher Equation and Inflation Expectation

Reminder

Recall the Fisher equation:

$$r_t = i_t - \pi_{t+1}$$

To be more precise, we should write:

$$r_t = i_t - E_t[\pi_{t+1}]$$

Because it is only the "expected" inflation that is known at date t. We omit the expectation sign, but keep in mind that π_{t+1} represents expected inflation.

Monetary rule and inflation expectation

When deriving the AD curve, we wrote real interest rule (MP) as follows:

$$r_t = r^\star + \gamma(\pi_t - \overline{\pi})$$

But the CB does not directly control real interest rate. It controls the *nominal* interest rate i_t.

Now, take the Fisher equation $r_t = i_t - \pi_{t+1}$. We can replace it above to get:

$$i_t = r^\star + \gamma(\pi_t - \overline{\pi}) + \pi_{t+1}$$

We see that the central bank sets the interest rate to control a combination of inflation and "expected inflation". Closer to a modern Taylor Rule.

Short Term Interest Rates

Actually, the CB doesn't control i_t directly (the quarterly or the yearly rate)

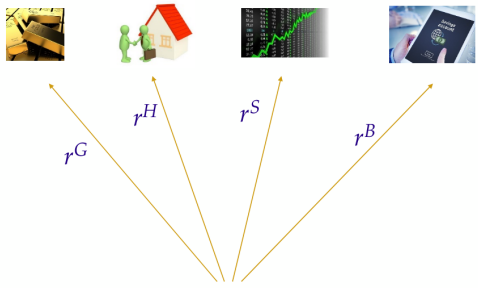
The CB controls instead very short-term interest rates typically overnight. Where does it happen? On the *Interbank market*:

- Banks lend to each others reserves they hold on a Central Bank account
- Central bank is a price maker on this market

How does setting a short term interest rate affect the long run interest rate at any maturity (horizon)?

- Through the market's ability to *arbitrage* between several investment options.

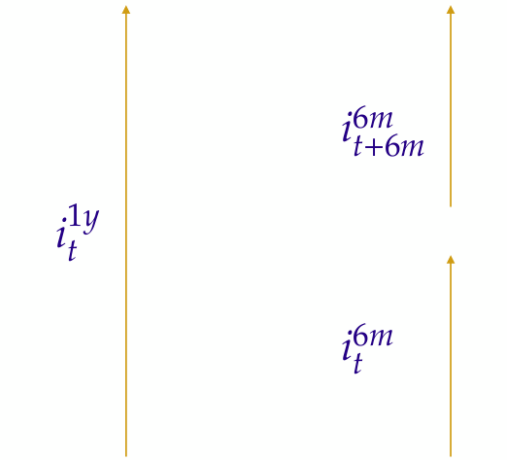
Arbitrage



Arbitrage is a very generic concept
When two or more equivalent investment options yield different returns on investment, investors rush on the most profitable one... until returns equalize
So in equilibrium, all, equivalent investment options, must eventually have the same return.
Differences between rates of return are explained by differences in:

- risk characteristics
- liquidity

Term Structure of Interest Rates



Apply the arbitrage principle to:

- A one year bond yielding i^{1y}_t
- Two 6 months bonds yielding (annualized)
  - i^{6m}_t bought at date t
  - i^{6m}_{t+6m} bought at date $t + 6m$
- This provides us with two options to invest over 1 year.
- What is the arbitrage condition?

Term Structure of Interest Rates

Invest value X at date t

Option 1 yields:

- $X(1 + i^{1y})$ after one year
- (Gross) return is $(1 + i^{1y})$

Option 2 yields (pay attention to the fact that returns are annualized)

- $X(1 + i_t^{6m})^{1/2}$ after 6 months
- $X(1 + i_t^{6m})^{1/2}(1 + i_{6m}^{t+6m})^{1/2}$ after one year
- (Gross) Return is $(1 + i_t^{6m})^{1/2}(1 + i_{6m}^{t+6m})^{1/2}$

Term Structure of Interest Rates

The arbitrage equation would read:

$$(1 + i^{1y}) = (1 + i_t^{6m})^{1/2}(1 + i_{6m}^{t+6m})^{1/2}$$

Or in log-terms: $i_t^{1y} = \frac{1}{2}i_t^{6m} + \frac{1}{2}i_{t+6m}^{6m}$ Given that investors are risk-averse and value the flexibility of having the cash sooner, they ask for a risk premium φ:

$$i^{1y} = \frac{1}{2}i^{6m}t + \frac{1}{2}i^{6m}t + 6m + \varphi$$

The risk premium incorporates the uncertainty about the fact that investment opportunities might change before one year, and about the possibility that 6-months interest rate might change before one year.

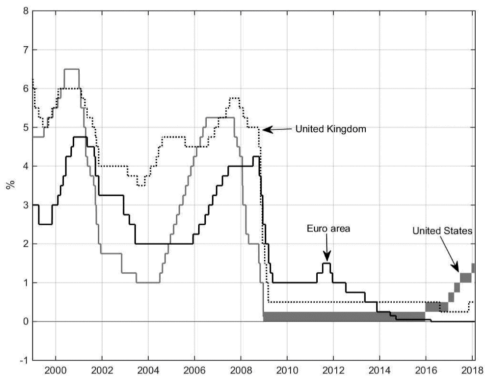
Term Structure of Interest Rates

The same reasoning applies to the daily rate set by the central bank:

$$i_t^{1y} = \frac{1}{365}\left(i_{1d}^{t} + i_{t+1d}^{1d} + i_{t+2d}^{1d} i_{t+2d}^{1d} + \cdots i_{t+364d}^{1d}\right) + \varphi$$

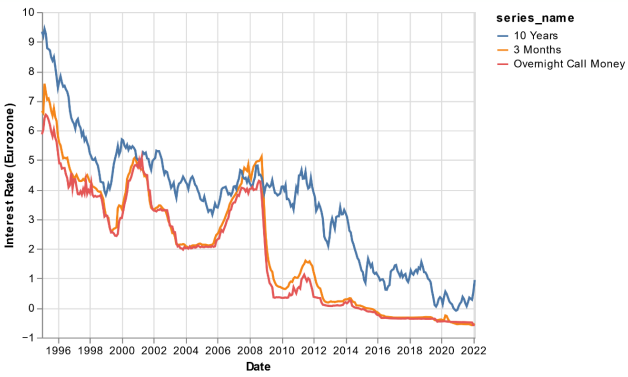
- By manipulating overnight interest rates (annualized term), the central bank can manipulate the yearly interest rate.
- It does so by announcing a path for future interest rates.
- For the manipulation to be effective, the path of future interest rates, must be clear and predictable as well as its potential adjustment to economic contingencies.
- This is one of the reason, the central bank tries to commit to a clear and transparent policy.

Short Term Interest Rates



- Interest rates are reviewed at a regular basis (a few months).
- In general they evolve slowly, in a predictible way.
  - US Fed let rates fluctuate within a band.
- Note that rates have stayed at historically low levels since 2008

Short Term and Long Term Interest Rates



- Overnight interest rates on the interbank market, affect longer maturities (3 months and 10 years)
- Long term interest rates do not vary one to one with short term interest rates.
- This is because long-term interest rates incorporate *future* changes in short term interest rates.

The Interbank Market

Interest Rate on Reserves and the Interest Rate in the Interbank Market

- So, the CB, manipulates r by manipulating i by setting the i.r. on the overnight interbank market...
- But how does the CB set the price on the interbank market ?
  - It is an equilibrium price, not directly decided by the CB.

The Interbank market

What is the role of the interbank market?

When clients of a given bank trade with each other no money is leaving the bank

Now let's consider the following mental experiment:

- When a client of bank A pays a client of bank B, bank A should receive reserves from bank B
- In the same day there might be transactions from B to A to offset the first transaction.
- But at the end of the day, imbalances must be corrected and bank A needs to pay bank B
- If A has enough reserves it can use them
- Otherwise, it can borrow them from another bank C to cover the transaction
  - on the interbank market

Interest Rate on Reserves and the Interest Rate in the Interbank Market

- To ensure they can make the transactions to settle imbalances:
  - Banks hold reserves at the CB to cover interbank payment when needed
  - And lend to each other on the interbank market
- There are two corresponding rates:
  - Reserves at the CB yield interest rate i^R. Set exogenously by the CB.
  - The market rate i_M
- The total amount R_0 of reserves (central bank money) is decided by the central bank.
- Two instruments:
  - introduce more reserves via open market operations : change R_0
  - change interest rate paid on reserves

Equilibrium in the interbank market

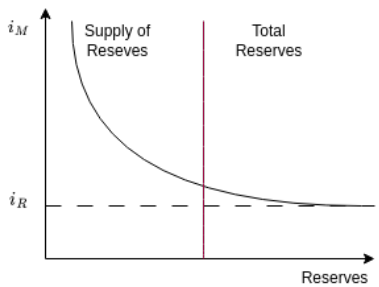


Figure 5: Equilibrium in the interbank market

- The higher the interest rate, the higher the incentive for a bank needing liquidity to draw from its own reserves (at the cost of some operational risk)
- Demand is decreasing in the short term interest rate

Equilibrium in the interbank market

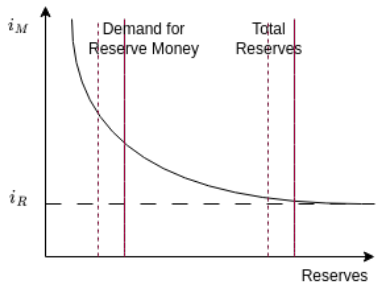


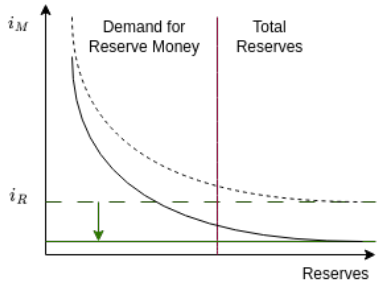
Figure 6: Equilibrium in the interbank market: quantitative intevention

Quantitative intervention:

- Higher supply of reserves decrese market rate i_M
  - as in the ISLM ♡ model
- The higher the level of reserves, the lower the quantitative channel.

Equilibrium in the interbank market

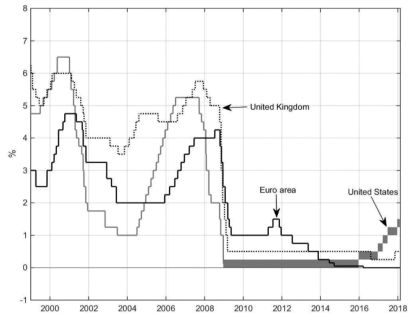
quantitative



Direct interest rate setting:

- Decreasing interest rates on reserves always work.
- No liquidity trap
- Interest rates can even be negative
  - banks pay for liquidity provisions

Equilibrium in the Interbank Market



The interest rate on reserves has become the main policy instrument. It is a consequence of the large excess (precautionary) reserves held by banks.

Conclusion

Takeaways

- Central Banks control interest rates through several policy tools
- Nowadays, it concentrates on setting the interest rate on the interbank market
- Controlling interest rate through money growth is less efficient because private banks don't lend enough and hold vast amounts of reserves at the central bank
- Interest rates on reserves held by commercial banks at the central bank have become the main instrument of the central bank
- ... But recently, unconventional policies have brought back quantitative measures to the center stage.