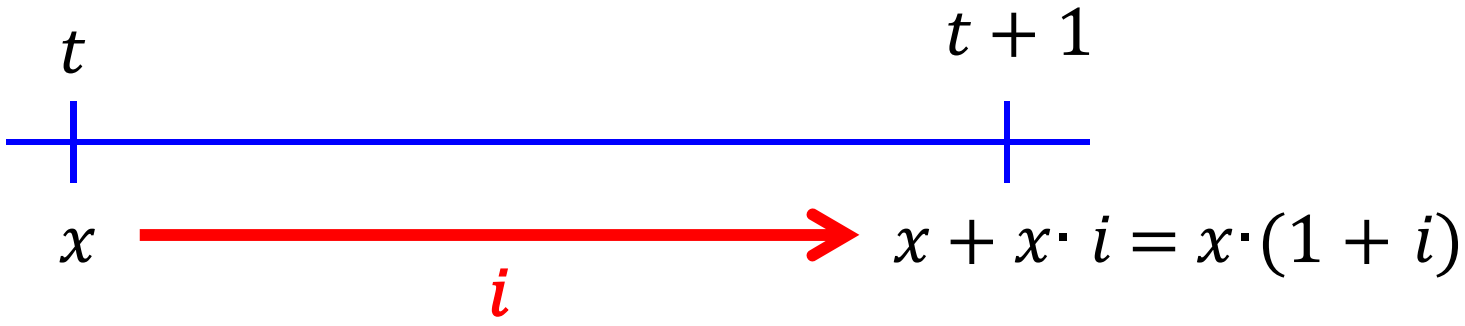

KEEP
CALM
IT'S THE
LAST DAY
OF CLASS

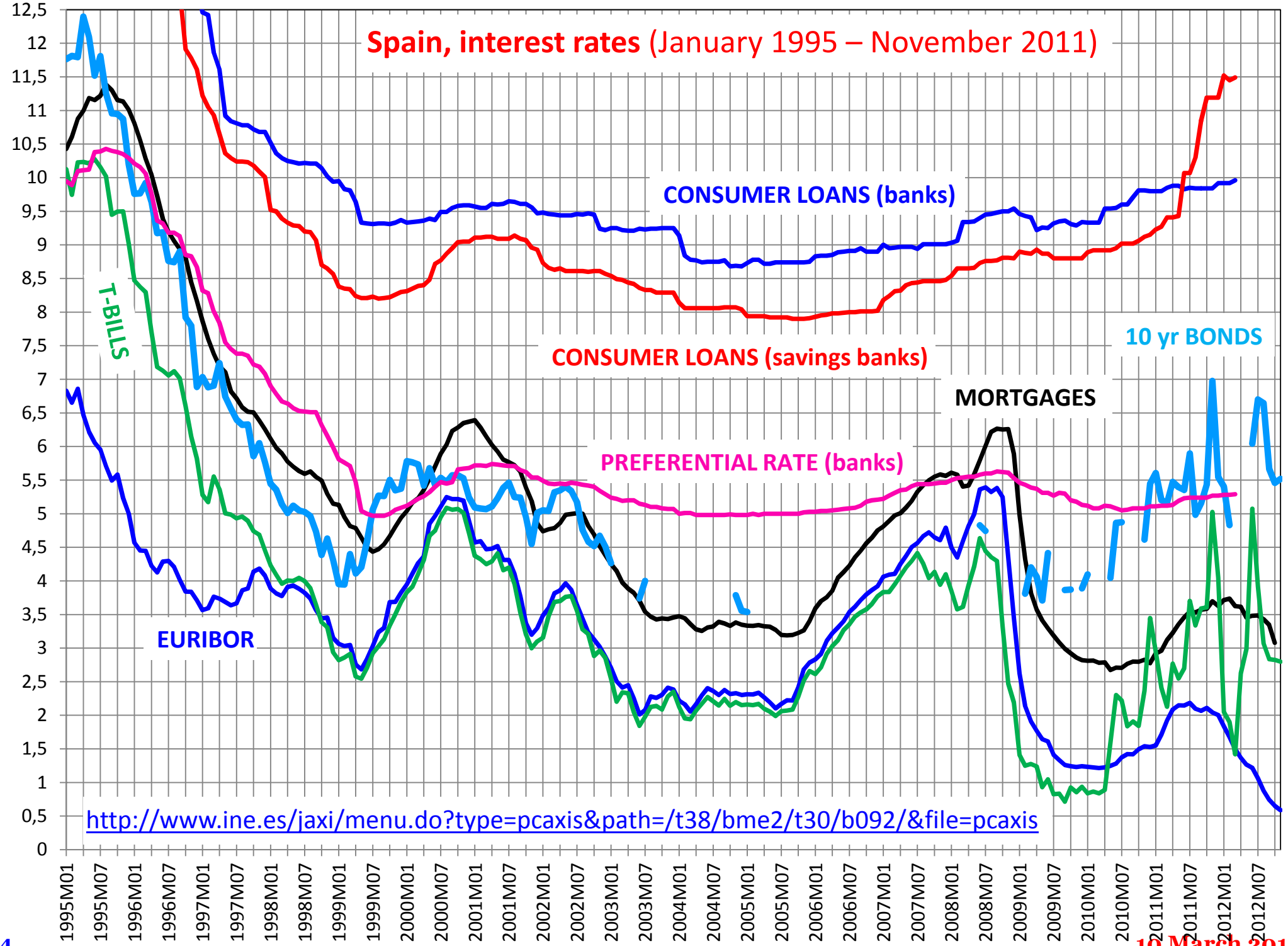
Interest rate i

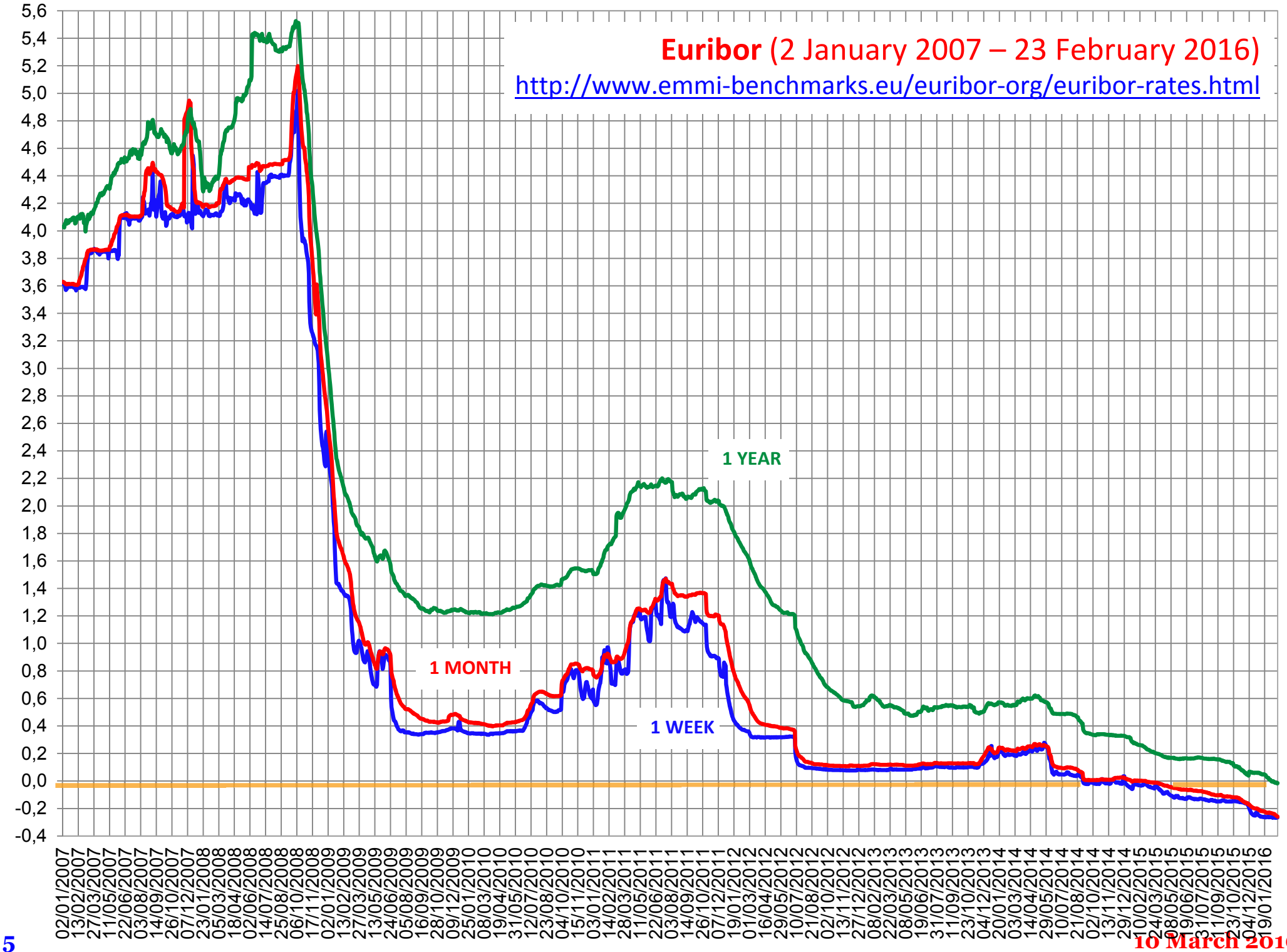
- Can be taken to represent the cost/reward of a loan.
- Intuitively, it is 'the price of money'.
- That i is the interest rate between period t and period $t + 1$ means that by lending [borrowing] any amount x of euros in t, $x + x \cdot i = x \cdot (1 + i)$ euros are received [paid] in $t + 1$.

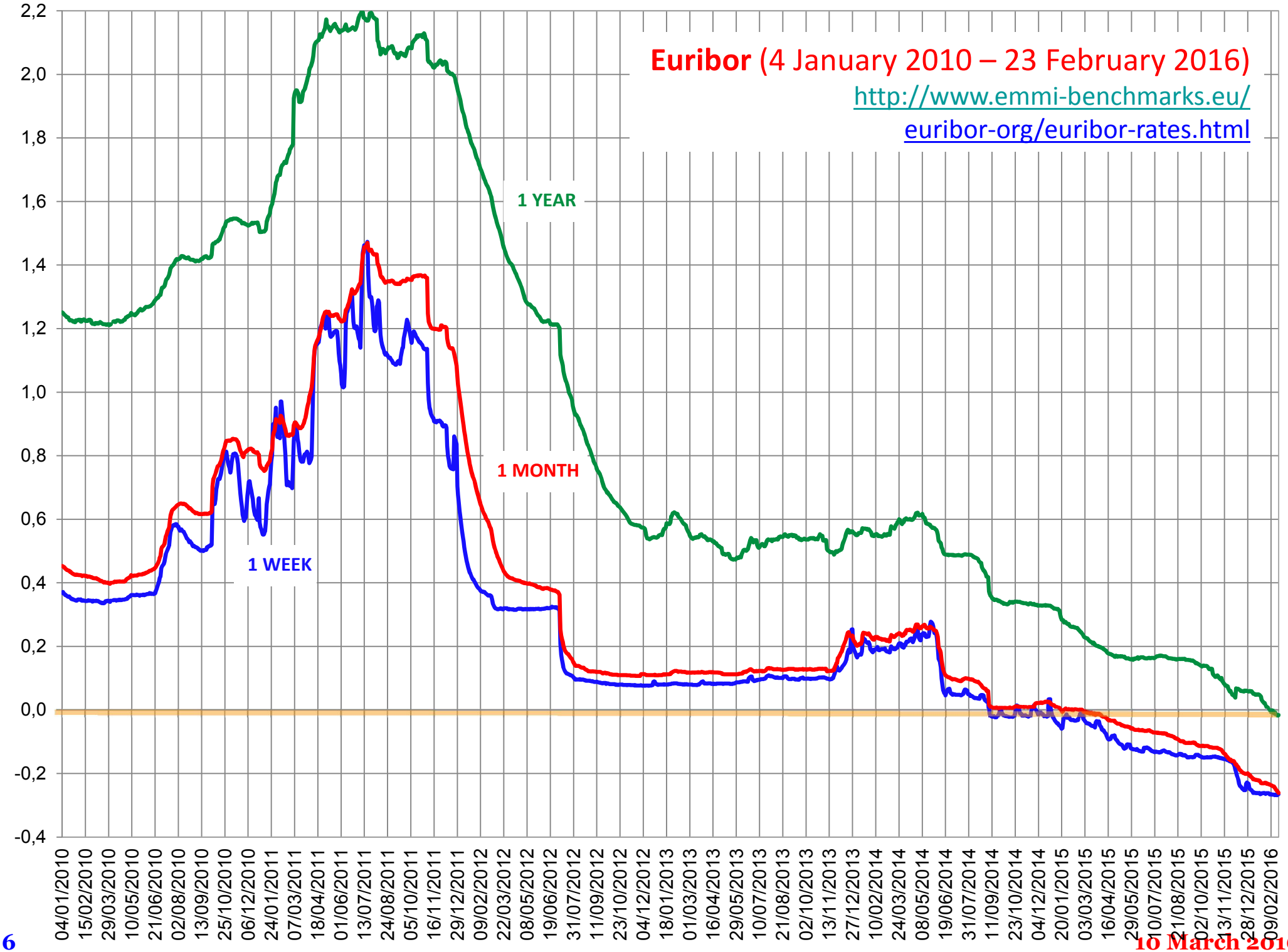
Interest rate i

- The interest rate transforms present values into future values: € x of t are worth $x \cdot (1 + i)$ euros of $t + 1$.



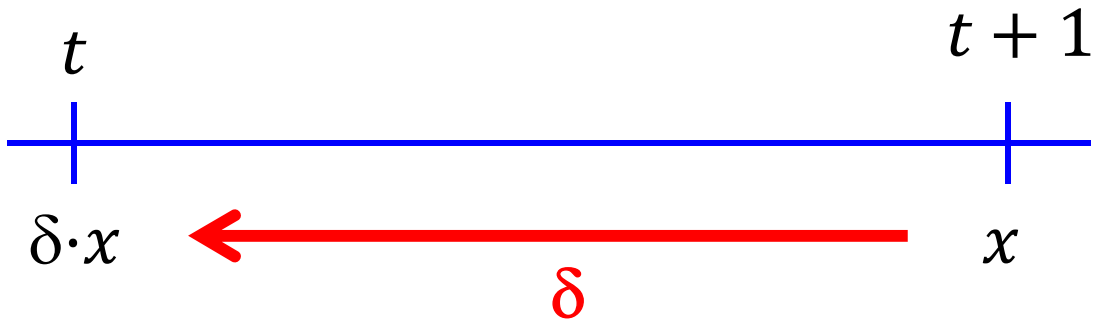

Spain, interest rates (January 1995 – November 2011)
CONSUMER LOANS (banks)
CONSUMER LOANS (savings banks)
MORTGAGES
PREFERENTIAL RATE (banks)
10 yr BONDS
T-BILLS
EURIBOR
http://www.ine.es/jaxi/menu.do?type=pcaxis&path=/t38/bme2/t30/b092/&file=pcaxis
12,5
12
11,5
11
10,5
10
9,5
9
8,5
8
7,5
7
6,5
6
5,5
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
1995M01
1995M07
1996M01
1996M07
1997M01
1997M07
1998M01
1998M07
1999M01
1999M07
2000M01
2000M07
2001M01
2001M07
2002M01
2002M07
2003M01
2003M07
2004M01
2004M07
2005M01
2005M07
2006M01
2006M07
2007M01
2007M07
2008M01
2008M07
2009M01
2009M07
2010M01
2010M07
2011M01
2011M07
2012M01
2012M07


Euribor (2 January 2007 – 23 February 2016)
http://www.emmi-benchmarks.eu/euribor-org/euribor-rates.html
1 YEAR
1 MONTH
1 WEEK
5,6
5,4
5,2
5,0
4,8
4,6
4,4
4,2
4,0
3,8
3,6
3,4
3,2
3,0
2,8
2,6
2,4
2,2
2,0
1,8
1,6
1,4
1,2
1,0
0,8
0,6
0,4
0,2
0,0
-0,2
-0,4
02/01/2007
13/02/2007
27/03/2007
11/05/2007
22/06/2007
03/08/2007
14/09/2007
26/10/2007
07/12/2007
23/01/2008
05/03/2008
18/04/2008
02/06/2008
14/07/2008
25/08/2008
06/10/2008
17/11/2008
02/01/2009
13/02/2009
27/03/2009
13/05/2009
24/06/2009
05/08/2009
16/09/2009
28/10/2009
09/12/2009
25/01/2010
08/03/2010
19/04/2010
31/05/2010
12/07/2010
23/08/2010
04/10/2010
15/11/2010
03/01/2011
14/02/2011
28/03/2011
11/05/2011
22/06/2011
03/08/2011
14/09/2011
26/10/2011
07/12/2011
19/01/2012
01/03/2012
16/04/2012
29/05/2012
10/07/2012
21/08/2012
02/10/2012
13/11/2012
27/12/2012
08/02/2013
22/03/2013
08/05/2013
19/06/2013
31/07/2013
11/09/2013
23/10/2013
04/12/2013
20/01/2014
03/03/2014
14/04/2014
29/05/2014
10/07/2014
21/08/2014
02/10/2014
13/11/2014
29/12/2014
10/02/2015
24/03/2015
28/05/2015
09/07/2015
31/08/2015
13/10/2015
24/12/2015
29/01/2016


Euribor (4 January 2010 – 23 February 2016)
http://www.emmi-benchmarks.eu/
euribor-org/euribor-rates.html
1 YEAR
1 MONTH
1 WEEK
2,2
2,0
1,8
1,6
1,4
1,2
1,0
0,8
0,6
0,4
0,2
0,0
-0,2
-0,4
04/01/2010
15/02/2010
29/03/2010
10/05/2010
21/06/2010
02/08/2010
13/09/2010
25/10/2010
06/12/2010
24/01/2011
07/03/2011
18/04/2011
01/06/2011
13/07/2011
24/08/2011
05/10/2011
16/11/2011
29/12/2011
09/02/2012
22/03/2012
08/05/2012
19/06/2012
31/07/2012
11/09/2012
23/10/2012
04/12/2012
18/01/2013
01/03/2013
16/04/2013
29/05/2013
10/07/2013
21/08/2013
02/10/2013
13/11/2013
27/12/2013
10/02/2014
24/03/2014
08/05/2014
19/06/2014
31/07/2014
11/09/2014
23/10/2014
04/12/2014
20/01/2015
03/03/2015
16/04/2015
29/05/2015
10/07/2015
21/08/2015
02/10/2015
13/11/2015
28/12/2015
09/02/2016

Discount factor δ

- The discount factor transforms future values into present (or discounted) values.



Discount factor δ

- The discount factor inverts the interest rate: if € x of $t + 1$ are equivalent to € $\delta \cdot x$ of t, and i is the interest rate between t and $t + 1$, then x should be the result of applying the interest rate to $\delta \cdot x$. That is,

$$x = \delta \cdot x \cdot (1 + i)$$

- Solving for δ yields the expression of the discount factor:

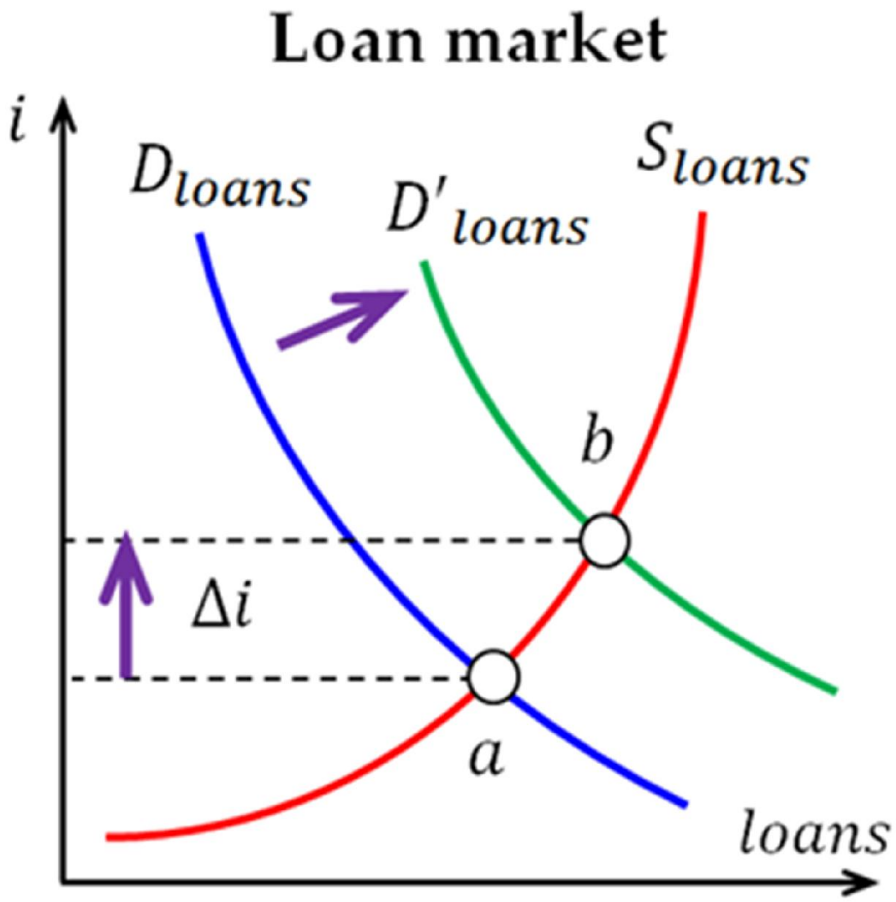
$$\delta = \frac{1}{1 + i} .$$

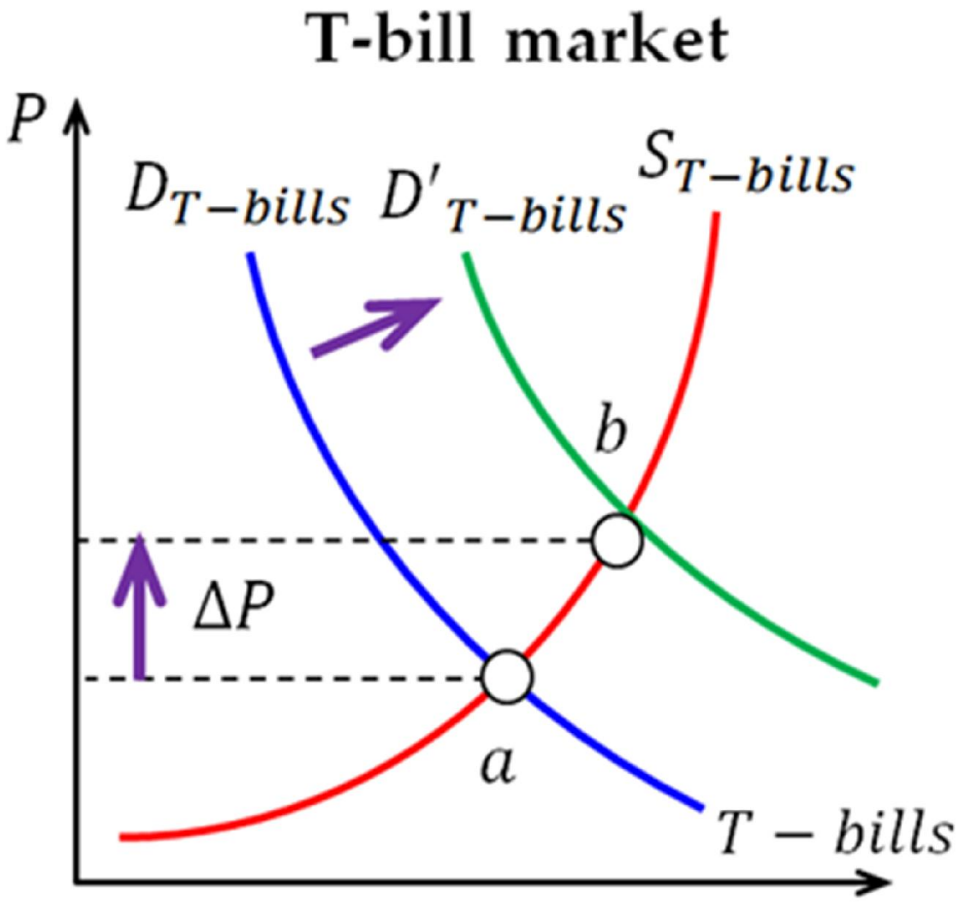
Prices of financial assets and *i*

- The price of financial assets and the interest rate move in opposite directions: a rise in the interest rate leads to a fall in the price of financial assets.

- Justifications of the inverse relationship
  - financial arbitrage
  - prices of financial assets as present values
  - equalization of rates of return

Financial arbitrage





Central bank (CB)

- Monetary authority of an economy
- Monetary policy instruments
  - Open market operations
  - Standing facilities: lending / deposit
  - Reserve requirements
  - Policy interest rate
  - Credit controls
- Tension between controlling i and **M1**

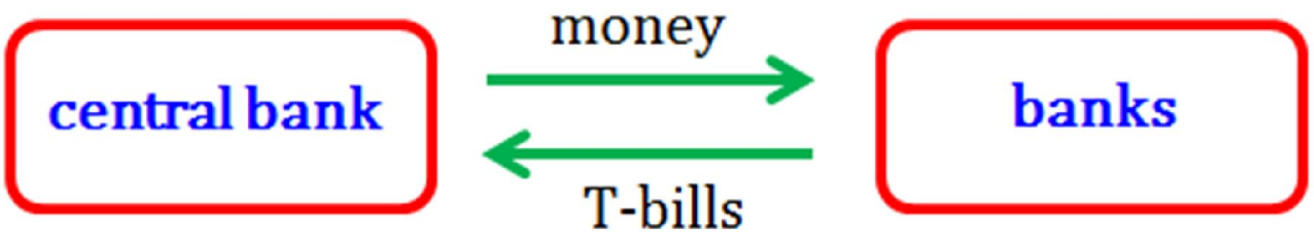
Open market operation (OMO)

- Open market operations are sales or purchases of financial assets by the central bank.
- The central bank only performs OMOs with the main banks of the economy.
- OMOs allow the CB to intervene directly in financial markets.
- With standing facilities the CB takes a passive role: the banks should take the initiative.

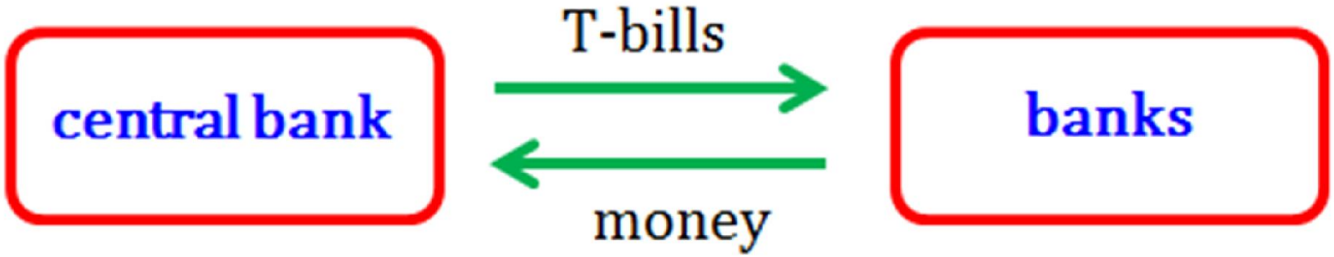
Standing facilities

- A standing facility is a procedure by means of which banks can borrow or lend funds directly with the central bank.
  - A deposit facility allows banks having an excess of liquidity to deposit the excess in the central bank.
  - A lending facility allows banks unable to obtain short-term liquidity in the markets to borrow directly from the central bank.

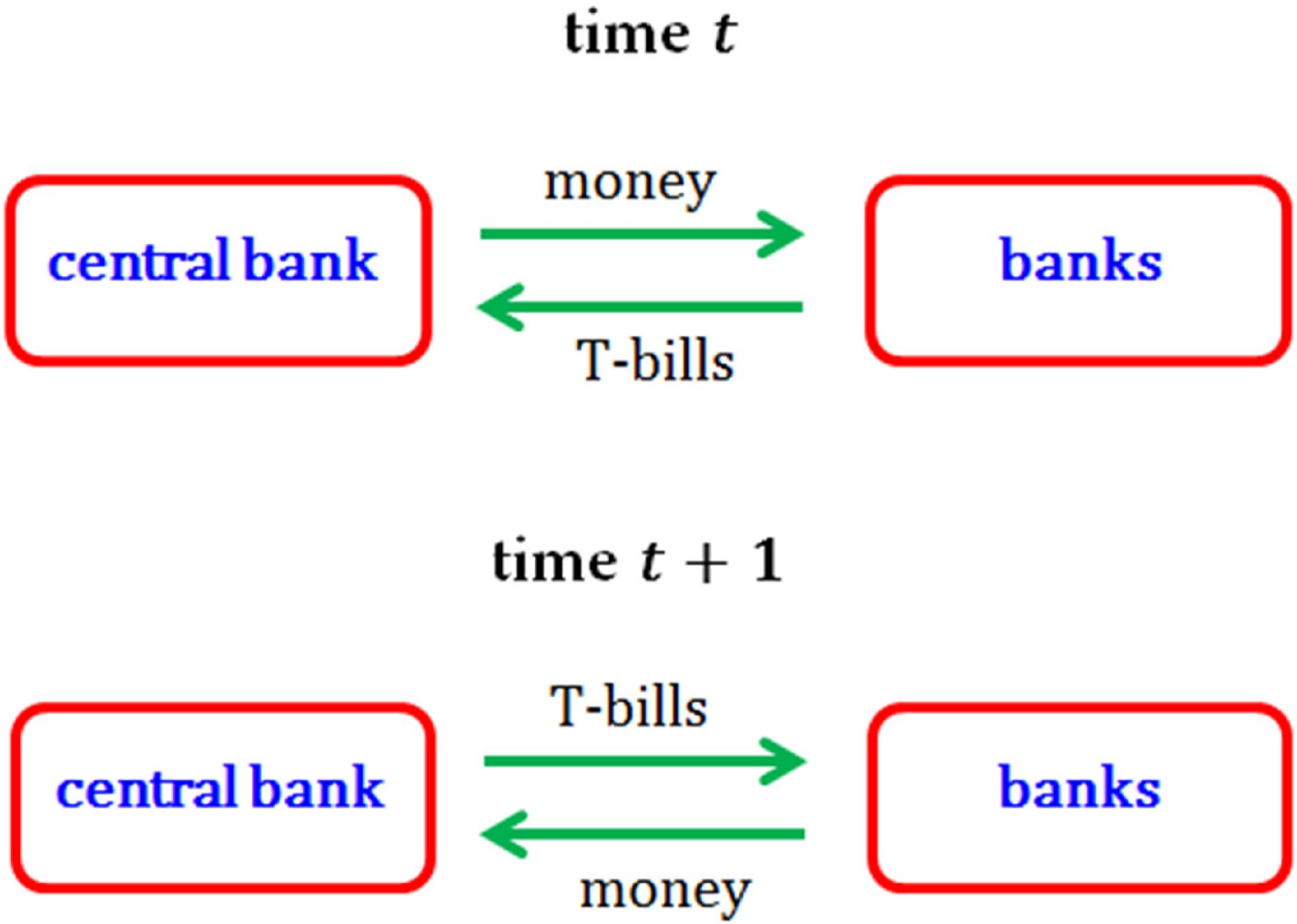
Expansionary OMO



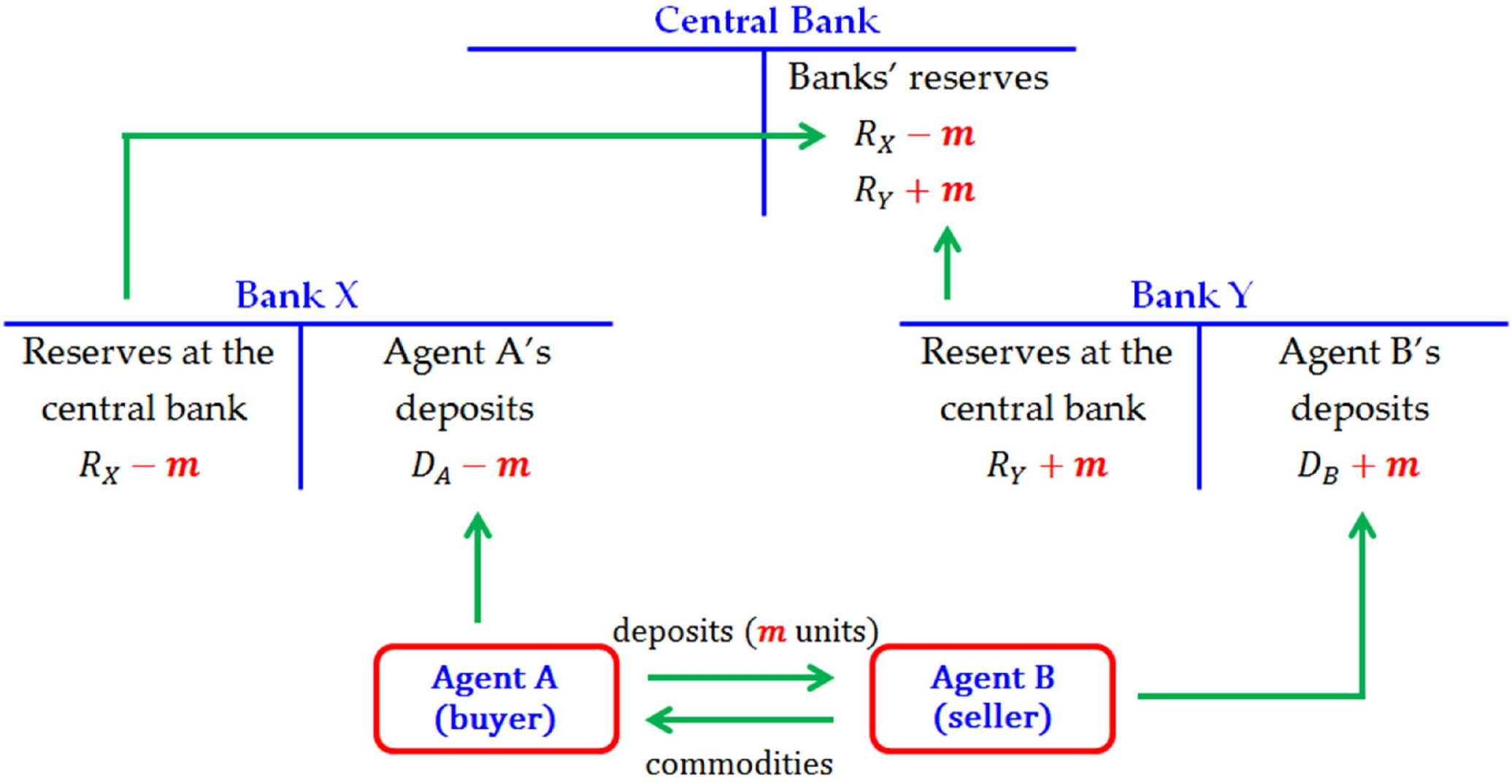
Contractionary OMO



Reverse-repo



Central bank and the payment system



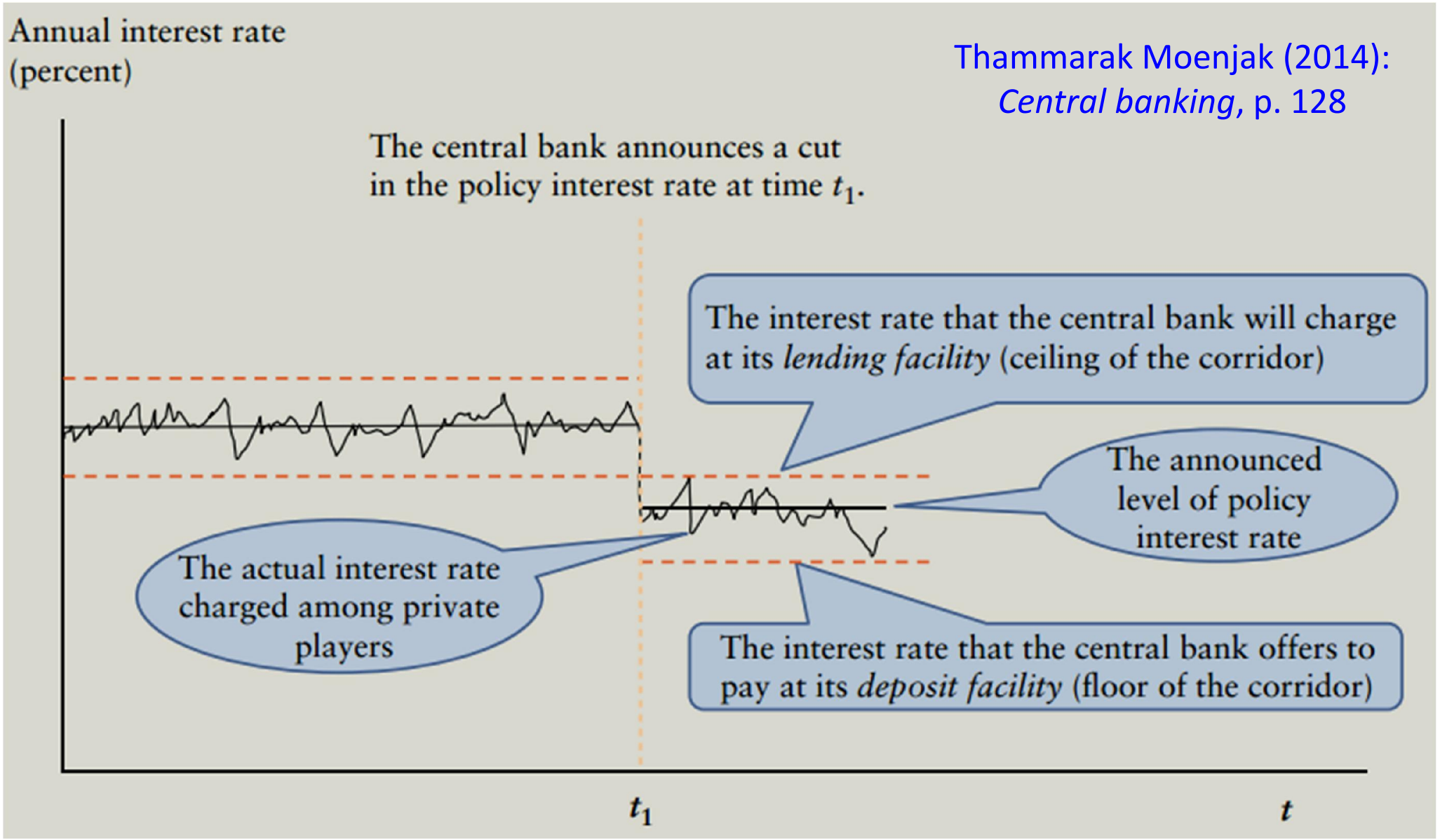
The policy interest rate

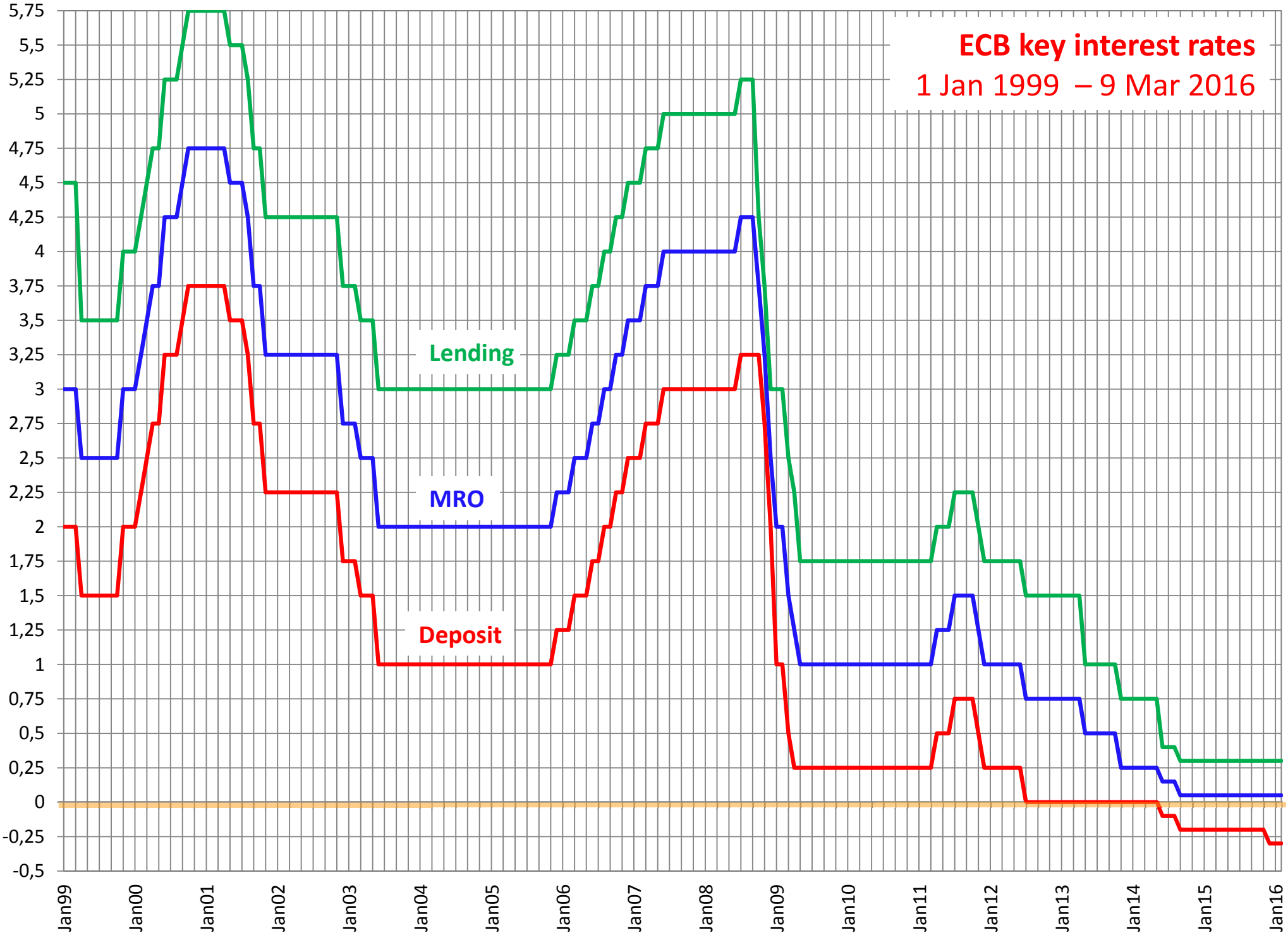
- The policy interest rate is some short term interest rate that the central bank uses to indicate the monetary policy goal.

- OMOs and standing facilities are tools to induce the market interest rates to be near the policy rate.

- The interest rate of the lending facility is a ceiling for short-term market rates. The interest rate of the deposit facility is a floor for market rates. The interest rate of OMOs lies between the two.

The interest rate corridor

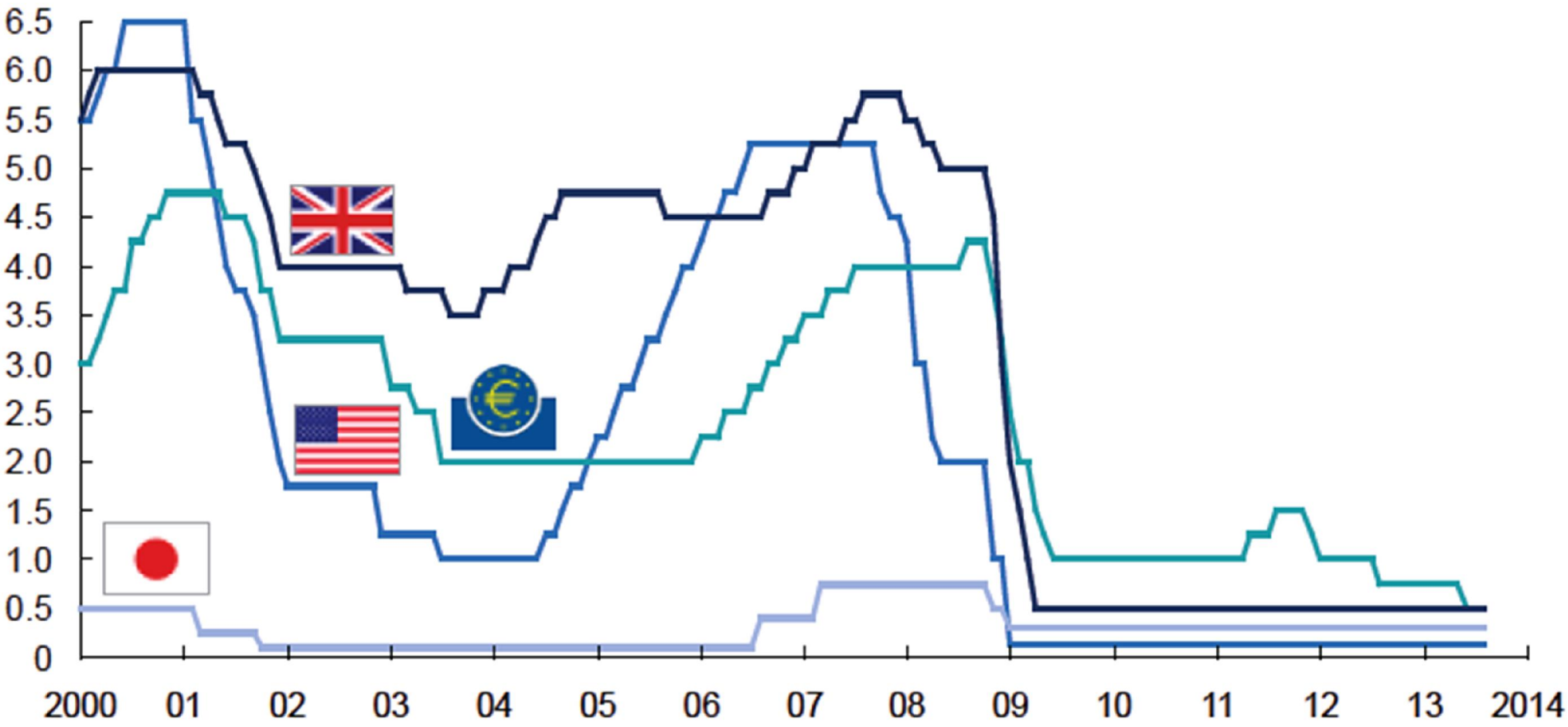



ECB key interest rates
1 Jan 1999 – 9 Mar 2016
Lending
MRO
Deposit
5,75
5,5
5,25
5
4,75
4,5
4,25
4
3,75
3,5
3,25
3
2,75
2,5
2,25
2
1,75
1,5
1,25
1
0,75
0,5
0,25
0
-0,25
-0,5
Jan99
Jan00
Jan01
Jan02
Jan03
Jan04
Jan05
Jan06
Jan07
Jan08
Jan09
Jan10
Jan11
Jan12
Jan13
Jan14
Jan15
Jan16

Central banks pushed policy rates to ultra-low levels in 2009 and have held them there since

Main policy rates

%



SOURCE: US Federal Reserve; European Central Bank; Bank of England; Bank of Japan; McKinsey Global Institute analysis

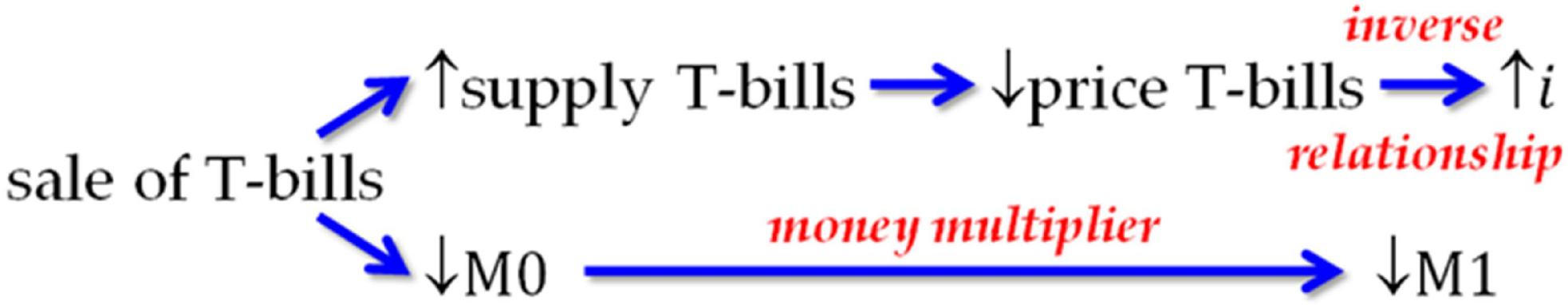
http://www.mckinsey.com/insights/economic_studies/qe_and_ultra_low_interest_rates_distributional_effects_and_risks

Name of interest rate	country/region	current rate	direction	previous rate	change
American interest rate FED	United States	0.500 %	↑	0.250 %	12-16-2015
Australian interest rate RBA	Australia	2.000 %	↓	2.250 %	05-05-2015
Banco Central interest rate	Chile	3.500 %	↑	3.250 %	12-17-2015
Bank of Korea interest rate	South Korea	1.500 %	↓	1.750 %	06-11-2015
Brazilian interest rate BACEN	Brazil	14.250 %	↑	13.750 %	07-30-2015
British interest rate BoE	Great Britain	0.500 %	↓	1.000 %	03-05-2009
Canadian interest rate BOC	Canada	0.500 %	↓	0.750 %	07-15-2015
Chinese interest rate PBC	China	4.350 %	↓	4.600 %	10-23-2015
Czech interest rate CNB	Czech Republic	0.050 %	↓	0.250 %	11-01-2012
Danish interest rate Nationalbanken	Denmark	0.050 %	↓	0.200 %	01-19-2015
European interest rate ECB	Europe	0.050 %	↓	0.150 %	09-04-2014
Hungarian interest rate	Hungary	1.350 %	↓	1.500 %	07-21-2015
Indian interest rate RBI	India	6.750 %	↓	7.250 %	09-29-2015
Indonesian interest rate BI	Indonesia	7.000 %	↓	7.500 %	02-18-2016
Israeli interest rate BOI	Israel	0.100 %	↓	0.250 %	02-23-2015
Japanese interest rate BoJ	Japan	0.000 %	↓	0.100 %	02-01-2016
Mexican interest rate Banxico	Mexico	3.750 %	↑	3.250 %	02-17-2016
New Zealand interest rate	New Zealand	2.250 %	↓	2.500 %	03-10-2016
Norwegian interest rate	Norway	0.750 %	↓	1.000 %	09-24-2015
Polish interest rate	Poland	1.500 %	↓	2.000 %	03-04-2015
Russian interest rate CBR	Russia	11.000 %	↓	11.500 %	07-31-2015
Saudi Ariabian interest rate	Saudi Arabia	2.000 %	↓	2.500 %	01-19-2009
South African interest rate SARB	South Africa	6.750 %	↑	6.250 %	01-28-2016
Swedish interest rate Riksbank	Sweden	-0.500 %	↓	-0.350 %	02-11-2016
Swiss interest rate SNB	Switzerland	-0.750 %	↓	-0.500 %	01-15-2015
Turkish interest rate CBRT	Turkey	7.500 %	↓	7.750 %	02-24-2015

http://www.global-rates.com/interest-rates/central-banks/central-banks.aspx

Tension between M1 and *i*

- The central bank cannot simultaneously control M1 and the interest rate.
- Example: effects of a contractionary OMO.



Exogenous vs endogenous money

- The money stock is exogenous when it can be controlled by the central bank. Once the desired level of M1 is chosen, the interest rate is allowed to take the value consistent with M1.

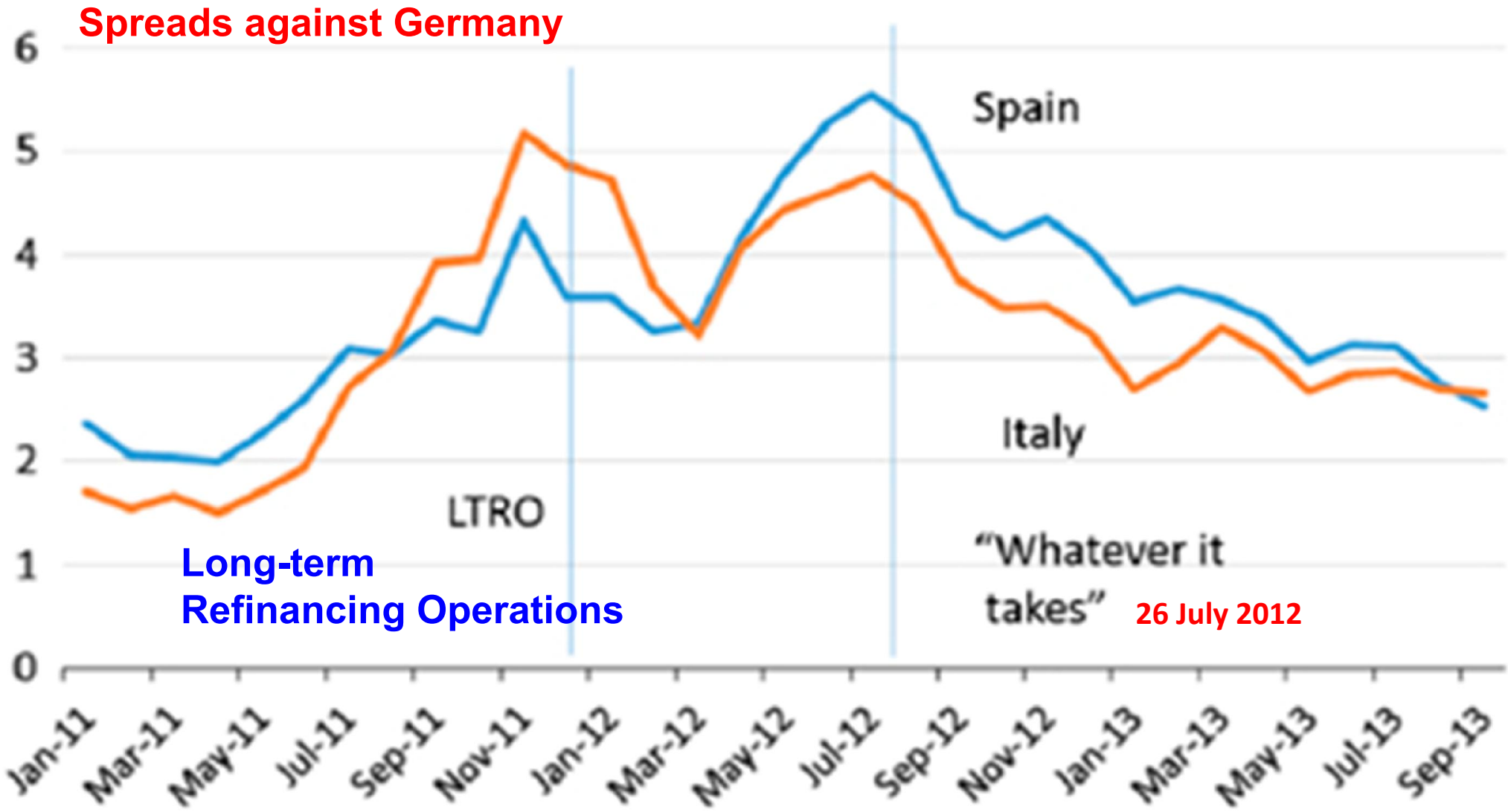
- The money stock is endogenous when the demand for loans determines M1. In this case, the central bank chooses the policy interest rate, which influences the price of loans.

What is central banking about?

- "Virtually every monetary economist believes that the central bank can control the monetary base… Almost all those who have worked in a central bank believe that this view is totally mistaken." Charles Goodhart

- "What is it that monetary policy-makers do and how do they do it? The simple answer is that a central banker moves interest rates in order to maintain steady real growth and stable prices." Stephen Cecchetti

The power of central banks



http://www.palgrave-journals.com/imfer/journal/v62/n4/full/imfer20149a.html

"When people talk about the fragility of the euro (… they…) underestimate the amount of political capital that is being invested in the euro.

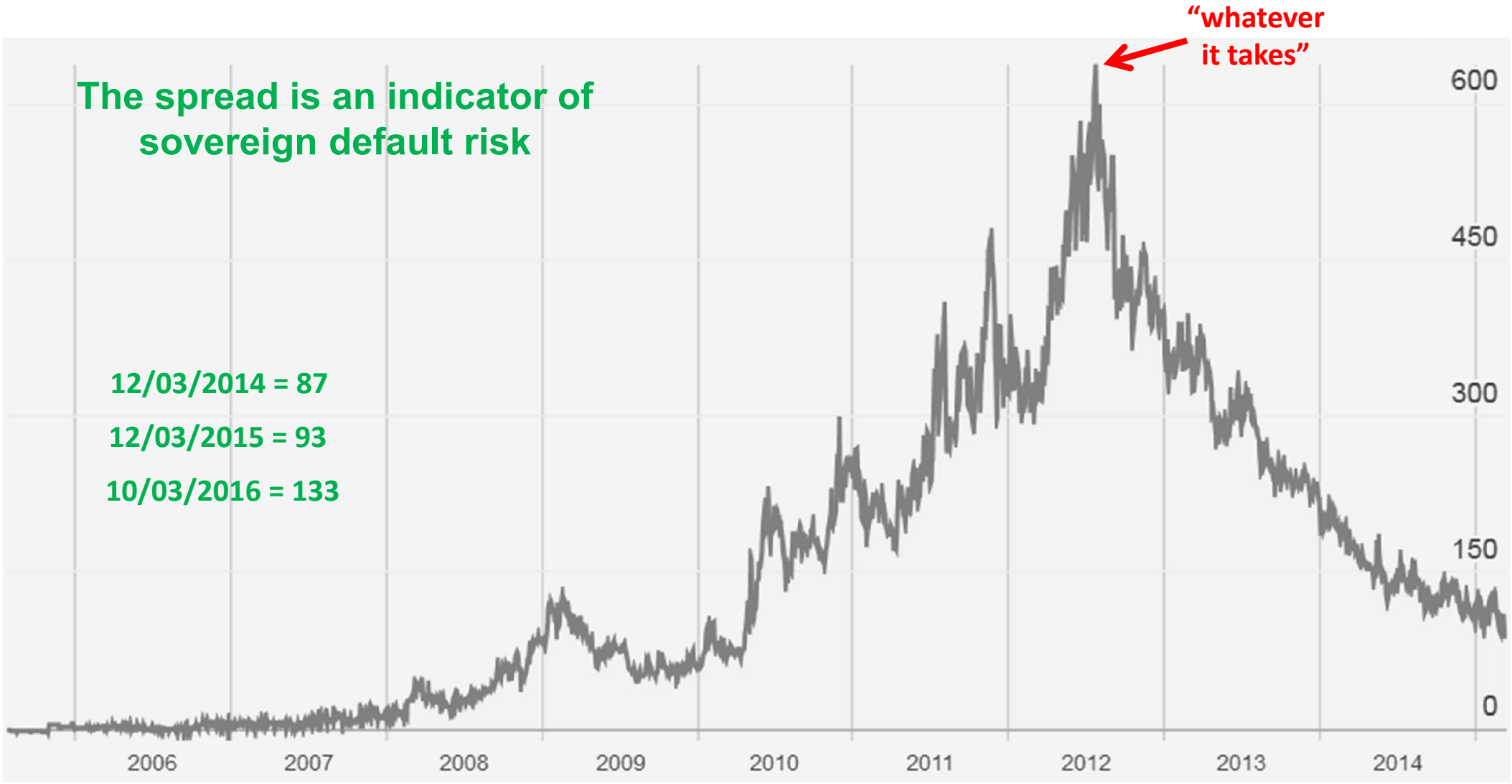
(…) we think the euro is irreversible. And it's not an empty word now, because I preceded saying exactly what actions have been made, are being made to make it irreversible.

But there is another message I want to tell you. Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough."

Mario Draghi, 26 July 2012

http://www.ecb.europa.eu/press/key/date/2012/html/sp120726.en.html

Spain – spread to Germany



http://www.datosmacro.com/prima-riesgo/espana

Spain – spread to Germany

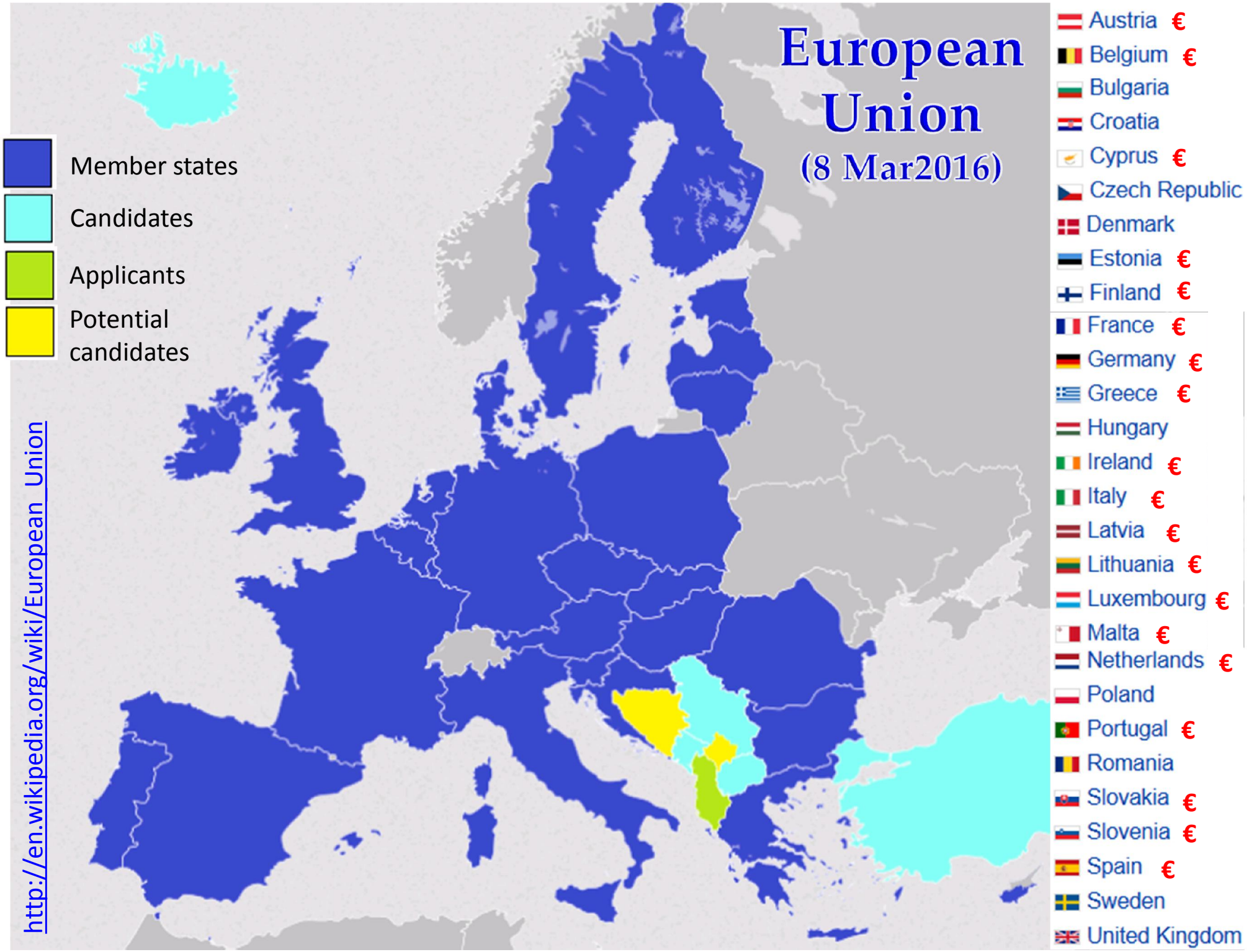
10/03/2016 = 133

http://www.datosmacro.com/prima-riesgo/espana

European Central Bank

- Eurosystem = ECB + 19 national central banks of Eurozone members
- Primary objective: price stability
- Secondary objective: financial stability
- Decision making bodies
  - Governing Council
  - Executive Board
  - General Council

http://en.wikipedia.org/wiki/File:Eurozone.svg



http://en.wikipedia.org/wiki/European_Union

ECB Executive Board

Consists of six members, including the President (Mario Draghi) and the Vice-President.

http://www.ecb.int/ecb/orga/decisions/eb/html/index.en.html

ECB Governing Council

Consists of the six members of the Executive Board plus the 19 governors of the national central banks of the 19 euro area countries.

Luis María Linde

Jan 2016

http://www.ecb.int/ecb/orga/decisions/govc/html/index.en.html

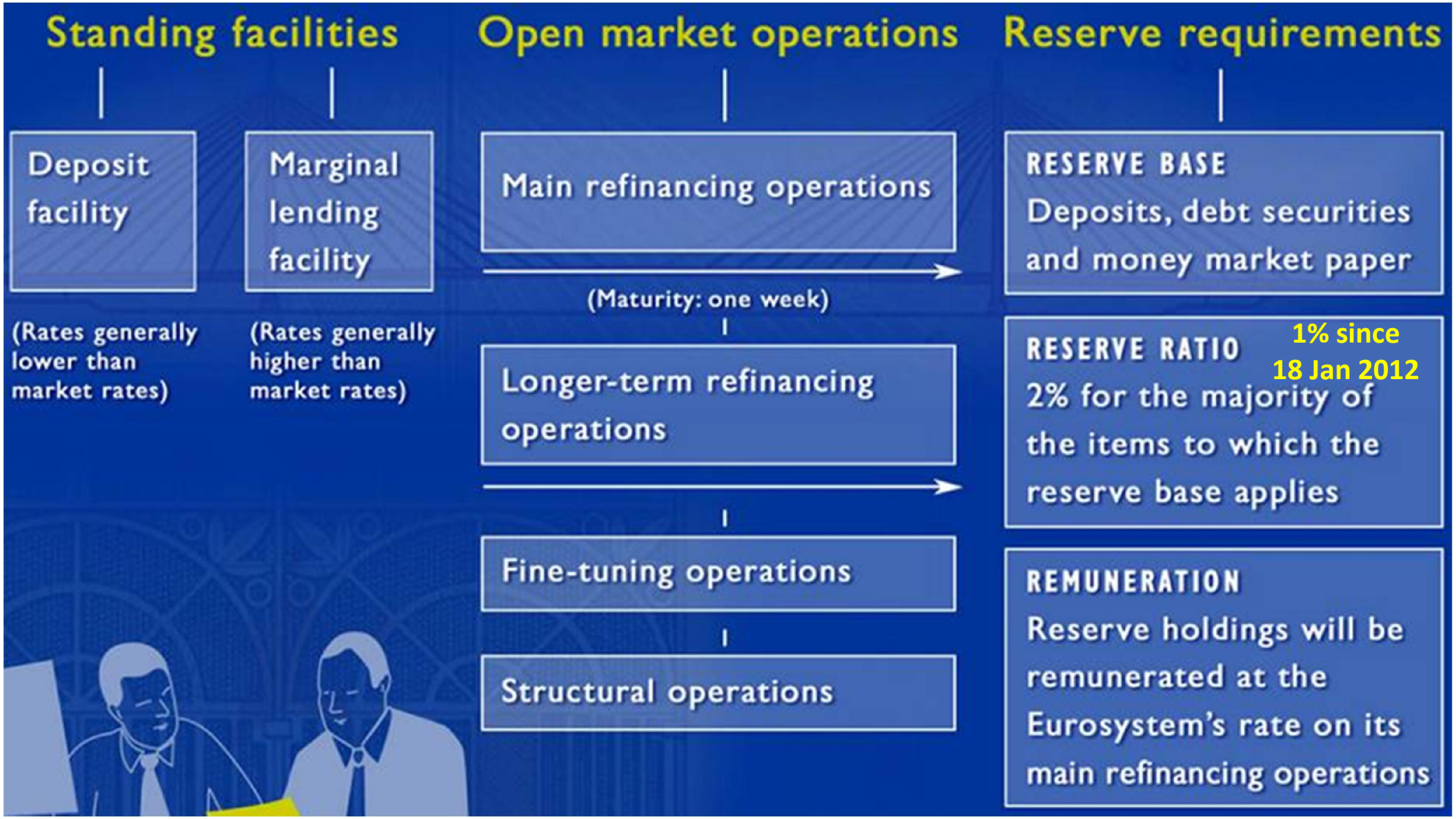
ECB General Council

Consists of the President and the Vice-President of the ECB plus the governors of the national central banks of the 28 EU Member States.

http://www.ecb.int/ecb/orga/decisions/genc/html/index.en.html

4. Monetary tools of the ECB

- Main refinancing operations
  - fixed rate tender
  - variable rate tender
- Standing facilities: lending / deposit
- Policy interest rate
- Reserve requirements



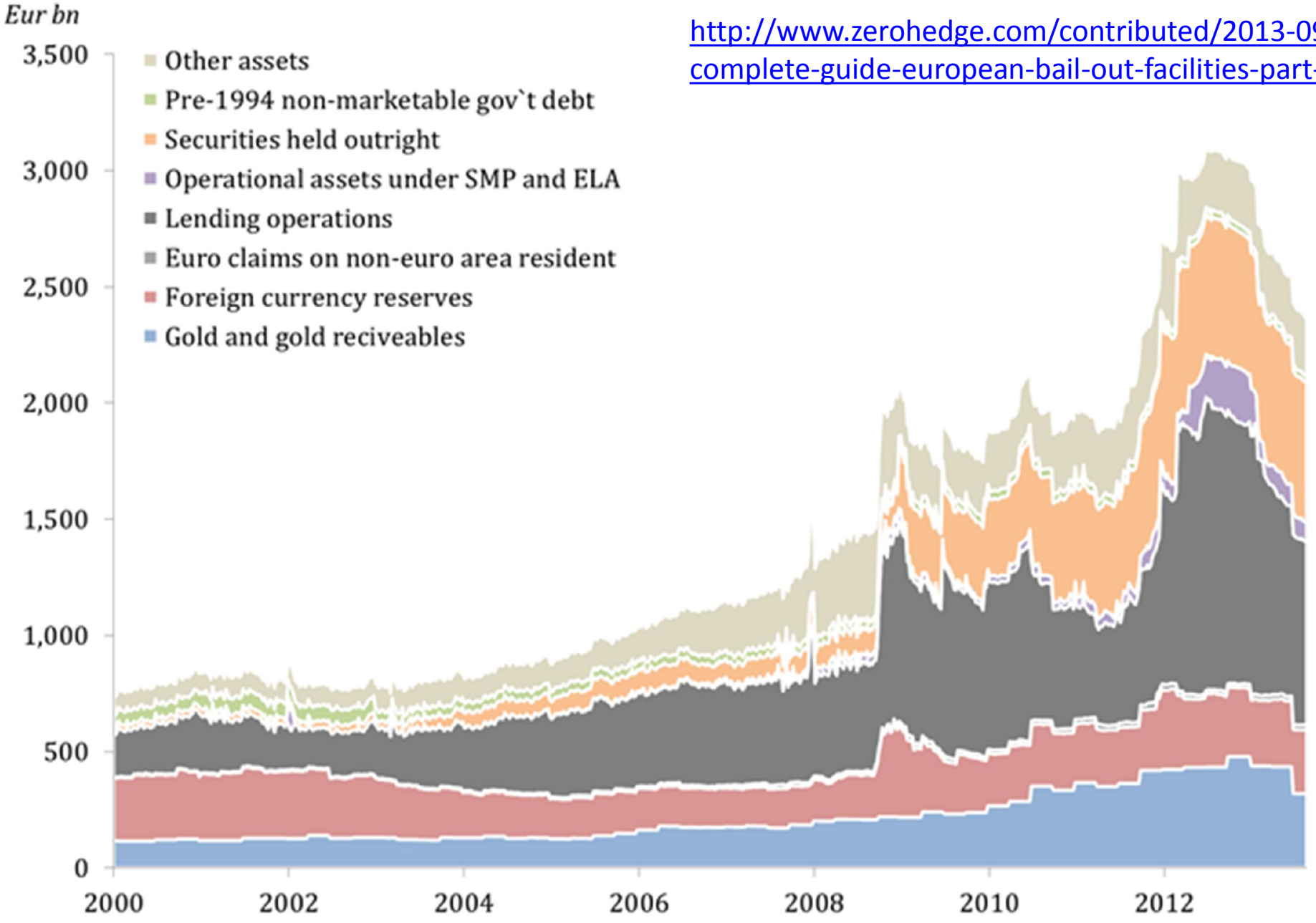
Monetary policy instruments of the European Central Bank

http://www.ecb.int/ecb/educational/shared/img/presentation_mp.en.zip

Example of an MRO

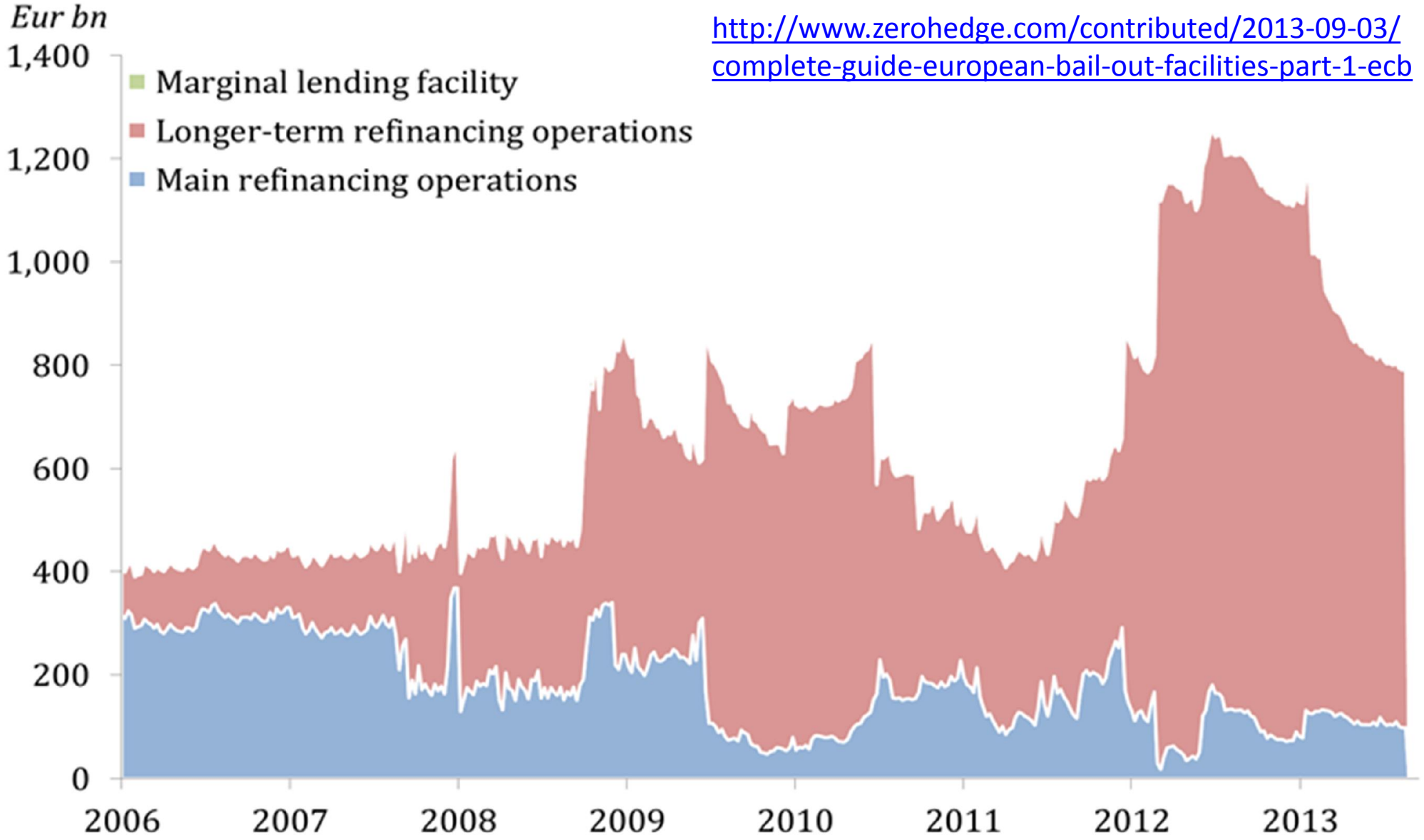
i	*bids by banks*		*total bids*	*cumu lative bids*	*allotment*		
	B1	B2			B1	B2	
5%	7	3	10	10	7	3	
4%	10	20	30	40	10	20	
3%	20	30	50	90	$20 \cdot 60\% = 12$	$30 \cdot 60\% = 18$	
2%	40	70	110	200	–	–	
Total The ECB wants to supply 70					29	41	70

ECB balance sheet; assets



http://www.zerohedge.com/contributed/2013-09-03/complete-guide-european-bail-out-facilities-part-1-ecb

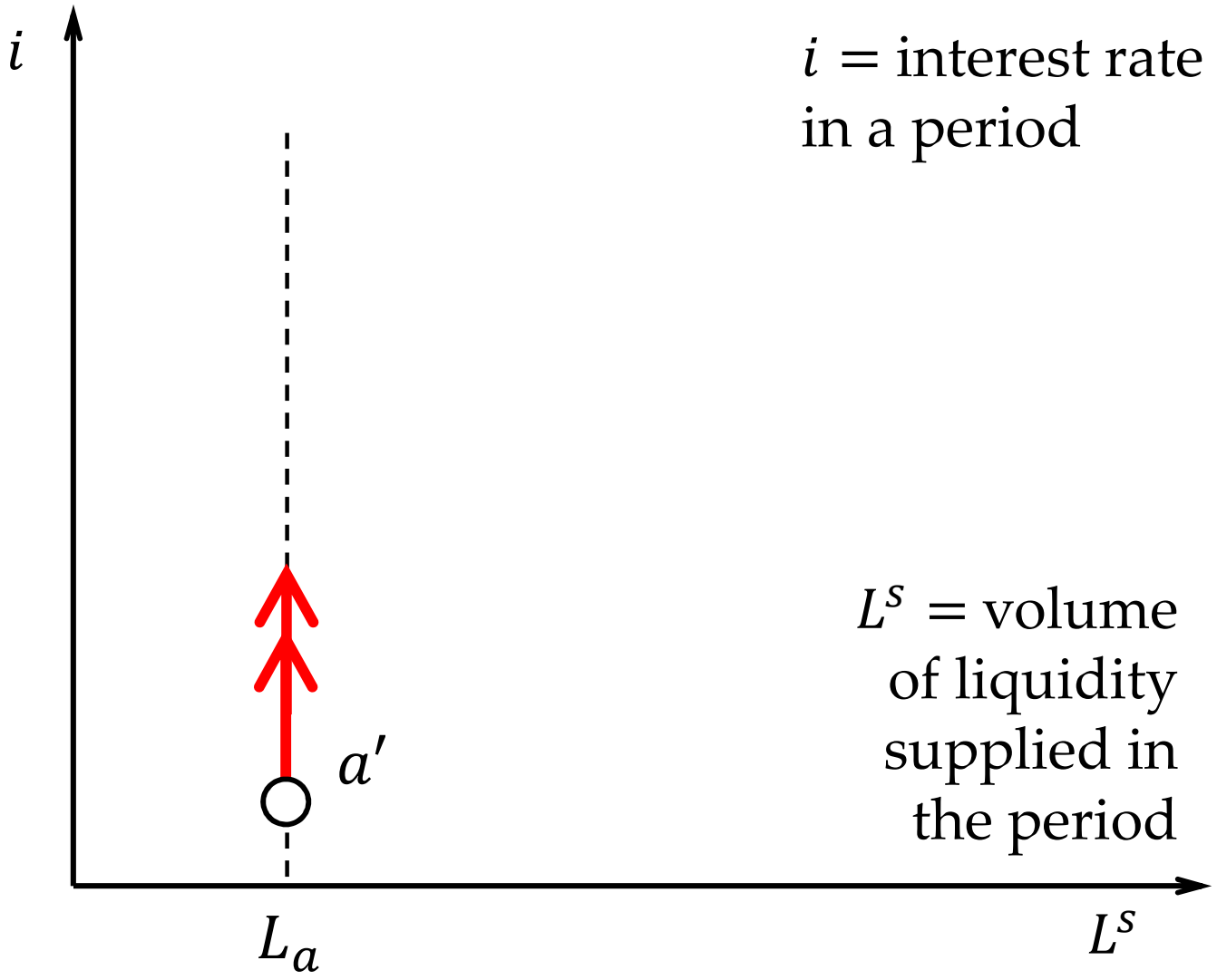
Refinancing operations (MRO & LTRO)



http://www.zerohedge.com/contributed/2013-09-03/complete-guide-european-bail-out-facilities-part-1-ecb

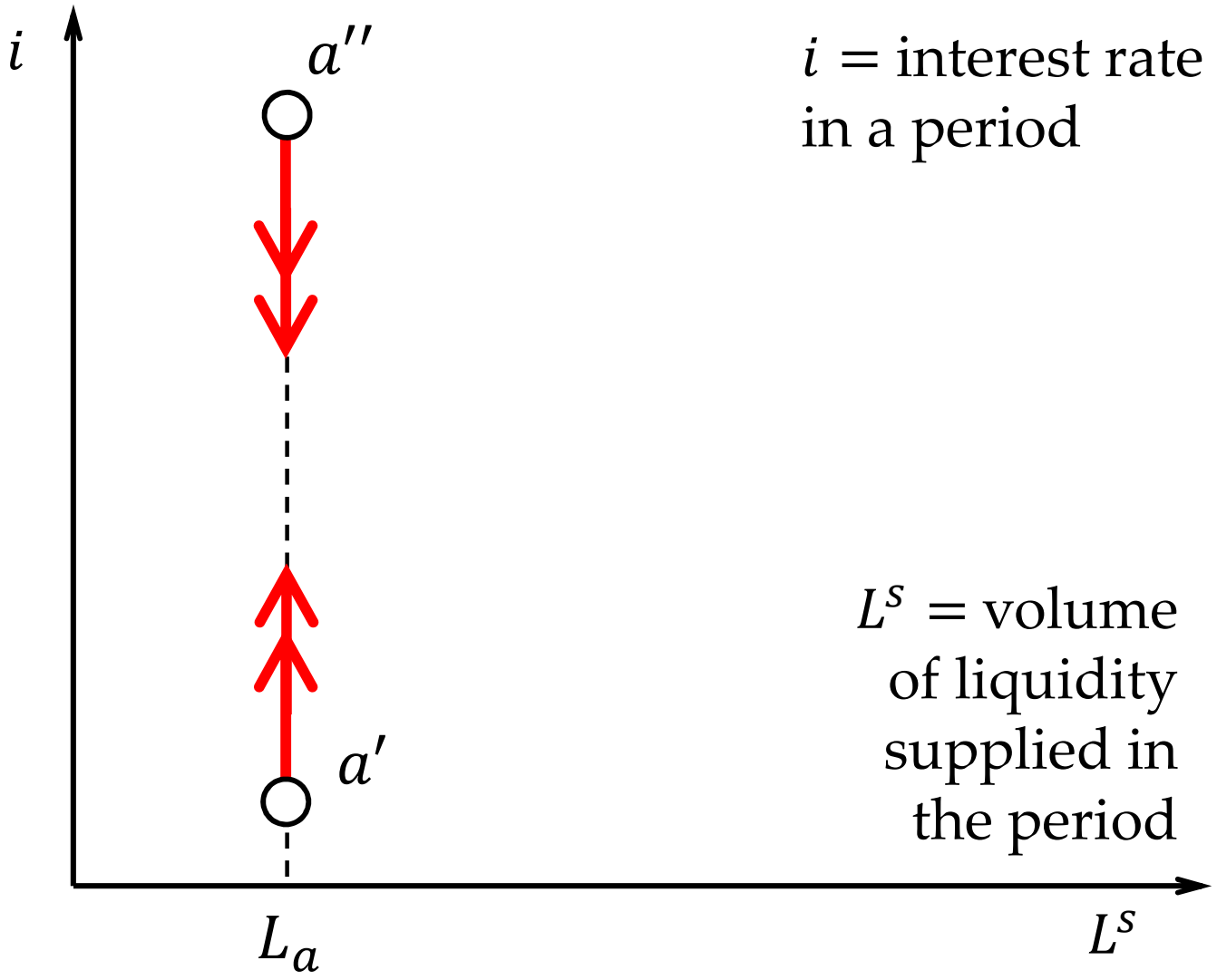
A liquidity market model

- Supply of liquidity: direct / indirect
- Supply of liquidity function
- Demand for liquidity: direct / indirect
- Demand for liquidity function
- Market equilibrium
- Comparative statics



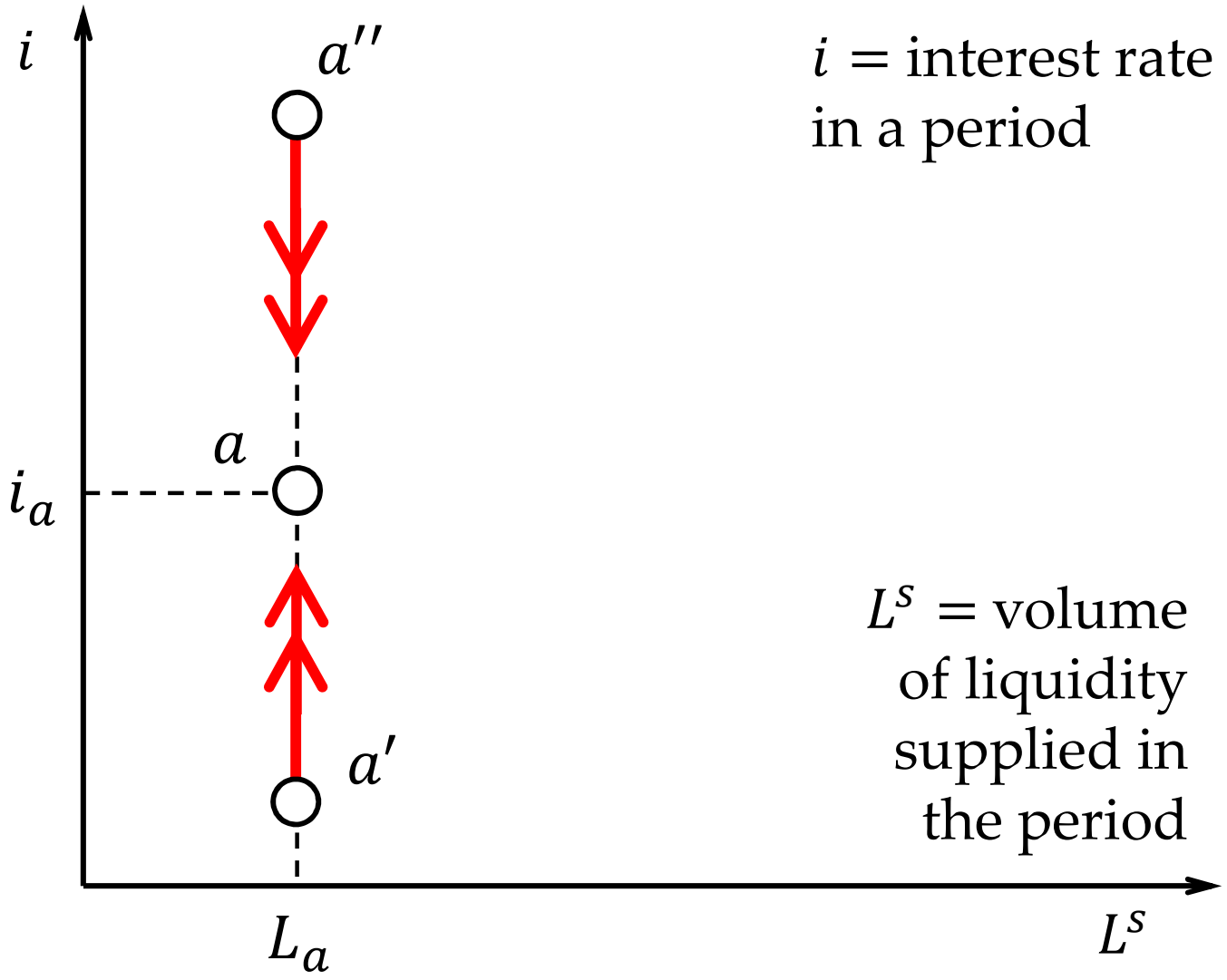
i = interest rate in a period

L^s = volume of liquidity supplied in the period



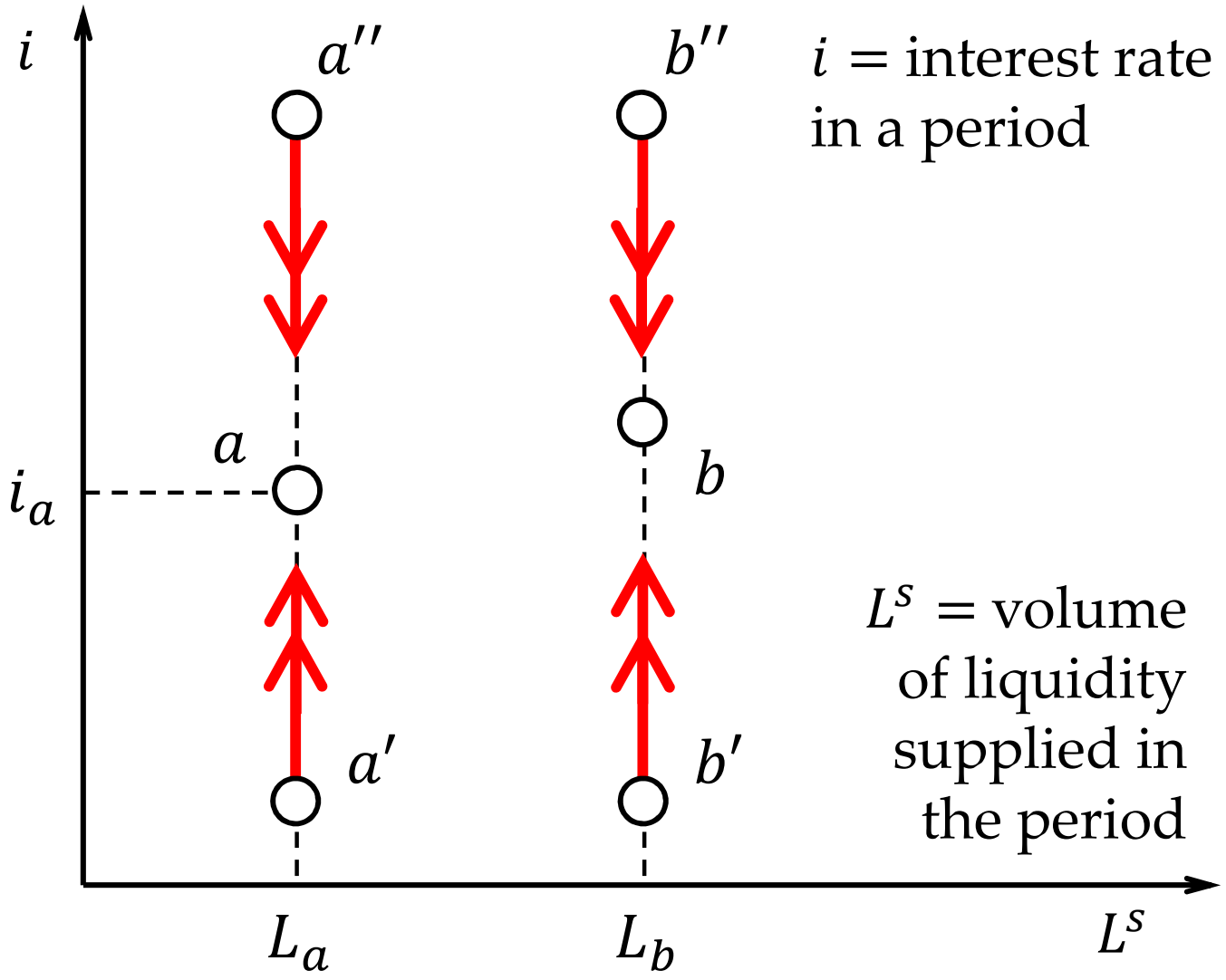
i = interest rate in a period

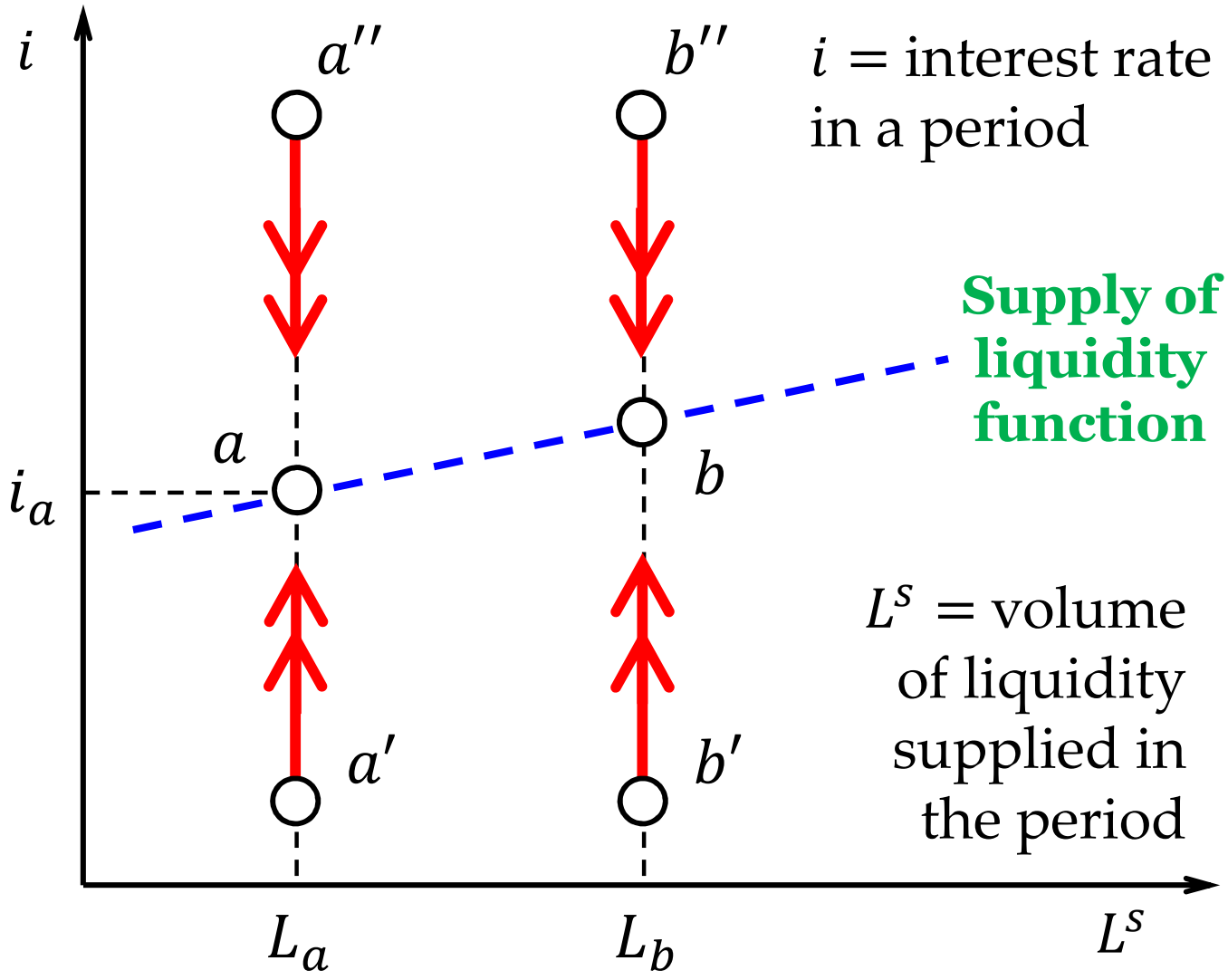
L^s = volume of liquidity supplied in the period

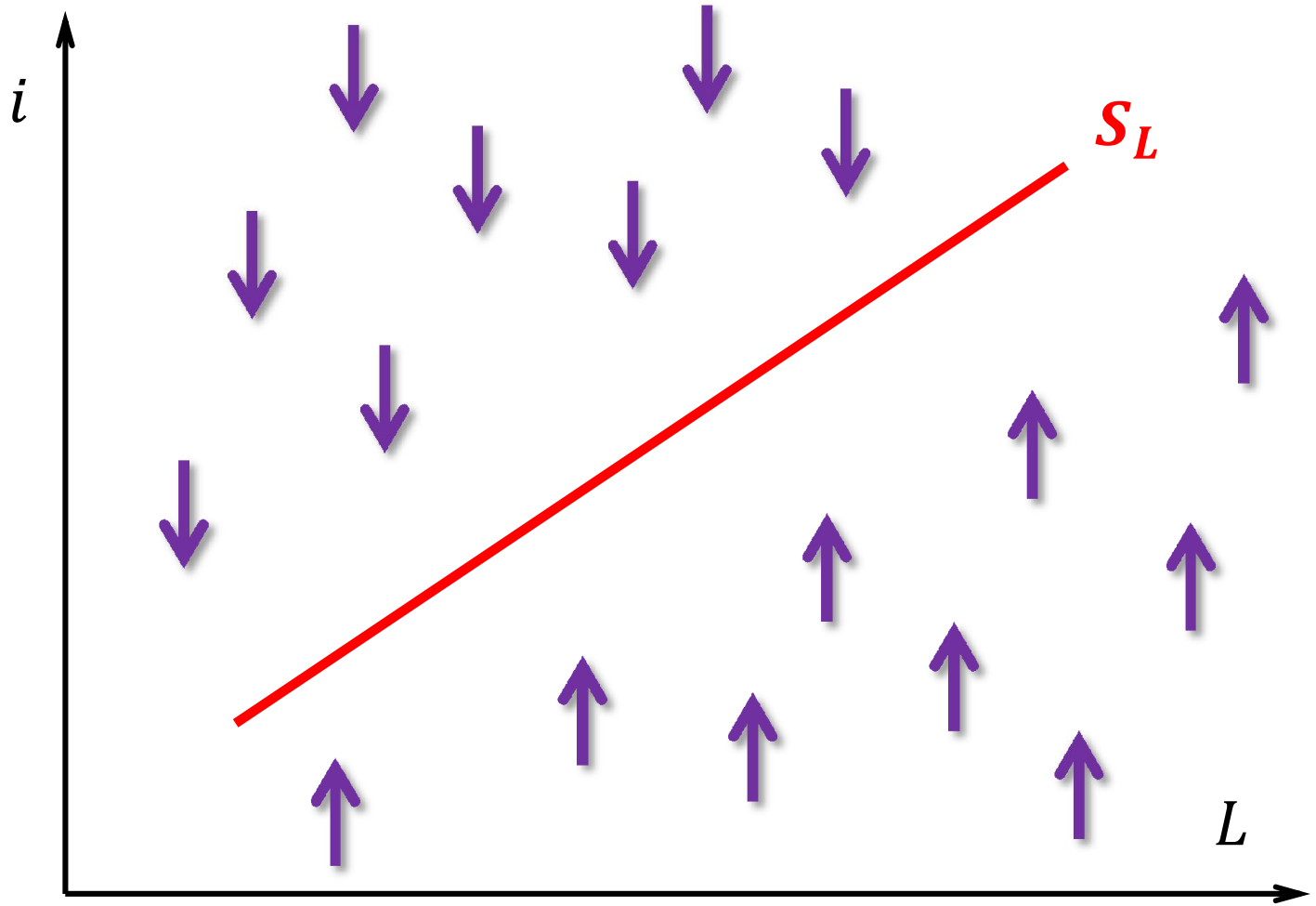


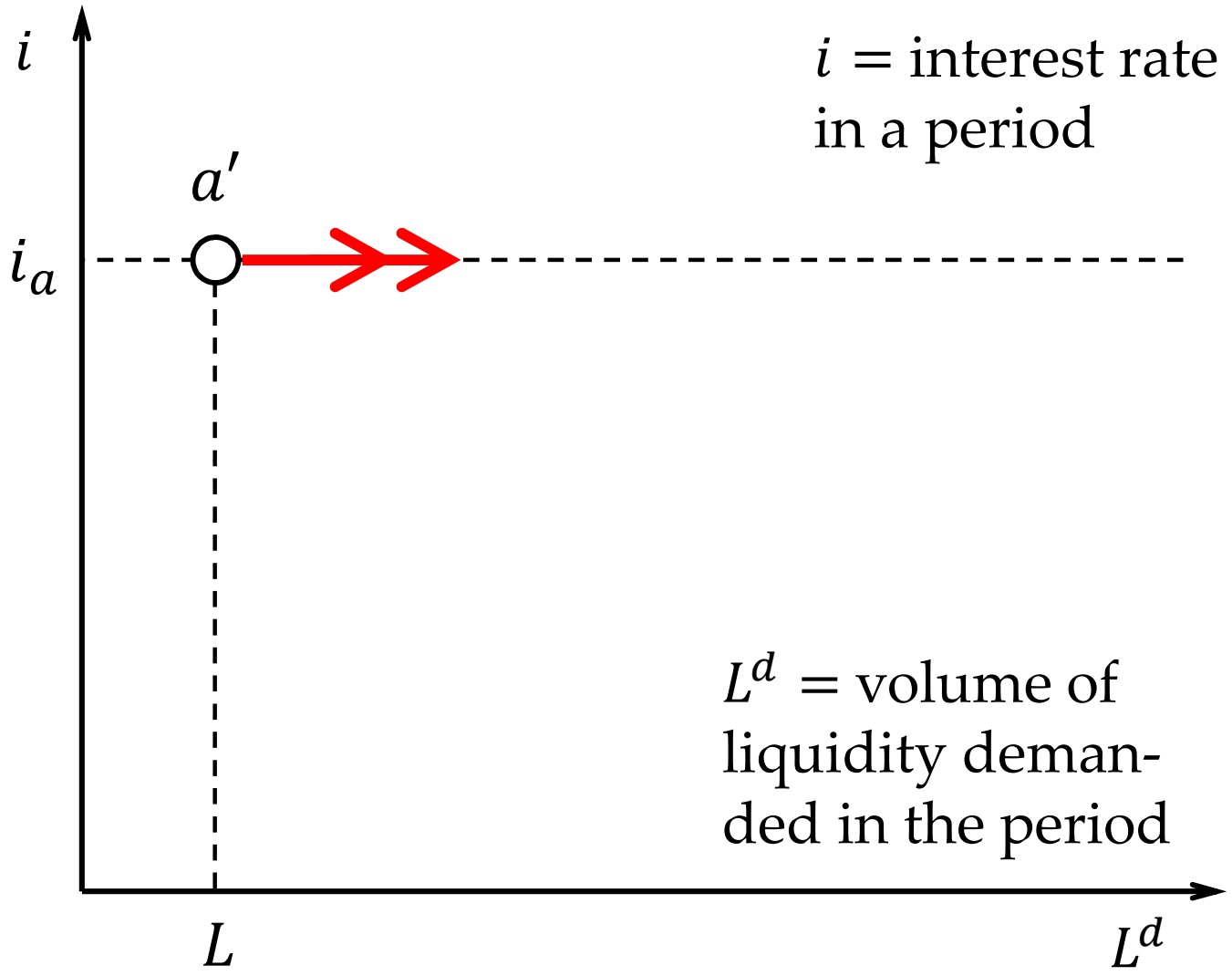
i = interest rate in a period

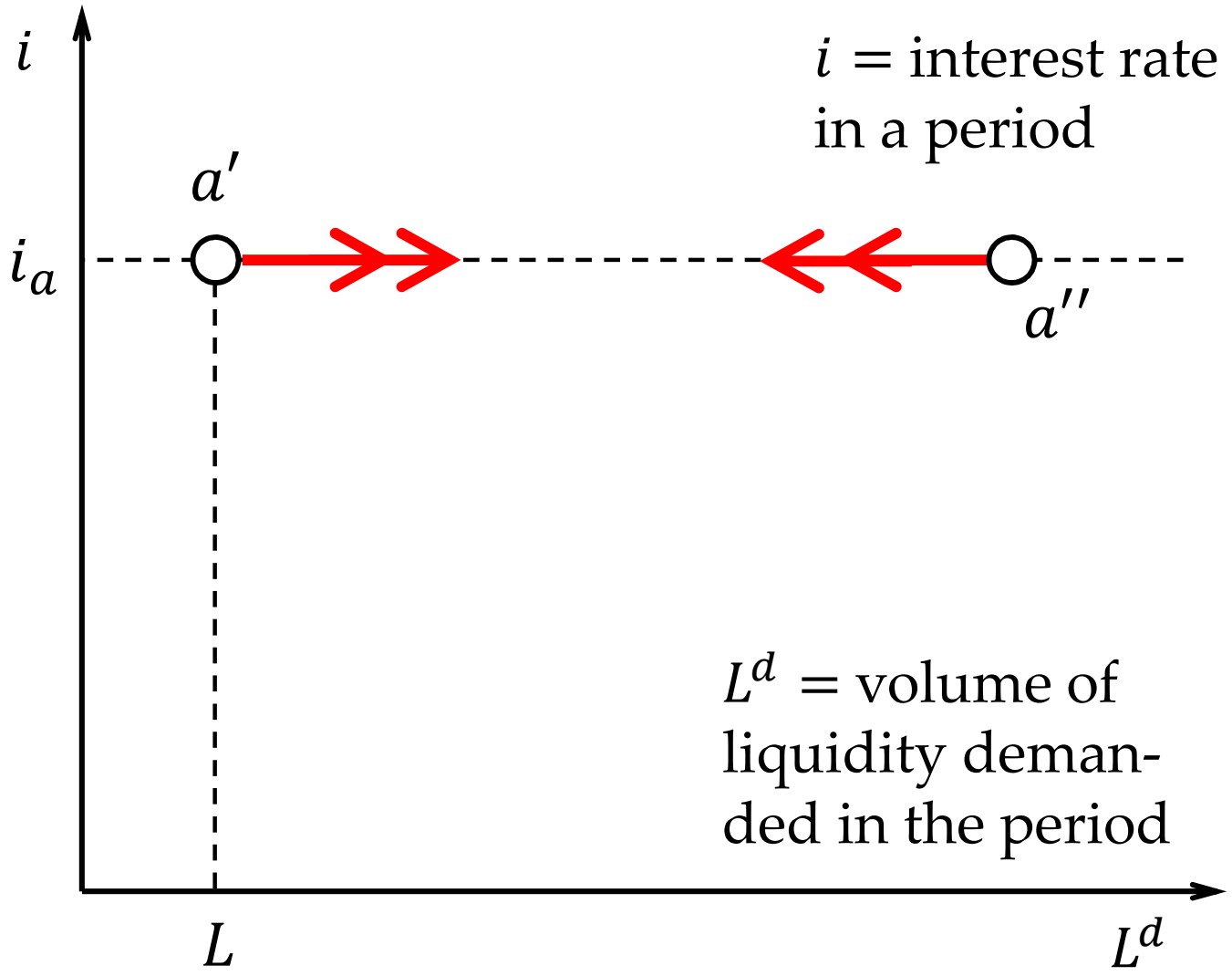
L^s = volume of liquidity supplied in the period

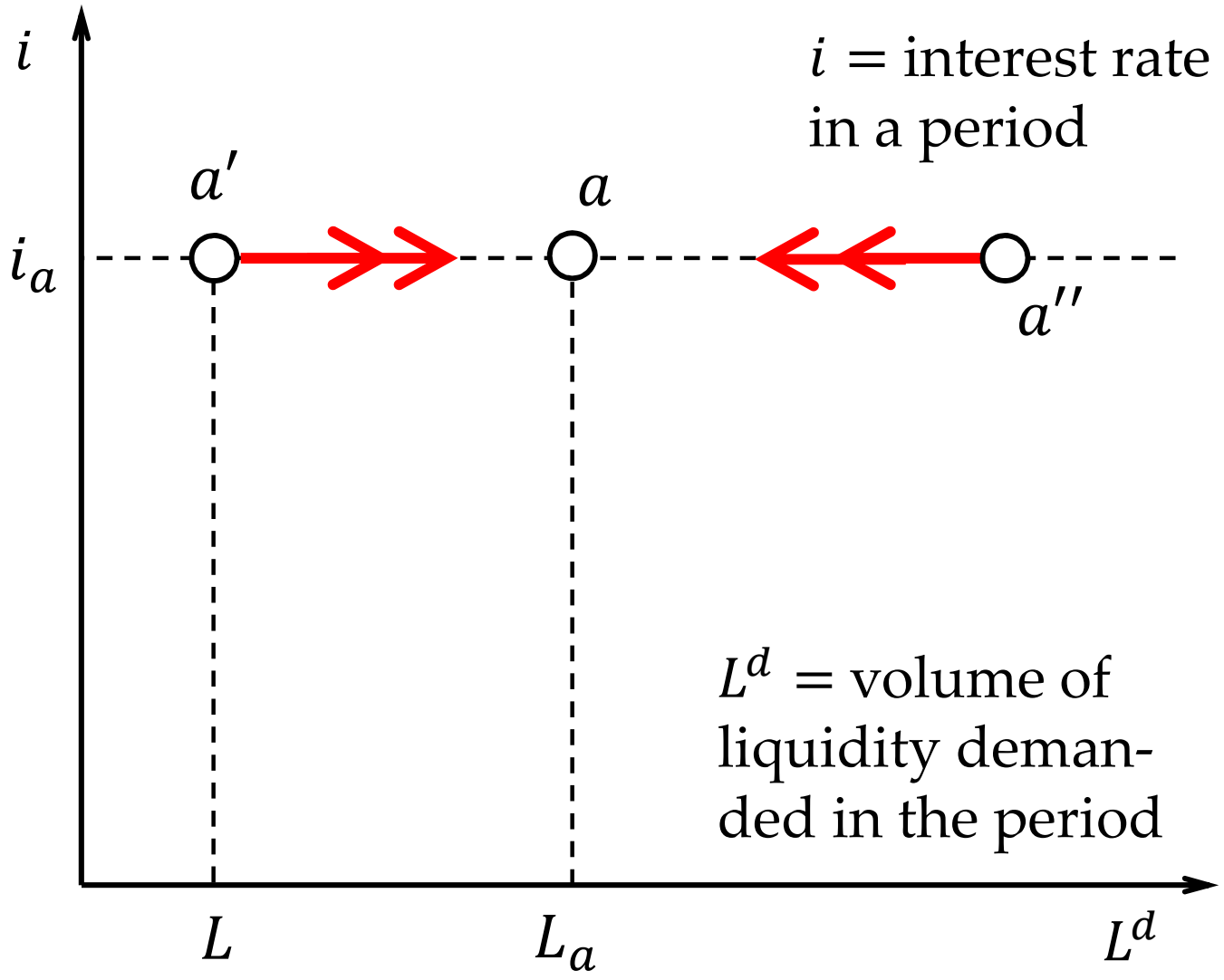

i
a''
b''
i = interest rate
in a period
a
i_a
b
L^s = volume
of liquidity
supplied in
the period
a'
b'
L_a
L_b
L^s

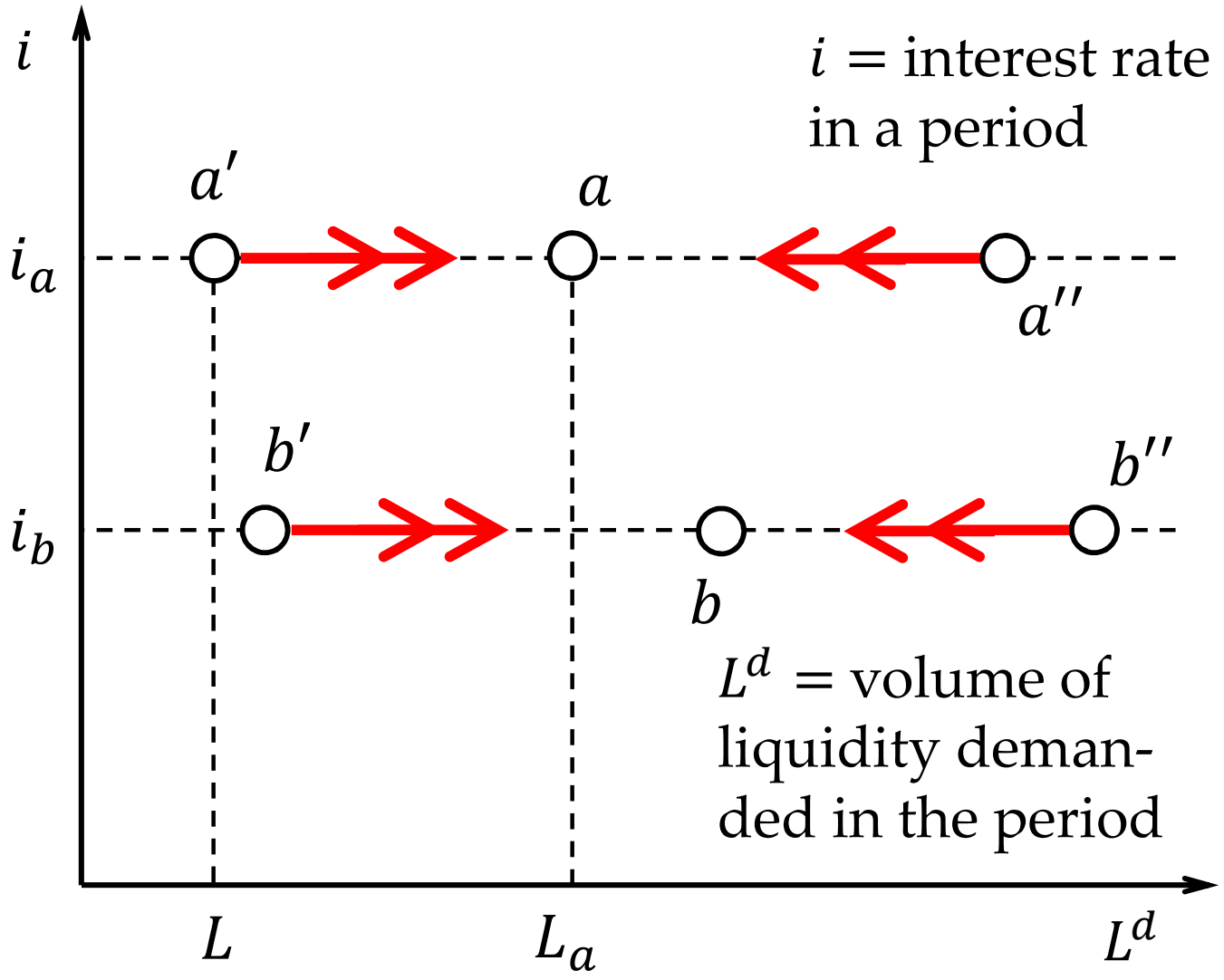

i
a''
b''
i = interest rate in a period
Supply of liquidity function
a
b
i_a
L^s = volume of liquidity supplied in the period
a'
b'
L_a
L_b
L^s

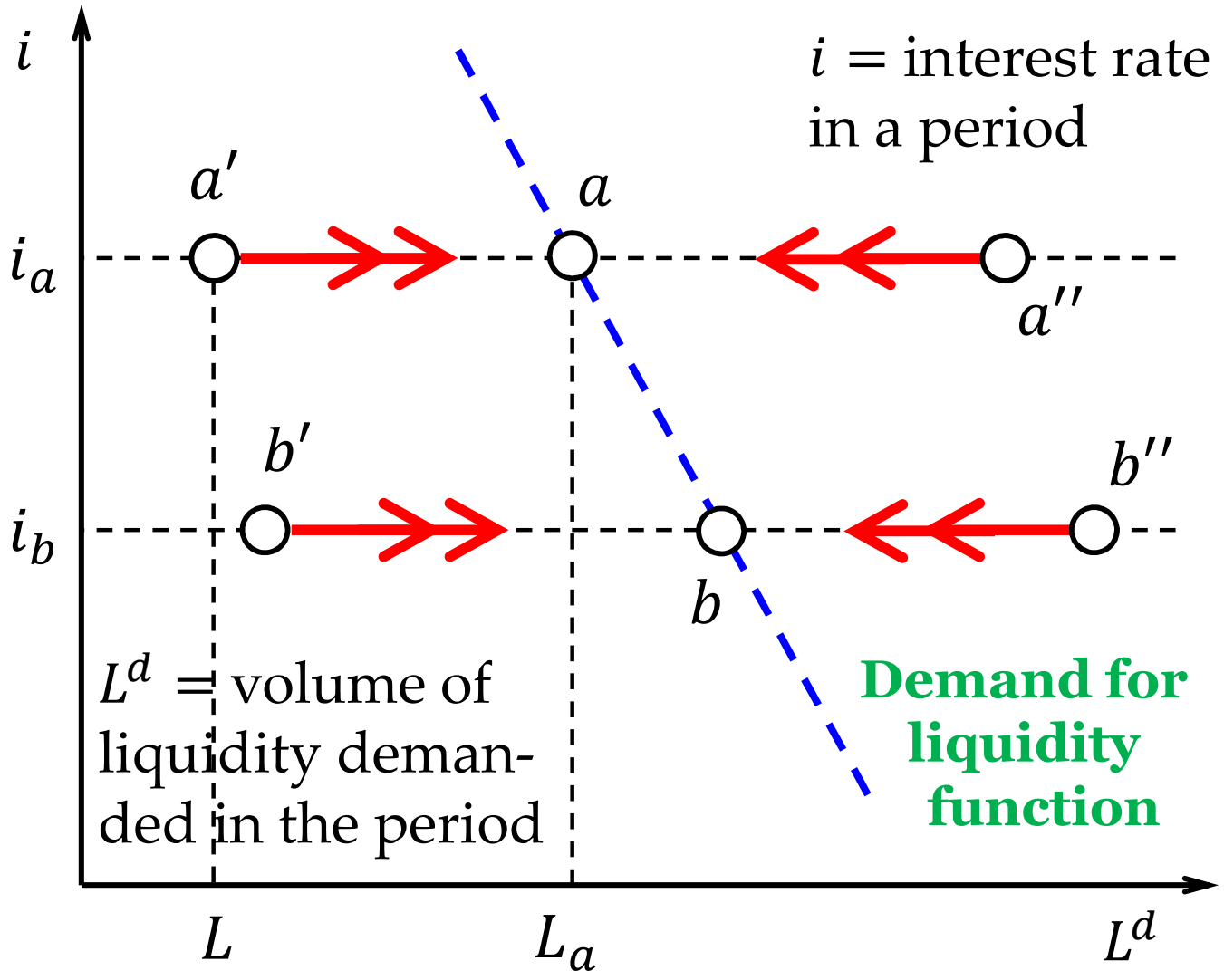

i
S_L
L

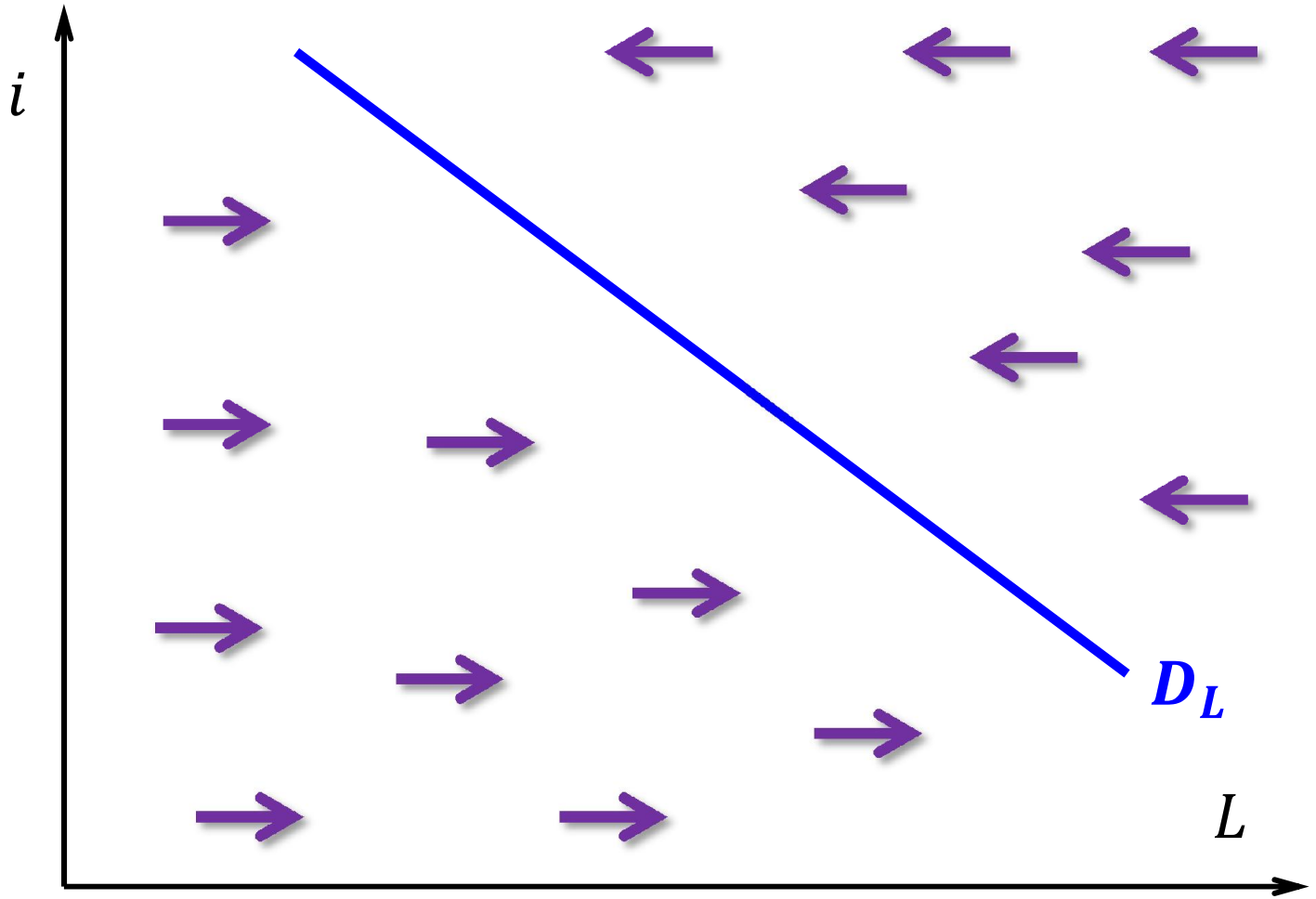

i
a'
i_a
i = interest rate
in a period
L^d = volume of
liquidity deman-
ded in the period
L
L^d

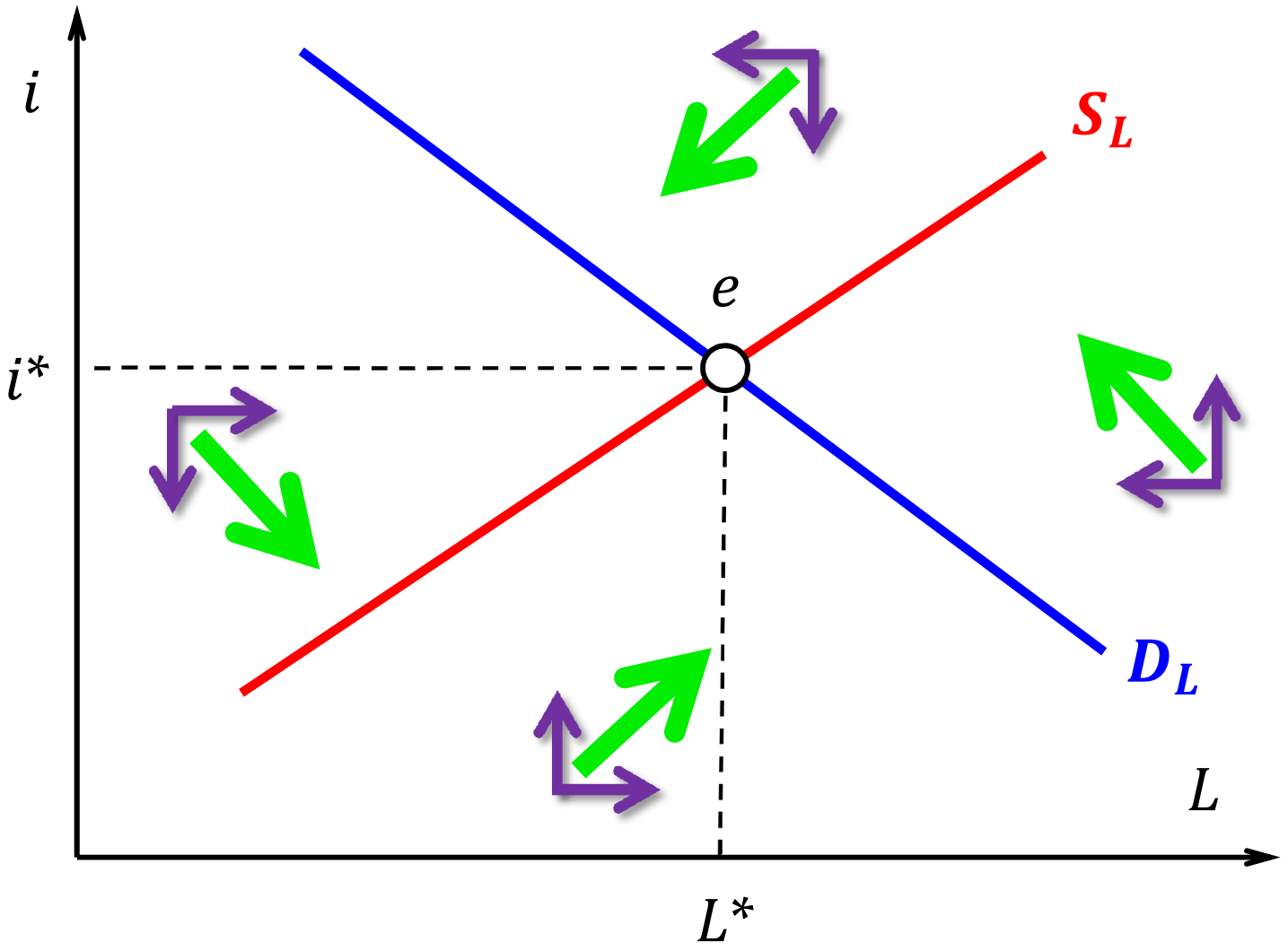

i
i = interest rate
in a period
a'
i_a
a''
L^d = volume of
liquidity deman-
ded in the period
L
L^d

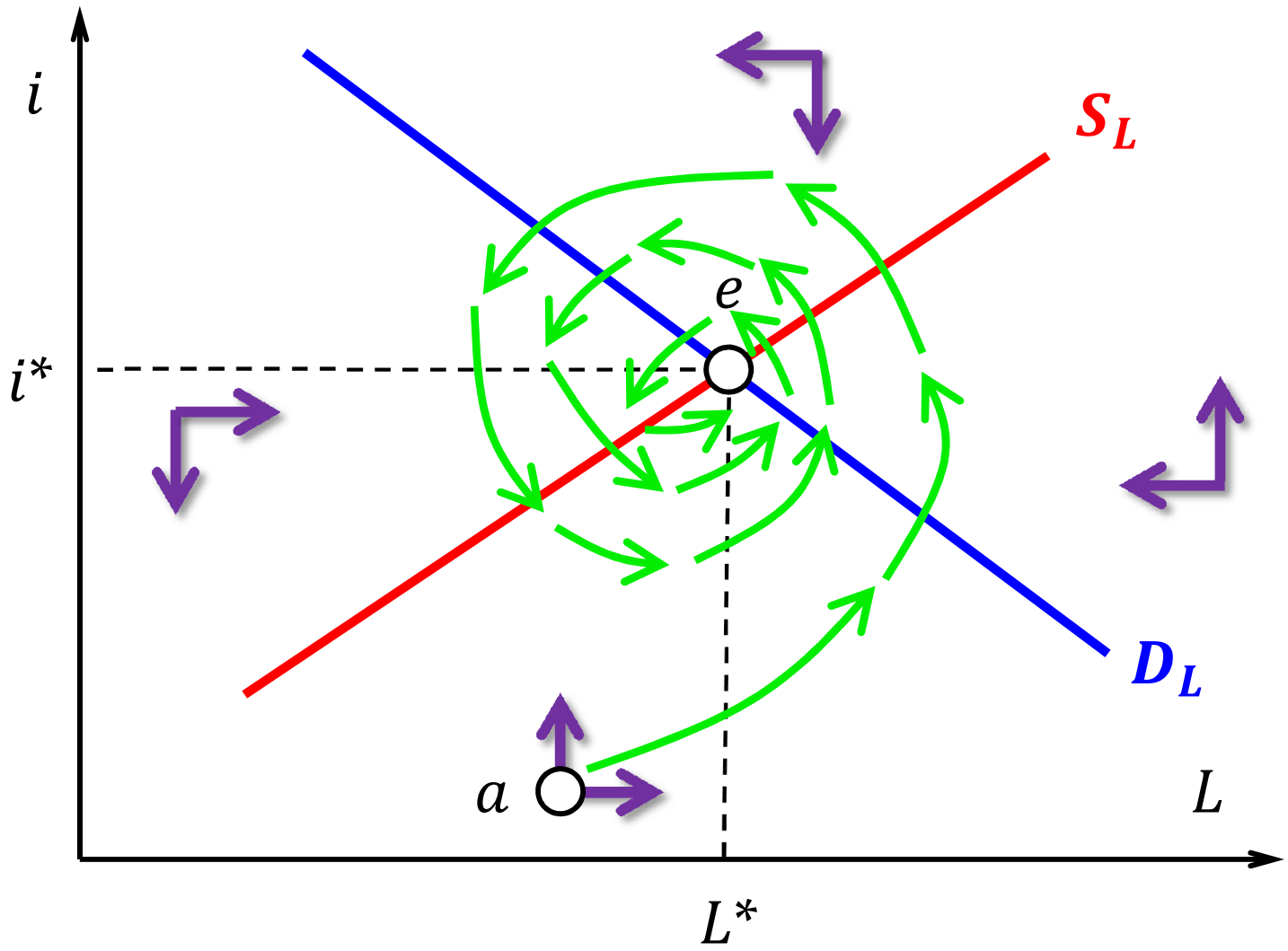

i
i = interest rate
in a period
a'
a
i_a
a''
L^d = volume of
liquidity deman-
ded in the period
L
L_a
L^d


i
i = interest rate
in a period
a'
a
i_a
a''
b'
b''
i_b
b
L^d = volume of
liquidity deman-
ded in the period
L
L_a
L^d

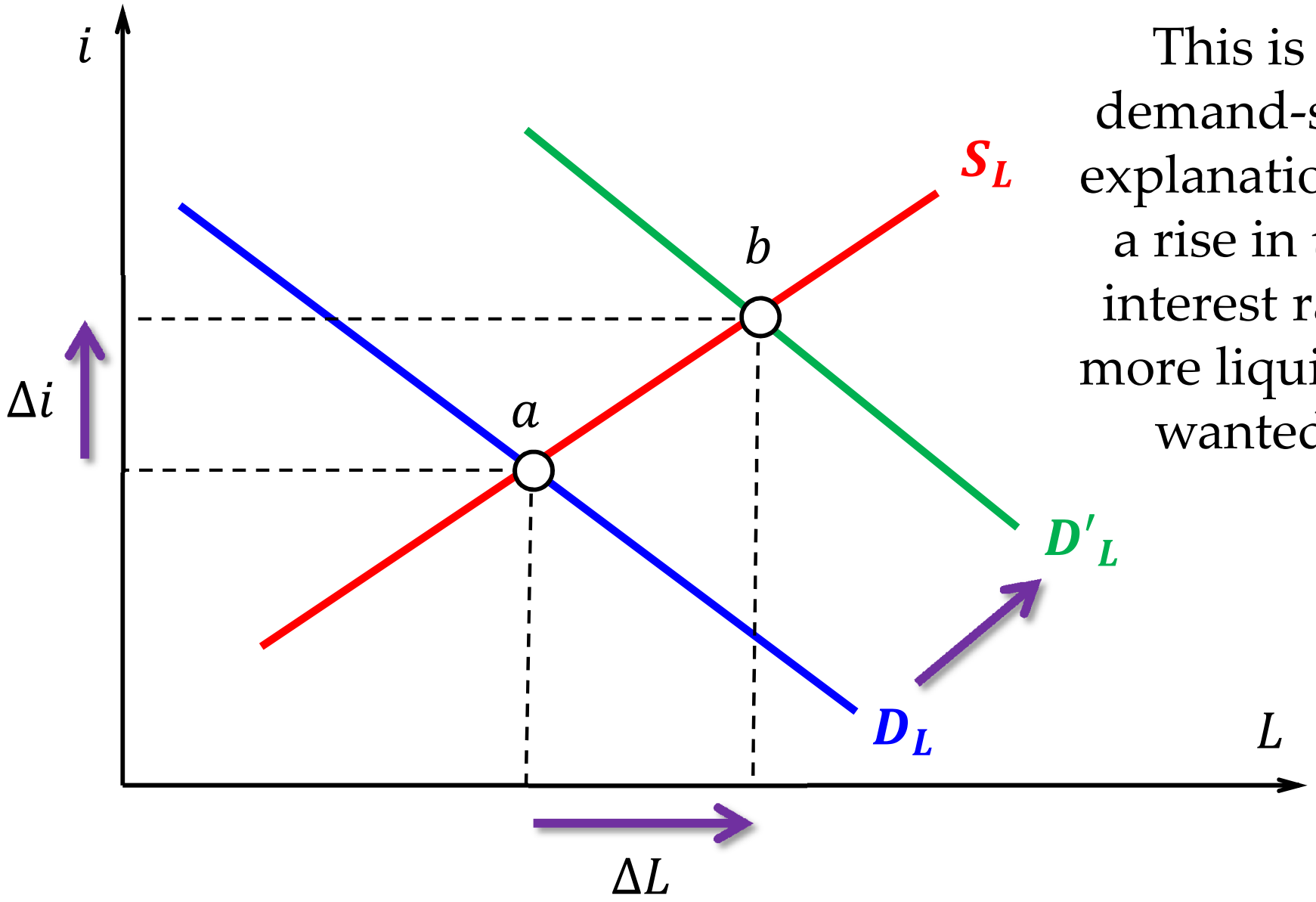

i
i = interest rate
in a period
a'
a
i_a
a''
b'
b''
i_b
b
L^d = volume of
liquidity deman-
ded in the period
Demand for
liquidity
function
L
L_a
L^d


i
L
D_L


i
i*
e
S_L
D_L
L
L*

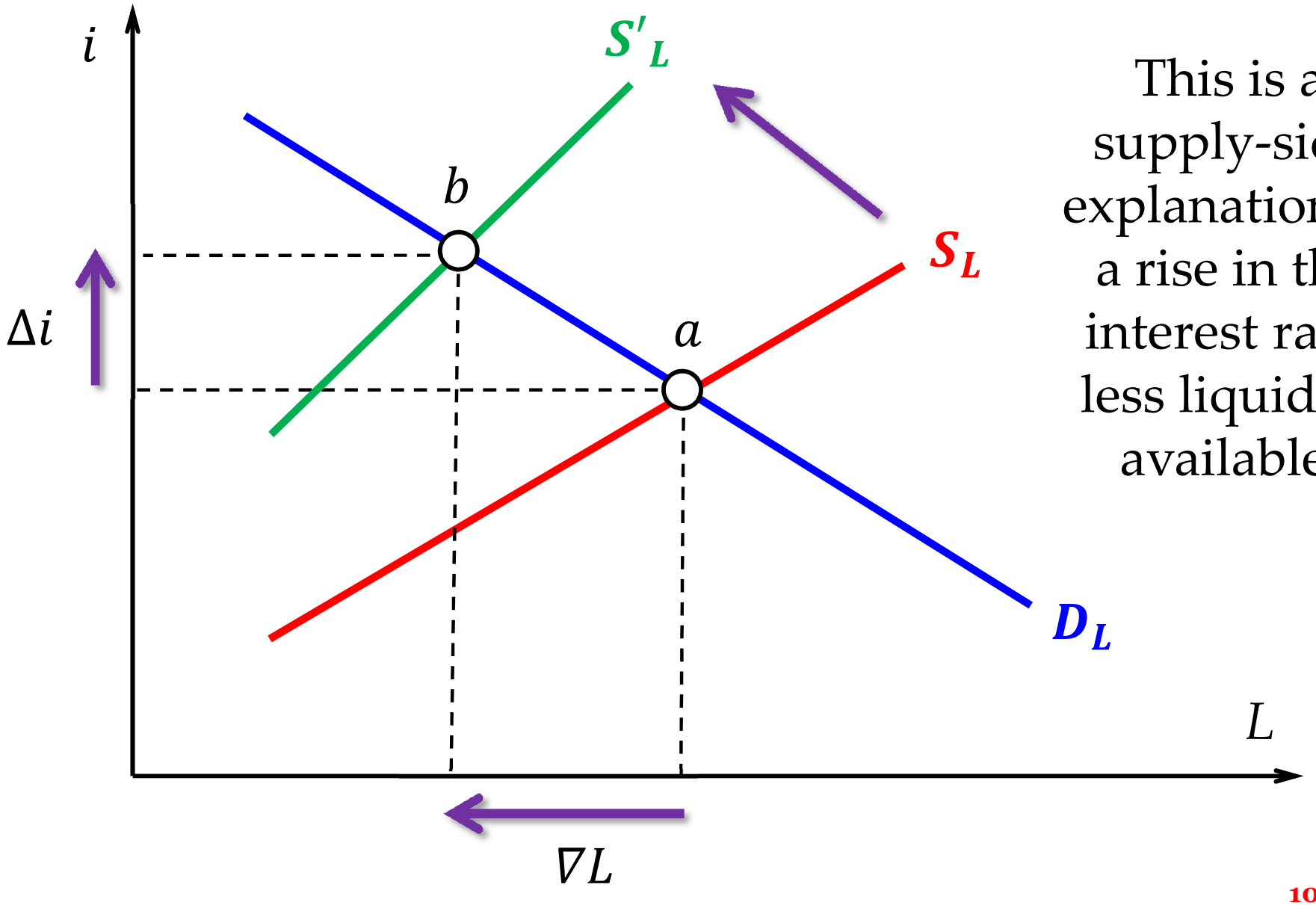

i
i*
e
S_L
D_L
a
L
L*

Equilibrium effect of a demand shift



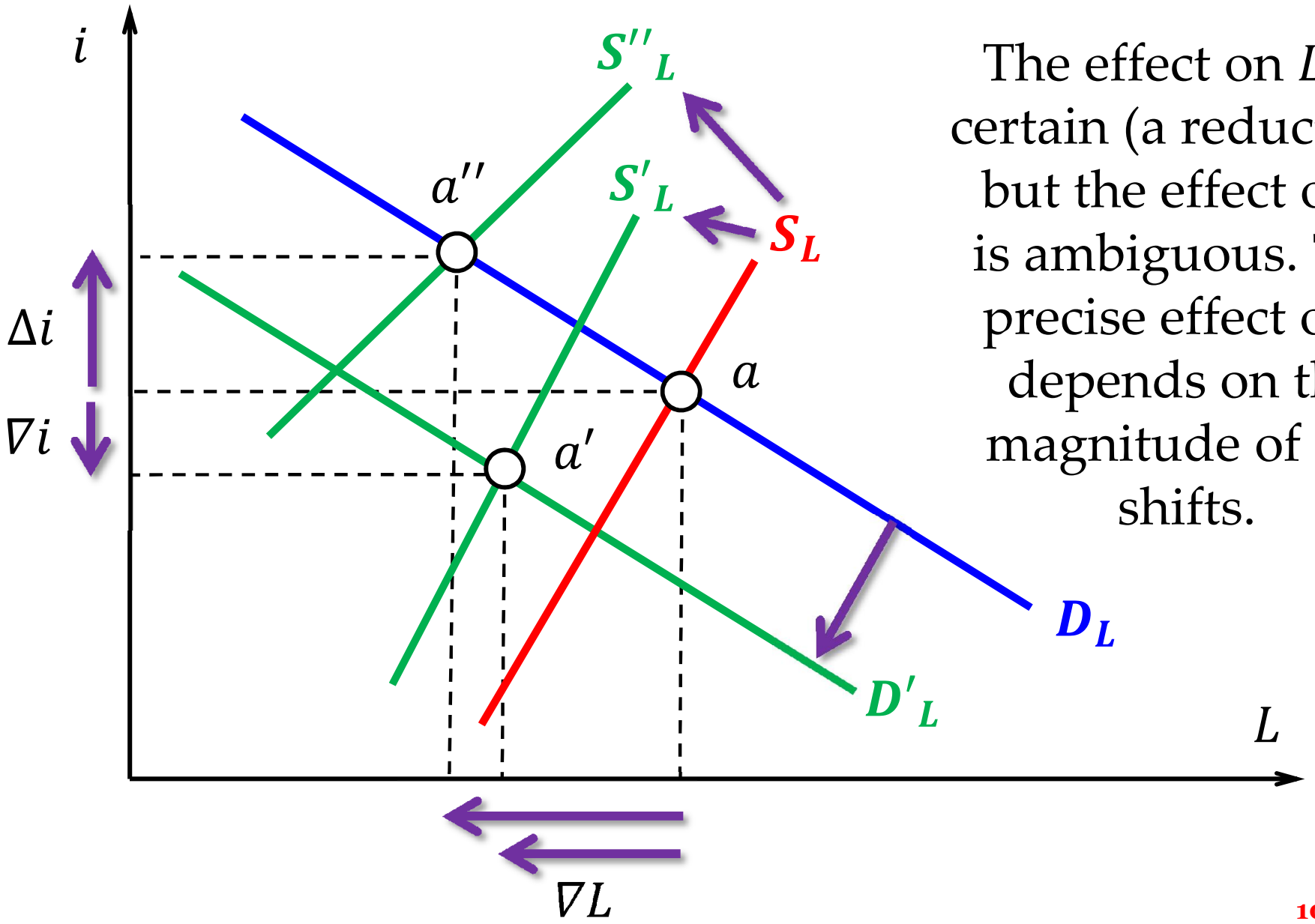
This is a demand-side explanation of a rise in the interest rate: more liquidity wanted.

Equilibrium effect of a supply shift



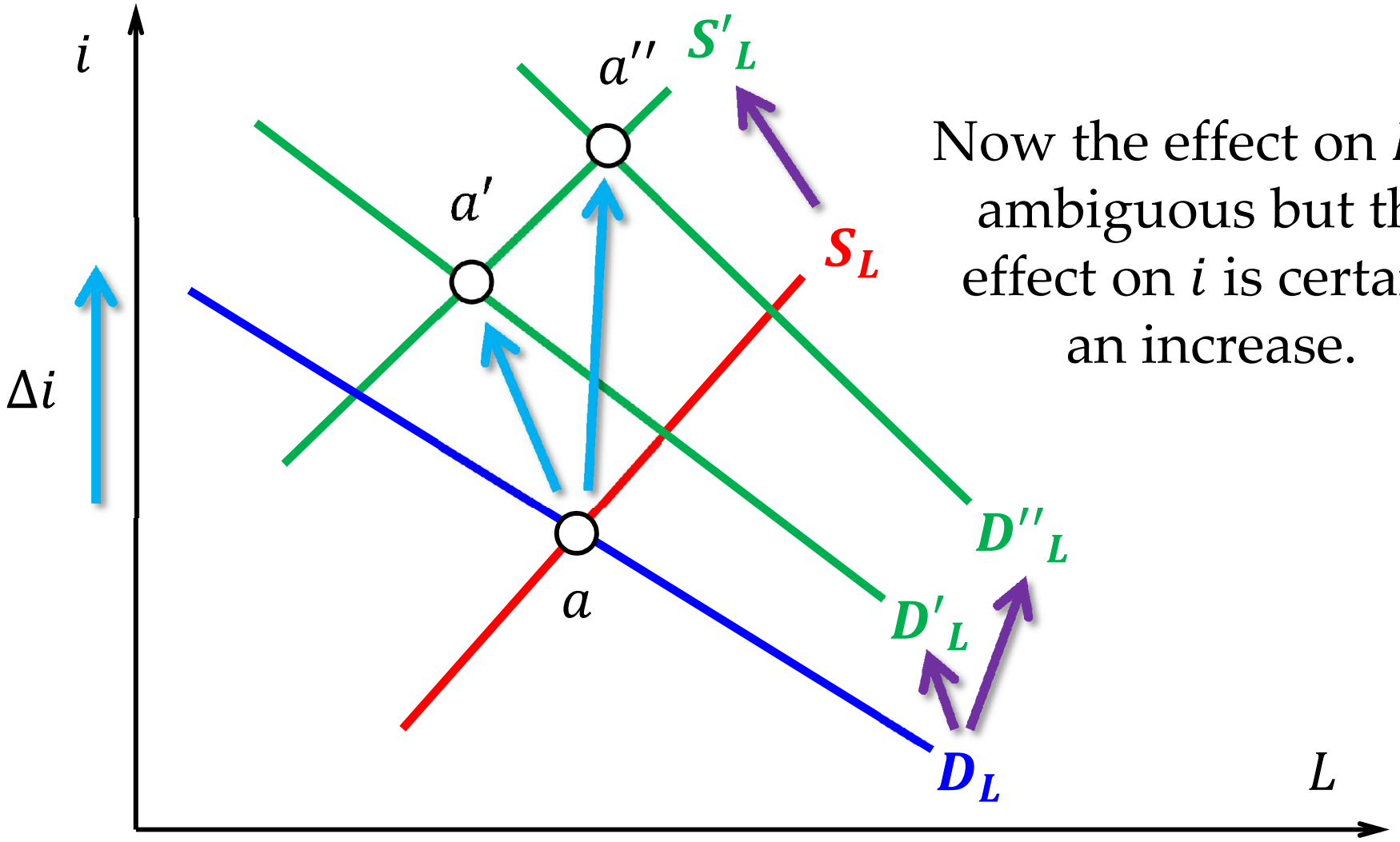
This is a supply-side explanation of a rise in the interest rate: less liquidity available.

Effect of simultaneous shifts /1



The effect on L is certain (a reduction) but the effect on i is ambiguous. The precise effect on i depends on the magnitude of the shifts.

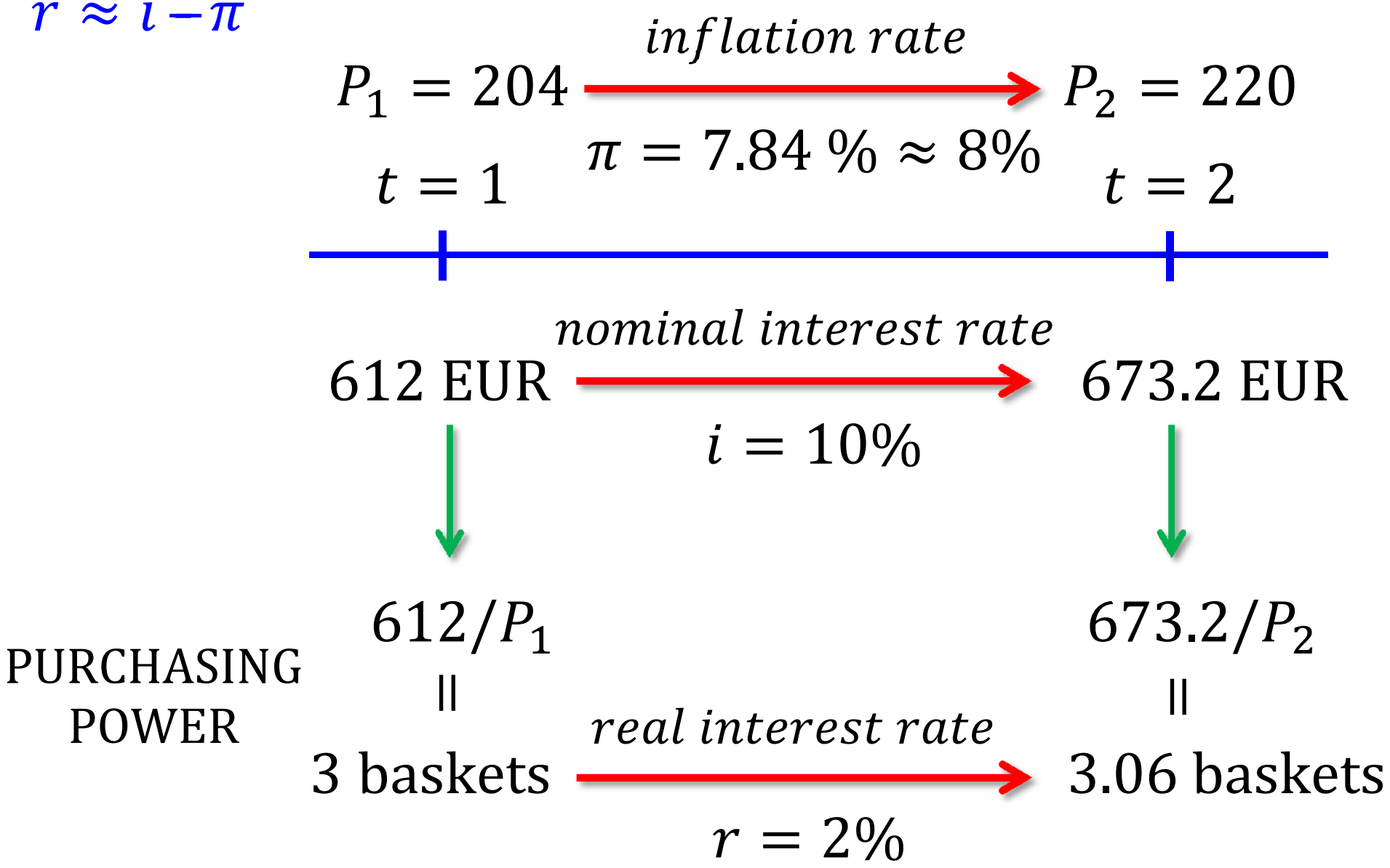
Effect of simultaneous shifts /2

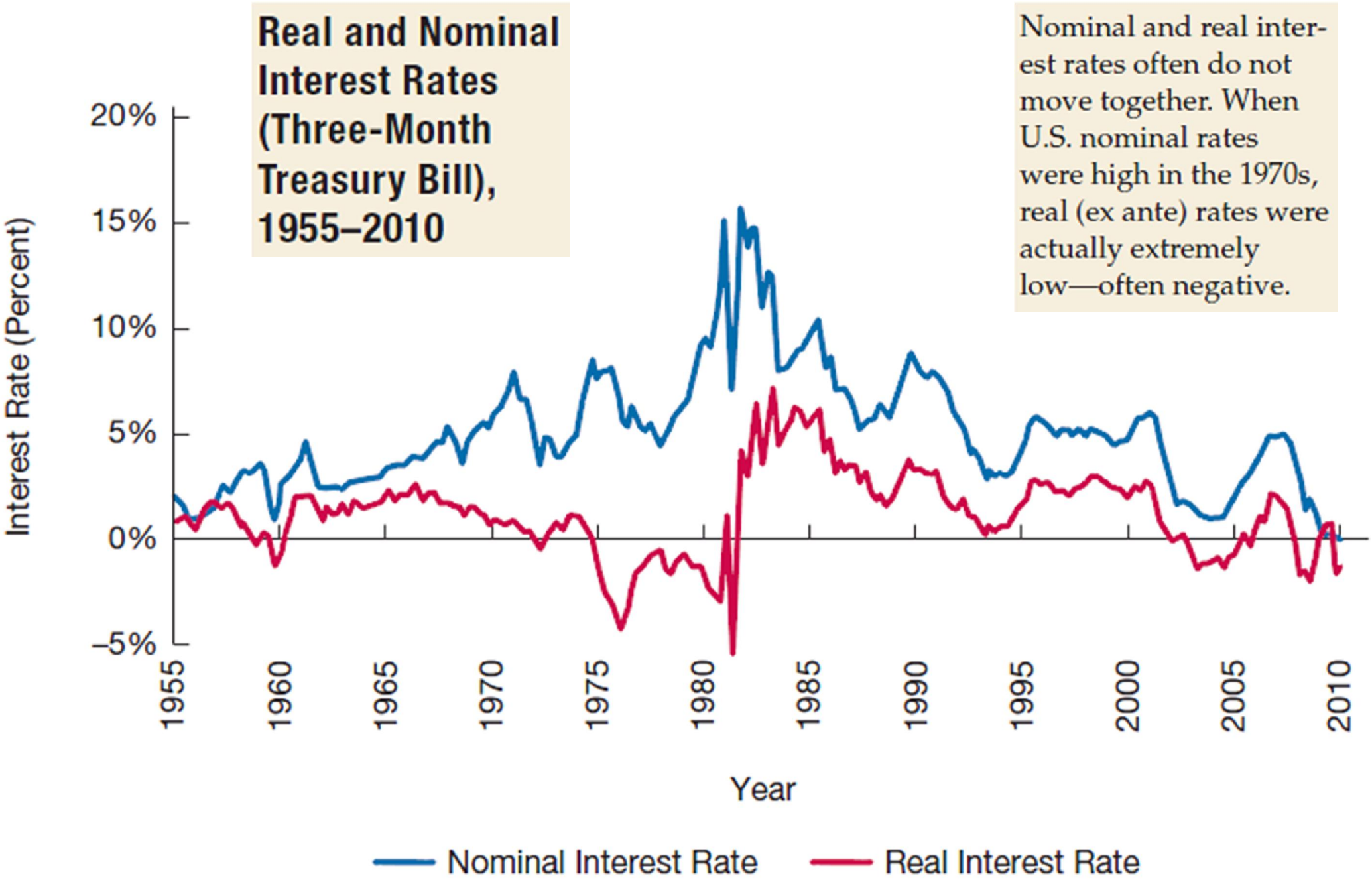


Now the effect on L is ambiguous but the effect on i is certain: an increase.

The real interest rate

$r \approx i - \pi$





Frederic S Mishkin (2011): *Macroeconomics. Theory and practice*, p. 40

Fisher equation and Fisher effect

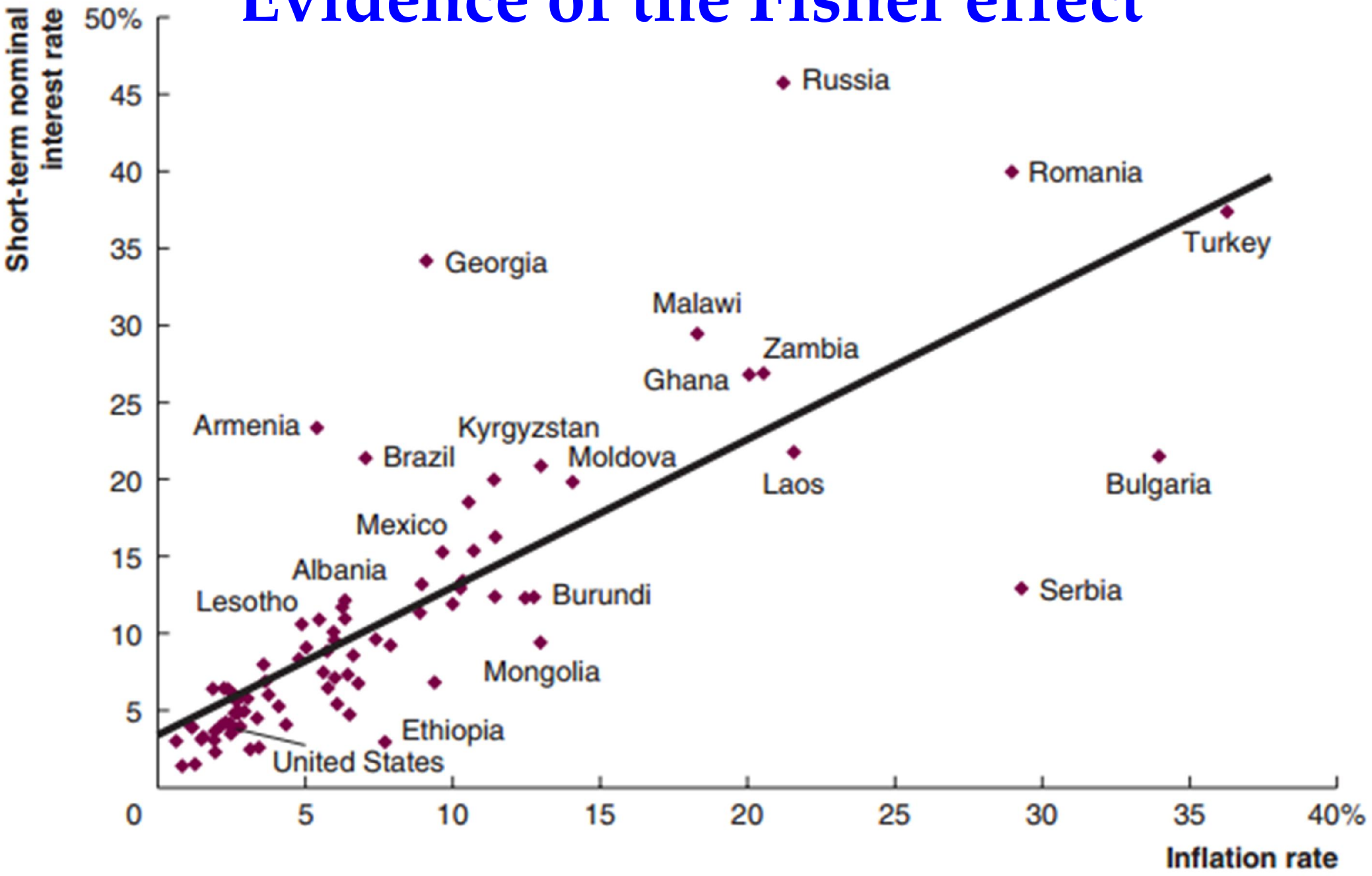
- Fisher equation

$$i = r + \pi$$

- Fisher effect: there is a one-to-one relationship between the inflation rate and the interest rate (going from the inflation rate to the interest rate).

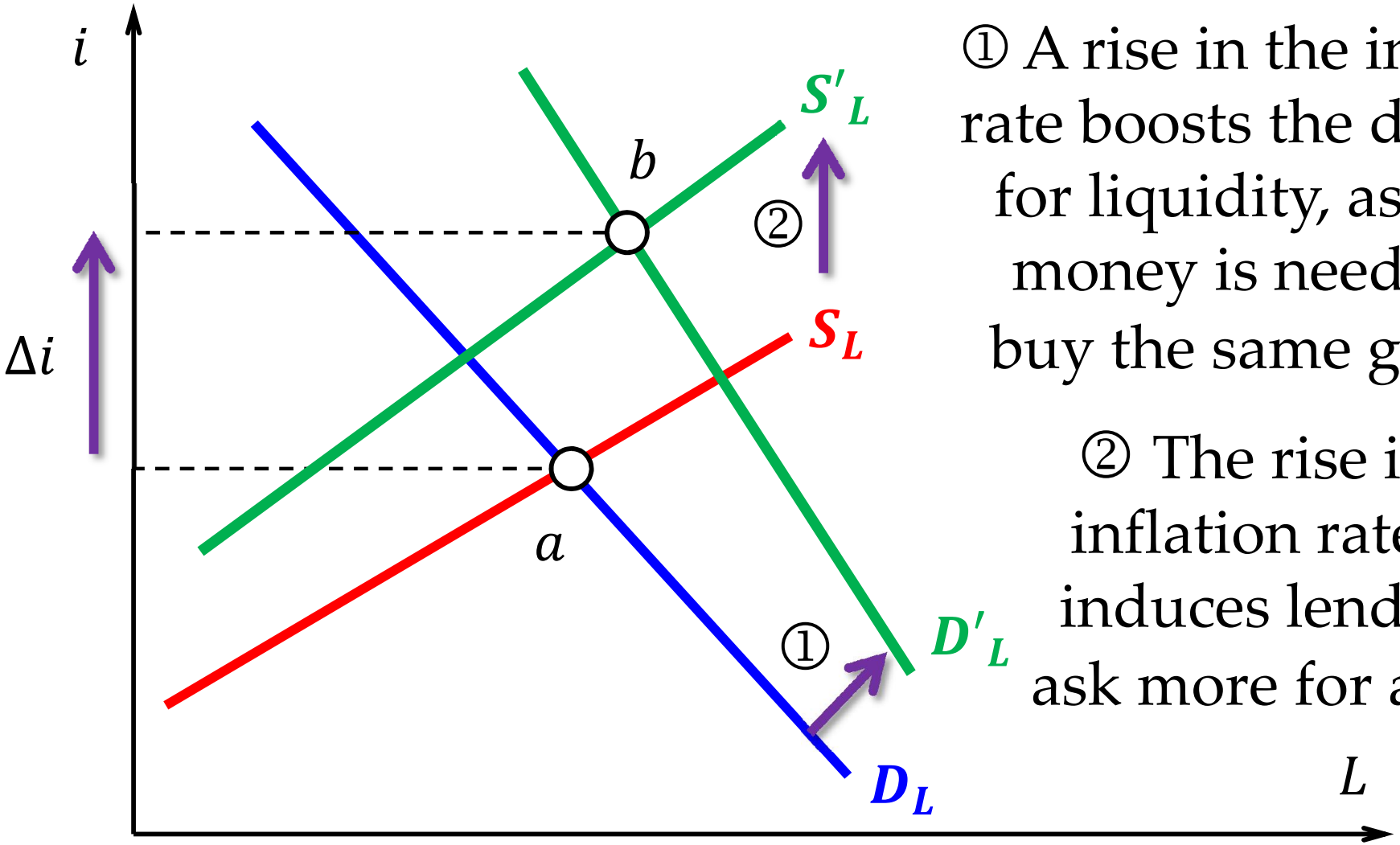
$$\uparrow \pi \Rightarrow \uparrow i$$

Evidence of the Fisher effect



RG Hubbard, AP O'Brien, M Rafferty (2012): Macroeconomics, p. 204

The Fisher effect in the liquidity model



① A rise in the inflation rate boosts the demand for liquidity, as more money is needed to buy the same goods.

② The rise in the inflation rate also induces lenders to ask more for a loan.