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# Chapter 5: **Macroeconomic Policy (II): Monetary Policy**

- The institutional framework of the single monetary policy
- The monetary policy strategy of the European Central Bank (ECB)
- Monetary policy implementation of the ECB
- Nominal *versus* real interest rates
- The ‘neutral’ interest rate
- The ‘zero lower-bound trap’
- Unconventional monetary policy

# The institutional framework of the single monetary policy (I)

- According to Article 127.1 of the Treaty on European Union:

‘The primary objective of the European System of Central Banks (hereafter ESCB) shall be to maintain *price stability*. Without prejudice to the objective of price stability, the ESCB shall support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union. The ESCB shall act in accordance with the principle of an open market economy with free competition, favouring an efficient allocation of resources, and in compliance with the principles set out in Article 119.’

# The institutional framework of the single monetary policy (II)

- According to Article 127.2 of the Treaty on European Union:

‘The basic tasks to be carried out through the ESCB shall be:

— to define and implement the monetary policy of the Union,

— to conduct foreign-exchange operations consistent with the provisions of Article 219,

— to hold and manage the official foreign reserves of the Member States,

— to promote the smooth operation of payment systems.’

# The institutional framework of the single monetary policy (III)

- The institutional framework for the single monetary policy has established a Central Bank that is *independent* from political influence in Article 130 of the Treaty on European Union:

'When exercising the powers and carrying out the tasks and duties conferred upon them by the Treaties and the Statute of the ESCB and of the ECB, *neither the European Central Bank, nor a national central bank, nor any member of their decision-making bodies shall seek or take instructions from Union institutions, bodies, offices or agencies, from any government of a Member State or from any other body*. The Union institutions, bodies, offices or agencies and the governments of the Member States undertake to respect this principle and not to seek to influence the members of the decision-making bodies of the ECB or of the national central banks in the performance of their tasks.'

# The institutional framework of the single monetary policy (IV)

- Last, Art.123 prohibits the ECB or any CB of Member States to lend *directly* to public institutions or purchase debt from them:

  'Overdraft facilities or any other type of credit facility with the ECB or with the central banks of Member States (hereafter referred to as 'national central banks') in favour of Union institutions, bodies, offices or agencies, central governments, regional, local or other public authorities, other bodies governed by public law, or public undertakings of Member States *shall be prohibited, as shall the purchase directly from them by the European Central Bank or national central banks of debt instruments*'.

# The institutional framework of the single monetary policy (V)

- According to the ECB, in an environment of financial stability, price stability is the best contribution that monetary policy can make to achieving other economic policy objectives.

- The fact that financial stability is a *pure* public good requires an institutional framework that safeguards monetary and financial stability.

- Treaty of Lisbon (Title VIII: Economic and Monetary Policy), in *Official Journal of the European Union*, 9/05/2008.
  http://eur-lex.europa.eu/JOHtml.do?uri=OJ:C:2008:115:SOM:EN:HTML

# The institutional framework of the single monetary policy (VI)

- The monetary policy of the ECB is based on a 'collective' decision-making system (Art. 129 and 132 of the TFEU). There are two decision-making bodies of the ECB (Article 129.1 of the TFEU) which are held responsible for the implementation of the single monetary policy: the Governing Council and the Executive Board.

- First, the Executive Board of the ECB consists of the President, the Vice-President and four other members, all of whom – since the entry into force of the Treaty of Lisbon – are appointed by the European Council of the EU acting by a *qualified majority*.

# The institutional framework of the single monetary policy (VII)

**Members of the Executive Board**
(as of April 2026)

Piero Cipollone
Executive Board Member

Isabel Schnabel
Executive Board Member

Frank Elderson
Executive Board Member

Philip R. Lane
Executive Board Member

Christine Lagarde
President ECB

Luís de Guindos
Vice-president ECB

# The institutional framework of the single monetary policy (VIII)

- Second, the Governing Council consists of the six members of the Executive Board and the governors of the euro-area NCBs.

- The Governing Council strives to reach decisions by consensus, reflecting the collaborative nature of monetary policymaking.

- If consensus cannot be achieved, decisions are made by a *simple majority* of the members present and voting.

- Each member of the Governing Council has one vote, and in case of a tie, the ECB President has the casting vote.

# The institutional framework of the single monetary policy (IX)

- Last, a third decision-making body is the General Council which is composed of the President and Vice-President of the ECB and the governors of the NCBs of all EU Member States.

- It will exist as long as there are some EU Member States whose currency is not the euro (e.g., Denmark, Poland, Sweden).

# The monetary policy strategy of the ECB (I)

- According to the ECB, the costs of high inflation and deflation (negative inflation) are substantial. By contrast, in a regime of price stability these costs are small. *Price stability promotes long-run economic growth by helping the price system allocate resources more efficiently.*

- When inflation is high or negative 'relative prices' (i.e., prices of commodities in terms of other commodities) stop acting as 'signals' that reflect the *relative scarcity* of different goods and production factors. It becomes difficult to determine whether a change in the price of a commodity is the result of a change in its relative scarcity or in the overall price level.

# The monetary policy strategy of the ECB (II)

- The institutional framework presented above is founded on the principle that the Euro-system's objective of maintaining price stability is of overriding importance.

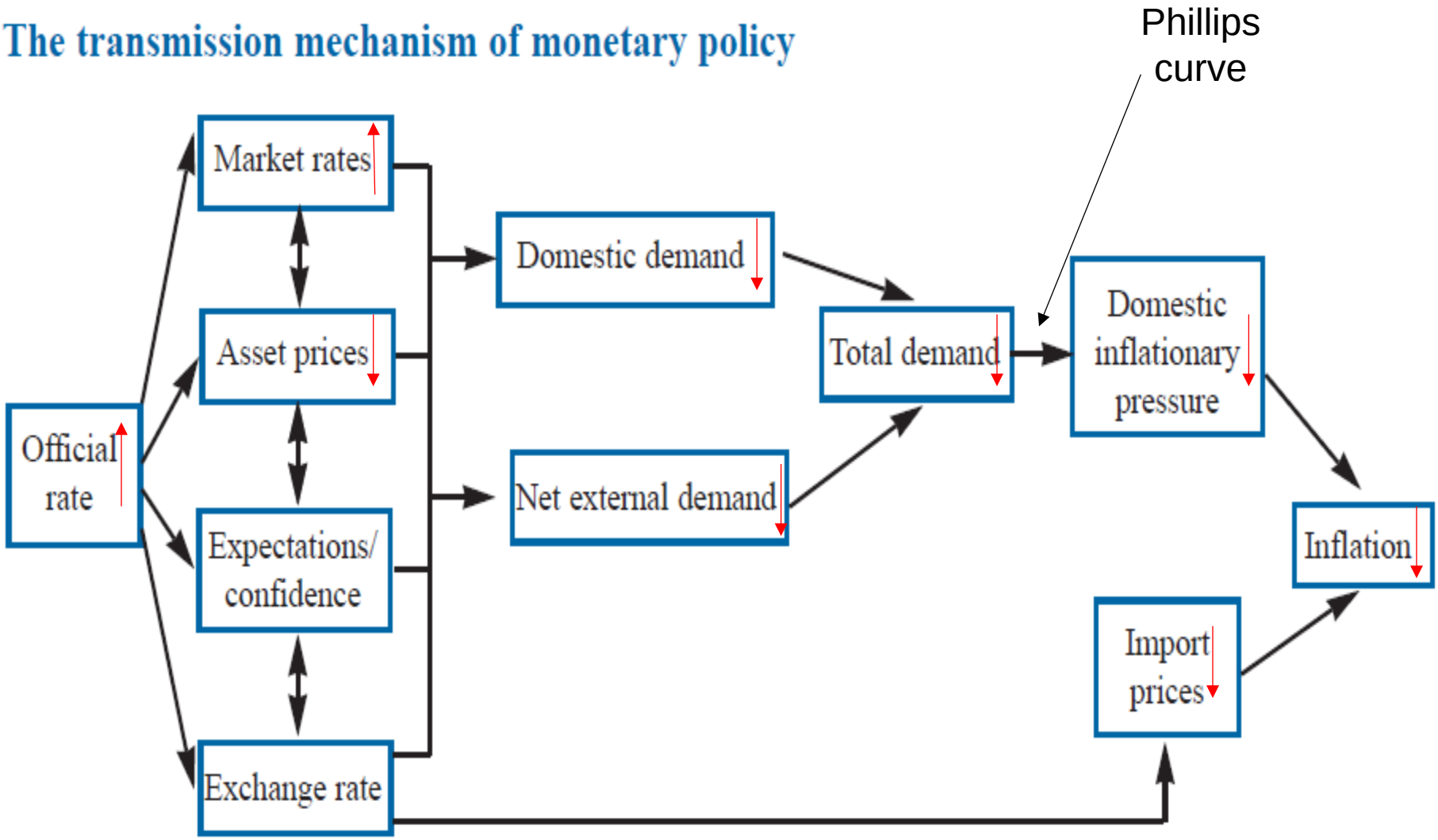
- Since, according to the ECB, monetary policy doesn't affect aggregate output or unemployment in the long run (it assumes that the long-run Phillips curve is *vertical*), it thus follows that long-run price stability is the best contribution that it can make to social welfare.

# The monetary policy strategy of the ECB (III)

- The ECB aims to influence conditions in money markets (i.e., markets where financial *assets with a maturity of less than one year* are traded). Thus, the level of short-term nominal interest rates needs to be set so that price stability is maintained. The transmission mechanism of monetary policy is shown below.

- Monetary policy is *forward-looking* and *pre-emptive* because, owing to the lags and uncertainty in the transmission process, changes in nominal interest rates today *only* affect the inflation rate after several quarters or years.

# The transmission mechanism of monetary policy




Note: For simplicity, this figure does not show all interactions between variables, but these can be important.

# The monetary policy strategy of the ECB (IV)

- This means that the ECB must ascertain what policy *stance* is needed today to maintain price stability in the future, after the transmission lags unwind.

- Further, and owing to the sheer complexity of the transmission process, there is always a large element of uncertainty surrounding the effects of monetary policy.

- For this reason, monetary policy should have a *medium-term* orientation to avoid too much 'activism' or excessive volatility in interest rates and the introduction of unnecessary volatility into financial markets.

# The monetary policy strategy of the ECB (V)

- The central element of the ECB's monetary policy strategy is a *quantitative* definition of price stability.

- Following a thorough evaluation of its monetary policy strategy in 2003, the Governing Council clarified that it aims to maintain inflation rates 'below, but close to, 2% over the medium term'.

- The inflation rate that the ECB targets is based on the 'Harmonized Index of Consumer Prices' (HICP) *averaged* (using different weights for different countries) across the Euro-area.

# The monetary policy strategy of the ECB (VI)

- The ECB has adopted an ‘inflation-targeting’ regime whereby changes in short-term nominal interest rates are used to target the *average* inflation rate in the Euro-area as indicated in the Figure above.

- By referring to ‘an increase in the HICP of *below but close to 2%*’ the definition makes clear that not only inflation above 2% but also ‘deflation’ (i.e., a decrease in the broad price index) is *inconsistent* with price stability.

# The monetary policy strategy of the ECB (VII)

- By setting the lower bound for inflation above zero and aiming at inflation close to 2% the ECB also takes account of the possibility that 'measured' inflation overstates true inflation due to a *positive bias* in the measurement of inflation using the HICP.

$$True\ inflation = Measured\ inflation - Measurement\ bias$$

(unobserved)

0-1% 2% 1-2%

- The *positive inflation measurement bias*, estimated at 1-2%, is a consequence of the use of a 'Laspeyres' index to measure the HICP.

## Questions for self-evaluation

1. Why is price stability the best contribution that central banks can make to long-run economic growth?

2. Why does monetary policy need to be forward-looking and pre-emptive?

3. Why has the ECB set an inflation target of 2 percent inflation for the Euro-area?

# Monetary policy implementation (I)

- The ECB uses two types of operations: open market operations and standing facilities (Table 4.1 below provides an overview).

- The most important operations are *open market operations* in money markets. 'Money market' refers to the market in which the maturity of transactions is generally *less* than one year.

- Open market operations include:
  - *main refinancing operations* (MROs)
  - longer-term refinancing operations (LTROs)
  - fine-tuning operations (FTOs) and
  - structural operations.

**Table 4.1 Eurosystem monetary policy operations**

| Monetary policy operations | Type of transaction [1] | | Maturity | Frequency |
|---|---|---|---|---|
| | Liquidity-providing | Liquidity-absorbing | | |
| **Open market operations** | | | | |
| Main refinancing operations | • Reverse transactions | — | • One week [2] | • Weekly |
| Longer-term refinancing operations | • Reverse transactions | — | • Three months | • Monthly |
| Fine-tuning operations | • Reverse transactions<br>• Foreign exchange swaps | • Reverse transactions<br>• Collection of fixed-term deposits<br>• Foreign exchange swaps | • Non-standardised | • Non-regular |
| Structural operations | • Reverse transactions | • Issuance of ECB debt certificates | • Standardised/ non-standardised | • Regular and non-regular |
| | • Outright purchases | • Outright sales | — | • Non-regular |
| **Standing facilities** | | | | |
| Marginal lending facility | • Reverse transactions | — | • Overnight | • Access at the discretion of counterparties |
| Deposit facility | — | • Deposits | • Overnight | • Access at the discretion of counterparties |

# Monetary policy implementation (II)

- MROs are the most important open market operations and represent the key policy instrument of the Euro-system. Through MROs, the Euro-system lends funds to its counterparties.

- Lending through open market operations normally takes place by means of 'reverse transactions'. In the latter, the ECB purchases assets under a 'repurchase agreement' (REPO) or grants a loan against assets pledged as collateral.

- 'Reverse transactions' (or REPOS) are *temporary* open market operations which provide funds for a limited, pre-specified period only. They constitute a sort of 'revolving fund'.

# Monetary policy implementation (III)

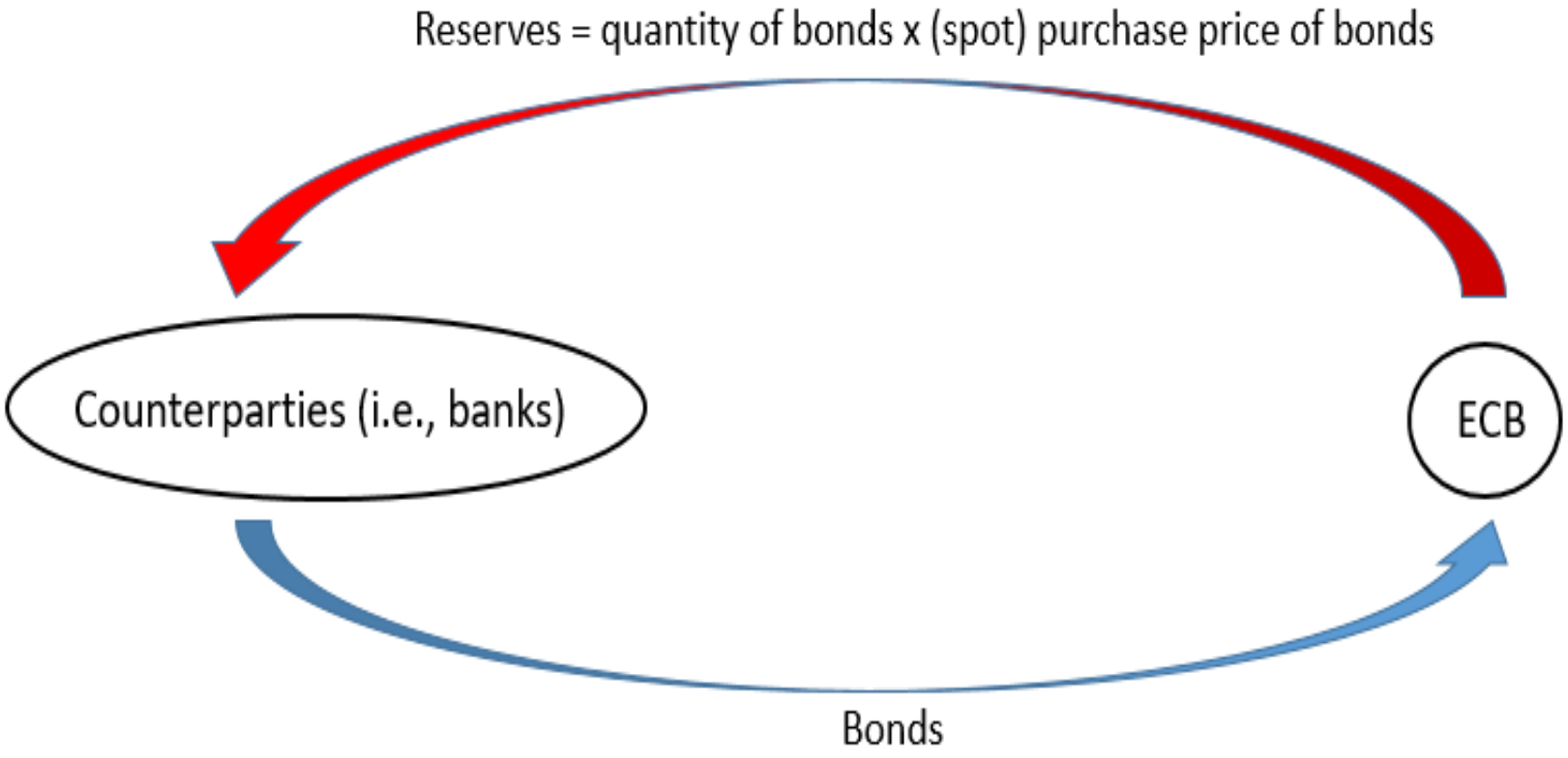
- MROs are liquidity-providing operations conducted regularly on a *weekly* basis. They generally have a maturity of one week. MROs are executed through standard tenders.

- 'Standard' indicates tender operations conducted in accordance with a pre-announced schedule that is completed within a 24 hours' period from the public announcement of the tender to the communication of the results.

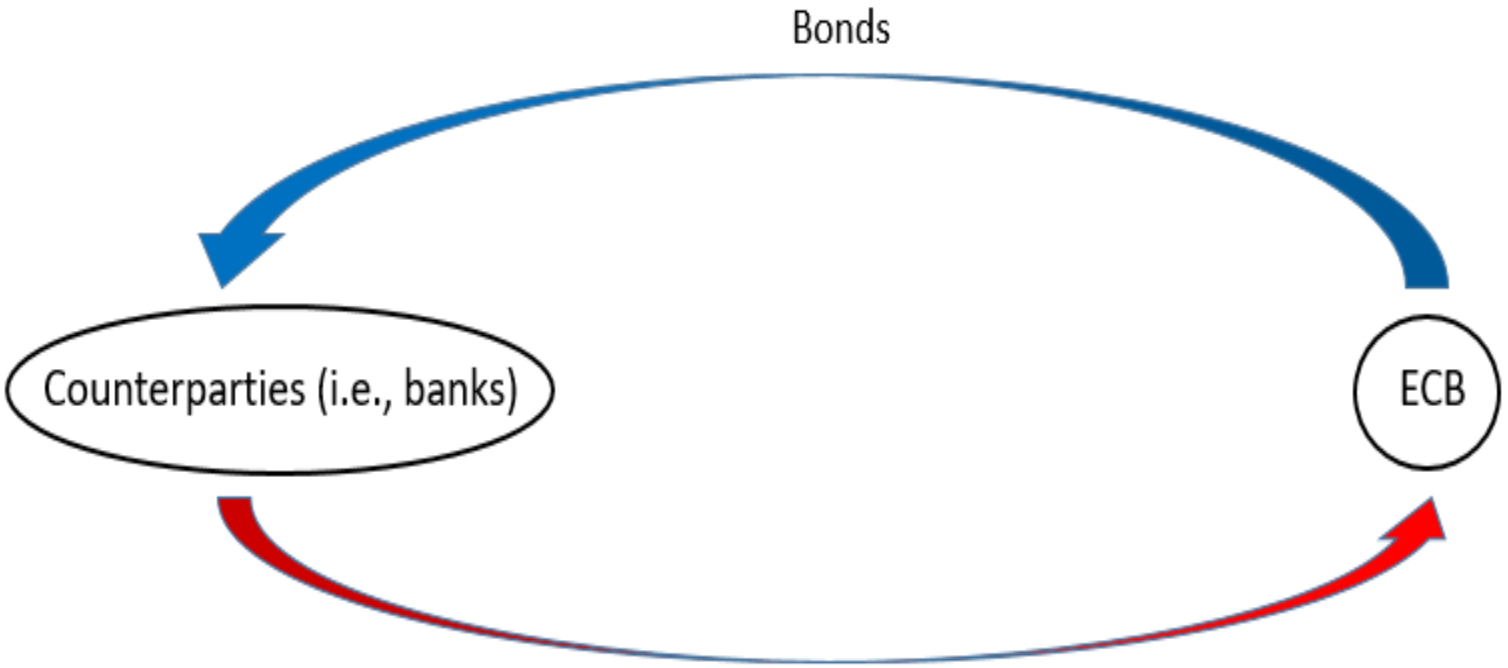
- All counterparties fulfilling *eligibility criteria* are allowed to participate in these operations.

## Main refinancing operations (MROs): Repurchase agreements (REPOs)

'Spot' transaction (on the same day the 'tender' takes place)



## 'Reverse' transaction (a week later)




Reserves = quantity of bonds x (reverse) selling price of bonds

Short-term nominal interest rate *implicit* in the MRO = ECB's (reverse) selling price – ECB's (spot) purchase price

# Monetary policy implementation (IV)

- The Euro-system may execute its tenders in the form of *fixed* rate or *variable* rate tenders. In the former, the ECB specifies the interest rate in advance and the counterparties (i.e., banks) bid the amount of money they wish to transact at the fixed rate.

- In *variable rate tenders*, counterparties bid both the amount of money they wish to transact and the interest rate at which they wish to enter into the transaction. Counterparties may submit multiple bids with different interest rates. In each bid, they must state the amount of funds they are willing to transact at the respective interest rate.

# Monetary policy implementation (V)

- Under both procedures, the ECB decides the amount of liquidity to be provided. In a *fixed rate tender* this normally implies a *pro rata allotment* to the participating banks, depending on the ratio between total bids and total liquidity to be allotted.

- In a *variable rate tender*, the bids with the highest interest rates are satisfied first, followed by bids with successively lower rates, until the total amount of liquidity to be provided is exhausted. At the lowest accepted rate or 'marginal rate of allotment', bids are satisfied pro rata in line with the ECB's decision on the total amount of liquidity to be allotted.

# Monetary policy implementation (VI)

- From the beginning of 1999 to June 2000 the ECB conducted its MROs as fixed rate tenders with partial allotment. From 27 June 2000 the MROs were conducted as variable rate tenders with a minimum bid rate using a multiple rate procedure. Last, starting from 15 October 2008, the MROs were conducted as fixed rate tenders with full allotment.

- The fact that the MROs aim at *injecting* liquidity in the system is an implication of the fact that in a growing economy, as the monetary value of transactions and bank deposits grow, banks need to keep a growing volume of (compulsory and voluntary) reserves to back the former.

*Appendix 1*

## EXAMPLES OF MONETARY POLICY OPERATIONS AND PROCEDURES

**List of examples**

EXAMPLE 1

**Liquidity-providing reverse transaction by fixed rate tender**

The ECB decides to provide liquidity to the market by means of a reverse transaction organised with a fixed rate tender procedure.

Three counterparties submit the following bids:

*(million EUR)*

| Counterparty | Bid |
|---|---|
| Bank 1 | 30 |
| Bank 2 | 40 |
| Bank 3 | 70 |
| Total | 140 |

The ECB decides to allot a total of EUR 105 million.

The percentage of allotment is:

$$\frac{105}{(30 + 40 + 70)} = 75\,\%$$

The allotment to the counterparties is:

*(million EUR)*

| Counterparty | Bid | Allotment |
|---|---|---|
| Bank 1 | 30 | 22,5 |
| Bank 2 | 40 | 30,0 |
| Bank 3 | 70 | 52,5 |
| Total | 140 | 105,0 |

EXAMPLE 2

**Liquidity-providing reverse transaction by variable rate tender**

The ECB decides to provide liquidity to the market by means of a reverse transaction organised with a variable rate tender procedure.

Three counterparties submit the following bids:

| Interest rate (%) | Amount (million EUR) | | | | |
|---|---|---|---|---|---|
| | Bank 1 | Bank 2 | Bank 3 | Total bids | Cumulative bids |
| 3,15 | | | | 0 | 0 |
| 3,10 | | 5 | 5 | 10 | 10 |
| 3,09 | | 5 | 5 | 10 | 20 |
| 3,08 | | 5 | 5 | 10 | 30 |
| 3,07 | 5 | 5 | 10 | 20 | 50 |
| 3,06 | 5 | 10 | 15 | 30 | 80 |
| 3,05 | 10 | 10 | 15 | 35 | 115 |
| 3,04 | 5 | 5 | 5 | 15 | 130 |
| 3,03 | 5 | | 10 | 15 | 145 |
| Total | 30 | 45 | 70 | 145 | |

The ECB decides to allot EUR 94 million, implying a marginal interest rate of 3,05 %.

All bids above 3,05 % (for a cumulative amount of EUR 80 million) are fully satisfied. At 3,05 % the percentage of allotment is:

$$\frac{94 - 80}{35} = 40\ \%$$

The allotment to Bank 1 at the marginal interest rate is, for example:

$$0{,}4 \times 10 = 4$$

The total allotment to Bank 1 is:

$$5 + 5 + 4 = 14$$

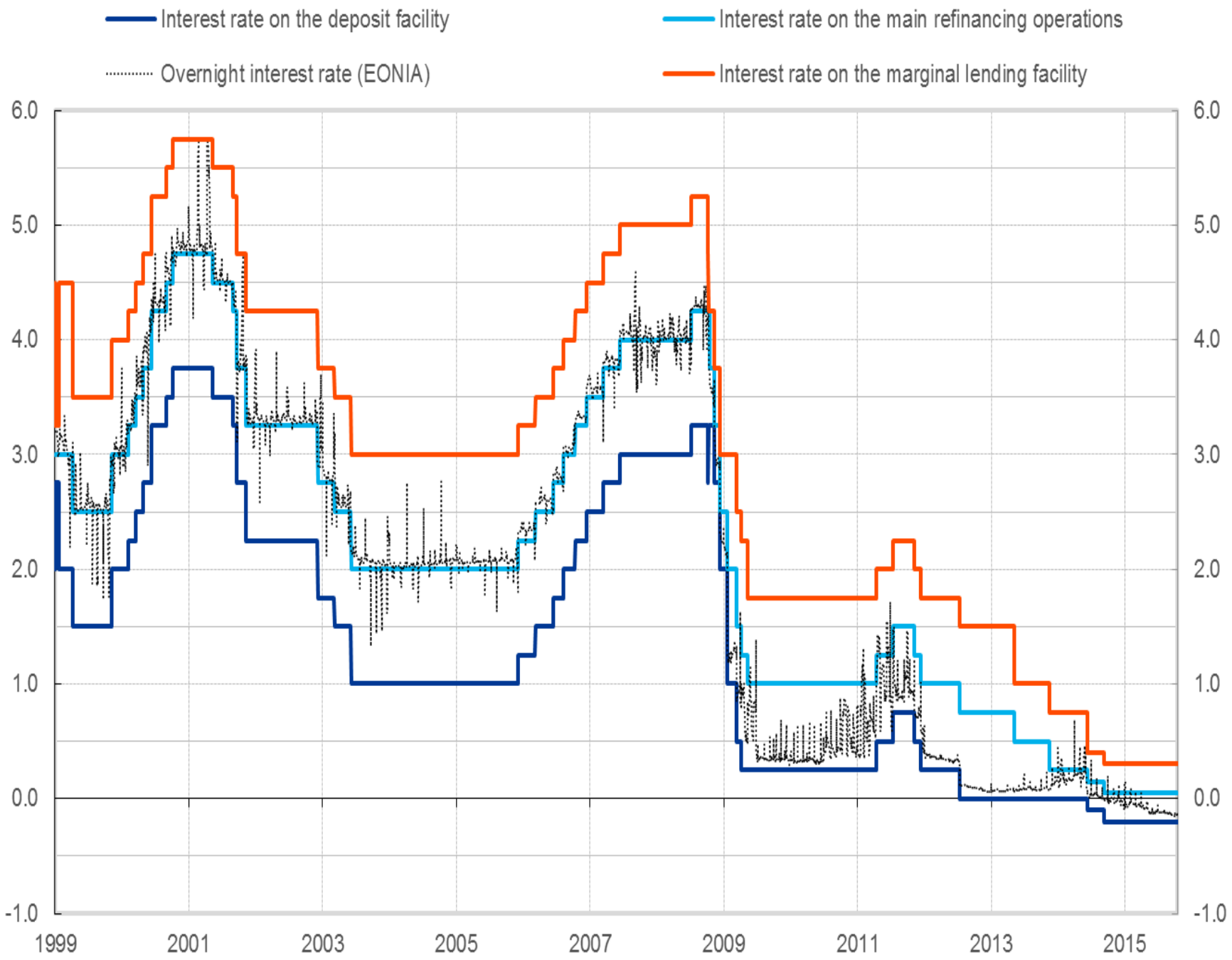
The allotment results can be summarised as follows:

(million EUR)

| Counterparties | Amount | | | |
|---|---|---|---|---|
| | Bank 1 | Bank 2 | Bank 3 | Total |
| Total bids | 30,0 | 45,0 | 70,0 | 145 |
| Total allotment | 14,0 | 34,0 | 46,0 | 94 |

If the allotment procedure follows a single rate (Dutch) auction, the interest rate applied to the amounts allotted to the counterparties is 3,05 %.

If the allotment procedure follows a multiple rate (American) auction, no single interest rate is applied to the amounts allotted to the counterparties: for example, Bank 1 receives EUR 5 million at 3,07 %, EUR 5 million at 3,06 % and EUR 4 million at 3,05 %.


Interest rate on the deposit facility
Interest rate on the main refinancing operations
Overnight interest rate (EONIA)
Interest rate on the marginal lending facility
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
1999
2001
2003
2005
2007
2009
2011
2013
2015

# Monetary policy implementation (VII)

- With a view to restricting the volatility of short-term nominal interest rates the Euro-system offers two standing facilities to its counterparties:
  - The *marginal lending* facility (MLF) and
  - The *deposit* facility (DF)

- Both facilities have an *overnight maturity* and are available to counterparties at their own initiative.

- The nominal interest rate on MLF is *higher* than the nominal interest rate on the 'main refinancing operations' whereas the nominal interest rate on DF is *lower* than the former. Banks resort to MLF only in the absence of better alternatives.

# Monetary policy implementation (VIII)

- Since there are no limits on the access to the standing facilities (except for collateral requirements), the nominal rates on MLF and DF set a *ceiling* and a *floor* respectively for the overnight nominal interest rate in the interbank market.

- The chart below shows how the rates on the standing facilities have set a *ceiling* and a *floor* for the overnight market interest rate, measured by the *euro overnight index average* (EONIA).

- The *Euro interbank offered rate* (Euribor) is another important interest rate that is calculated using the averaged interest rates at which Euro-zone banks borrow funds from counterparties in money markets for several periods (e.g., one week, two weeks, one month, 3 months, etc.)

# Monetary policy implementation (IX)

- The chart shows that, in normal times, EONIA has generally remained close to the rate on the MROs thereby demonstrating the role of these operations as the main monetary policy instrument of the Euro-system.

- This behaviour changed abruptly in October 2008 (following the collapse of Lehman Brothers) when the ECB adopted *non-standard* measures to offset the effects of the financial crisis.

- The chart also shows that the marginal interest rate of the 'main refinancing operations' (captured by the light blue line that lies at the centre of the corridor) changes in a stepwise fashion reflecting that it is an *administered* price rather than a market price (i.e., it is set unilaterally by the ECB).

# Monetary policy implementation (X)

- The main function of the *minimum reserve system* (MRS) is to stabilise money market interest rates. This function is performed by the *averaging provision*.

- The former allows banks to smooth out daily liquidity fluctuations (arising from fluctuations in the demand for banknotes), since transitory reserve imbalances can be offset by *opposite* reserve imbalances generated within the same maintenance period.

# Monetary policy implementation (XI)

- The ECB requires euro-area credit institutions to hold *compulsory deposits* on current accounts with the NCBs: these are called ‘required reserves’ (RR).

- The amount of RR to be held by each institution is determined by its *reserve base*. The former is defined in relation to items located on the liability side of its balance sheet (i.e., deposits).

- To determine an institution’s reserve requirement, the reserve base is multiplied by a constant *reserve ratio*. The ECB applies a uniform positive reserve ratio to most of the items included in the reserve base. This reserve ratio was set at 2 percent.

# Monetary policy implementation (XII)

- To comply with their reserve requirements, credit institutions must hold balances (i.e., reserves) on their reserve accounts with NCBs. However, the MRS allows counterparties to make use of *averaging provisions*.

- This means that compliance with ‘reserve requirements’ is determined on the basis of the *average of the daily balances* on the institutions’ reserve accounts over the maintenance period of around one month.

- A maintenance period starts on the settlement day of the first MRO following the ECB meeting at which the assessment of the monetary policy stance is scheduled and ends on the day preceding the corresponding settlement day *in the following month*.

## THE 'MINIMUM RESERVE SYSTEM' OF THE ECB

Total volume of reserves of bank 'i' (**TRi**) = Required or compulsory reserves (**RRi**) + Voluntary or excess reserves (**VRi**)

**RRi** = Reserve base of bank 'i' (items on the liability side of its balance sheet from the previous month) * Reserve Ratio (currently at 2%)

**Compliance** with RR by bank 'i' requires that:

| | | |
|---|---|---|
| **Actual** average daily balance of bank's 'i' reserve account (deposits) at the ECB during the current 'maintenance period' (30 days) | ≥ | Average daily **minimum** required balance of bank's 'i' reserve account at the ECB during the current 'maintenance period' (30 days) |

The ECB's **averaging provision** helps stabilizing money market rates by letting banks run *temporary* reserve surpluses or deficits → Intertemporal **arbitrage** opportunities (i.e. lending out funds to other banks when inter-bank market rates are high and borrowing from them when they are low) in the inter-bank market by individual banks

Use of **arbitrage opportunities** by banks in the interbank market will make the shortest money market rates 'converge' to bank's *expected* average 'marginal rate of allotment' of the ECB's 'main refinancing operations' (MROs) during the current 'maintenance period'

This is the **joint** result of the operation of the **ECB's averaging provision** and of the fact that banks' *required* reserves are **remunerated** at the *average* level of the 'marginal rate of allotment' during the current maintenance period.

Let us denote by: '**A**' the level of the shortest money market interest rates, and
'**B**' banks' **expected** *average* 'marginal rate of allotment' of the MROs over the current maintenance period

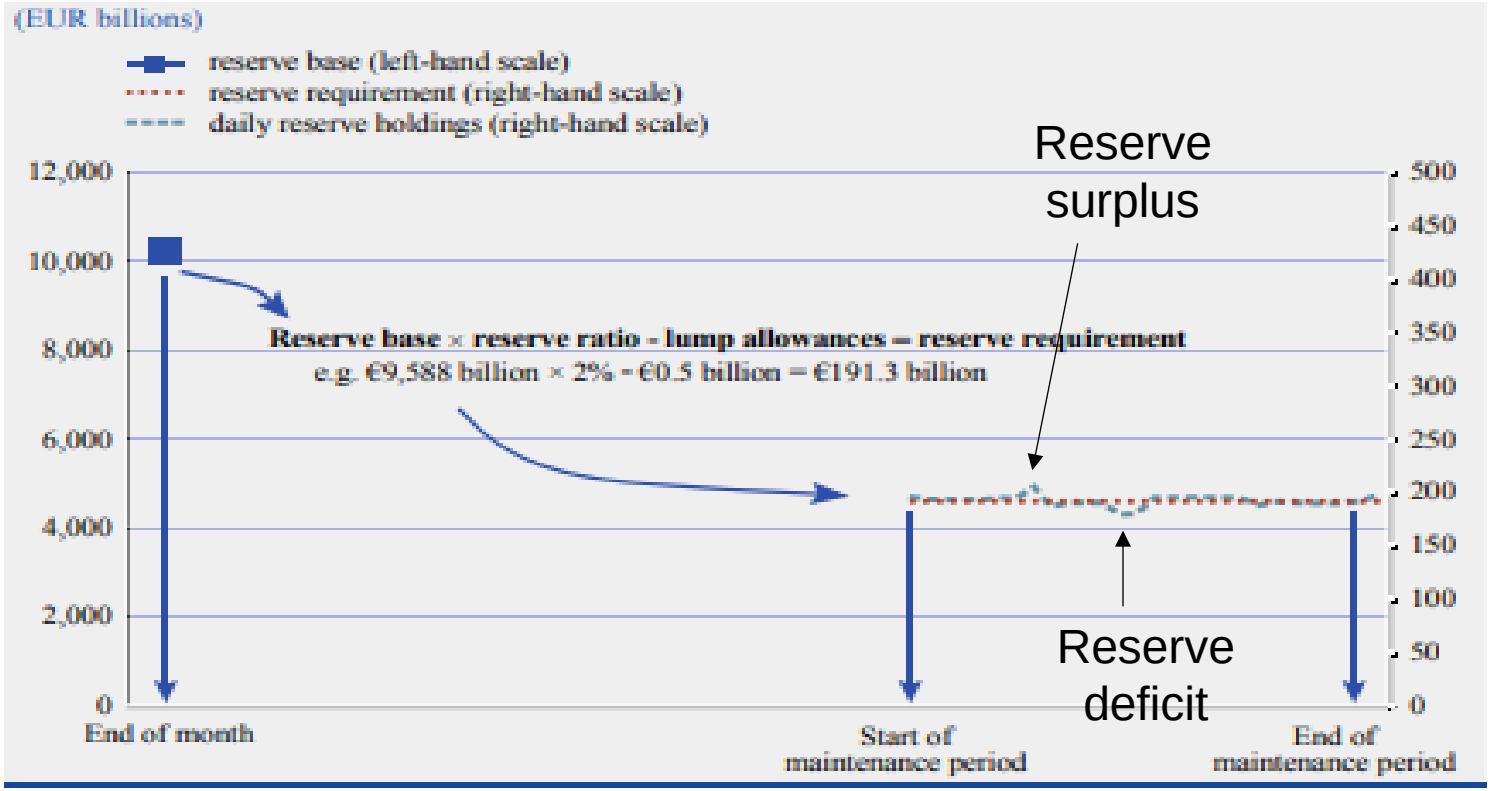
We have that:

If **A > B** banks will run **reserve deficits**, the supply of funds (loans) in the interbank market will **increase** and money market rates will tend to **decrease**.

If **A < B** banks will run **reserve surpluses**, the supply of funds (loans) in the interbank market will **decrease** and money market rates will tend to **increase**.

As a result of **arbitrage** by banks in the inter-bank market **A** will tend to *converge* to **B** thus keeping inter-bank market rates very close to the *average* 'marginal rate of allotment'.

## Chart 4.3 The functioning of the Eurosystem's reserve requirement system




Source: ECB.

Note: The example is based on data referring to the last maintenance period before the outbreak of the financial market tensions in August 2007, i.e. the period from 11 July to 7 August 2007. During the financial market tensions, the behaviour of market participants changed, as there was a desire to frontload the fulfilment of reserve requirements.

# Monetary policy implementation (XIII)

- Euro-area credit institutions' holdings of RR are remunerated. The remuneration is the average, over the maintenance period, of the 'marginal rate of allotment' (weighted according to the number of calendar days) of the MROs.

- As the marginal tender rates tend to be very close to the short-term money market interest rates, RR are also remunerated at close to the market rate.

- A credit institution's reserve account holding at the ECB may fluctuate freely around its reserve requirement, but the *average* reserve account holding must be at least equal to the reserve requirement over the whole maintenance period.

# Monetary policy implementation (XIV)

- The averaging provision does imply that banks can profit from lending in the market and run a *reserve deficit* whenever the shortest money market rates are above those rates expected to prevail for the remainder of the maintenance period.

- In the opposite scenario, they can borrow in the money market and run a *reserve surplus*. Thus, this inter-temporal 'arbitrage' should ensure equality throughout the maintenance period between the current level of the shortest money market rates and their *expected* level at the end of the maintenance period.

- This mechanism stabilises the overnight nominal interest rate during the maintenance period and makes it unnecessary for the ECB to intervene frequently in the money market.

# Monetary policy implementation (XV)

- To the extent CBs are *monopoly suppliers of base money*, they are only the institutions that can supply base money to the banking system; they set both the 'quantity' and 'price' (the overnight nominal interest rate) at which they supply base money.

- *Base money* consists of primary reserves or banks' deposits at the ECB plus cash (notes and coins) in the vaults of the banks.

- In Figure 1, the reserves' market is depicted by a *downward-sloping* 'demand for reserves' schedule since the 'opportunity cost' of holding reserves decreases as the interbank short-term nominal interest rate decreases, and a perfectly-elastic 'supply of reserves' schedule.

# Monetary policy implementation (XVI)

- Increases in banks' demand for reserves can be illustrated by a rightward shift of the 'demand for reserves' schedule (from Do to $D_1$)

- Monetary policy changes that lead to changes in the policy-controlled short-term nominal interest rate can be represented by means of vertical shifts of the 'supply of reserves' schedule in Figure 1 below.

# Monetary policy implementation (XVII)

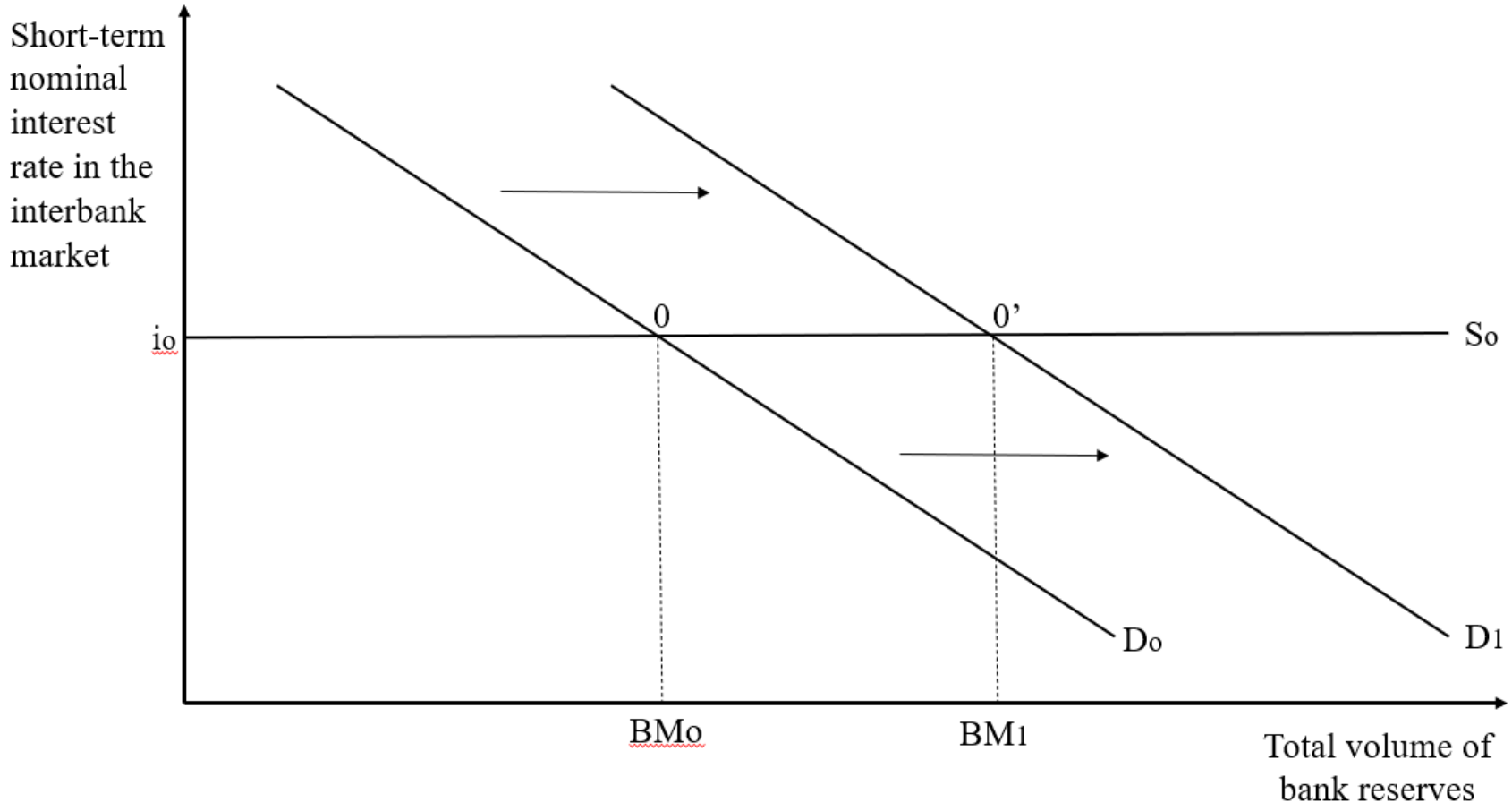



Figure 1

## Questions for self-evaluation

1. How does a REPO work? What does the ECB use REPOs for? How is the interest rate of the ‘main refinancing operations’ (MROs) implicitly determined in a REPO?
2. Is the nominal interest rate of MROs market-determined? Why?
3. What are the functions of the two ‘standing facilities’ of the ECB? How do they work?
4. What is the main function of the ‘minimum reserve system’ of the ECB? How does it work?

# Nominal *versus* real interest rates (I)

- *Nominal* interest rates are the yields expressed in money terms of a fixed-income financial asset (e.g., bonds).

- A real interest rate is the *difference* between a nominal interest rate and the inflation rate.

$$r_t^{real} = i_t^{nominal} - \pi_t$$

- Real interest rates can be expressed in two different ways:
  - *Ex-ante* or expected: the difference between the current nominal interest rate and the expected inflation rate.
  - *Ex-post rate*: the difference between the current nominal interest rate and the inflation rate at the end of the current period.

# Nominal *versus* real interest rates (II)

- Financial assets may have a range of maturities (e.g., one day, one month, twenty years). Accordingly, the rate of return of a fixed-income financial asset covers a time span that depends on *maturity* of the latter.

- The current level of *long-term* interest rates depends on several factors:
  - The monetary policy stance reflected in the current level of short-term interest rates.
  - Expectations about the future level of short-term interest rates which may depend, in turn, on inflation expectations.
  - A *term premium* $\mu_t$ that is directly proportional to investors' degree of liquidity preference.

# Nominal *versus* real interest rates (III)

- The first two factors depend on the current and future *stance* of monetary policy. The third factor captures financial investors' preferences among assets with various maturities since, *ceteris paribus*, the longer the maturity of the asset, the more liquid it is.

- We can express an ex-ante real *long-term* real interest rate as:

$$r_{t,long}^{real} = \underbrace{i_{t,short}^{nominal} - \pi_t^e}_{\text{Ex-ante short-term } \textit{real} \text{ interest rate}} + \mu_t$$

where $\pi_t^e$ denotes the expected inflation rate.

# Nominal *versus* real interest rates (IV)

- If we look at the previous expression, it should be clear that if the expected inflation increases and the central bank seeks to keep the current inflation close to its target level, it will need to induce *an increase in ex-ante real long-term interest rates*.

- Now, assuming realistically that $\mu_t$ remains roughly constant when the expected inflation rate changes, this requires that:

$$\frac{\partial i_{t,short}^{nominal}}{\partial \pi_t^e} > 1$$

- That is, the change in the short-term nominal interest rate must be *more than proportional* to the change in the expected inflation rate to raise ex-ante real interest rates.

# Nominal *versus* real interest rates (V)

- This condition is known as ‘Taylor’s principle’ (Taylor, 1993) and must be strictly satisfied if monetary policy is to provide a ‘nominal anchor’ to the economy, namely, if the current inflation rate is to *converge* to the target inflation rate in the wake of demand and supply shocks.

- Fulfilment of Taylor’s principle may be seen as an *institution-based* built-in’ negative feedback mechanism.

- Thus, the maintenance of long-run price stability requires that the central bank sets short-term nominal interest rates to make ex-ante real interest rates follow a *pro-cyclical* pattern.

# The ‘neutral’ interest rate (I)

- Let’s define the *neutral* interest rate as the long-term *real* interest rate that is *neutral* with respect to the inflation rate in the sense that it tends neither to increase it nor to decrease it in the absence of supply shocks.

- This means that, when the long-term real interest rate is equal to the ‘neutral’ interest rate, the unemployment rate equals the NAIRU, current aggregate output equals potential aggregate output, and the current inflation rate remains constant.

# The ‘neutral’ interest rate (II)

- We can pin down the ‘neutral’ interest rate using the national income identity for an open economy, which reads as follows:

$$C + I(r) + G + XN(r) = C + S + T \qquad (1)$$

where $C$ = aggregate private consumption

$I$ = aggregate private investment

$G$ = government spending

$XN$ = net exports

$S$ = aggregate private saving

$T$ = tax revenue

$r$ = current long-term real interest rate.

# The ‘neutral’ interest rate (III)

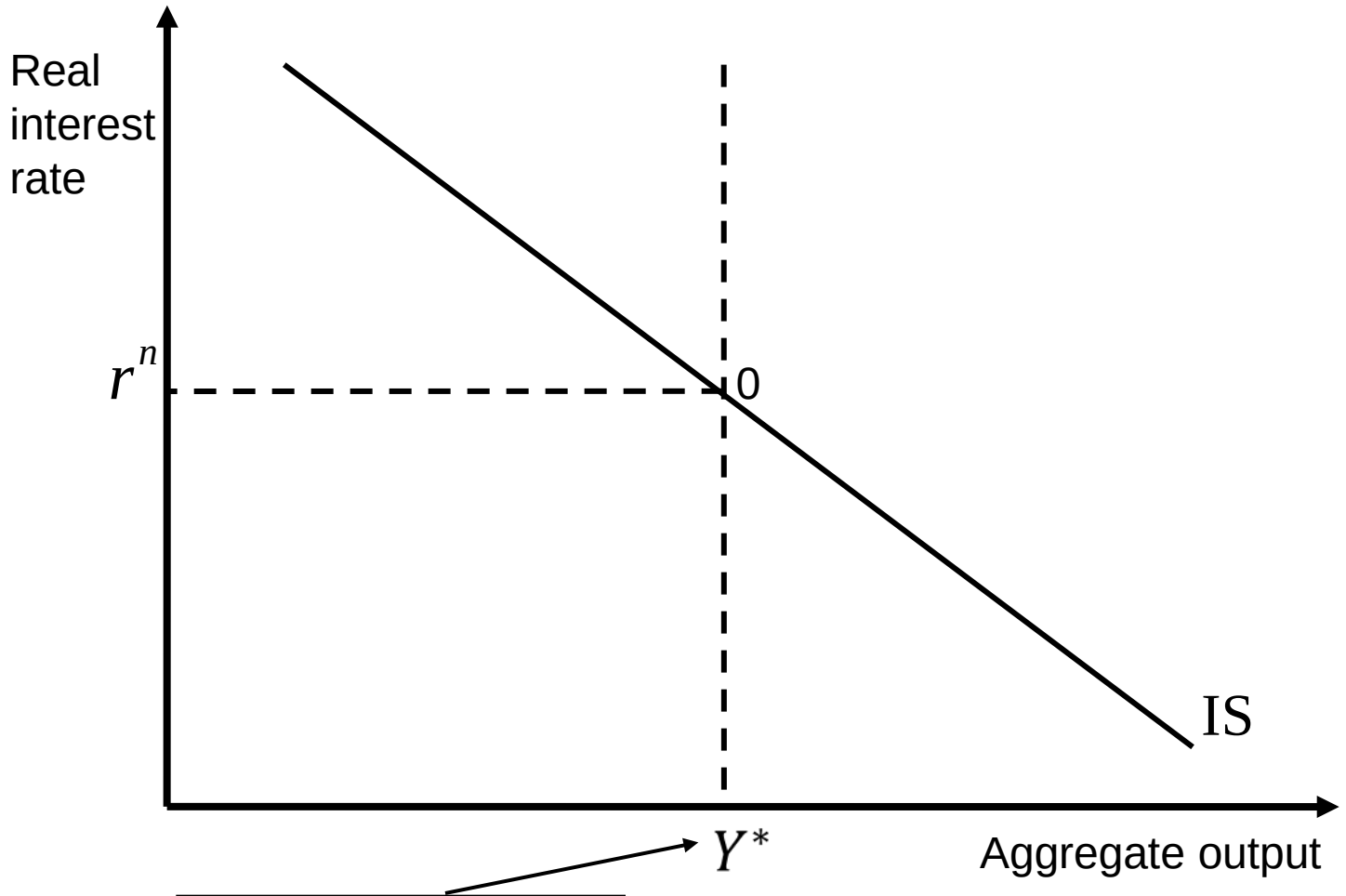
- If we *impose* the condition that current aggregate output equals potential aggregate output ($Y^*$) and re-arrange (1), we get:

$$I(r) + (G - T) + XN(r) = S(Y^*) \qquad (2)$$

- In short, the ‘neutral’ interest rate is the long-term *real* interest rate that ensures that aggregate private saving equals the sum of (i) private investment, (ii) the fiscal budget deficit, and (iii) net exports when current output equals potential output.

- Thus, the ‘neutral’ interest rate depends on the stance of fiscal policy, profit expectations, and international competitiveness.

# The ‘neutral’ interest rate (IV)



# The ‘neutral’ interest rate (V)

- Cost-push shocks affect the ‘neutral’ interest rate. For example, a favourable one (e.g., a temporary increase in average labour productivity) will lower it and vice-versa.

- When the current real interest rate exceeds the ‘neutral’ interest rate the inflation rate tends to decrease, and vice-versa.

- Thus, we say that monetary policy is:
  - Expansionary if the current long-term real interest rate *falls short* of the ‘neutral’ interest rate.
  - Contractionary if the current long-term real interest rate *exceeds* the ‘neutral’ interest rate.
  - Neutral if the current long-term real interest rate is roughly *equal* to the ‘neutral’ interest rate.

## Questions for self-evaluation

1. When do we say that monetary policy is expansionary, neutral, or contractionary? Why?
2. How will the ‘neutral’ interest rate change if the economy is hit by an adverse *supply* shock that reduces potential aggregate output?
3. How will the ‘neutral’ interest rate change if the economy is hit by an adverse *demand* shock (i.e., a decrease in the level of aggregate expenditure)?

# The ‘zero lower-bound trap’ (I)

- We define a ‘zero lower-bound trap’ (ZLBT) as a situation where the *expected* long-term real interest rate (in a closed economy with no public sector) at which the flows of aggregate saving and investment at potential output would be equal, is *negative*.

- The ZLBT is ultimately the result of the fact that *fiat* or *fiduciary* money (currency and notes in circulation) and banks’ reserves at the CB are the most *liquid* assets, and their respective nominal rates of return are zero and the CB’s deposit rate.

# The ‘zero lower-bound trap’ (II)

- These nominal rates of return set a *lower bound* to the nominal rates of return of the spectrum of real and financial assets in an economy. Nobody will keep its wealth in the form of real or financial assets other than fiat money or bank deposits unless their nominal yields are positive.

- However, as we know, the CB’s deposit rate may be negative. The reason is that banks may prefer to keep large quantities of reserves even if they are remunerated at a *negative* interest rate because it is costly and even dangerous to keep large quantities of cash in their vaults.

# The ‘zero lower-bound trap’ (III)

- This means that CBs are generally *unable* to push nominal interest rates below zero which implies that conventional monetary policy is *asymmetric*: CBs can raise nominal rates as much as they wish but they cannot lower them as much as needed.

- If we denote by $\omega$ the *minimum* expected real interest rate that a CB can set for a given set of inflation expectations, we define a ZLBT as a situation in which:

$$r^n < \omega \qquad (1)$$

where $r^n$ is the ‘neutral’ interest rate.

# The ‘zero lower-bound trap’ (IV)

- The real interest rate that matters for expenditure decisions is a *long-term* rate. We thus need to consider the existence of a gap between the minimum short-term nominal interest rate, which is roughly equal to zero, and the minimum long-term nominal interest rate, which is positive because the term premium $\mu$ is always positive.

- It follows that $\omega$ above may be positive, negative, or zero since investors may require a term premium $\mu$ to compensate them for holding financial assets with a lower degree of liquidity.

# The ‘zero lower-bound trap’ (V)

- Since the *minimum* level of nominal interest rates is close to zero, then $\omega$ may be defined as the difference between $\mu$ and the expected inflation rate, or:

$$\omega = \mu - \pi^e \tag{2}$$

- Last, combining (1) and (2) above, we have that an economy is mired in a ZLBT iff:

$$r^n + \pi^e < \mu \tag{3}$$

# The ‘zero lower-bound trap’ (VI)

- Expression (3) above tells us that the lower are $r^n$ and $\pi^e$, and the higher is $\mu$, the more likely it is an economy will get stuck in a ZLBT in the wake of a large negative demand shock like the one shown in Fig. 2 below.

- In Fig. 1 below, the economy gets mired in a ZLBT if $\omega = \omega_0$ even if the ‘neutral’ interest rate $r^n$ is positive.

- In Fig. 2 below a large *negative* demand shock caused by a drop in aggregate investment pushes $r^n$ into negative territory thereby making the economy get mired in a ZLBT since $\omega_0 > r_1^n$.

# The ‘zero lower-bound trap’ (VII)

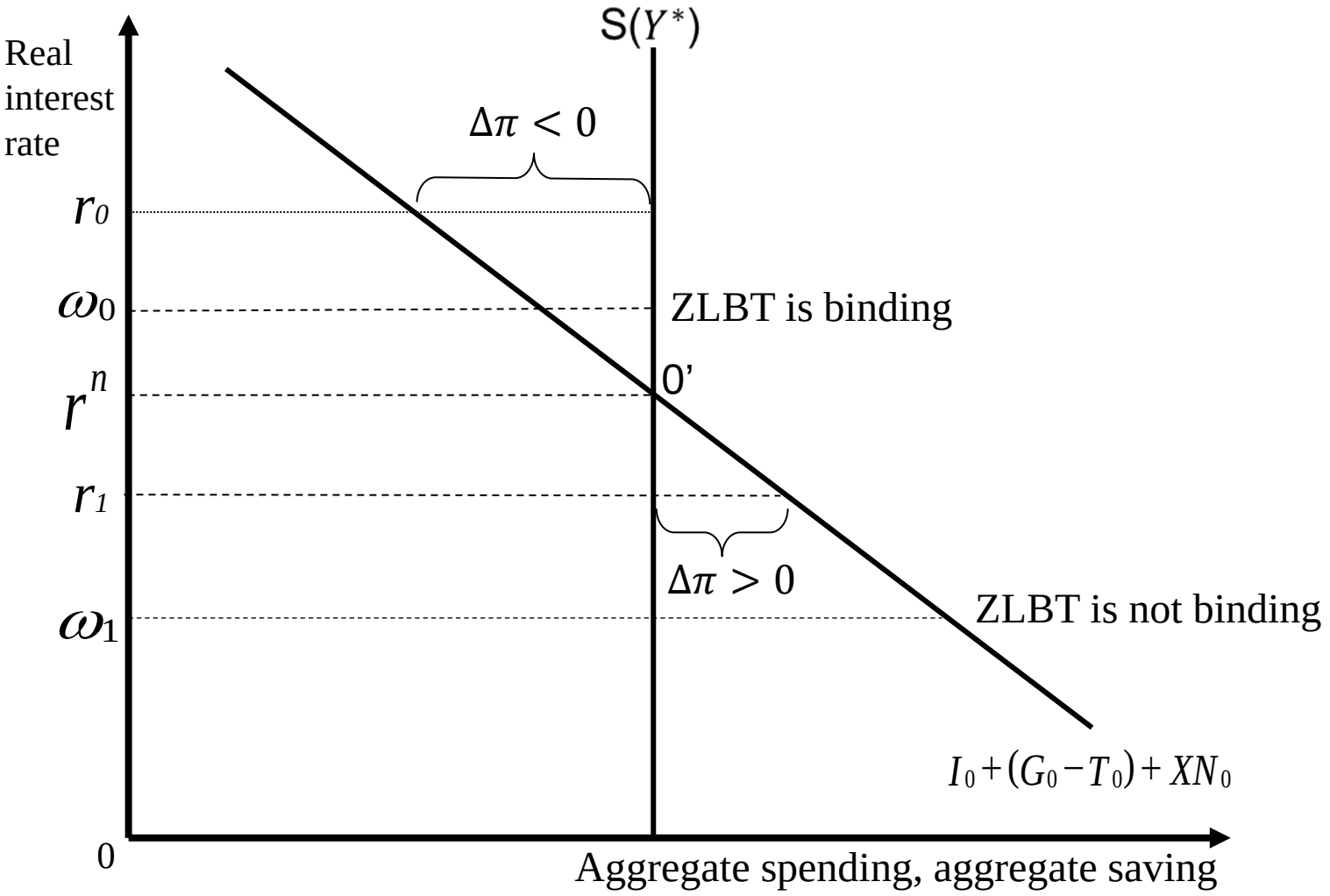



**Fig. 1**: The ZLBT with a *positive* ‘neutral’ interest rate

# The ‘zero lower-bound trap’ (VIII)

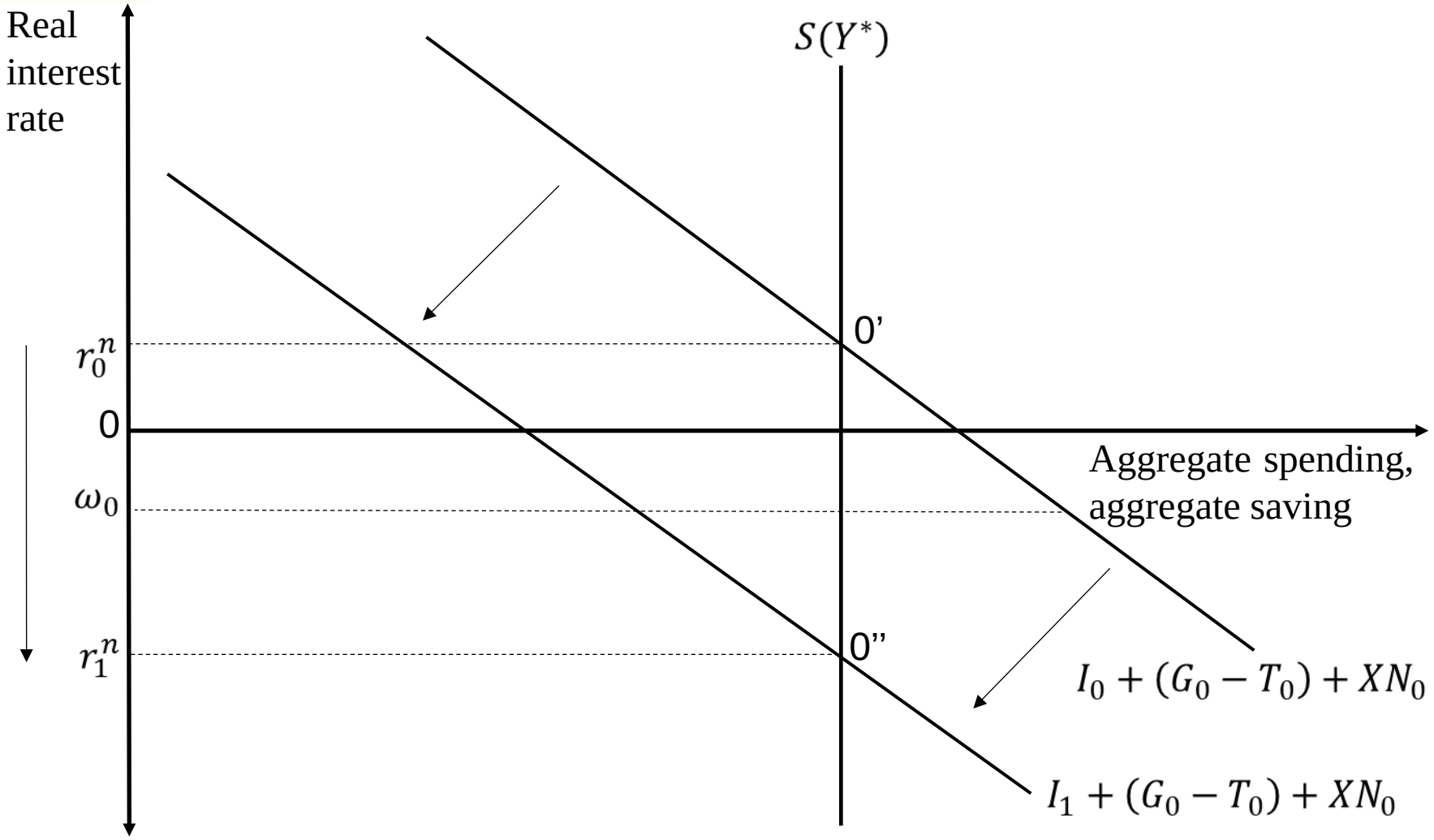



**Fig. 2**: The ZLBT with a *negative* ‘neutral’ interest rate

# The ‘zero lower-bound trap’ (IX)

- In addition to the possibility that a CB is unable offset a large *adverse* demand shock due to the ZLBT there is the further and more serious problem that, in the wake of a large *adverse* demand shock, *an economy may enter a ‘deflationary trap’*.

- This is because the *negative* output-gap created by a large adverse demand shock may also push the inflation rate down and cause a *decrease* in the expected inflation rate thus setting off a downward deflationary spiral (positive feedback loop) which may cause a large decrease in output and employment like in the Great Depression.

# The ‘zero lower-bound trap’ (X)

- A ‘deflationary trap’ is the result of the fact that nominal interest rates cannot be negative. If the nominal interest rate $i_t$ is zero and, in the wake of a large negative demand shock, the expected inflation rate $\pi_t^e$ becomes negative then, instead of falling, the *ex-ante* real interest rate $r_t$ increases thus depressing the level of aggregate demand further.

$$\uparrow r_t = i_t - \pi_t^e \downarrow = 0 - \pi_t^e \downarrow$$

- As aggregate expenditure continues to decrease, the current and expected inflation rate will tend to decrease further thus pushing the *ex-ante* real interest rate $r_t$ further up. This may trigger off a positive or destabilizing feedback loop that leads to the collapse of the economy.

# The ‘zero lower-bound trap’ (XI)

- In a nutshell, a *deflationary spiral* may lead an economy to the brink of collapse unless the destabilizing feedback mechanism described above is duly short-circuited by, for example, a large expansionary fiscal policy that helps *offset* the fall in the level of aggregate private expenditure or, else, by a large increase in net exports caused by a devaluation/depreciation of the domestic currency.

- This suggests that institutionally-determined *downward* rigidity of money wages may make our economies more resilient to large adverse demand shocks by preventing the current and the expected inflation rate from falling *too rapidly* in the aftermath of a large negative output-gap.

# The ‘zero lower-bound trap’ (XII)

- Last, the possibility of getting stuck in a ZLBT in the wake of a large negative demand shock suggests that CBs should avoid choosing an inflation target $\pi^T$ that is *too close to zero*.

- The expression below is known as Fisher’s identity. In steady-growth equilibrium, the nominal interest rate $i$ must be equal to the sum of the ‘neutral’ (real) interest rate $r^n$ and $\pi^T$:

$$i = r^{neutral} + \pi^T$$

# The ‘zero lower-bound trap’ (XIII)

- If $\pi^T$ is close to zero, the *equilibrium* nominal interest rate may be very low and, hence, the CB may have little room to lower it further if the economy is hit by a large negative shock that pushes $r^n$ and the current inflation rate $\pi$ down.

- Thus, the higher $\pi^T$ is, the larger the size of the *buffer* a CB has at its disposal to offset large adverse demand shocks by lowering nominal rates before they hit the ‘zero lower bound’.

# The ‘zero lower-bound trap’ (XIV)

- However, setting a high $\pi^T$, say, an inflation rate that exceeds 2-3 percent may produce significant welfare costs; it may raise transaction costs by forcing economic agents to change prices and wages more frequently than otherwise and economize on the use of money balances.

- But higher transaction costs may reduce economic efficiency and, hence, impair long-run economic growth.

- To conclude, CBs face a *trade-off*: they must decide whether to set a low $\pi^T$ that reduces transaction costs but leaves no room for lowering interest rates when it is necessary, or else, set a high $\pi^T$ that reduces economic efficiency.

## Questions for self-evaluation

1. What is the ultimate determinant of the existence of a zero lower-bound on nominal interest rates? Why?
2. When do we say that an economy is mired in a ‘zero lower-bound trap’? Why?
3. What is a ‘deflationary trap’ (DT) ? Why can an economy get stuck in a DT?
4. How can central banks prevent economies from getting stuck in a DT? Why?
5. What can the authorities do to push an economy out of a DT?

# Unconventional monetary policy (I)

- In the face of the financial market turmoil that emerged globally in August 2007 central banks responded with both *standard* and *non-standard* monetary policy measures.

- Characterizing the former is straightforward: key central bank interest rates were cut substantially, reflecting a conventional policy reaction to a slowing economy.

- However, characterizing the latter is more challenging since, by their very nature, *non-standard* policy measures lie outside the regular conduct of monetary policy.

# Unconventional monetary policy (II)

- Prior to the failure of Lehman Brothers, the liquidity measures employed may be described as ‘qualitative easing’ (QLE): no expansion of the balance sheet but a change in the *composition* of its asset side.

- By contrast, ‘quantitative easing’ (QTE) entails an *expansion* of the balance sheet of the CB and, hence, an expansion of the monetary base as the CB purchases large quantities of private and government debt.

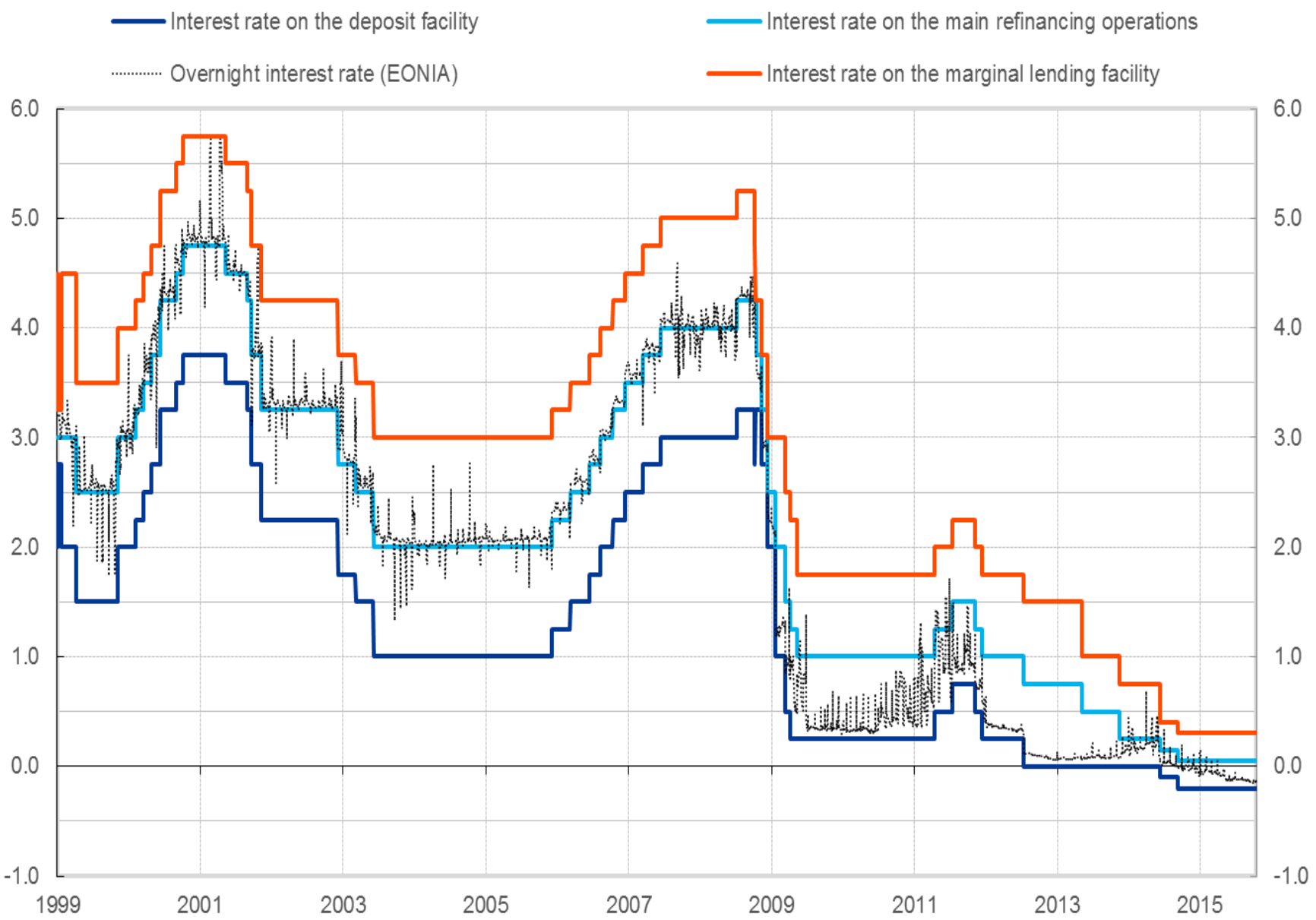
- When the CB purchases government and private debt:
  - The debt becomes an asset for the CB.
  - The CB pays for the debt it purchases by crediting the accounts of debt-holders at the CB thus making their portfolios more liquid.

# Unconventional monetary policy (III)

- Following its massive purchases of government debt starting in September 2012 the ECB chose to *reabsorb* the liquidity in excess of that required by its counterparties to fulfil 'minimum required reserves' by means of recourse to the deposit facility.

- Banks' holdings at the deposit facility *increased* substantially and EONIA *moved systematically away* from the rate at the main weekly tenders (the MRO rate, which had hitherto been seen as the ECB's key policy rate) and fell towards the rate on the deposit facility.

- With EONIA persistently 60-70 basic points *below* the MRO rate, money market rates of all types adjusted *downwards*.


Interest rate on the deposit facility
Interest rate on the main refinancing operations
Overnight interest rate (EONIA)
Interest rate on the marginal lending facility
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
1999
2001
2003
2005
2007
2009
2011
2013
2015

# Unconventional monetary policy (IV)

- The chart does suggest that the operating framework adopted by the ECB (and many other CBs) over the last fifteen years or so can be characterised as a ‘floor system’.

- A ‘floor system’ is a *variant* of an ‘interest rate corridor regime’ with an *adjustable* floor (i.e., deposit rate) whereby bank’s RR are remunerated at the average ‘marginal rate of allotment’ during the current maintenance period.

- By adopting a ‘floor system’ a CB can target *independently* the total amount of bank reserves *and* the overnight interest rate in the inter-bank market. Borio and Disyatat (2010) have labelled this feature the ‘decoupling principle’.

# Unconventional monetary policy (V)

- Under a 'floor-system' CBs can manipulate short-term nominal interest rates by *varying* the interest rate they pay on 'voluntary reserves' (i.e., deposit rate) instead of varying the 'total quantity of reserves' they supply (Borio and Disyatat, 2010).

- Under this approach the deposit rate effectively becomes a *floor* below which market rates cannot fall.

- By adopting a 'floor-system' the CB *de facto* divorces the quantity of reserves from the nominal interest rate target and gains one 'degree of freedom' since it can now use two instruments:
  - interest on banks' reserves (i.e., deposit rate), and
  - purchases of assets (e.g., government debt) to target *independently* short-term interest rates *and* the total quantity of reserves.

# Unconventional monetary policy (VI)

- Specifically, a CB will be able to target any aggregate quantity of reserves *above* the minimum required to keep the inter-bank short-term interest rate at the interest-on-reserves 'floor', that is, at the deposit rate.

- As noted by Lavoie (2010), the Reserve Bank of New Zealand and the CB of Norway had adopted a 'floor system' *before* the financial crisis got under way whereas, partly as a response to its inability to control interest rates in the aftermath of massive quantitative-easing operations the Fed adopted a 'floor system' on November 6, 2008.

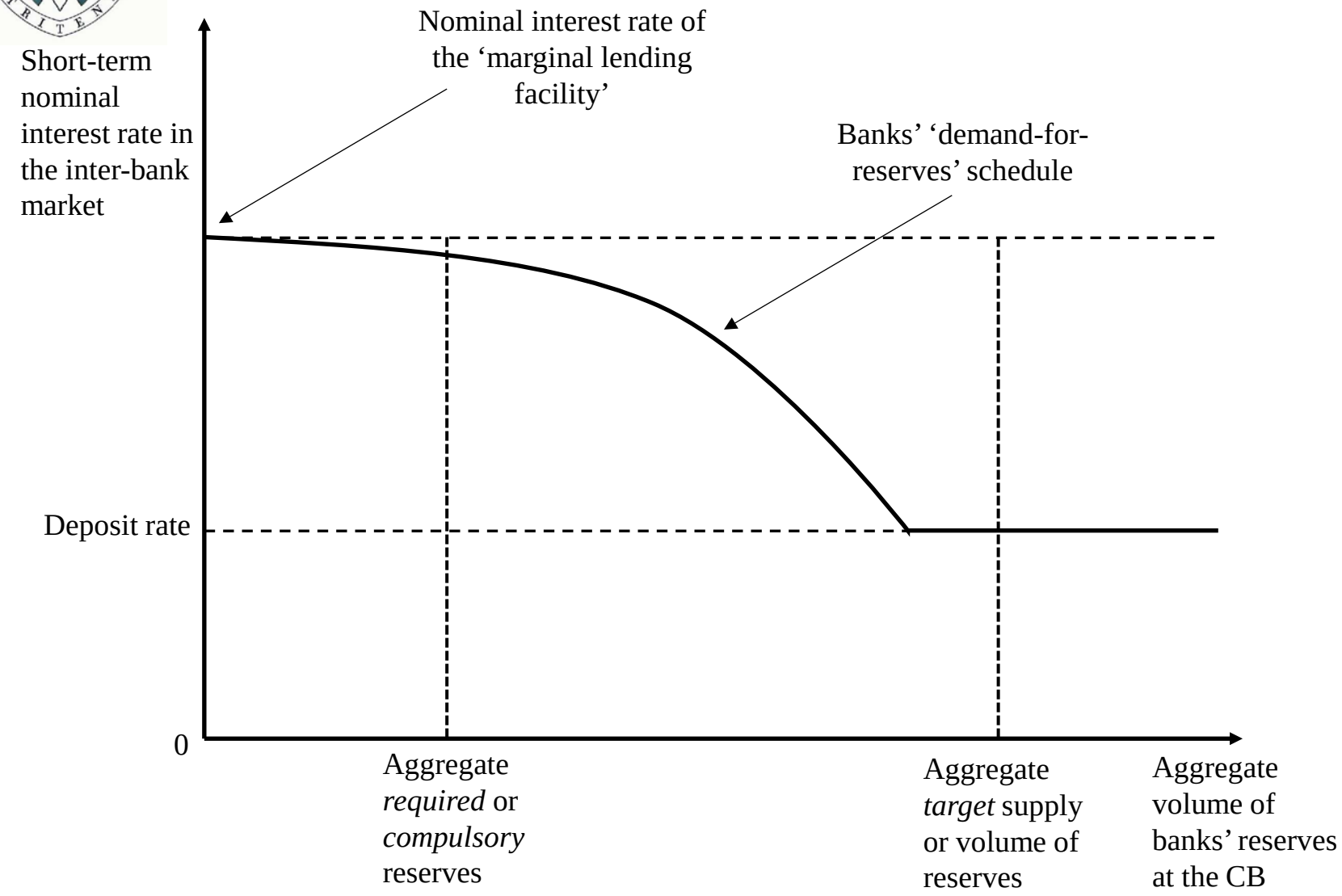
# Unconventional monetary policy (VII)

- Reserve balances are a risk-free asset and, hence, *dominate* all other investments in terms of liquidity. This means that a bank should only be willing to lend out its reserves to other banks if the interest rate earned in the interbank market is, at least, as high as the interest rate it would receive from the CB.

- Thus, this means that the nominal interest rate in the interbank market is the 'opportunity cost' to banks of holding reserve balances in their current accounts at the CB.

- Accordingly, the total volume of reserves demanded by banks varies *inversely* with the short-term nominal interest rate that prevails in the interbank market as shown in the Figure below.

# Unconventional monetary policy (VIII)



# Unconventional monetary policy (IX)

- In the Figure above, the negative slope of the ‘demand-for-reserves’ schedule captures the fact that banks’ demand for reserves depends *inversely* on the current inter-bank nominal interest rate.

- Crucially, if the total amount of banks’ reserves is large enough to cut the horizontal segment of the ‘demand-for-reserves’ schedule, the CB can purchase various types of debt to increase the quantity of banks’ reserves and *independently* bring about changes in the deposit rate to influence interest rates in the interbank market.

- Thus under a ‘floor system’ CBs have two *independent* tools and, as stipulated by the ‘Golden Rule of Economic Policy’, they can target two *independent* policy goals.

## The 'decoupling principle' (Borio and Disyatat, 2010)

**Key idea**: Under a 'floor-system' central Banks (CBs) can manipulate short-term nominal interest rates by simply varying the interest rate they pay on banks' reserves (i.e., the 'deposit' rate) instead of varying the total quantity of reserves.

**Main advantage**: CBs gain one 'degree of freedom' since they can now simultaneously 'target' a certain level of nominal interest rates in the inter-bank market (e.g., EONIA) and certain total volume of reserves. In terms of the 'Golden Rule of Economic Policy' CBs now possess two (independent) instruments and, hence, they can target two (different) objectives. In a tentative fashion, this new monetary policy framework enables CBs to:

A) Manipulate the level of short-term nominal interest rates in order to target the inflation rate as in an 'inflation-targeting' framework, and

B) Change the total volume of reserves, or volume of liquidity, in order to:

1. Reduce the 'debt service' stemming from the stock of outstanding government debt by:
   - Compressing 'risk premia' on government bonds.
   - Generating revenue or income for the CB that is then transferred back to the Treasury.

2. Guarantee the smooth working of money markets by providing ample liquidity so as to encourage banks to increase their supply of loans to both households and small/medium-sized businesses.

## Questions for self-evaluation

1. What is a ‘floor system’? What are the potential advantages for central banks of adopting it?
2. Can you rationalize the advantages of adopting a ‘floor system’ by means of the ‘Golden Rule of Economic Policy’? How?
3. What is ‘quantitative easing’ (QE)? What is its main purpose? How does QE allegedly help stimulate aggregate expenditure?