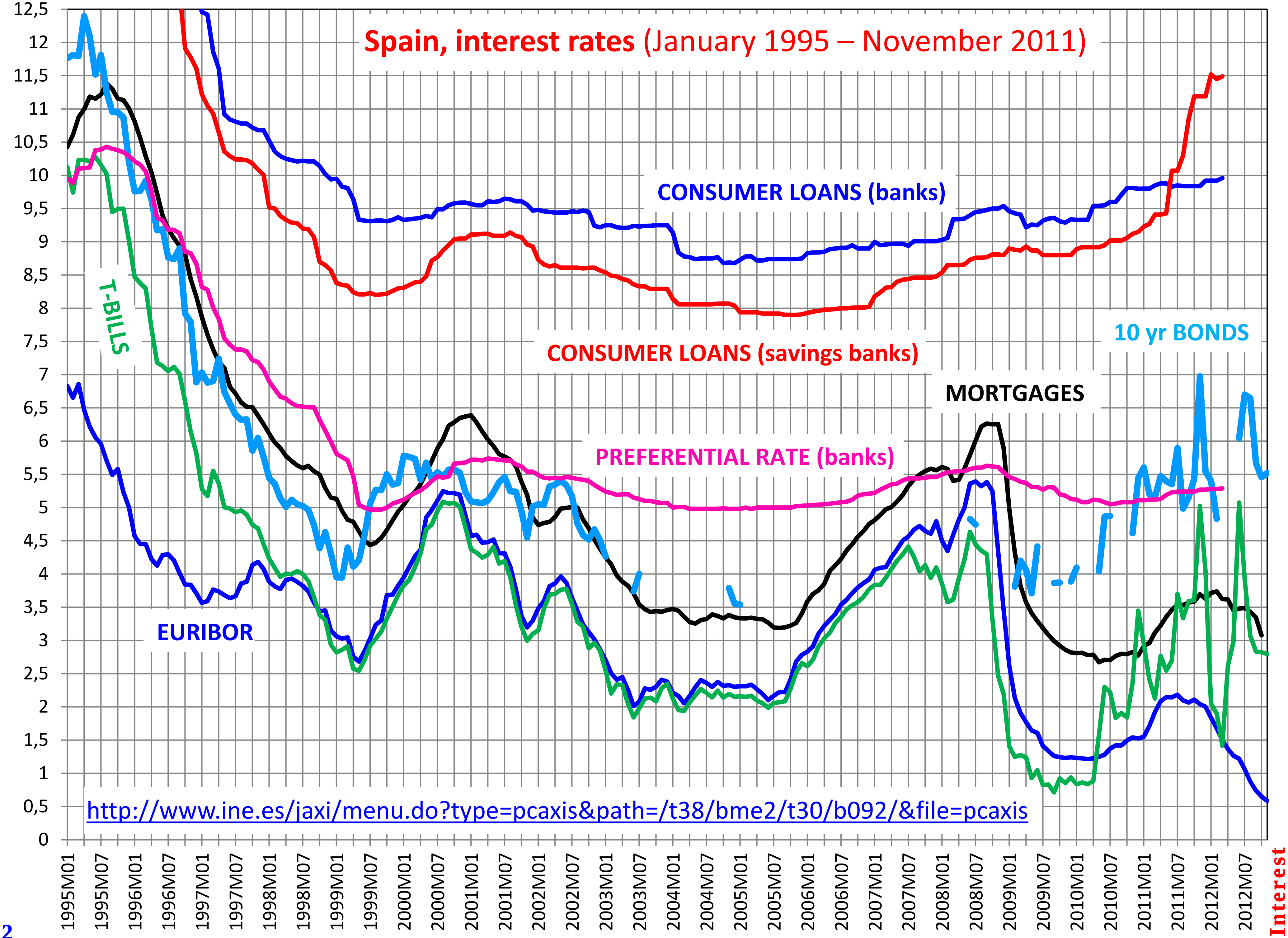
"The" interest rate of an economy

- The rate of return associated with a financial asset is the nominal interest rate of the asset.

- An economy has nearly as many interest rates as financial assets. The empirical evidence shows that all of them tend to move in parallel. It is therefore reasonable to adopt the fiction that there is a unique interest rate i in the economy.

- That unique rate could be taken to be the interest rate of a loan, which is itself a reference interest rate. So, for convenience, i could be seen as the average interest rate charge for a typical loan.



Spain, interest rates (January 1995 – November 2011)
CONSUMER LOANS (banks)
CONSUMER LOANS (savings banks)
10 yr BONDS
MORTGAGES
PREFERENTIAL RATE (banks)
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
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2
1,5
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0
1995M01
1995M07
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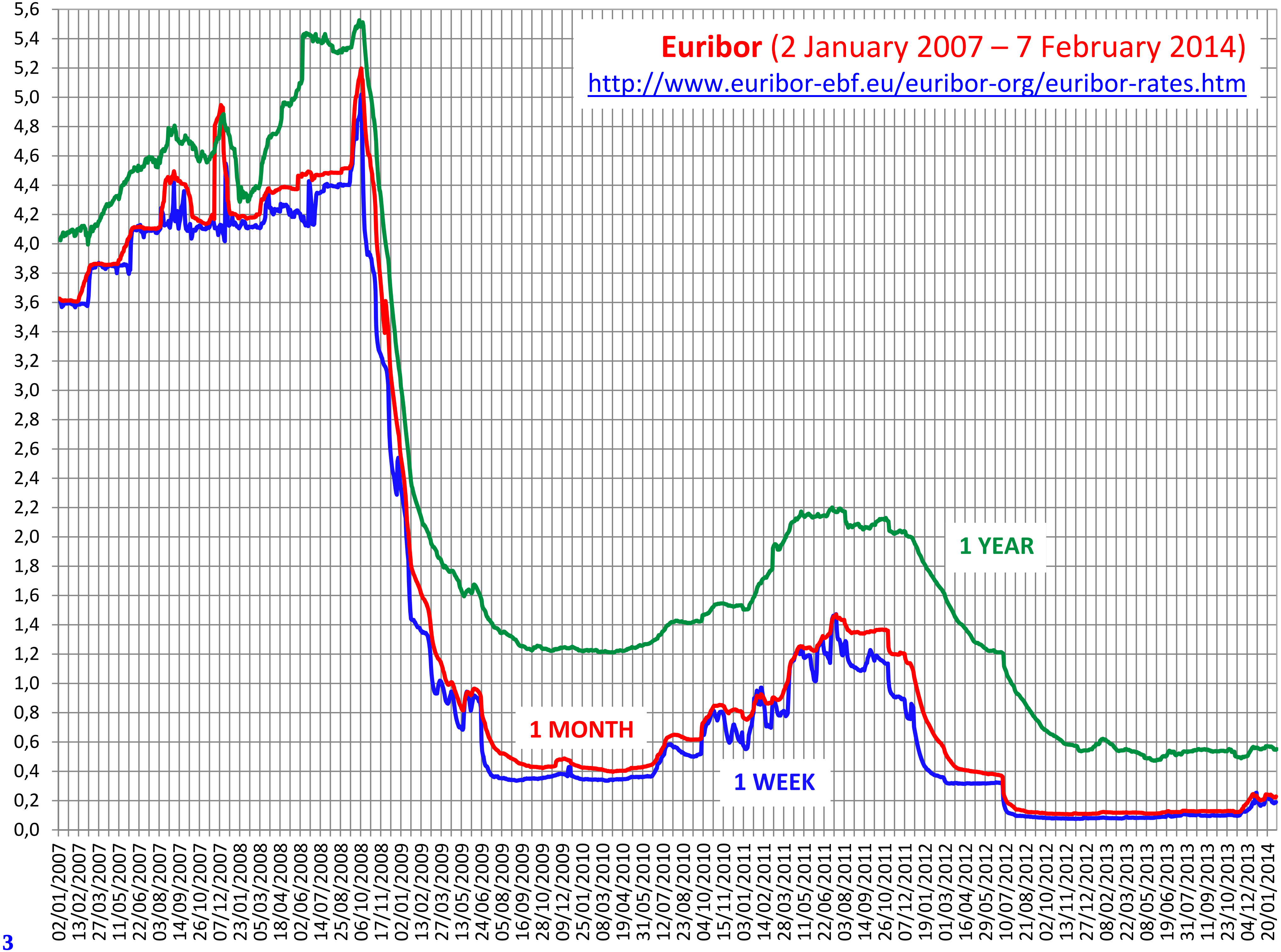
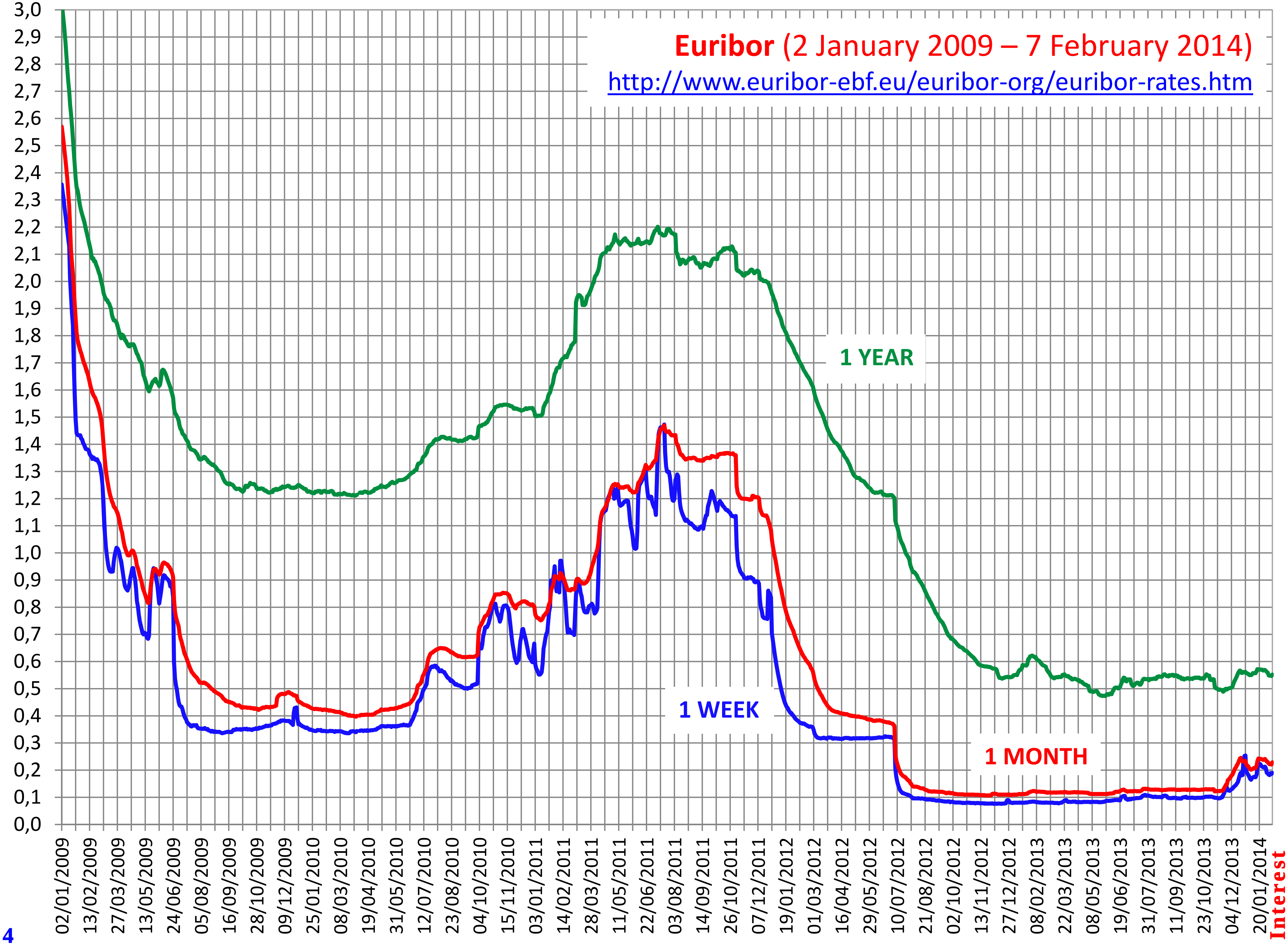

Euribor (2 January 2007 – 7 February 2014)
http://www.euribor-ebf.eu/euribor-org/euribor-rates.htm
1 YEAR
1 MONTH
1 WEEK
5,6 5,4 5,2 5,0 4,8 4,6 4,4 4,2 4,0 3,8 3,6 3,4 3,2 3,0 2,8 2,6 2,4 2,2 2,0 1,8 1,6 1,4 1,2 1,0 0,8 0,6 0,4 0,2 0,0
02/01/2007 13/02/2007 27/03/2007 11/05/2007 22/06/2007 03/08/2007 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



Euribor (2 January 2009 – 7 February 2014)
http://www.euribor-ebf.eu/euribor-org/euribor-rates.htm
1 YEAR
1 WEEK
1 MONTH
Interest
3,0
2,9
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2,0
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1,6
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0,5
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0,3
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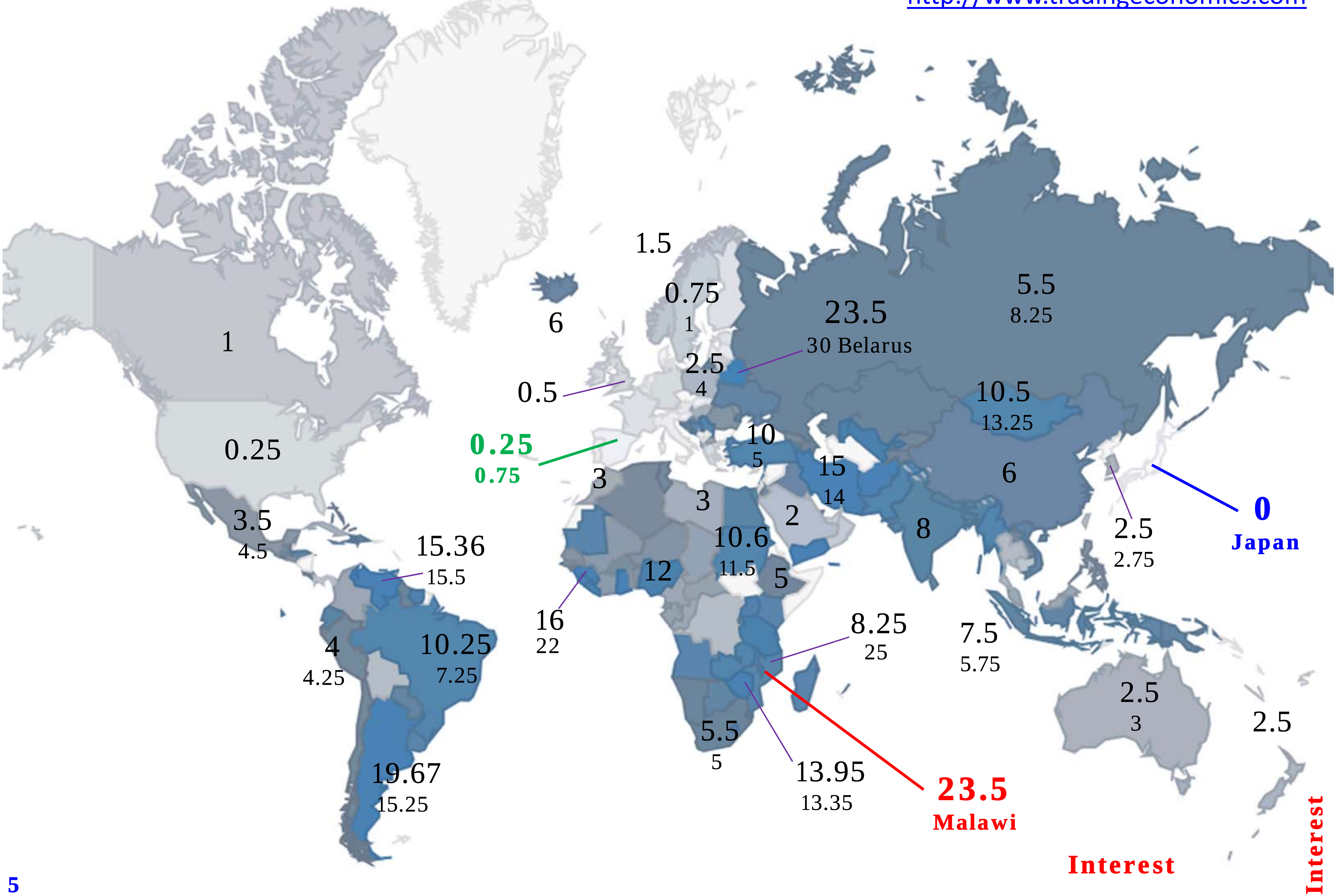
02/01/2009
13/02/2009
27/03/2009
13/05/2009
24/06/2009
05/08/2009
16/09/2009
28/10/2009
09/12/2009
25/01/2010
08/03/2010
19/04/2010
31/05/2010
12/07/2010
23/08/2010
04/10/2010
15/11/2010
03/01/2011
14/02/2011
28/03/2011
11/05/2011
22/06/2011
03/08/2011
14/09/2011
26/10/2011
07/12/2011
19/01/2012
01/03/2012
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

Interest rates · 7 February 2014 (January 2013)

http://www.tradingeconomics.com



	GDP BILLION USD	GDP YOY	GDP QOQ	INTEREST RATE	INFLATION RATE	JOBLESS RATE
JAPAN	5960	2.40%	0.30%	0.00%	1.60%	3.70%
SWITZERLAND	632	1.90%	0.50%	0.00%	0.10%	3.50%
SINGAPORE	275	4.40%	-2.70%	0.01%	1.50%	1.80%
BULGARIA	51	0.70%	0.50%	0.04%	-1.60%	12.00%
CZECH REPUBLIC	230	-1.20%	0.20%	0.05%	1.40%	8.20%
DENMARK	314	0.50%	0.40%	0.20%	0.80%	4.30%
UNITED STATES	15685	2.70%	3.20%	0.25%	1.50%	6.70%
EURO AREA	12195	-0.30%	0.10%	0.25%	0.70%	12.00%
GERMANY	3400	1.10%	0.25%	0.25%	1.34%	5.10%
FRANCE	2613	0.20%	-0.10%	0.25%	0.70%	10.90%
ITALY	2013	-1.80%	0.00%	0.25%	0.70%	12.70%
SPAIN	1349	-0.10%	0.30%	0.25%	0.20%	26.03%
UNITED KINGDOM	2440	2.80%	0.70%	0.50%	2.00%	7.10%
HONG KONG	263	2.90%	0.50%	0.50%	4.30%	3.20%
MACAO	44	10.50%		0.50%	5.72%	1.90%
FIJI	4	2.50%		0.50%	2.30%	7.00%
SWEDEN	526	0.30%	0.10%	0.75%	0.10%	7.50%
LITHUANIA	42	3.30%	1.20%	0.75%	0.40%	10.90%
PANAMA	36	8.90%		0.75%	3.70%	4.00%
CANADA	1821	1.91%	0.70%	1.00%	1.20%	7.20%
UNITED ARAB EMIRATES	360	4.40%	4.40%	1.00%	1.44%	4.20%
ISRAEL	244	3.20%	0.58%	1.00%	1.80%	5.80%
OMAN	76	5.00%		1.00%	1.70%	15.00%
NEW CALEDONIA	10	3.10%		1.00%	0.70%	14.00%
CAMBODIA	14	7.20%		1.12%	4.12%	0.10%
NORWAY	500	2.10%	0.70%	1.50%	2.00%	3.50%
COMOROS	1	3.00%		1.67%	4.20%	13.50%

http://www.tradingeconomics.com · 7 February 2014

	GDP BILLION USD	GDP YOY	GDP QOQ	INTEREST RATE	INFLATION RATE	JOBLESS RATE
MALAWI	4	5.00%		25.00%	23.50%	3.00%
BELARUS	63	0.70%		23.50%	15.33%	0.50%
GAMBIA	1	6.30%		20.00%	5.88%	6.00%
ARGENTINA	475	5.50%	-0.20%	19.67%	10.90%	6.80%
GHANA	41	0.30%	0.50%	18.00%	13.50%	12.90%
GUINEA	7	3.90%		16.00%	10.30%	22.30%
VENEZUELA	382	1.10%	1.19%	15.36%	56.10%	5.60%
IRAN	549	-5.50%		15.00%	35.50%	10.30%
YEMEN	36	0.10%		15.00%	8.60%	29.00%
AFGHANISTAN	20	11.80%		15.00%	6.65%	15.00%
SAO TOME AND PRINCIPE	0	4.00%		14.00%	6.80%	14.00%
ZIMBABWE	11	4.40%		13.95%	0.33%	10.70%
LIBERIA	2	8.30%		13.53%	8.50%	3.70%
NIGERIA	263	7.67%	7.67%	12.00%	8.00%	23.90%
UZBEKISTAN	51	8.10%		12.00%	7.00%	4.80%
TANZANIA	28	6.50%	1.50%	12.00%	5.60%	10.70%
SIERRA LEONE	4	6.20%		12.00%	9.38%	3.40%
SURINAME	5	4.50%		11.74%	0.60%	8.00%
UGANDA	20	2.20%	-0.60%	11.50%	6.90%	4.20%
BURUNDI	2	4.20%		11.45%	9.00%	35.00%
DJIBOUTI	1	4.50%		10.61%	4.88%	59.50%
SUDAN	59	-0.60%		10.60%	29.40%	15.90%
BRAZIL	2435	2.20%	-0.50%	10.50%	5.91%	4.30%
MONGOLIA	10	11.50%	11.50%	10.50%	12.50%	3.60%

http://www.tradingeconomics.com · 7 February 2014

Meaning of the interest rate /1

- That the interest rate (considered as the rate of return of a loan [of currency]) is i means that a moneylender receives at maturity $1+i$ for every unit lent. So 1 (in t) becomes $1+i$ (in $t+1$).

- For the moneylender, i measures the profit of lending 1 unit of currency. For the borrower, i measures the cost of receiving a loan of 1 unit.

- For the moneylender, i is the reward of saving: by giving up 1 today, (s)he gets $1+i$ tomorrow. For the borrower, i is the cost of bringing currency from the future: $1+i$ units from tomorrow can be transformed into 1 unit today.

Meaning of the interest rate /2

- On the one hand, i represents the profit of sending money to the future: the reward for saving.
- On the other, i also represents the cost of bringing money from the future: the cost of a loan.
- It can also be interpreted as a measure of patience: the higher i, the more a borrower is willing to pay for having 1 unit of currency today instead of tomorrow, so the less patient the borrower is.
- A positive i expresses a preference for the present: better to have money today than tomorrow.

The discount factor

- <u>The interest rate transforms today's money into tomorrow's money</u>: 1 today is $(1+i)$ tomorrow.

- <u>The discount factor</u> does the opposite: it <u>transforms tomorrow's money into today's money</u>. It determines present values out of future values as follows.

t		$t+1$
1	$\longrightarrow$	$1+i$
β	$\longleftarrow$	1

- The discount factor transforms 1 into β. This β is the value that, with interest rate i, becomes 1.

- By the rule of three, $\beta = \frac{1 \cdot 1}{1+i} = \frac{1}{1+i}$ is the <u>discount factor</u> (it depends on i).

Interest rate and asset prices

- The price of an asset and the price of money (= the nominal interest rate) move in opposite directions.

- Illustration. A T-bill has face value V and price P. Let i be defined for a loan with the same maturity as the T-bill. If you have €P, you have two options.

  - Option 1: lend P. At maturity, you get $(1 + i) \cdot P$.
  - Option 2: buy the T-bill. At maturity, you get V.

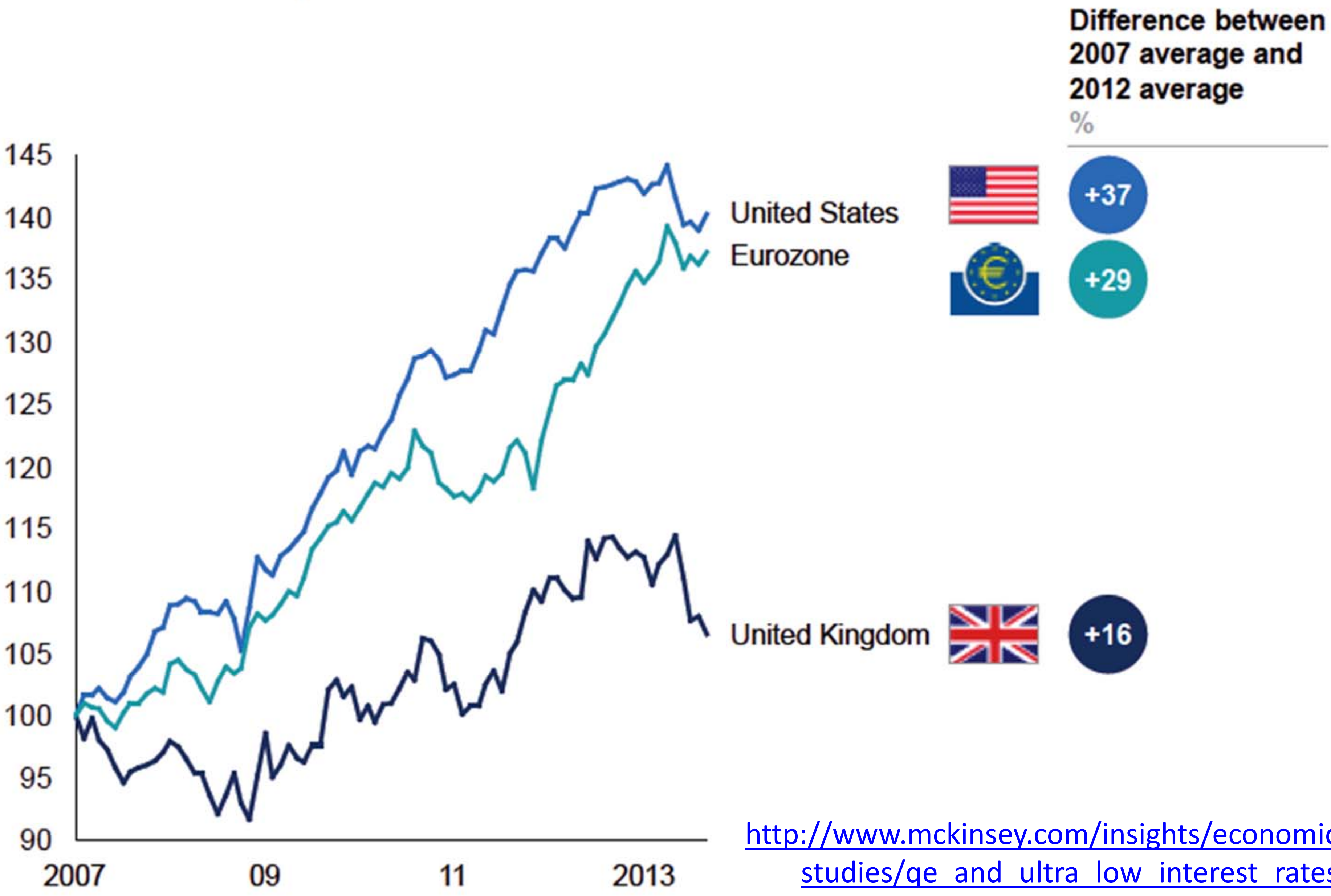
- If the results must be equal, then $(1 + i) \cdot P = V$, so

$$P = \frac{V}{1 + i} \quad : \quad \text{the larger } i \text{, the smaller } P.$$

Bond prices rose significantly across advanced economies

Bond price indexes[1]

Index: 100 = January 2007

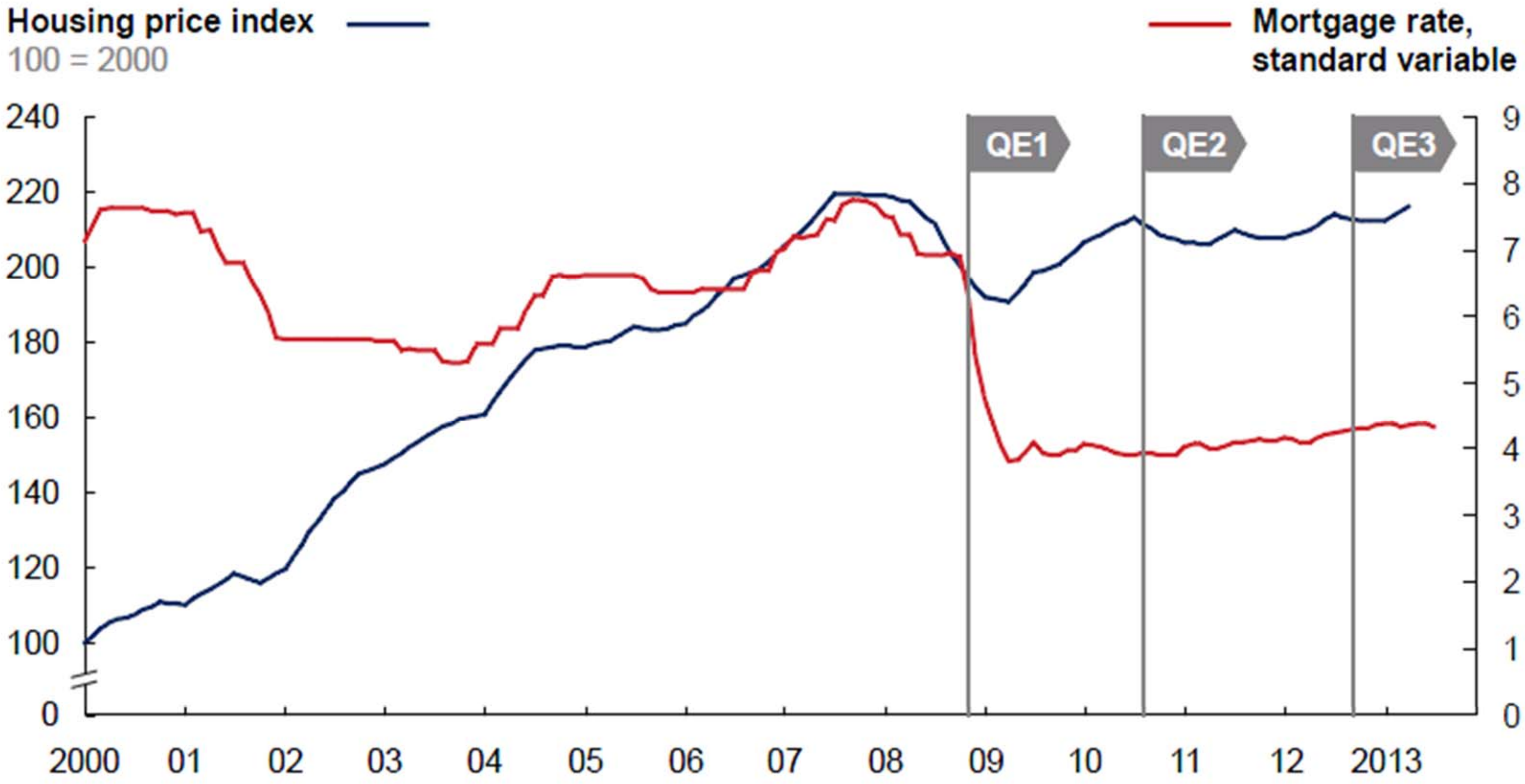


http://www.mckinsey.com/insights/economic_studies/qe_and_ultra_low_interest_rates_distributional_effects_and_risks

1 Barclays aggregate total return indexes in local currency.

SOURCE: Datastream; Bloomberg; McKinsey Global Institute analysis

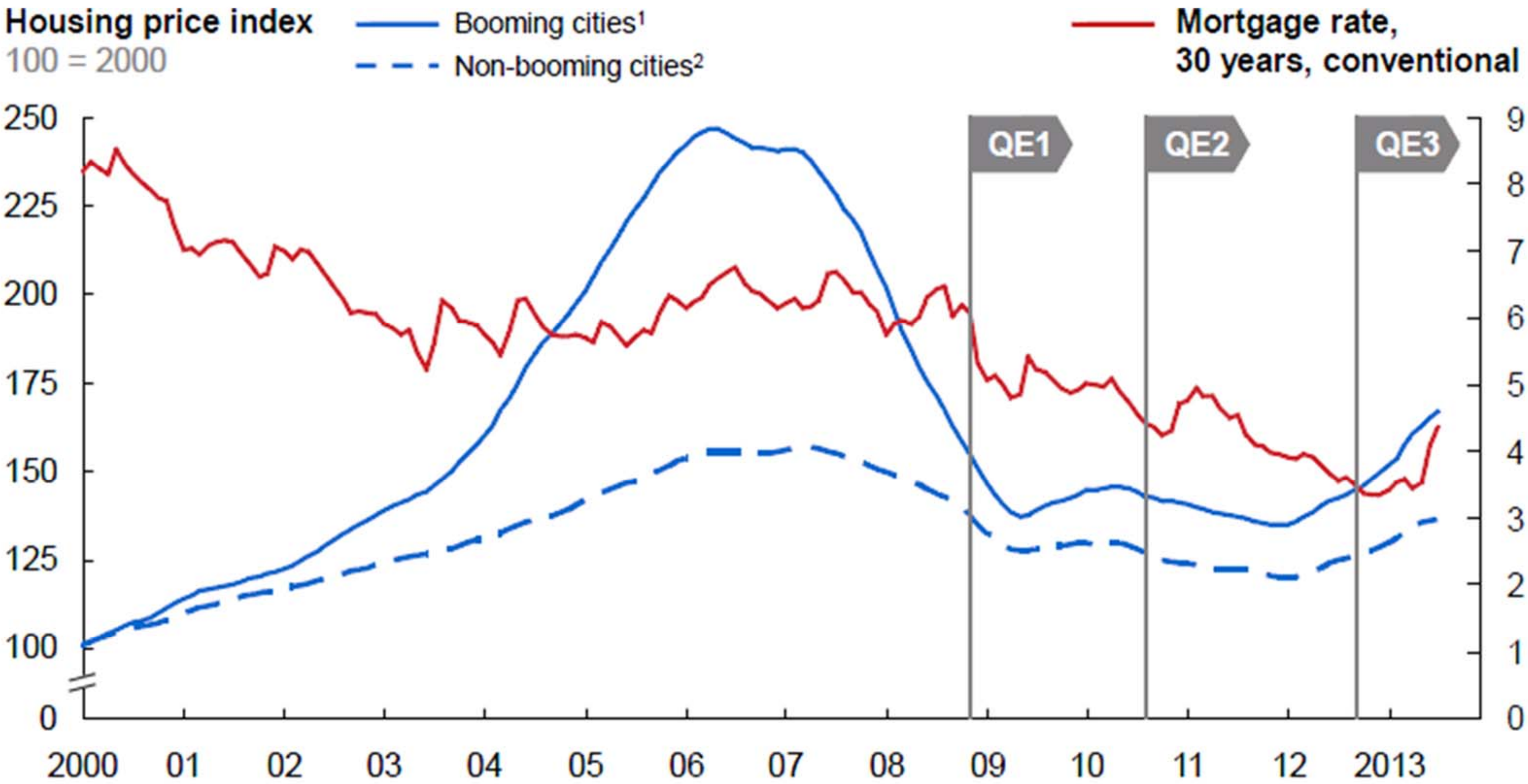
In the United Kingdom, the typical relationship between mortgage rates and house prices weakened after 2003, but the trend persists



SOURCE: Bank of England; UK Office for National Statistics; McKinsey Global Institute analysis

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

In the United States, the typical inverse relationship between mortgage rates and house prices broke down after 2004



1 Las Vegas; Tampa; Miami; Washington DC; San Francisco; San Diego; Los Angeles; and Phoenix.
2 Seattle, Dallas, Portland (Oregon), Cleveland, New York, Charlotte, Minneapolis, Detroit, Boston, Chicago, Atlanta, and Denver.

SOURCE: Standard & Poor's; US Federal Reserve; McKinsey Global Institute analysis

Source: sames as immediately preceding slide

Interest

Arbitrage in action /1

- Suppose $V > (1+i) \cdot P$. An arbitrageur can then obtain sure profits (even having no money at all).

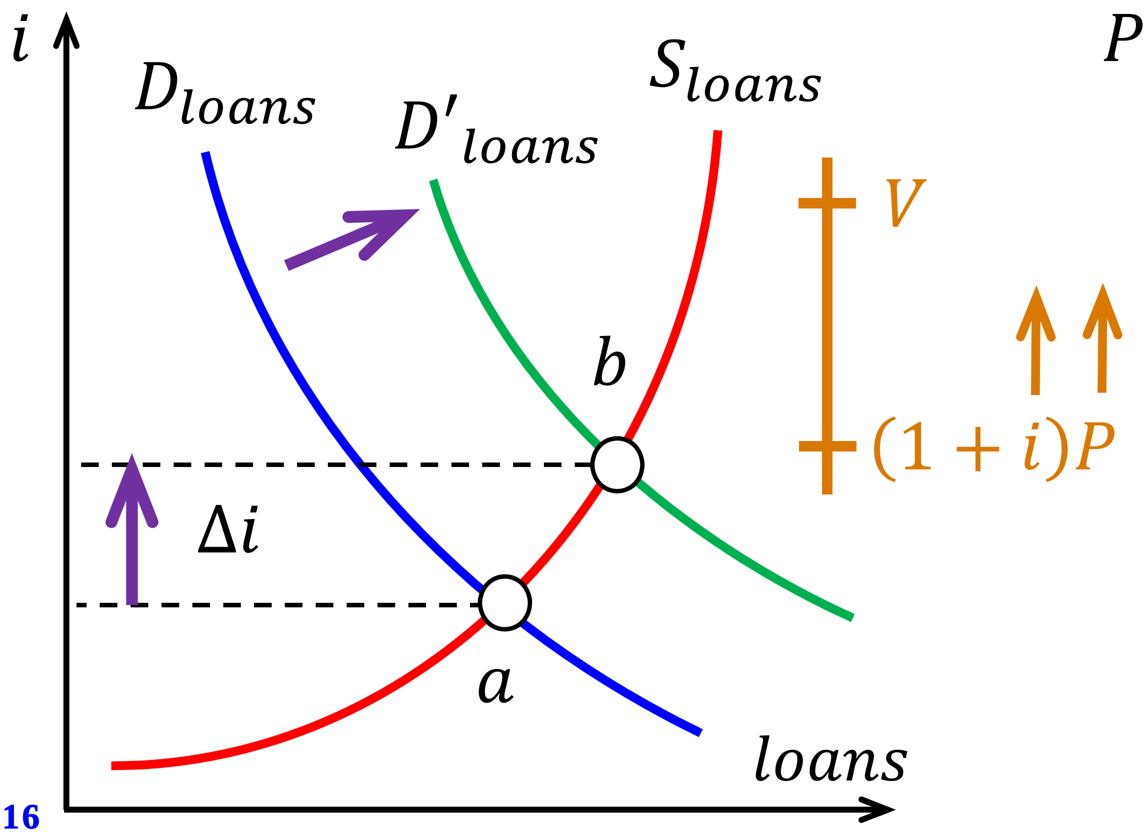
- First, €P are borrowed, so $(1+i) \cdot P$ must be repaid the next period. A T-bill is purchased with €P.

- At maturity, the T-bill pays V. As $V > (1+i) \cdot P$, the arbitrageur repays the loan and pockets a profit of $V - (1+i) \cdot P$. If $V = 1{,}000$, $P = 800$, and $i = 10\%$, each T-bill financed by a loan generates a profit of 120. If this is done by many arbitrageurs, both i and P tend to rise. As a result, $V - (1+i) \cdot P$ tends to diminish.

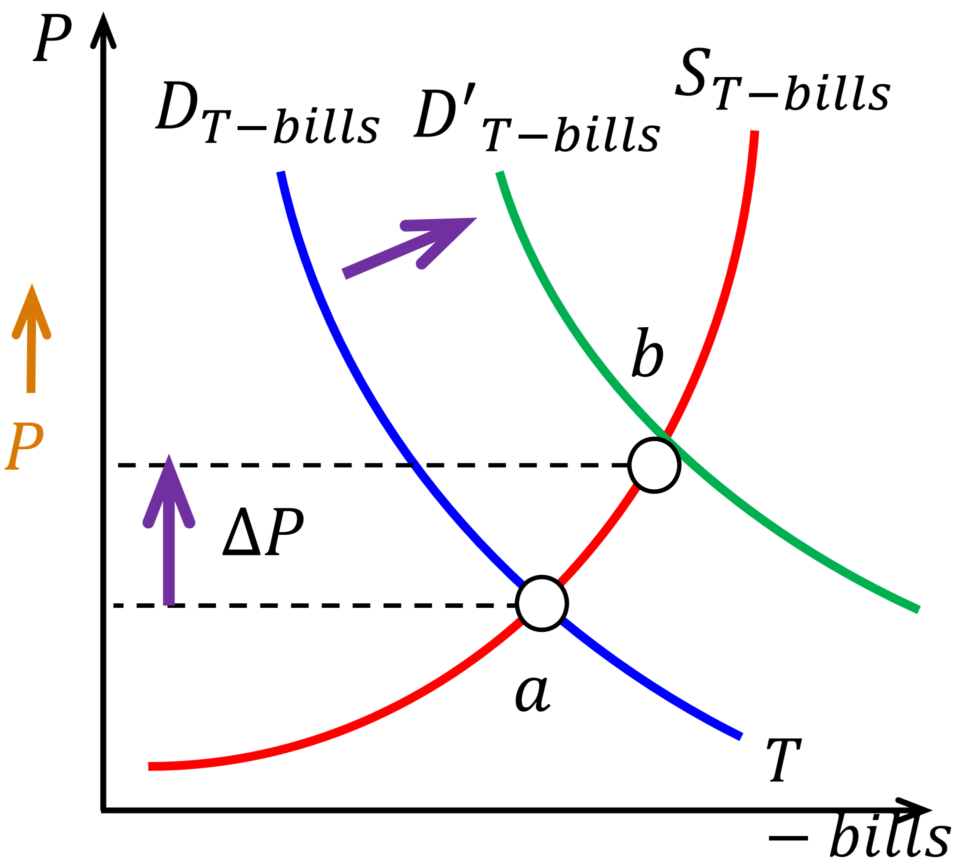
Arbitrage in action /2

- If $V > (1+i) \cdot P$, EUR are borrowed. D_{loans} shifts to the right and i increases. T-bills are bought with the borrowed EUR. This shifts $D_{T-bills}$ to the right and P goes up. Thus, $(1+i) \cdot P$ approaches V.

Loan market



T-bill market



Prices of assets as present values

- The future value of the T-bill is V. With interest rate i, the present discounted value of V is

$$\frac{1}{1+i}V, \quad \text{where } \frac{1}{1+i} \text{ is the discount factor.}$$

- Therefore, the condition

$$P = \frac{V}{1+i}$$

states that <u>the price of a T-bill coincides with the present discounted value of its face (future) value</u>.

Equalization of rates of return

- It is reasonable to expect the equalization of the interest rates of all financial assets, for otherwise the assets with smaller rate would have no demand.
- The interest rate i_B implicit in the T-bill is $i_B = \dfrac{V-P}{P}$ whereas i represents the interest rate of a loan.
- Accordingly, the equalization $i = i_B$ of rates leads to
$$i = i_B = \frac{V-P}{P} = \frac{V}{P} - 1, \quad \text{so } 1 + i = \frac{V}{P}.$$
- Solving for P yields the condition $P = \dfrac{V}{1+i}$.

Central banks

- The central bank is the monetary authority in an economy. It is the public institution that, typically,
  - provides and regulates the money supply (M1, M2, M3);
  - issues the currency (see the letters "ECB" in banknotes);
  - controls the interest rates and/or the inflation rate;
  - oversees the banking system;
  - acts as a lender of last resort to the banking system;
  - establishes mininum reserve requirements;
  - is independent of the government.

- For the purposes of this course, the CB is the agent who determines and executes the monetary policy.

Monetary policy instruments

- There are three standard tools by means of which a central bank can influence the money stock.
- The quantity tool: changes in the supply of reserves to the banking system through open market operations or direct lending.
- The formal regulatory tool: changes in the reserve requirement.
- The price tool: changes in the interest rate at which the CB lends (called "discount rate" in the US).

Open market operations (OMOs)

- Open market operations. Consist of the sale or purchase of financial assets (government bonds, for instance). They try to control the money supply.

- Expansionary OMOs expand the money supply by buying bonds: the CB gets bonds in exchange for currency, so there is more currency in the economy.

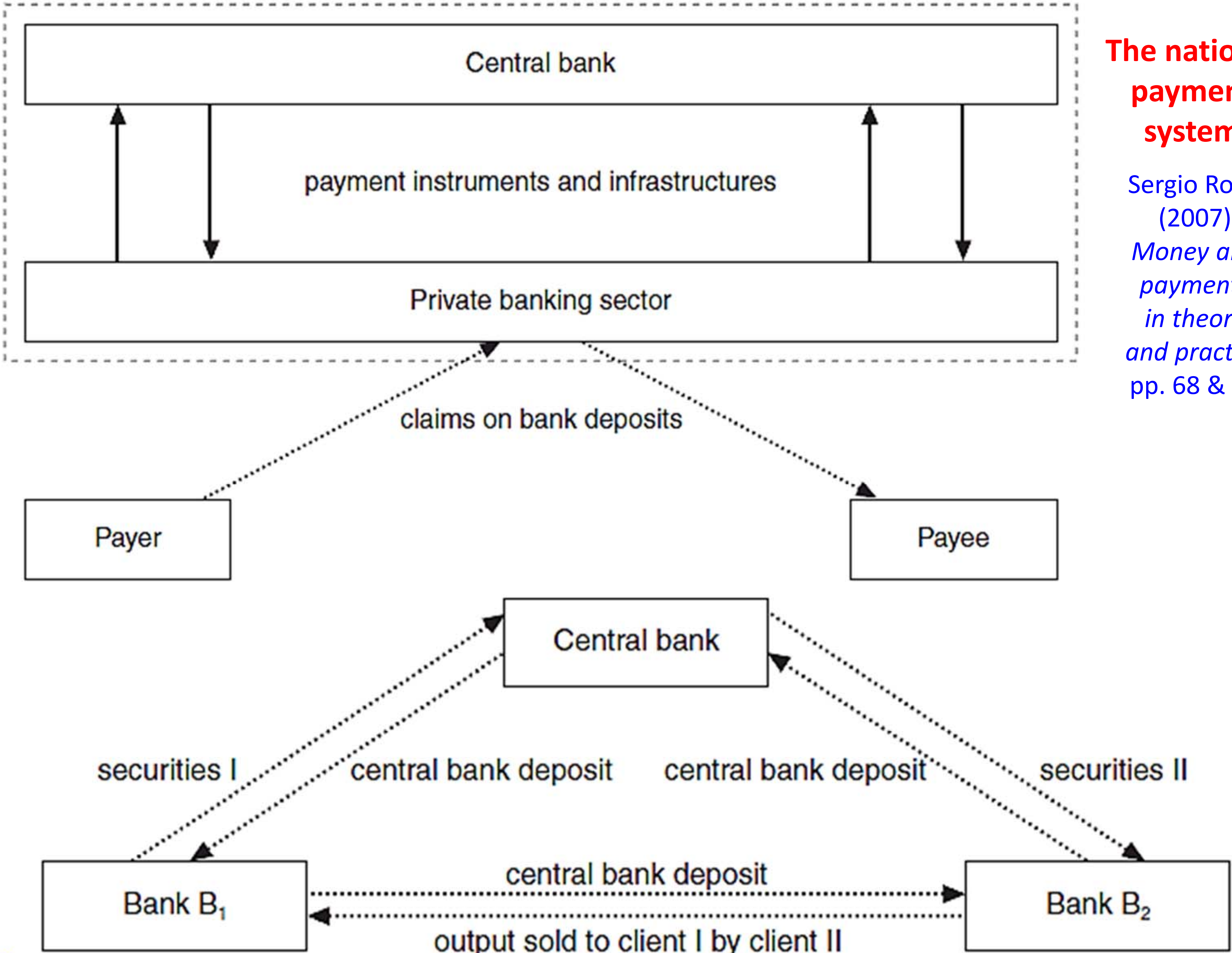
- Contractionary OMOs contract the money supply by selling bonds: the CB injects bonds in the economy in exchange for currency, which, in entering the CB, is detracted from the economy.

Reserves /1

- Reserve requirements. They define the minimum amount of reserves that banks must deposit on the central bank. It is usually computed as a fraction (the reserve ratio) of (sight) deposits.

- By increasing the reserve ratio, the CB detracts lending funds from banks: less loans, less expenditure, less revenue, less deposits, smaller M1. This reduces the money multiplier: $\uparrow r \Rightarrow \downarrow mm$.

- A reduction of the reserve ratio has an expansive effect on M1: more fuel can be added to the flames.



The national payment system

Sergio Rossi (2007) *Money and payments in theory and practice* pp. 68 & 78

Interest

Reserves /2

- The banks' reserves held on account at the CB are simply numbers (like deposits). One of the purposes of the reserves system is to settle inter-bank payments. That is why banks must retain each day enough reserves to facilitate the interbank clearing process plus enough cash reserves to meet the withdrawal requests from depositors.

- Reserves also contribute to control the money stock by altering the portion of any deposit that has to be retained (under a zero reserve requirement, banks would have no constraint to create deposits).

The CB interest rate(s)

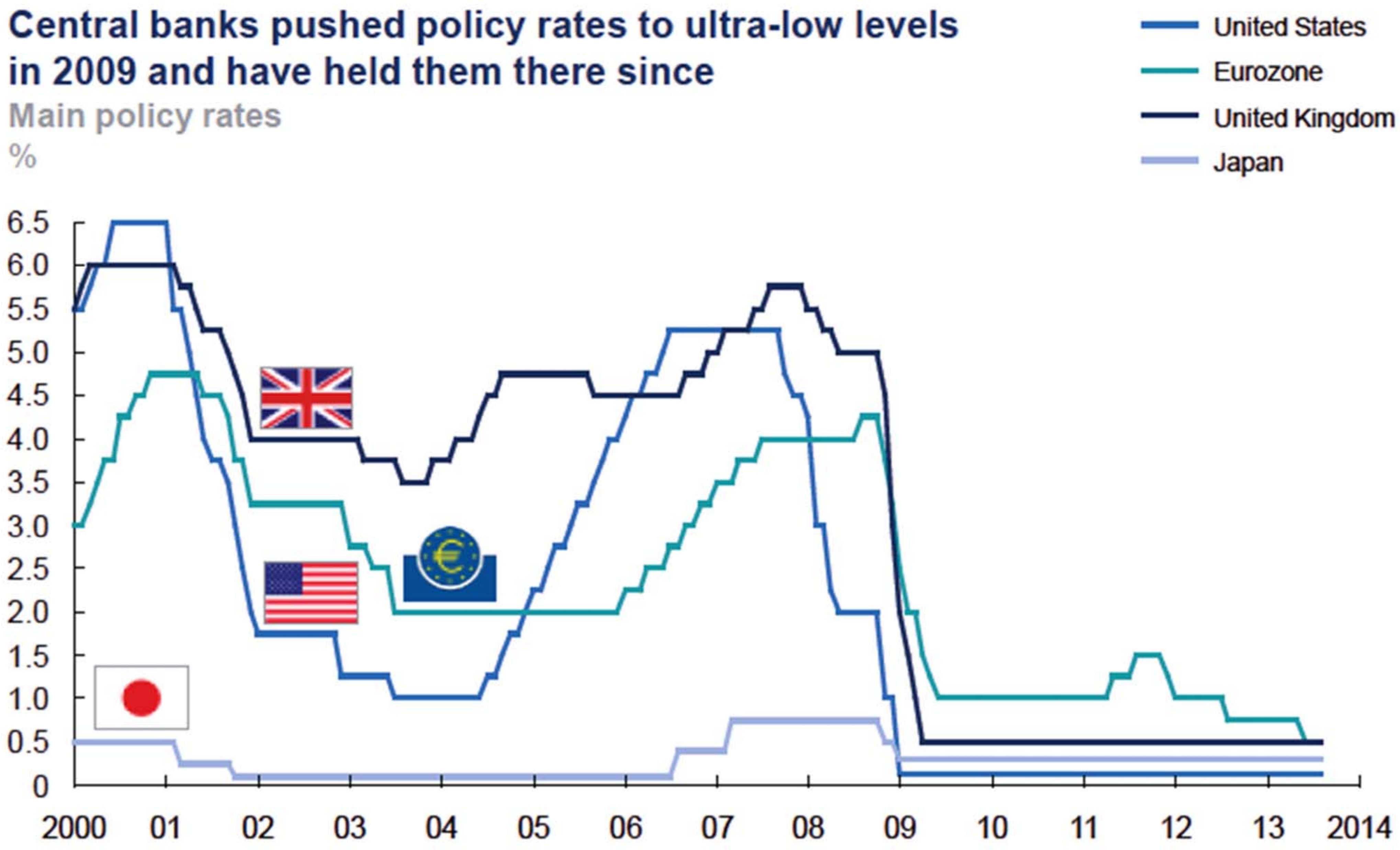
- The interest rate (or rates) at which the CB lends. Both in normal or in distress situations the CB may be interested in lending or borrowing.

- To reduce the money stock by borrowing, the CB must make lending to the CB sufficiently attractive for banks by rising appropriately the interest rate offered.

- Conversely, to expand the money stock by lending, the CB must make borrowing from the CB more attractive for banks by lowering appropriately the interest rate offered.

Name of interest rate 21 Feb 2014	country/region	current rate	direction	previous rate	change
American interest rate FED	United States	0.250 %	↓	1.000 %	12-16-2008
Australian interest rate RBA	Australia	2.500 %	↓	2.750 %	08-06-2013
Banco Central interest rate	Chile	4.250 %	↓	4.500 %	02-18-2014
Bank of Korea interest rate	South Korea	2.500 %	↓	2.750 %	05-09-2013
Brazilian interest rate BACEN	Brazil	10.500 %	↑	10.000 %	01-15-2014
British interest rate BoE	Great Britain	0.500 %	↓	1.000 %	03-05-2009
Canadian interest rate BOC	Canada	1.000 %	↑	0.750 %	09-08-2010
Chinese interest rate PBC	China	6.000 %	↓	6.310 %	07-06-2012
Czech interest rate CNB	Czech Republic	0.050 %	↓	0.250 %	11-01-2012
Danish interest rate Nationalbanken	Denmark	0.200 %	↓	0.300 %	05-02-2013
European interest rate ECB	Europe	0.250 %	↓	0.500 %	11-07-2013
Hungarian interest rate	Hungary	2.700 %	↓	2.850 %	02-19-2014
Indian interest rate RBI	India	8.000 %	↑	7.750 %	01-28-2014
Indonesian interest rate BI	Indonesia	7.500 %	↑	7.250 %	11-12-2013
Israeli interest rate BOI	Israel	1.000 %	↓	1.250 %	09-23-2013
Japanese interest rate BoJ	Japan	0.100 %	↓	0.100 %	10-05-2010
Mexican interest rate Banxico	Mexico	3.500 %	↓	3.750 %	10-25-2013
New Zealand interest rate	New Zealand	2.500 %	↓	3.000 %	03-10-2011
Norwegian interest rate	Norway	1.500 %	↓	1.750 %	03-14-2012
Polish interest rate	Poland	2.500 %	↓	2.750 %	07-03-2013
Russian interest rate CBR	Russia	8.250 %	↑	8.000 %	09-14-2012
Saudi Ariabian interest rate	Saudi Arabia	2.000 %	↓	2.500 %	01-19-2009
South African interest rate SARB	South Africa	5.500 %	↑	5.000 %	01-29-2014
Swedish interest rate Riksbank	Sweden	0.750 %	↓	1.000 %	12-17-2013
Swiss interest rate SNB	Switzerland	0.250 %	↓	0.500 %	03-12-2009
Turkish interest rate CBRT	Turkey	10.000 %	↑	4.500 %	01-29-2014

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



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

An informal tool

- CBs may also resort to an unofficial ("extra-legal") regulatory tool: direct control of the quantity of bank credit. The CB informs the banks by how much they are allowed to increase lending in a certain period. Violation of the limit is punished.

- This practice has been widespread in developing countries but also adopted by most developed countries (from 1945 to the 1980s). Names given: "credit controls", "corset", "lending ceilings", "credit planning scheme", "window guidance", "*Kredit-Plafondierung*", "*encadrement du crédit*", …

The CB cannot control both *i* and M1

- Suppose the CB wants to reduce the money supply by selling T-bills. To induce banks to buy T-bills, the CB must lower appropriately the current price of T-bills: otherwise, banks may not be willing to buy T-bills. But a reduction in the price of the T-bill rises its rate of return, so the average interest rate of the economy rises. In sum, <u>↓M1 implies ↑*i*.</u>

- Conversely, if the CB wants to increase the money supply by buying T-bills, the demand for T-bills shifts to the right, causing a price rise. This leads to a fall in the rate of return of T-bills: <u>↑M1 implies ↓*i*</u>.

Effects of OMOs on *i* and M1

- Suppose the aim of the CB is to reduce M1 by means of an OMO (for instance, a sale of T-bills).

sale of T-bills → ↑supply T-bills → ↓price T-bills → (*inverse relationship*) ↑*i*

sale of T-bills → ↓M0 → (*money multiplier*) ↓M1

- The attempt to control M1 entails a loss of control over *i*: the two cannot simultaneously be controlled (M1 and *i* cannot be both reduced). If the sale of T-bills aims at rising *i*, the loss of control is over M1.

Endogenous and exogenous money

- M1 is exogenous (imposed by the CB) when the CB exercises a rigid control over M0, leaving the interest rate to settle at whatever value is necessary for loans to generate the desired level of M1.

- M1 is endogenous (demand-led) when the CB supplies whatever reserves banks require to achieve a certain desired intereste rate. The CB chooses the interest rate (the price of bank loans) and M1 is next determined by "the economy" (factors behind the demand for loans by people and firms).

Regulate M1 or *i*?

- In theory, by setting the level of CB reserves, the money stock could be largely controlled (given *mm*, controlling M0 implies controlling M1).

- Time ago monetary targets were chosen and the aim of was to control some monetary aggregate.

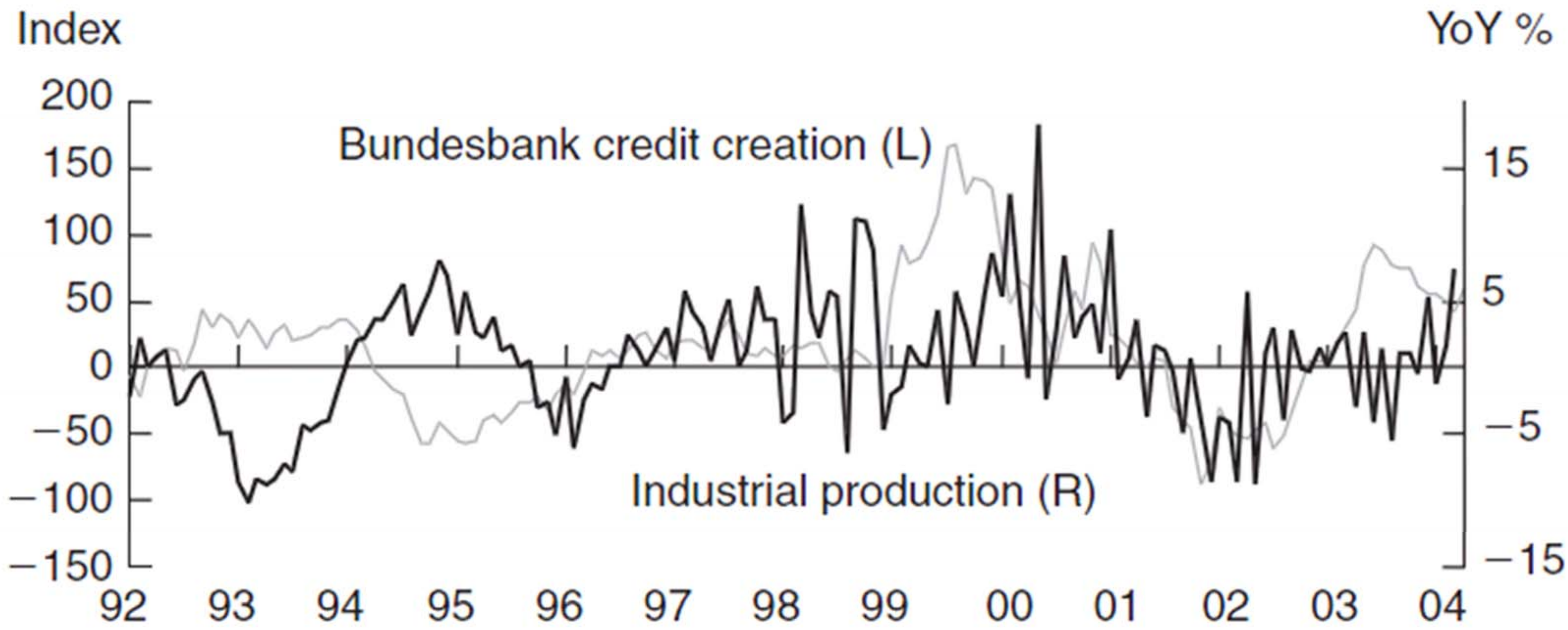
- To free regulated funds (mandatory reserves), banks created new financial assets that performed the same functions as regulated assets but were not subject to regulation. For the target not to be missed, the CB had to redefine the monetary aggregate to include the new assets.

CBs nowadays tend to control *i*

- The banks replied with more creativity, increasing the difficulties of monetary control. The list of monetary aggregates in UK includes M0, NIBM1, M1, M2, M3, M3c, PSL1, PSL2, M4, M4c, M3H, M5…

- CBs eventually gave up and nowadays M1 is endogenous: the CB supplies reserves on demand but sets its price (the interest rate). At that price, demand determines loans and M1. That price also guides banks to set their own interest rates.

Bundesbank credit creation and economic activity
(evidence for the endogeneity of the money stock)



Richard Werner (2005): *New paradigm in Macroeconomics. Solving the riddle of Japanese macroeconomic performance*, p. 315

Central banking in a nutshell

- "Virtually every monetary economist believes that the CB can control the monetary base . . . Almost all those who have worked in a CB 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

Four schools /1

- Endogenous money school. Holds that causation runs from economic activity to money.
- Monetarist school. Money is viewed as exogenous, so causation works in reverse order: from money to economic activity.
- The credit school. There are three versions. (1) Lending view. Money also affects the economy through liabilities (borrowing and credit). The reduction of bank reserves also reduces the banks' access to loanable funds, which affects negatively the supply of bank loans.

Four schools /2

- (2) Credit rationing argument. The interest rate alone does not fully captures the links between the real and financial sectors. The availability of credit is also important, which depends on the banks' willingness to grant credit. Borrowers may be rationed when loans have collateral requirements.

- (3) Balance sheet channel. Changes in interest rates affect the value of financial assets. This influences the access to, and the demand for, funding.

- Neutrality of money school. Contends that money is neutral, that is, has no influence (at least in the medium run) on real variables (economic activity).

Eurosystem

- The Eurosystem is the monetary authority of the eurozone, the 18 EU (European Union) members that have adopted the euro as official currency.
- It consists of the ECB (European Central Bank) and the CBs of the eurozone members (the national CBs applies the monetary policy (MP) the ECB decides).
- Primary objective: price stability. Secondary objectives: financial stability and financial integration.
- It is different from the European System of Central Banks (ESCB = ECB + CBs of all the EU members).

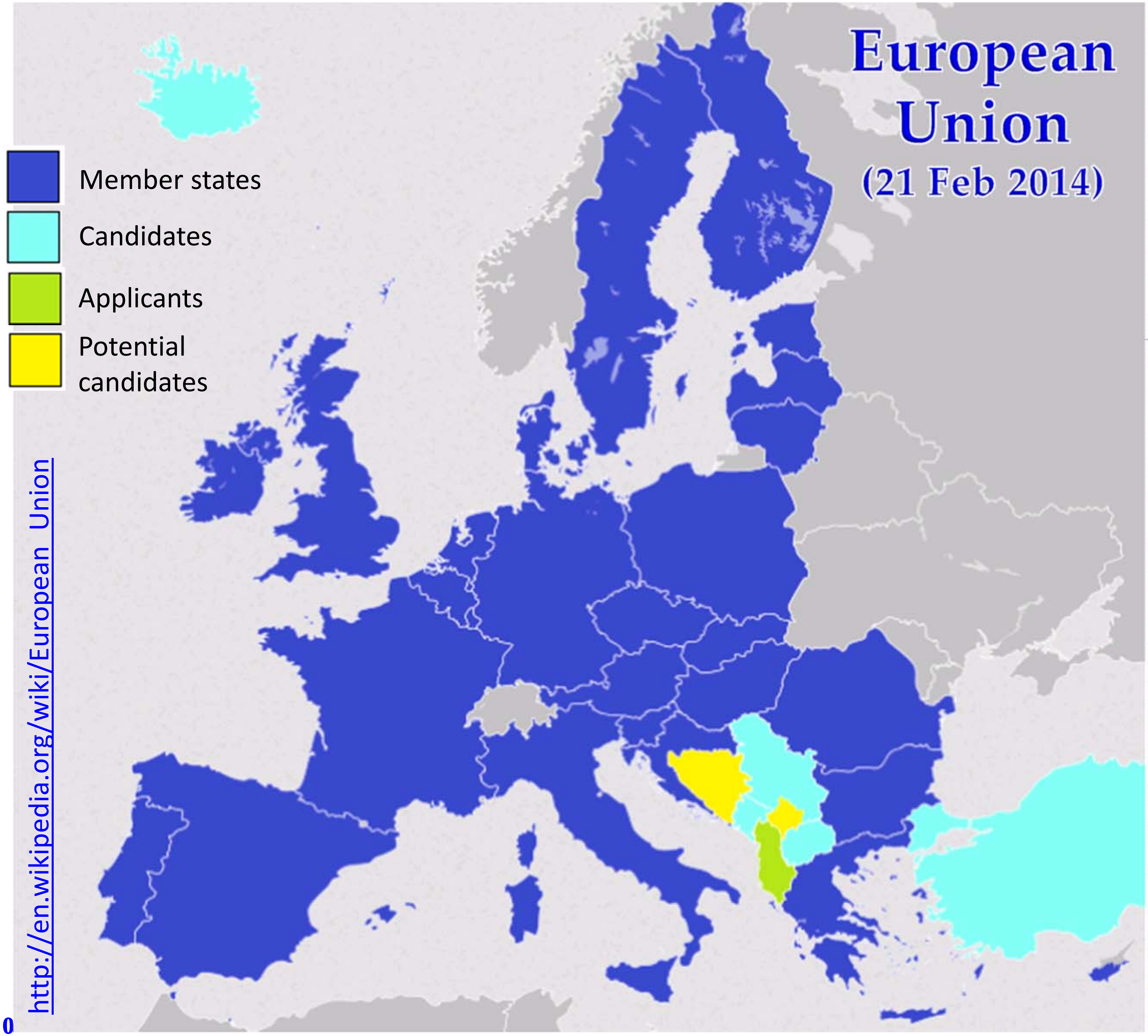
http://en.wikipedia.org/wiki/Eurosystem

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

The Eurozone

as from 1 Jan 2014

Interest



- Austria €
- Belgium €
- Bulgaria
- Croatia
- Cyprus €
- Czech Republic
- Denmark
- Estonia €
- Finland €
- France €
- Germany €
- Greece €
- Hungary
- Ireland €
- Italy €
- Latvia €
- Lithuania
- Luxembourg €
- Malta €
- Netherlands €
- Poland
- Portugal €
- Romania
- Slovakia €
- Slovenia €
- Spain €
- Sweden
- United Kingdom

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

Interest

European Central Bank

- Established by the Treaty of Amsterdam in 1998.
- Core of the Eurosystem and the ESCB and responsible for the conduct of the MP since 1 Jan 1999.
- In practice, the Eurosystem can be identified with the ECB (both have the same decision-making bodies).

http://www.ecb.int/ecb/html/index.en.html

Interest

Decision-making bodies of the ECB

- Governing Council. It is the main decision-making body of the ECB. Formulates the MP for the euro-zone (liquidity and key ECB interest rates decisions). Ensures the performance of the tasks assigned to the Eurosystem.

- Executive Board. Implements the MP according to the guidelines and decisions by the GC. Manages the day-to-day business of the ECB.

- General Council. It is a transitional body: will be dissolved once all EU members have adopted the euro. It helps to coordinate eurozone members with the rest of EU members.

Governing Council

- Consists of the six members of the Executive Board plus the 18 governors of the national central banks of the 18 euro area countries.

Feb 2014

Panicos O. Demetriades, Luis M. Linde, Ewald Nowotny, and Ignazio Visco were not available at the time the photograph was taken.

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

Interest

Executive Board

- Consists of 6 members, including the President (Mario Draghi) and th Vice-President.

Feb 2014

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

Interest

General Council

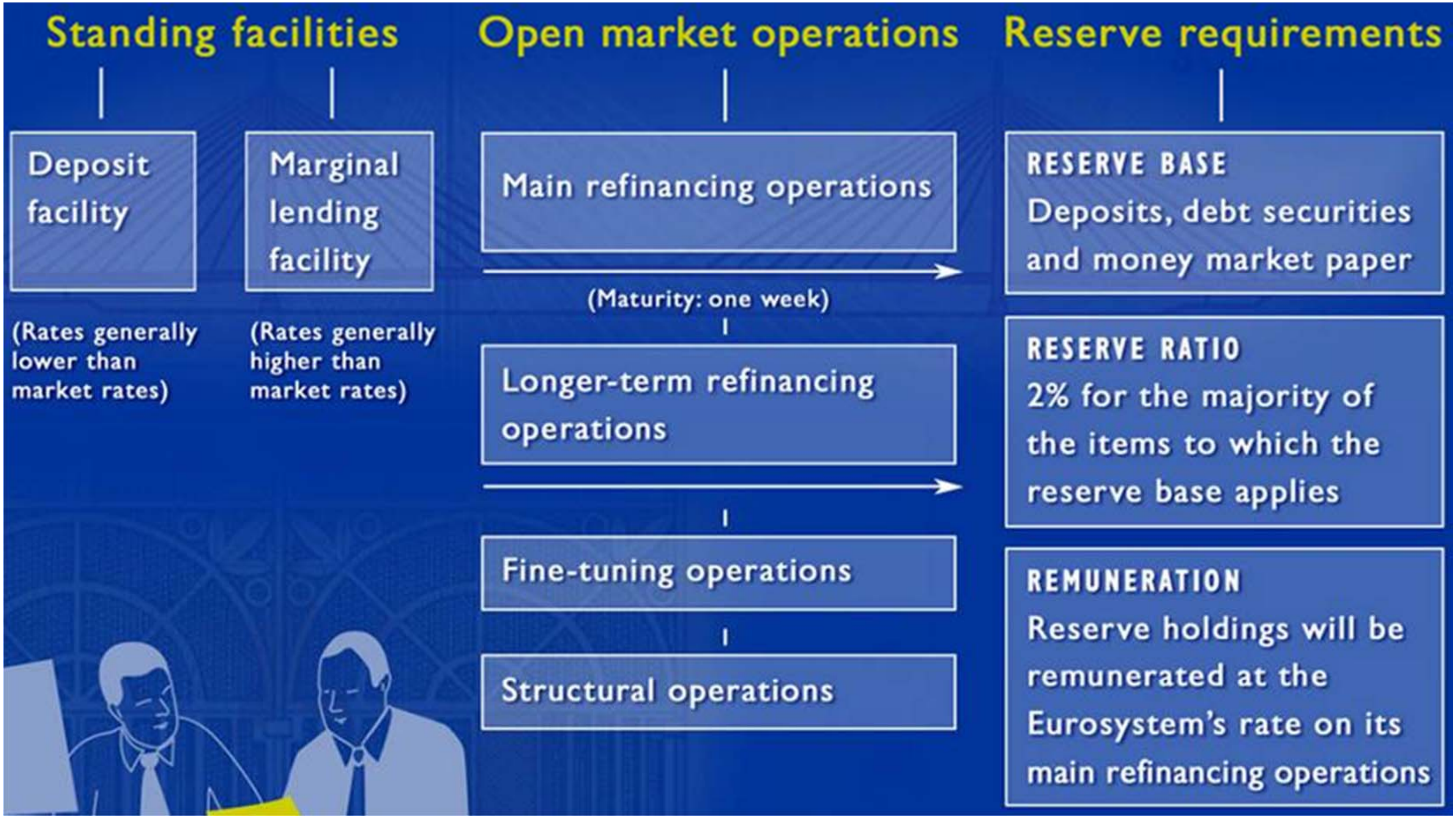
- Consists of the President and the Vice-President of the ECB plus the governors of the national CBs of the 28 EU Member States.

Sep 2013

George A. Provopoulos and Mugur Constantin Isărescu were not available at the time the photograph was taken.

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

Interest



Monetary policy instruments of the European Central Bank

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

Reserve requirements

- The minimum reserve system pursues the stabilization of money market interest rates and the regulation of liquidity.

- The reserve ratio is around 2% (1% since 18 Jan 12). Compliance is determined on the basis of averages of reserve holdings during the maintenance period.

- Reserves are remunerated at the average of MROs rates (.25%). Reserve holdings above the minimum are not remunerated. Non-compliance is penalized (penalty rate for deficiencies, 3.25%).

http://www.ecb.europa.eu/mopo/implement/mr/html/index.en.html

http://www.ecb.int/mopo/implement/mr/html/calc.en.html

Reserve maintenance statistics

- From 13/02 to 11/03/2008 average required reserves amounted to €200 billion, the remuneration rate was 4.1%, and the penalization rate 7.5%.
- From 21/01 to 10/02/09: €221 billion, 2%, 5.5%.
- From 08/12/09 to 19/01/10, €210 billion, 1%, 4.25%.
- In February 2011: €212 billion, 1%, and 4.25%.
- From 15/02 to 13/03/12, €104.2 billion, 1%, 4.25%.
- 12/12/12-15/01/13: €106 bn. Dec 2013: €103.3 bn.

http://www.ecb.int/mopo/implement/mr/html/index.en.html

Standing facilities

- "Standing facilities are aimed at providing and absorbing overnight liquidity, signal the general stance of MP and bound overnight market interest rates. Two standing facilities are available to eligible counterparties on their own initiative."

- Counterparties (banks) can use: (i) the marginal lending facility to obtain overnight liquidity from the national CBs against eligible assets (the interest rate on the MLF is a ceiling for overnight market rates); or (ii) the deposit facility to make overnight deposits with the national CBs (the interest rate on the DF is normally a floor rate).

Types of OMO by the ECB

- According to aim, regularity, and procedures, OMOs are classified into four categories: main refinancing operations (MROs), longer-term refinancing operations, structural operations, and fine-tuning operations.

- Five types of instruments are available to conduct OMOs : reverse transactions (the most important instrument), outright transactions, issuance of debt certificates, foreign exchange swaps, and the collection of fixed-term deposits.

http://www.ecb.int/pub/pdf/other/gendoc2006en.pdf

OMOs by the ECB	*Maturity/ frequency*	*Liquidity*
Main refinancing operations	1 week/weekly	provision (RT)
Longer-term refinancing operations	3 months/monthly	provision (RT)
Structural operations	not standardized	provision/absorption
Fine-tuning operations	not standardized	provision/absorption
Reverse transactions		provision/absorption
Outright transactions	not standardized	provision/absorption
Foreing exchange swaps	not standardized	provision/absorption
Issuance of debt certificates	< 12 months/…	absorption
Collection of fixed-term deposits	not standardized	absorption

http://www.ecb.europa.eu/ecb/legal/pdf/l_33120111214en000100951.pdf

http://www.ecb.int/mopo/implement/omo/html/index.en.html

Reverse transactions and MROs

- “Reverse transactions refer to operations where the Eurosystem buys or sells eligible assets under repurchase agreements or conducts credit operations against eligible assets as collateral.”

- “The MROs are the most important OMOs conducted by the Eurosystem, playing a pivotal role in pursuing the aims of steering interest rates, managing the liquidity situation in the market and signalling the stance of MP. They also provide the bulk of refinancing to the financial sector.”

http://www.ecb.int/pub/pdf/other/gendoc2006en.pdf Chapter 3

MROs

- MROs constitute the basic tool of monetary policy.
- They are liquidity-providing reverse transactions.
- Executed regularly each week.
- Normally have a maturity of one week.
- Executed in a decentralized manner by the national CBs of the Eurosystem.
- Executed in the form of standard tenders: a fixed rate (volume) tender or a variable rate (interest) tender.

Fixed/variable rate tender MROs

- In a fixed rate tender MRO, the ECB specifies the interest rate in advance. Participants next bid the amount of money they would like to transact at the given interest rate.

- In a variable rate tender MRO, participants "bid the amounts of money and the interest rates at which they want to enter into transactions with the national central banks".

- Since October 2008, MROs are conducted at fixed rates (as from 13 Nov 2013, 0.25%).

http://www.ecb.europa.eu/stats/monetary/rates/html/index.en.html

Example of a fixed rate tender MRO

- The ECB wants to provide liquidity and decides to allot €300 million at a given interest rate i.

- Only four counterparties (banks) submit a bid: $B1 = 160$, $B2 = 80$, $B3 = 100$, and $B4 = 60$ EUR millions. Thus, total demand is 400. The percentage of allotment is $300/400 = 0.75 = 75\%$.

- Each bank is allotted the 75% of its bid: B1 receives $120 = 160 \cdot 75\%$; B2 gets $60 = 80 \cdot 75\%$; B3 is assigned $75 = 100 \cdot 75\%$; and B4 obtains $45 = 60 \cdot 75\%$.

Fixed rate tender with full allotment

- The late-2000s financial crisis was triggered by a liquidity shortfall that caused some large US financial institutions to collapse.
- To enhance the provision of liquidity, the GC decided on 15 Oct 2008 to conduct all longer-term refinancing opera-tions through a fixed rate tender procedure with full allotment. On 7 Nov 2013 the GC decided to continue conducting its main, spe-cial-term and longer-term refinancing operations as fixed rate tender procedures with full allotment for as long as necessary, and at least until July 2015.

http://www.ecb.europa.eu/mopo/implement/omo/html/index.en.html
http://www.ecb.europa.eu/press/govcdec/otherdec/2013/html/gc131122.en.html
http://en.wikipedia.org/wiki/Late-2000s_financial_crisis

Example of a variable rate tender MRO

- The ECB decides to provide liquidity by an amount of €70 million. Only two banks bid, B1 & B2. The bid consists of a list of interest rates and amounts demanded at each rate; see the next slide. For instance, at 5%, B1 asks for €7 m and B2 asks for €3 m. Column 4 indicates total bids: 10 at 5%; 30 at 4%; 50 at 3%; and 110 at 2%. Column 5 displays cumulative bids: up to 5%, 10; up to 4%, 40; up to 3%, 90; and up to 2%, 200.

- Banks ask for 200, whereas the ECB only offers 70. The ECB determines the allotment as follows.

Example of a variable rate tender 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

Example of a variable rate tender MRO

- The ECB starts with the highest rate (5%) and fully allots the bids (10). Only 60 remain to be assigned.
- At the following rate (4%), banks ask for 30. Since there are 60 to be allocated, banks receive 30, so there are only 30 left to be assigned.
- At 3% banks ask for 50. Since there are only 30 to be assigned, the percentage of allotment is 30/50 = 60%. As in the fixed rate tender, this percentage is applied to the bids at 3%.
- The table in the previous slide summarizes the results: B1 is allotted 29 and B2 is assigned 41.

Marginal interest rate of the tender

- It is given by the smallest interest rate at which some bid is (maybe partially) satisfied.

- It is obtained by finding the first cumulative bid larger than the amount the ECB wants to inject. In the case at hand, the cumulative bid is 90.

- The interest rate associated with the cumulative bid defines the marginal interest rate of the tender (above that rate, full allotment holds: all banks are given what they ask for). In the present example, it is 3%.

Interest rates applied to allotments

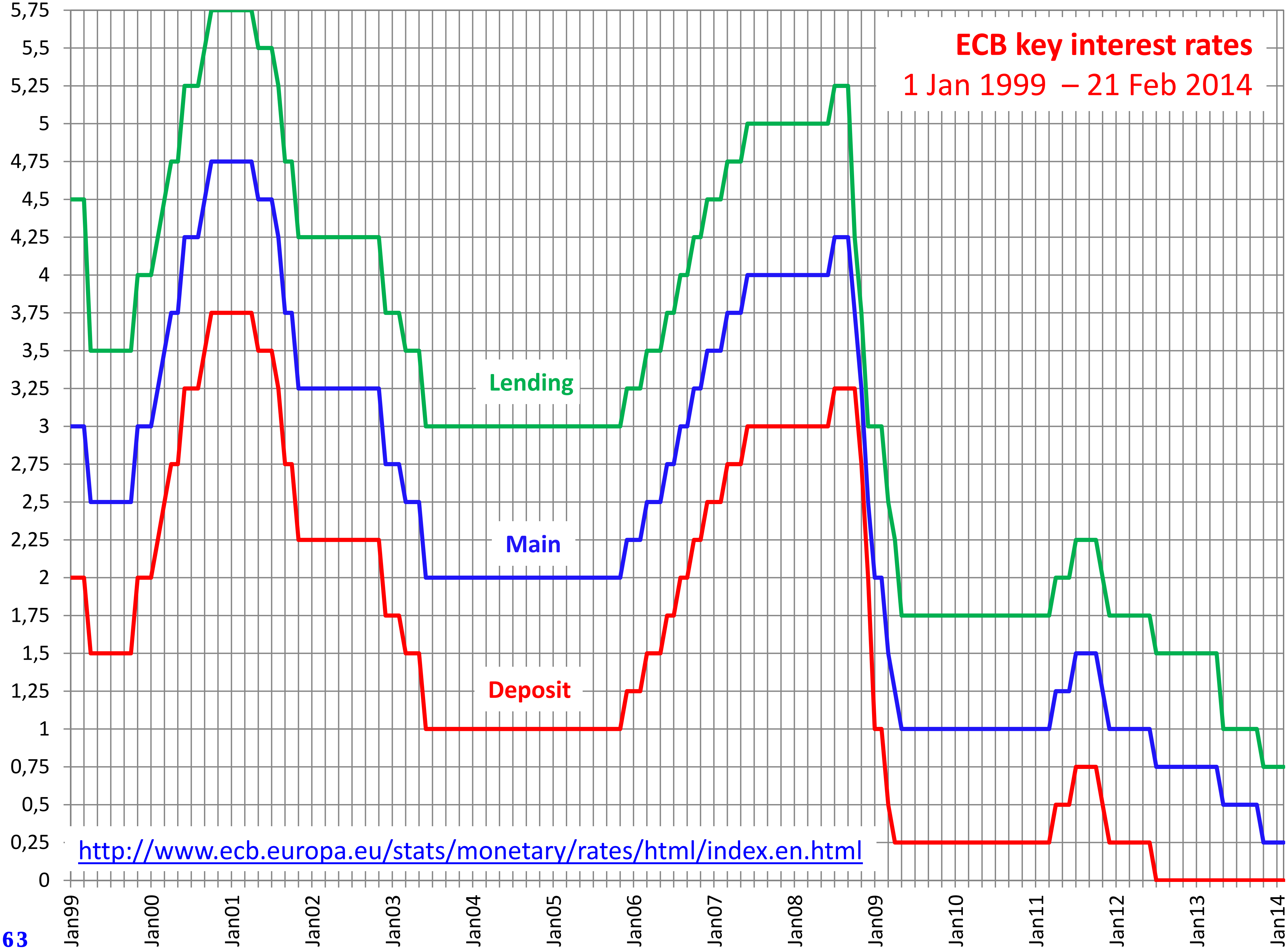
- There are two basic procedures to determine the interest rate applied to allotments.

- If the allotment procedure is given by a multiple rate (American) auction, B1 receives 7 (at 5%) + 10 (at 4%) + 12 (at 3%) = 29 and B2 gets 3 (at 5%) + 20 (at 4%) + 18 (at 3%) = 41.

- If the allotment procedure follows a fixed rate (Dutch) auction, B1 receives 29 at the marginal rate (3%) and B2 gets 41 also at the marginal rate (3%).

Interest rates set by the ECB

- Of the three interest rates set by the ECB, the key one is the interest rate of MROs. Since 13 Nov 2013, the fixed rate MROs , the procedure currently adopted, has been set at 0.25% (4.25% was the last minimum bid rate accepted in a variable rate MRO; the procedure changed to fixed rate in Oct 2008).
- The interest rate on the deposit facility (what banks obtain from an overnight deposit at national CBs) is, since 11 Jul 2012, at 0% (previously, 0.25%).
- The interest rate on the marginal lending facility (what banks must pay for overnight lending) is, since 13 Nov 2013, 0.75%. http://www.ecb.int/home/html/index.en.html


ECB key interest rates
1 Jan 1999 – 21 Feb 2014
Lending
Main
Deposit
http://www.ecb.europa.eu/stats/monetary/rates/html/index.en.html
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
Jan99
Jan00
Jan01
Jan02
Jan03
Jan04
Jan05
Jan06
Jan07
Jan08
Jan09
Jan10
Jan11
Jan12
Jan13
Jan14

Euro area NCBs' contributions to the ECB's capital

National central bank	Capital key %	Paid-up capital (€)
Nationale Bank van België/Banque Nationale de Belgique (Belgium)	2.4778	268,222,025.17
Deutsche Bundesbank (Germany)	17.9973	1,948,208,997.34
Eesti Pank (Estonia)	0.1928	20,870,613.63
Central Bank of Ireland (Ireland)	1.1607	125,645,857.06
Bank of Greece (Greece)	2.0332	220,094,043.74
Banco de España (Spain)	8.8409	957,028,050.02
Banque de France (France)	14.1792	1,534,899,402.41
Banca d'Italia (Italy)	12.3108	1,332,644,970.33
Central Bank of Cyprus (Cyprus)	0.1513	16,378,235.70
Latvijas Banka (Latvia)	0.2821	30,537,344.94
Banque centrale du Luxembourg (Luxembourg)	0.2030	21,974,764.35
Central Bank of Malta (Malta)	0.0648	7,014,604.58
De Nederlandsche Bank (The Netherlands)	4.0035	433,379,158.03
Oesterreichische Nationalbank (Austria)	1.9631	212,505,713.78
Banco de Portugal (Portugal)	1.7434	188,723,173.25
Banka Slovenije (Slovenia)	0.3455	37,400,399.43
Národná banka Slovenska (Slovakia)	0.7725	83,623,179.61
Suomen Pankki – Finlands Bank (Finland)	1.2564	136,005,388.82
Total[1]	**69.9783**	**7,575,155,922.19**

http://www.ecb.int/ecb/orga/capital/html/index.en.html

A model for the interest rate

- The liquidity (or loan or loanable funds) market model is a model to determine the nominal interest rate.
- It is similar to a competitive market model in which market equilibrium specifies the nominal interest rate.
- A market demand function represents the demand for liquidity (for loans, for credit) in the economy. A sort of market supply function represents the supply of liquidity (loans, credit) in the economy.

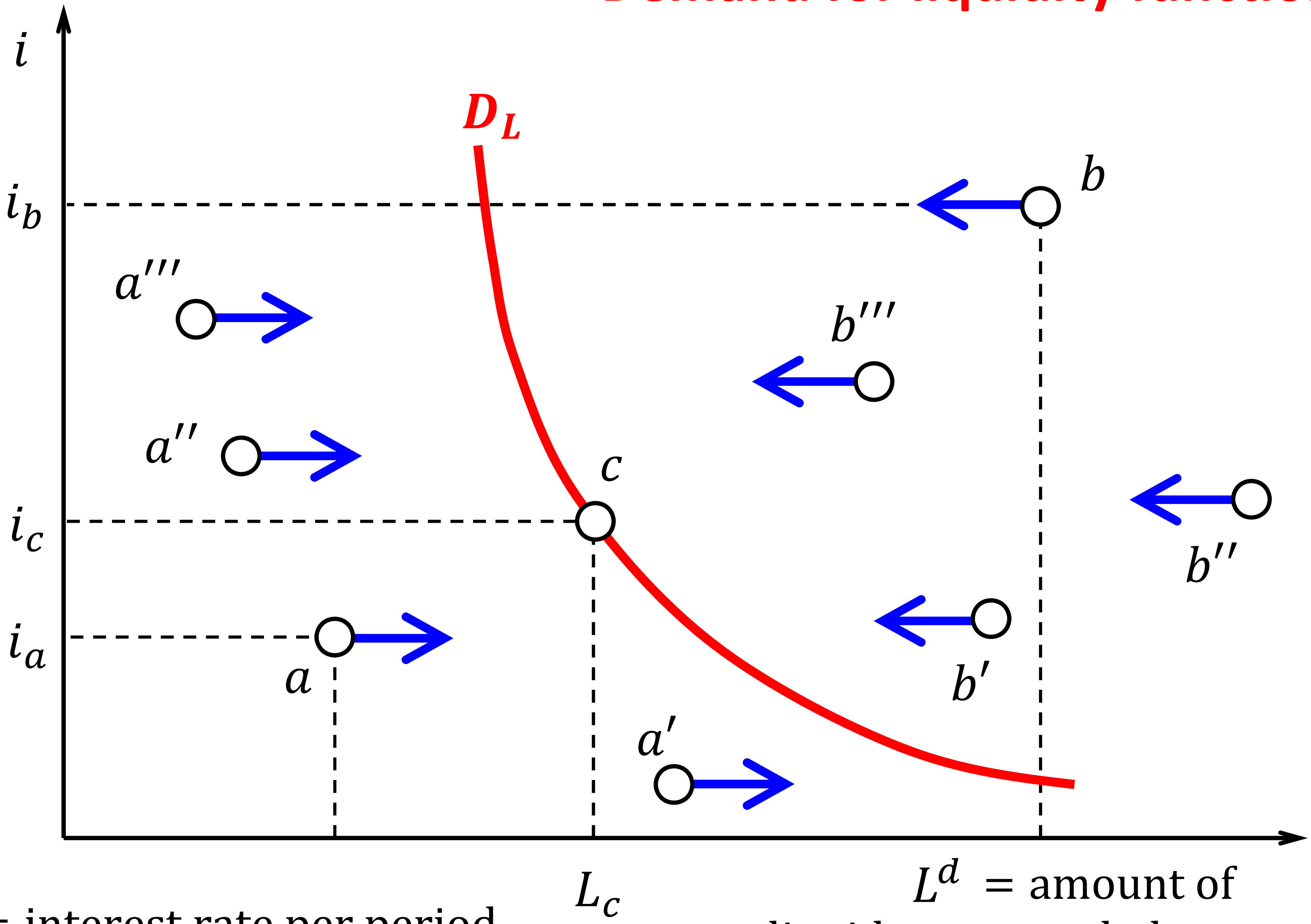
Dynamics of the demand for liquidity

- Let i denote the interest rate of the economy and L^d the volume of liquidity demanded in the economy.

- Consider the plane whose points are pairs (i, L^d); see the next slide. For some points (like a) corresponding to low levels of demand for liquidity, it is likely that, at the associated interest rate i_a, the demand for liquidity will tend to increase.

- Conversely, for points like b, representing a sufficiently high liquidity demand, it is likely to cut the demand for liquidity at the corresponding rate i_b.

Demand for liquidity function



L^d = amount of liquidity demanded per period

i = interest rate per period

Demand for liquidity function /1

- The same should be established at every point (i', L'^d) of the plane (like a', b', a'', …): at interest rate i', is there a tendency for L'^d to rise or to fall?

- The demand for liquidity function consists of those pairs (i, L^d) where, at the given interest rate i, there is no tendency for L^d to change.

- The demand for liquidity function could take any form. In the previous slide, it is represented by the downward sloping curve. For instance, point c on the curve means that, at interest rate i_c, the desired total amount of liquidity demanded is L_c.

Demand for liquidity function /2

- The market demand function for liquidity establishes, for each value of the nominal interest rate, the total amount of liquidity demanded at that rate.
- It represents the decisions by borrowers (investors).
- It is assumed downward sloping: the higher the rate, the smaller the volume of liquidity demanded.
- The agents generating the demand for liquidity are consumers (consumer credits, loans for house purchase), firms (trade credit, issuance of corporate bonds), and the government (T-bills, bonds).

Direct & indirect demand for liquidity

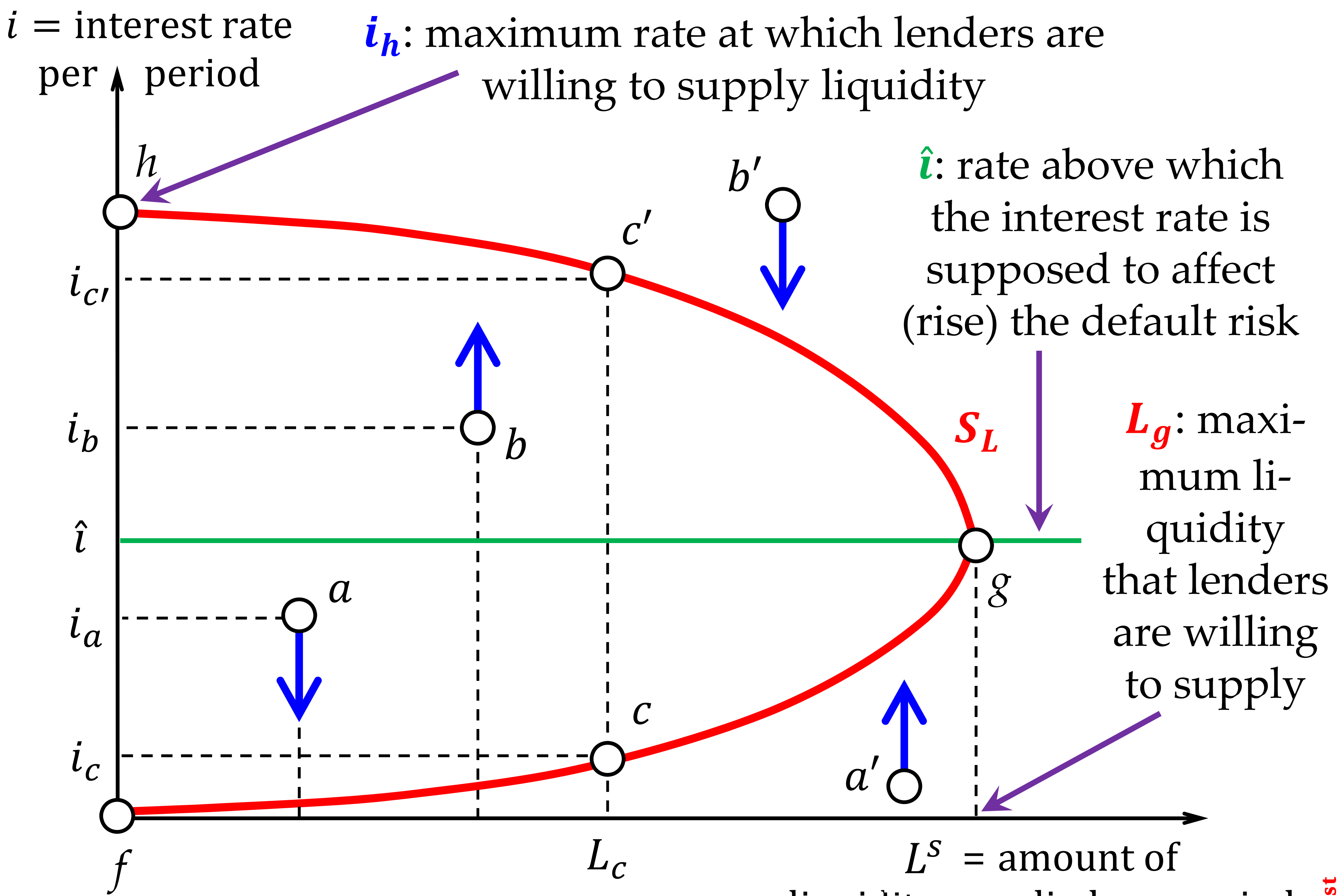
- The direct demand for liquidity corresponds to loan applications typically addressed to banks; for instance, the demand for loans for house purchase.
- The indirect demand for liquidity is given by the sale or issuing of interest-bearing financial assets, like T-bills, government bonds, corporate bonds…
- There is no substantial difference between the two components of liquidity demand: when a bank accepts a loan application, it is as if the applicant sold a financial asset to the bank (the loan).

Dynamics of the supply of liquidity

- The behaviour of the supply of liquidity is assumed to be slightly more complex that the demand for liquidity. To begin with, the adjustement variable will be i, not L.

- Given a pair (i, L^s) representing the supply of liquidity provided at interest rate i, the question is whether suppliers would be willing to rise or lower i.

- The answer is assumed to depend on whether i is higher or smaller than a given $\hat{\imath}$. The rate $\hat{\imath}$ separates two regions with different supply dynamics.



Supply of liquidity function

Supply of liquidity function /1

- Low risk (of default) is represented by the interval below $\hat{\imath}$. The high risk region is above $\hat{\imath}$.
- At points below the horizontal line drawn at $\hat{\imath}$, supply behaves "normally": it is upward sloping. At a, liquidity providers feel that the charged interest i_a may be excessive, so they are willing to supply the same amount of liquidity at a smaller rate.
- At points like a', they feel the opposite: a higher rate could be charged. There should lie, between a and a', the set of points at which it is felt that the interest rate is "the right one" for the given amount of liquidity supplied (the curve going from f to g).

Supply of liquidity function /2

- At points below the horizontal line drawn at $\hat{\imath}$, <u>supply behaves atypically: it is downward sloping</u>. At b, liquidity providers feel that the charged interest i_b is too low to compensate for the default risk presumed, so they tend to rise it. At points like b', the rate is considered too high, so it is lowered.

- There should lie, between a and a', the curve with the points where it is felt that the interest rate is "the right one" for the given amount of liquidity supplied (the curve joining g and h). <u>Supply diminishes when going from g and h because higher interests make default more likely</u>.

Supply of liquidity function /3

- A rise of the interest rate above $\hat{\imath}$ interpreted as an increase in default risk that also increases the likely that the money lent will not be retrieved at maturity. If the money was spent in buying securities, the risk rise increases i the likelihood that the securities could not be sold (or could only be sold at a very low price) in secondary markets.

- The resulting supply of liquidity function is such that any volume of liquidity L_c can be offered at two interest rates, depending on the level of risk perceived: low interest i_c corresponding to low risk; high interest $i_{c'}$, associated with high risk.

Supply of liquidity function /4

- The market supply function for liquidity relates the total amount of liquidity supplied to the nominal interest rate at which this amount is supplied.

- It represents the decisions by lenders (savers).

- In "normal" circumstances ($i < \hat{\imath}$), it is assumed upward sloping: higher rate, more liquidity supplied.

- The agents creating the supply of liquidity are banks & financial intermediaries, buyers of interest-bearing financial assets, and the central bank.

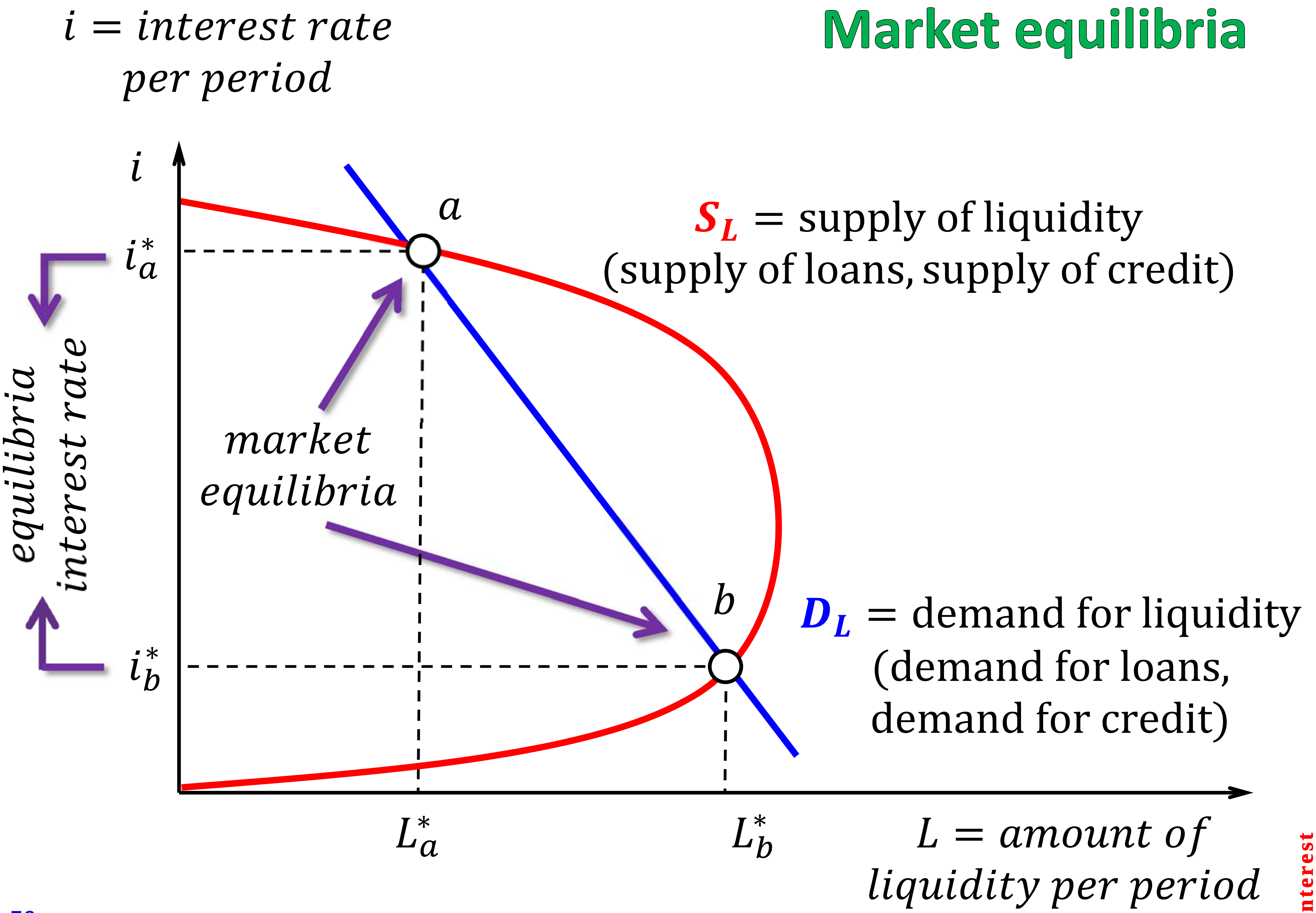
Direct & indirect supply of liquidity

- The direct supply of liquidity is provided by banks (who supply consumers, firms, and other banks) and the central bank (who supplies banks).

- The indirect supply of liquidity corresponds to <u>purchases of (interest-bearing) financial assets</u>.

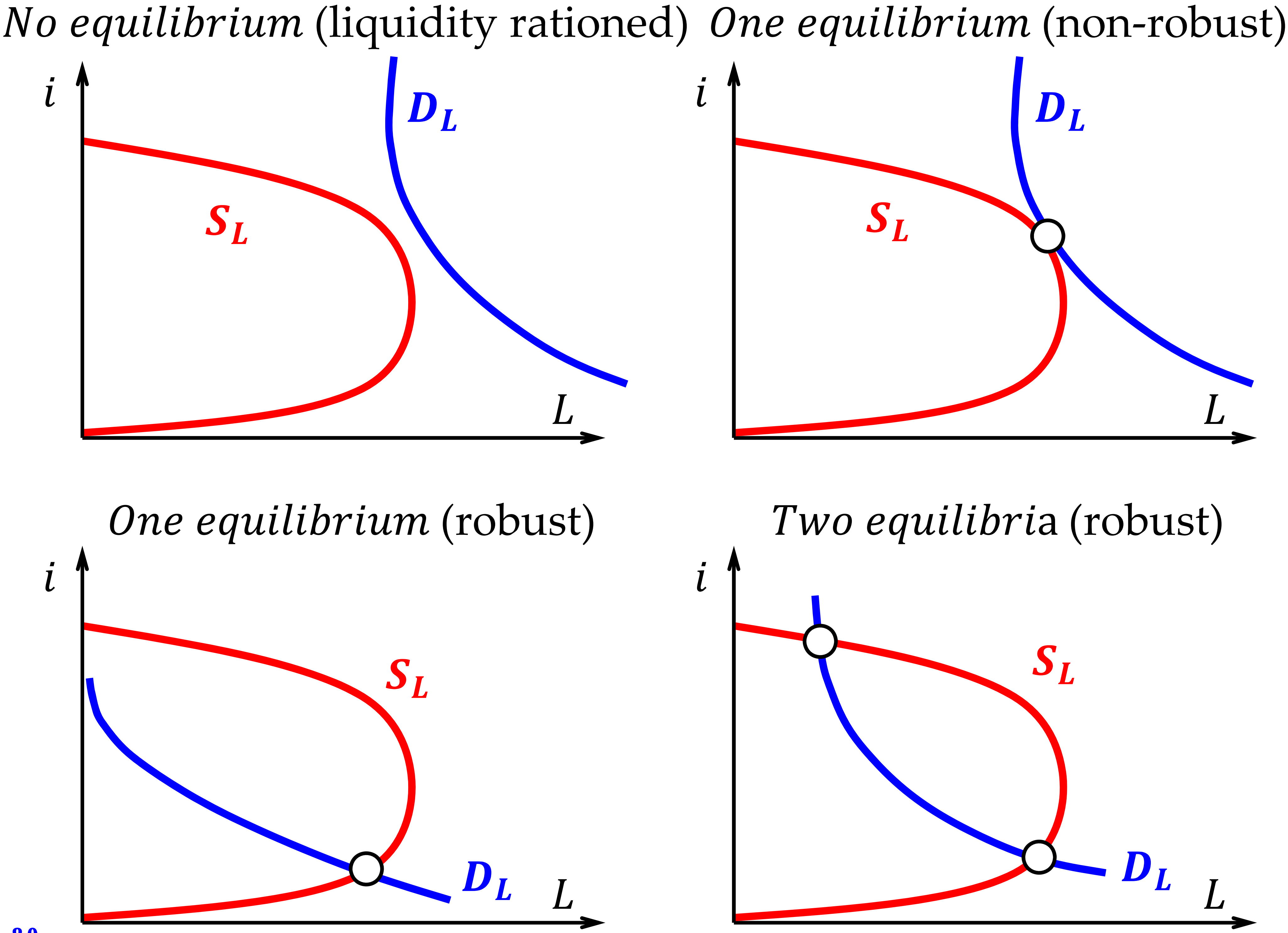
- Purchasing a financial asset supplies liquidity since (s)he who buys the asset gives money in exchange, so the seller is in practice obtaining a loan. The difference is that a bank's loan is not generally marketable, whereas interest-bearing assets can be resold (a lender can easily become a borrower).

Market equilibria



Market equilibrium

- A (liquidity market) equilibrium is a pair (i^*, L^*) such that:
  - when the interest rate is i^*, the total amount of liquidity demanded is L^*; and
  - the interest rate at which suppliers are willing to supply exactly the amount L^* is i^*.
- Graphically, a (market) equilibrium is represented by a point (i, L) where the supply and demand functions intersect.
- The next slide displays the possible equilibrium cases.

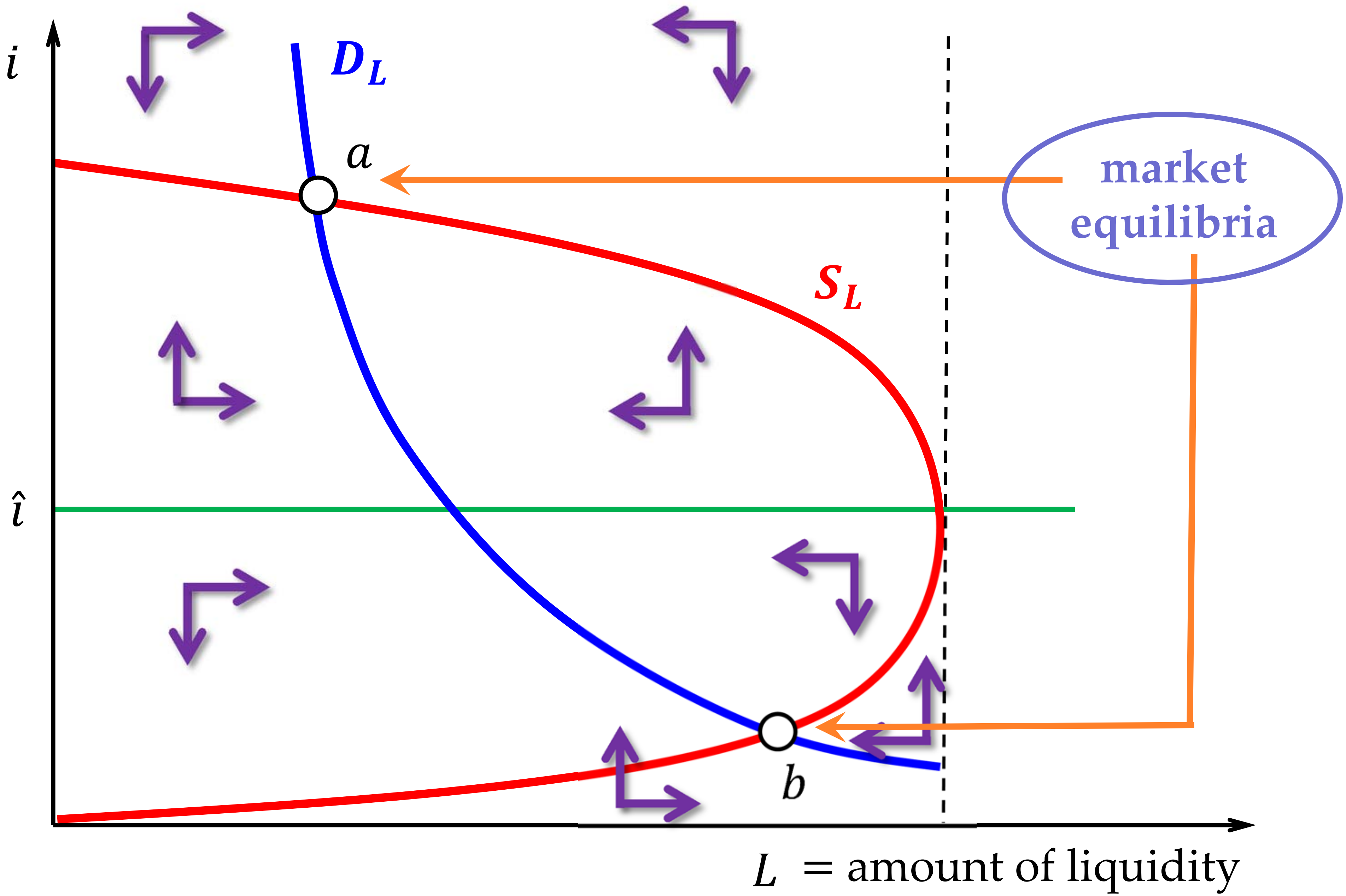


No equilibrium (liquidity rationed)
One equilibrium (non-robust)
One equilibrium (robust)
Two equilibria (robust)
i
L
S_L
D_L

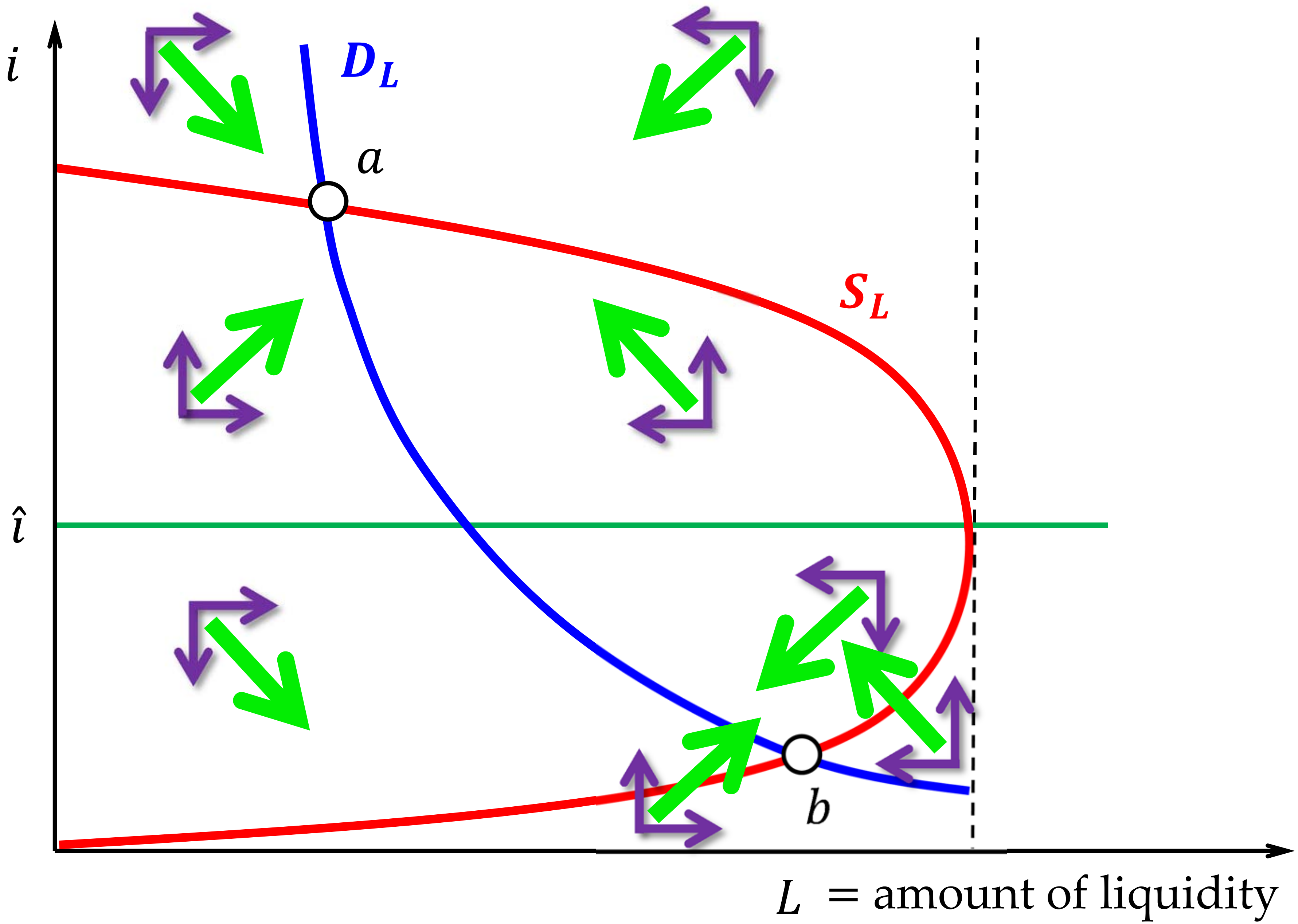
Convergence to equilibrium

- Is there a mechanism ensuring that some equilibrium is reached when starting from a non-equilibrium state of the market?
- The next slide shows that i and L move in the "right direction" (always towards some equilibrium) when i and L vary, at out-of-equilibrium points, according to the rules behind the demand function (slide 66) and the supply function (slide 72):
  - at any point below [above] D_L, L rises [falls]; and
  - at any point below [above] S_L, i goes up [down].

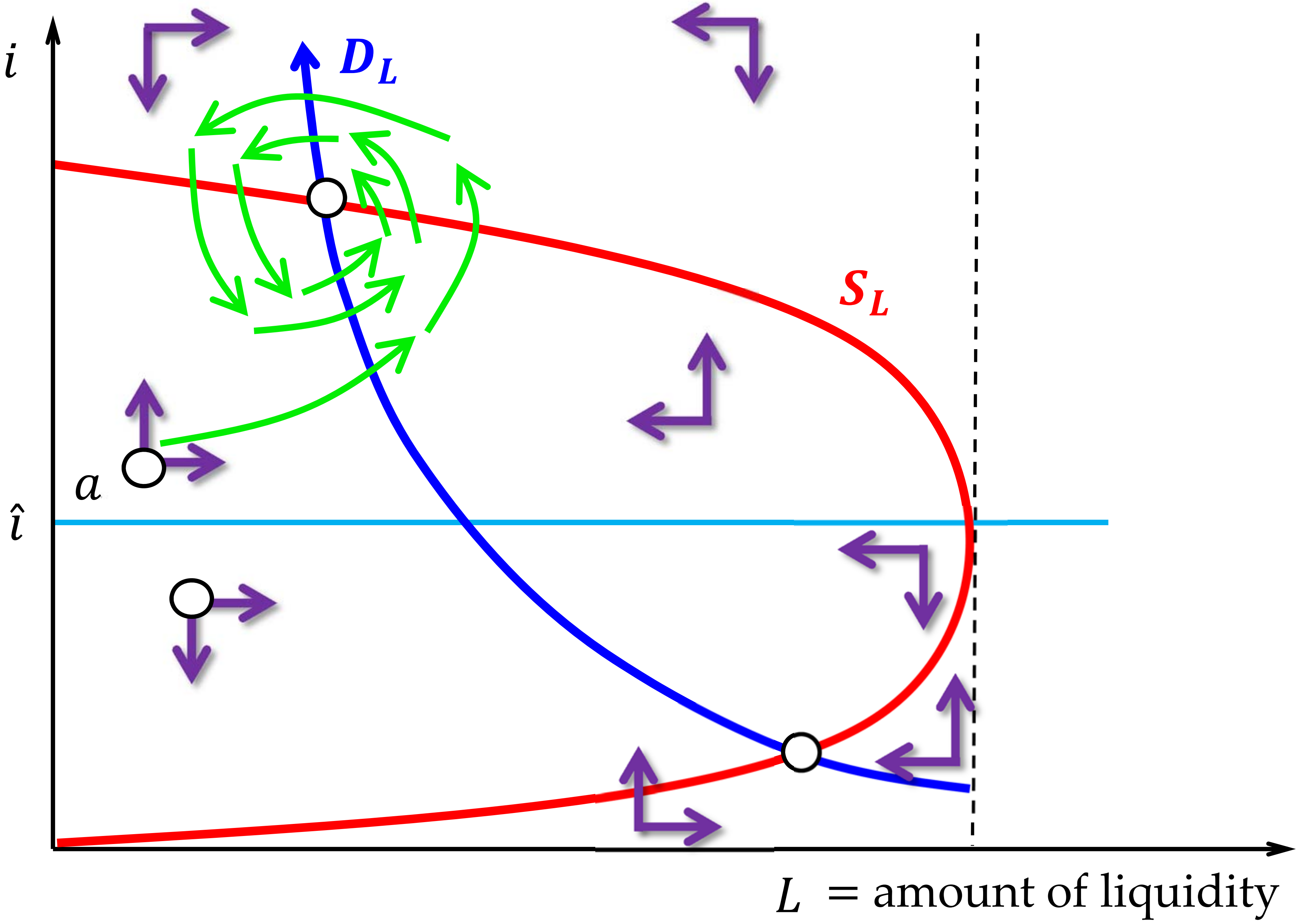
Out-of-equilibrium dynamics



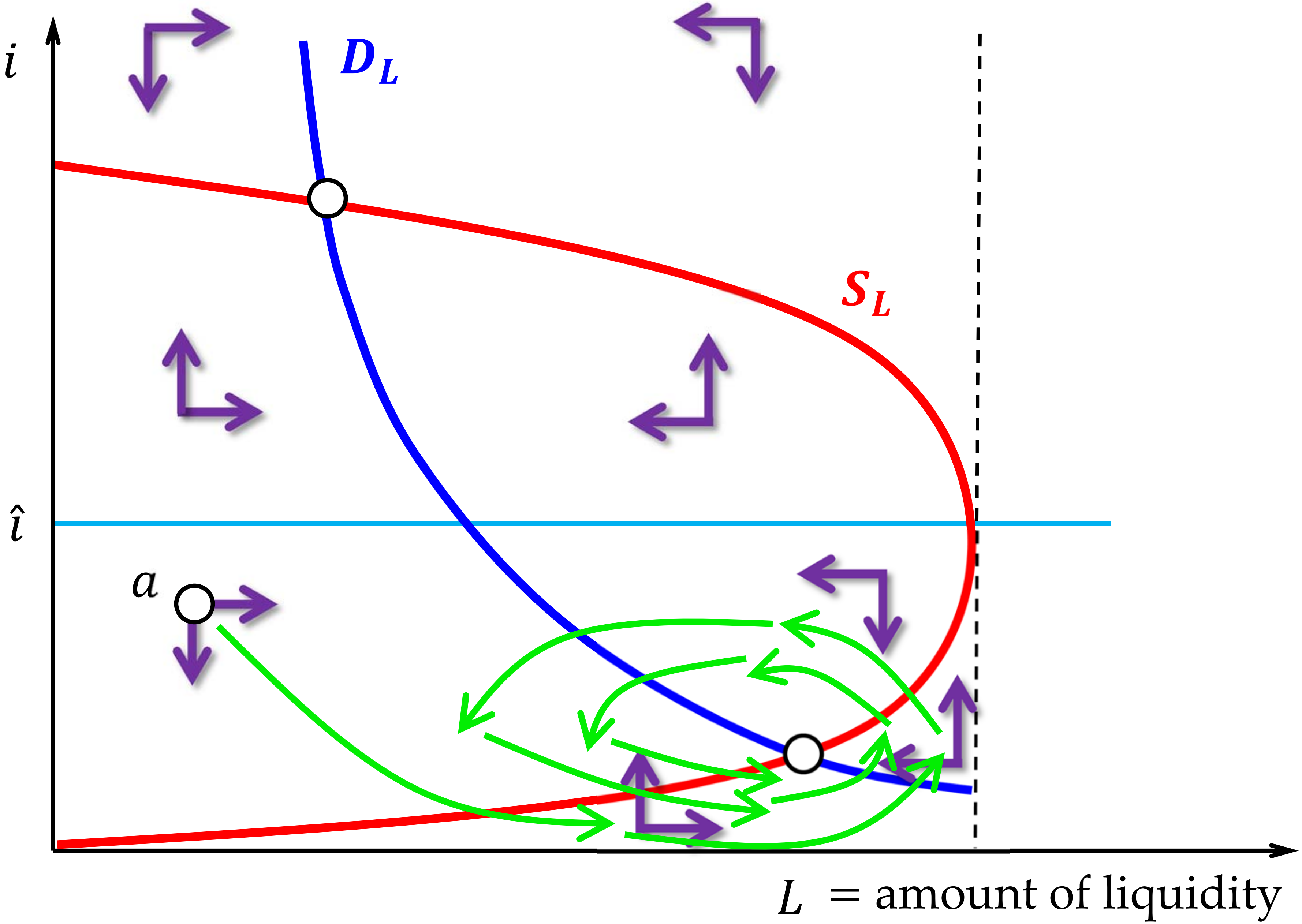
Out-of-equilibrium dynamics



Convergence to the high interest rate equilibrium



Convergence to the low interest rate equilibrium

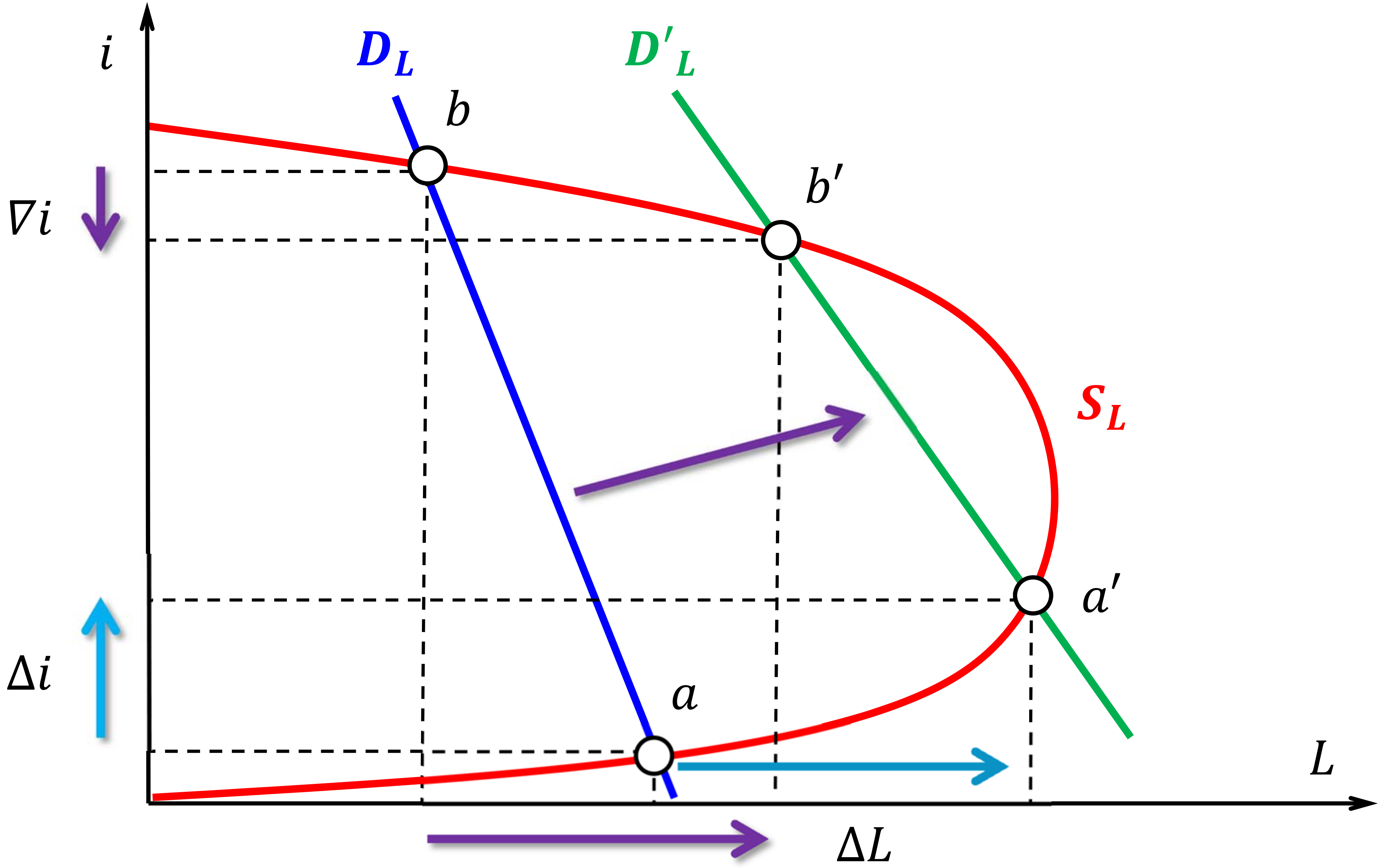


Shifting the liquidity demand function

- Any event that, for any given interest rate, stimulates [discourages] the demand for liquidity (loans, credit) shifts the market demand function for liquidity to the right [left].

- Shift to the right: more consumers, more firms, a higher budget deficit, the expectation of a higher inflation rate, an improvement in indices of business or consumer confidence, an increase in wealth or profits (may be), an increase in the foreign demand for domestic loans... The opposite changes shift the demand function to the left.

Equilibrium effects of a demand shift to the right



Effects of a demand shift to the right

- Call "<u>typical</u>" the upward sloping section (or region) of the supply of liquidity function and "<u>atypical</u>" the downward sloping section.
- Consider the previous slide. If the initial equilibrium point lies in the typical section of the supply function (point a), a demand shift to the right causes a rise in both the equilibrium interest rate and the amount of liquidity (from a to a').
- If the initial equilibrium is in the atypical section (point b), a demand surge leads to more liquidity and to a smaller interest rate (from b to b').

Explaining the atypical equilibrium

- At first, it may be surprising that an increase in demand may lead to a fall in the interest rate. The passage from b to b' can be explained as follows.

- At b, the high interest rate stems from a high default risk. Why a higher demand induces lenders to lend more and a smaller rate? More demand (more borrowers) under high rates can be interpreted in the sense that borrowers are better prepared (or have taken appropriate measures) to ensure that loans are paid back. This may induce lenders to lower rates and profit from apparently safer loans by supplying more funds to lend.

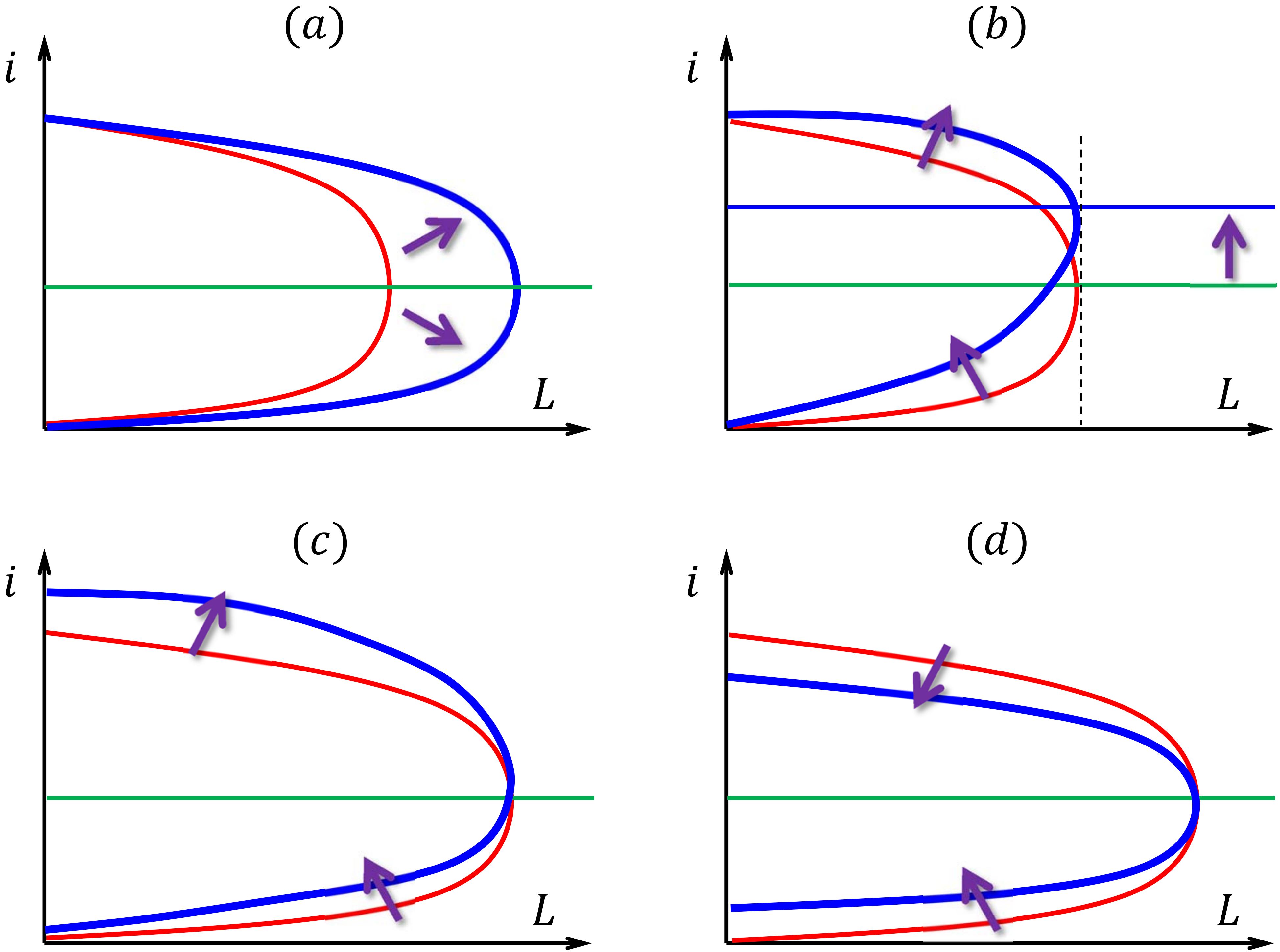
Shifting the liquidity supply function

- Any event that, for any given interest rate, stimulates [discourages] the supply of liquidity shifts (at least the typical section of the) market supply function of liquidity to the right [left].

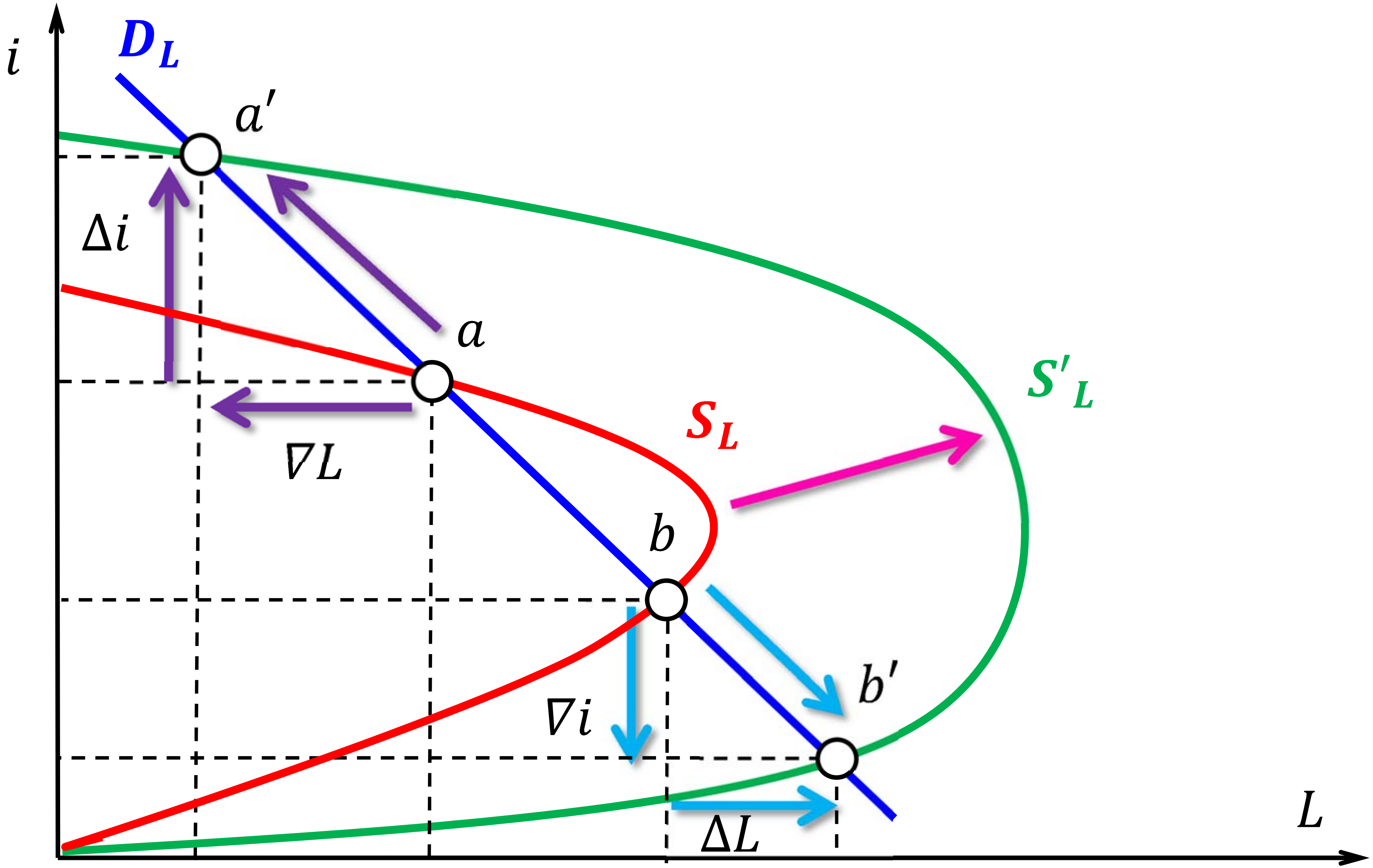
- <u>Shift to the right</u>: more banks, the expectation of a higher inflation rate, an increase in the consumers' or the firms' saving rate, expansionary open market operations by the central bank, fiscal advantages granted for purchasing financial assets... The opposite changes shift the supply function to the left.

Types of supply function shifts

- Changes in the supply function are not so straightforward as those of the demand function, because there are more basic sources of a shift.
  - The source could be a change in the maximum amount that could be lent; see graph (a) next.
  - It could be that only $\hat{\imath}$ changes; see (b).
  - Lenders would like to lend more below $\hat{\imath}$ but less above $\hat{\imath}$, or vice versa; see (c).
  - Lenders would like to lend always more (or always less) at every rate; see (d).
  - A combination of the above may occur as well.

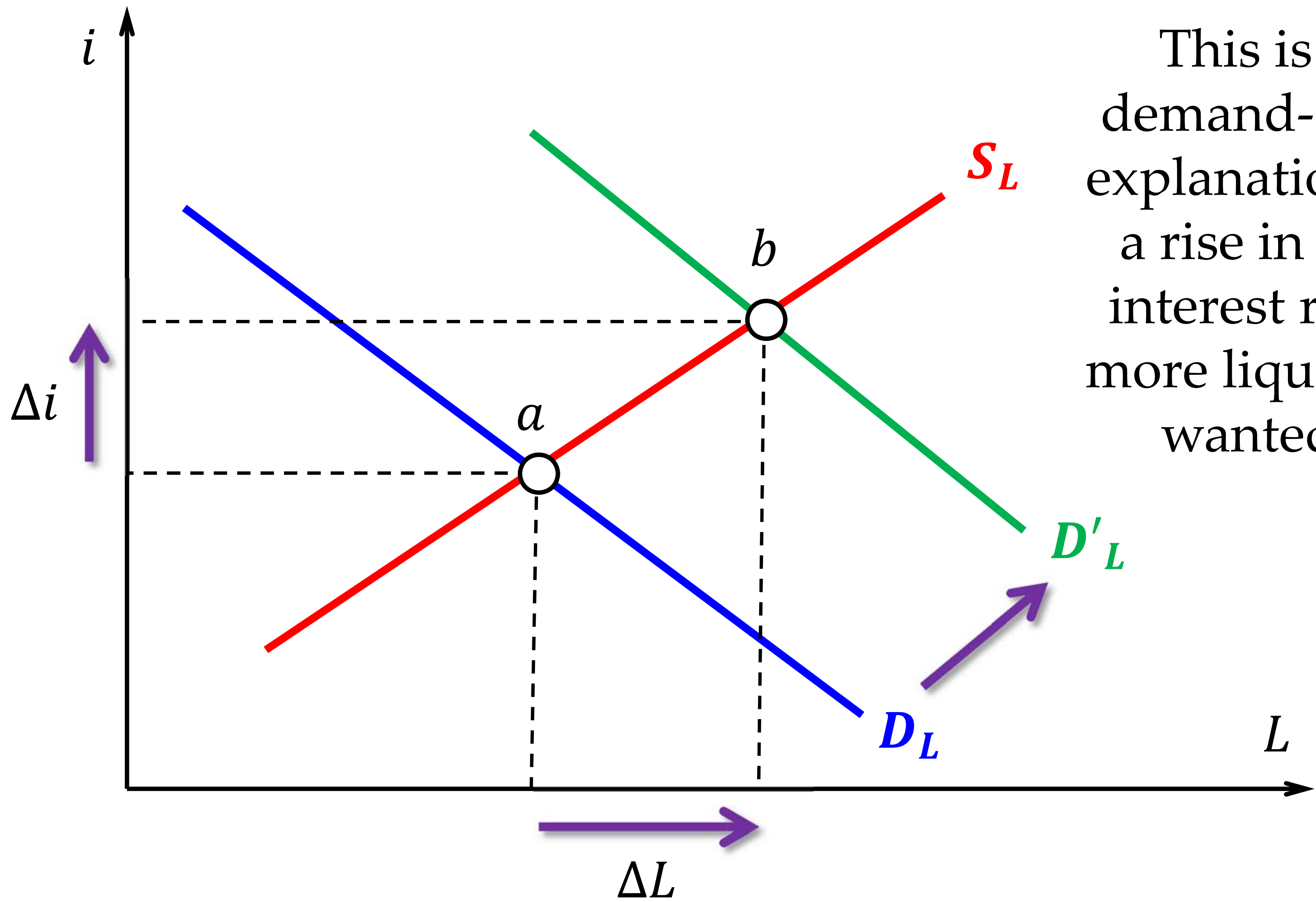

(a)
(b)
(c)
(d)
i
L

Equilibrium effects of a (strong) supply shift to the right



Equilibrium effects of a demand shift to the right

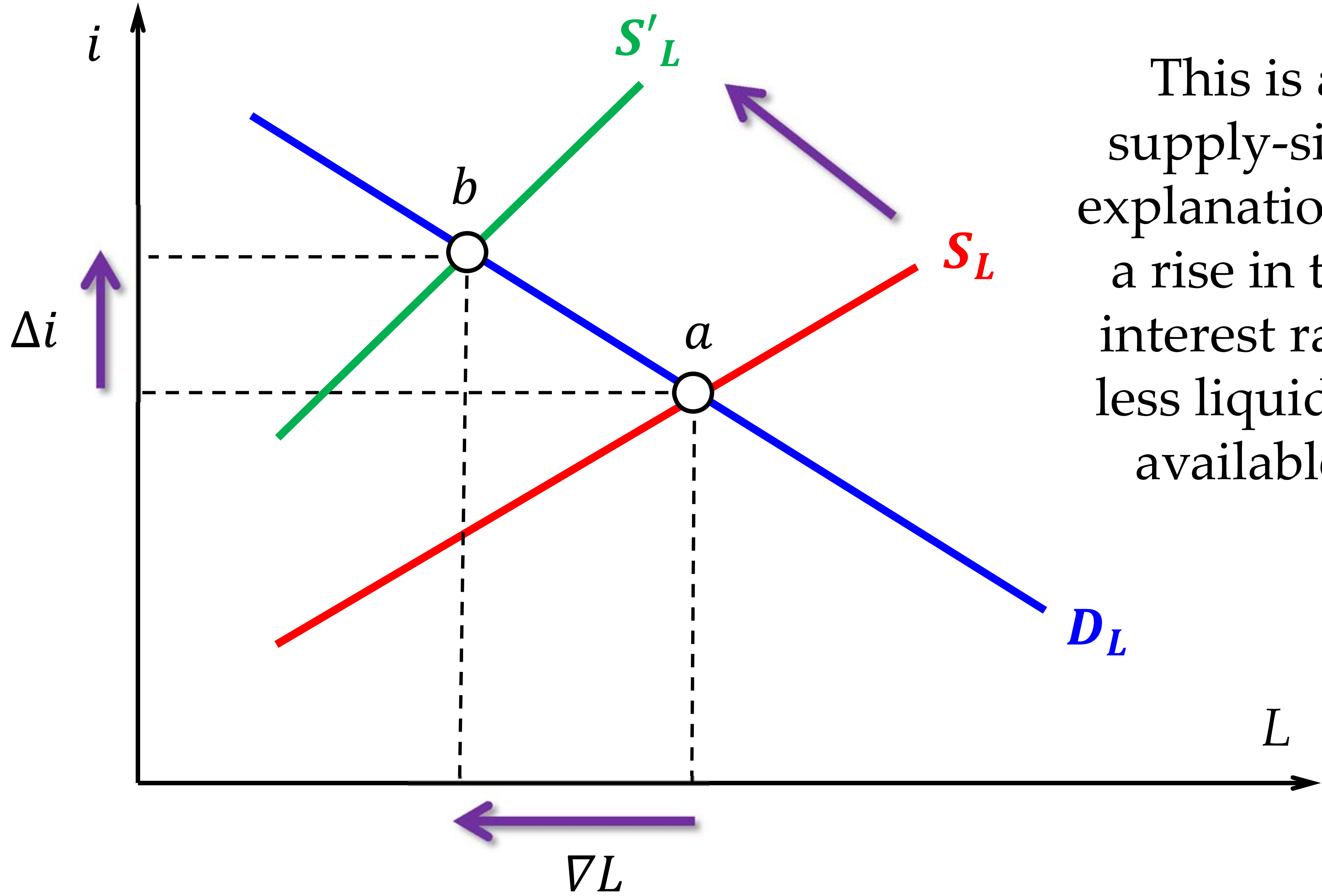
(analysis limited to the typical section of the supply function)



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

Equilibrium effects of a supply shift to the right

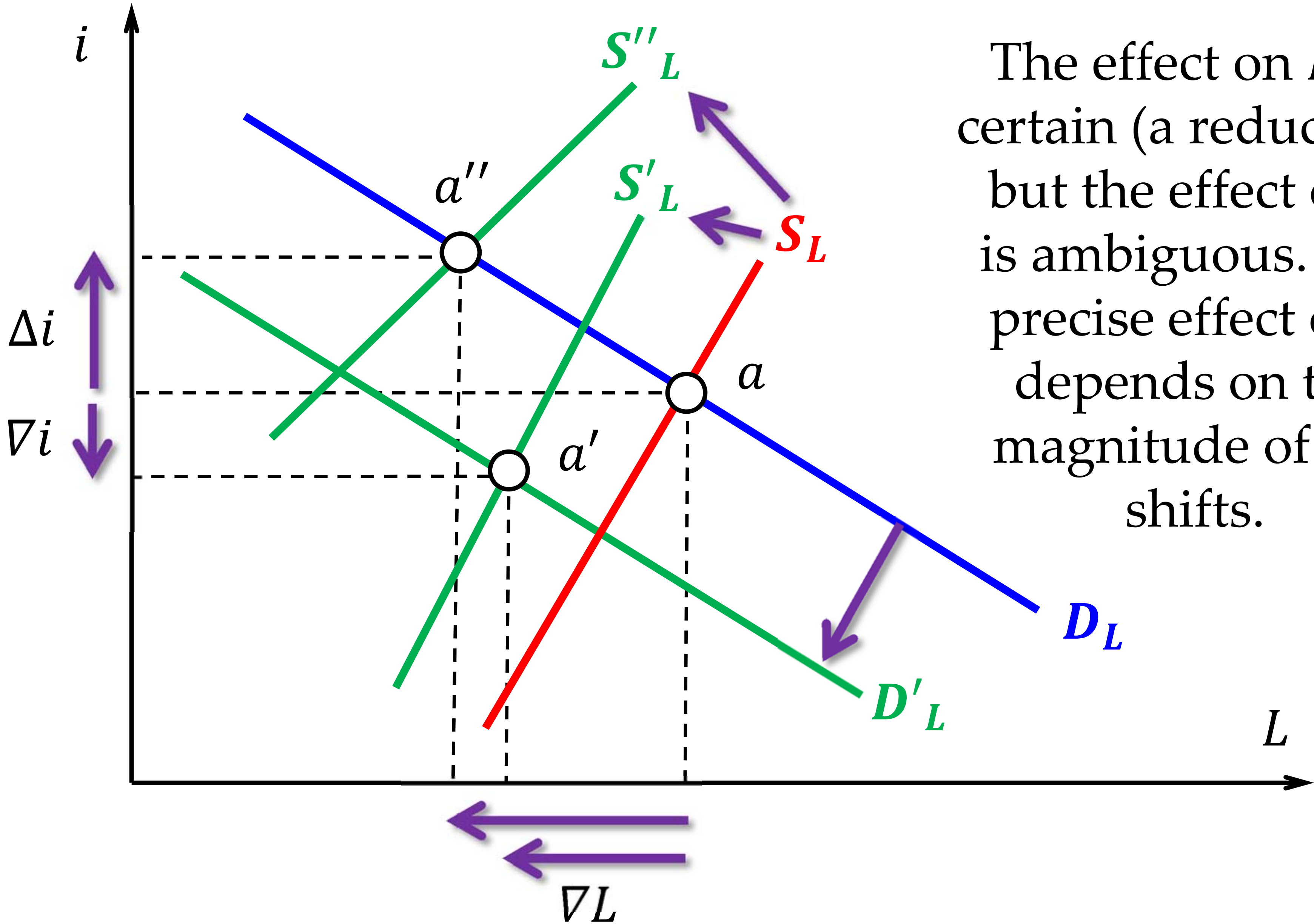
(analysis limited to the typical section of the supply function)



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

Equilibrium effects of S_L to the left & D_L to the left

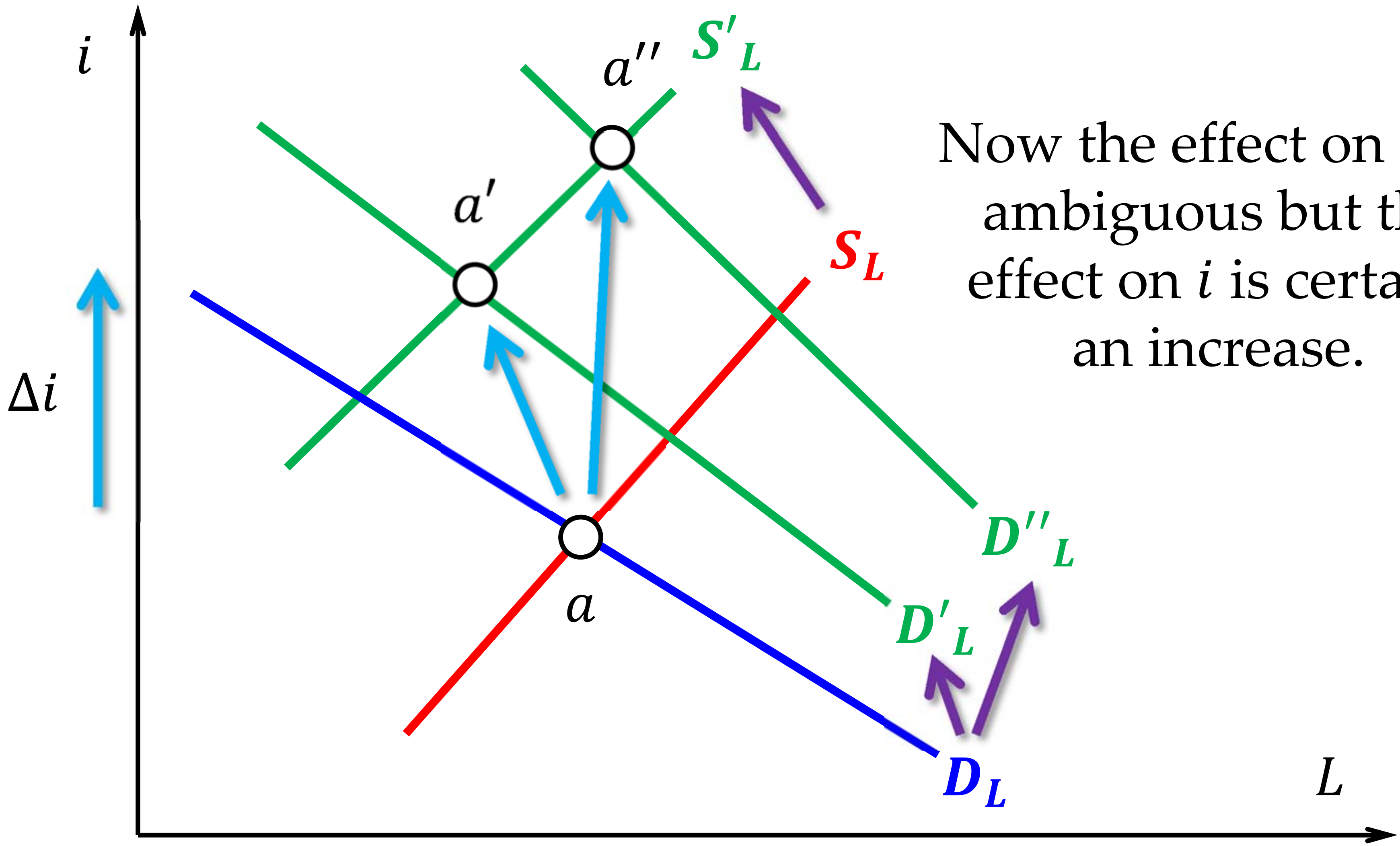
(analysis limited to the typical section of the supply function)



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.

Equilibrium effects of S_L to the left & D_L to the right

(analysis limited to the typical section of the supply function)



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

The real interest rate

- The real interest rate r of an economy represents the purchasing power of its nominal interest rate i: it is the nominal rate i expressed in terms of goods.

- Nominal rate i means that, by lending 1 currency unit today, you get $1 + i$ currency units tomorrow.

- The real rate r means that, by lending 1 unit of goods today, you get $1 + r$ units of goods tomorrow. Therefore, r expresses purchasing power: the amount of goods obtained from each unit of good lent.

Real & nominal interest: An example

- Let "goods" be represented by the CPI basket. Suppose $i = 10\%$ and $P_1 = 204$ EUR is the cost of the CPI basket. If 612 EUR are lent today ($t = 1$), then $612 \cdot (1 + i) = 612 \cdot (1 + 0.10) = 673.2$ EUR are obtained tomorrow ($t = 2$).

- In period 1, the purchasing power of 612 EUR was $612/P_1 = 3$ baskets. What is the purchasing power in period 2 of the 673.2 EUR received? It depends on P_2, the CPI in period 2. Suppose $P_2 = 220$. Then 673.2 EUR can purchase $673.2/220 = 3.06$ baskets. Thus r satisfies $3 \cdot (1 + r) = 3.06$, so $r = 0.02$ (2%).

Obtaining the real interest rate

$$P_1 = 204 \xrightarrow{inflation\ rate} P_1 = 220$$

$$\pi = 7.84\ \% \approx 8\%$$

$t = 1$ $\qquad$ $t = 2$

$$612 \text{ EUR} \xrightarrow{nominal\ interest\ rate} 673.2 \text{ EUR}$$

$$i = 10\%$$

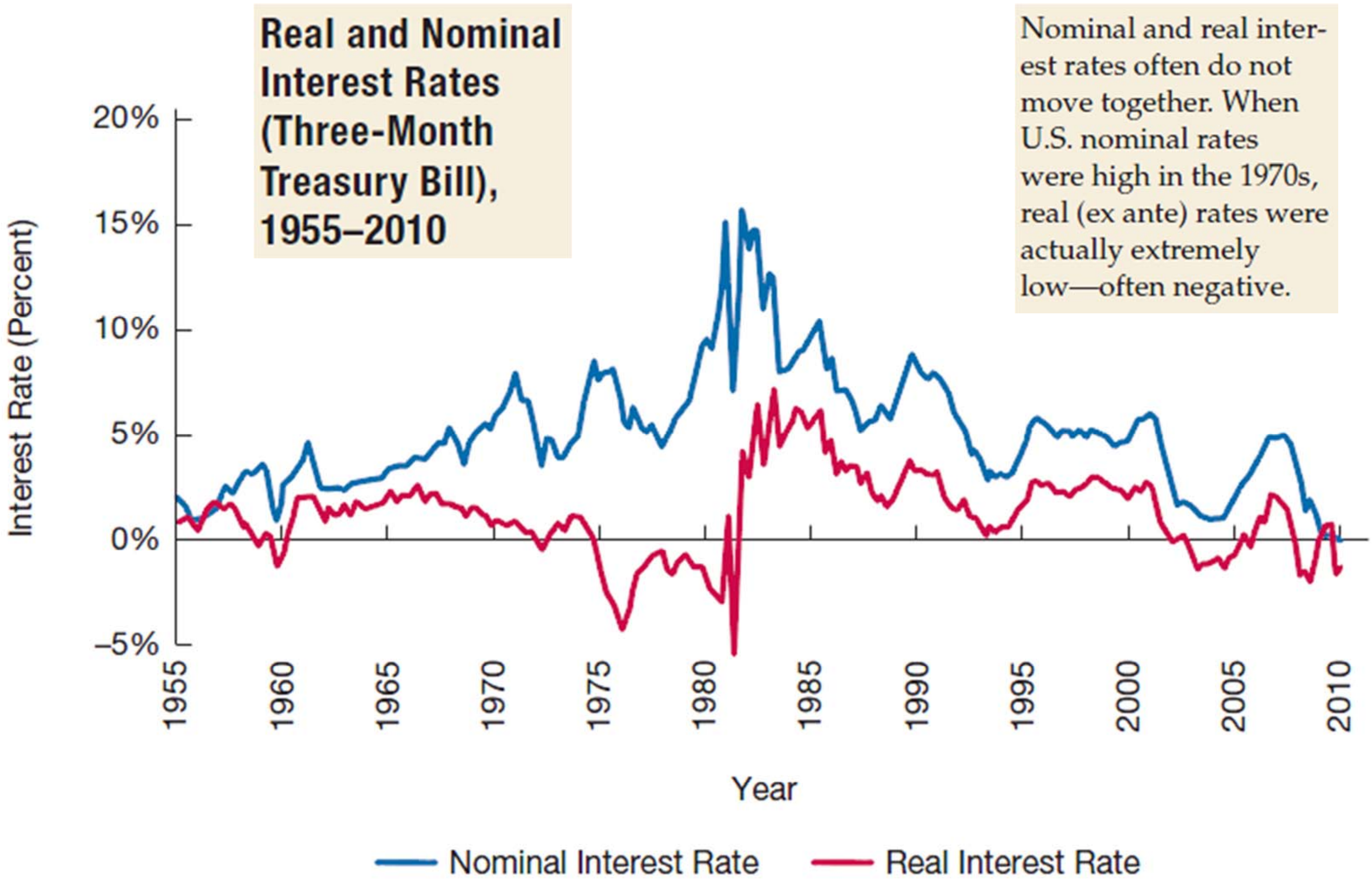
PURCHASING POWER

$612/P_1$ $\qquad$ $673.2/P_2$

|| $\qquad$ ||

$$3 \text{ baskets} \xrightarrow{real\ interest\ rate} 3.06 \text{ baskets}$$

$$r = 2\%$$



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

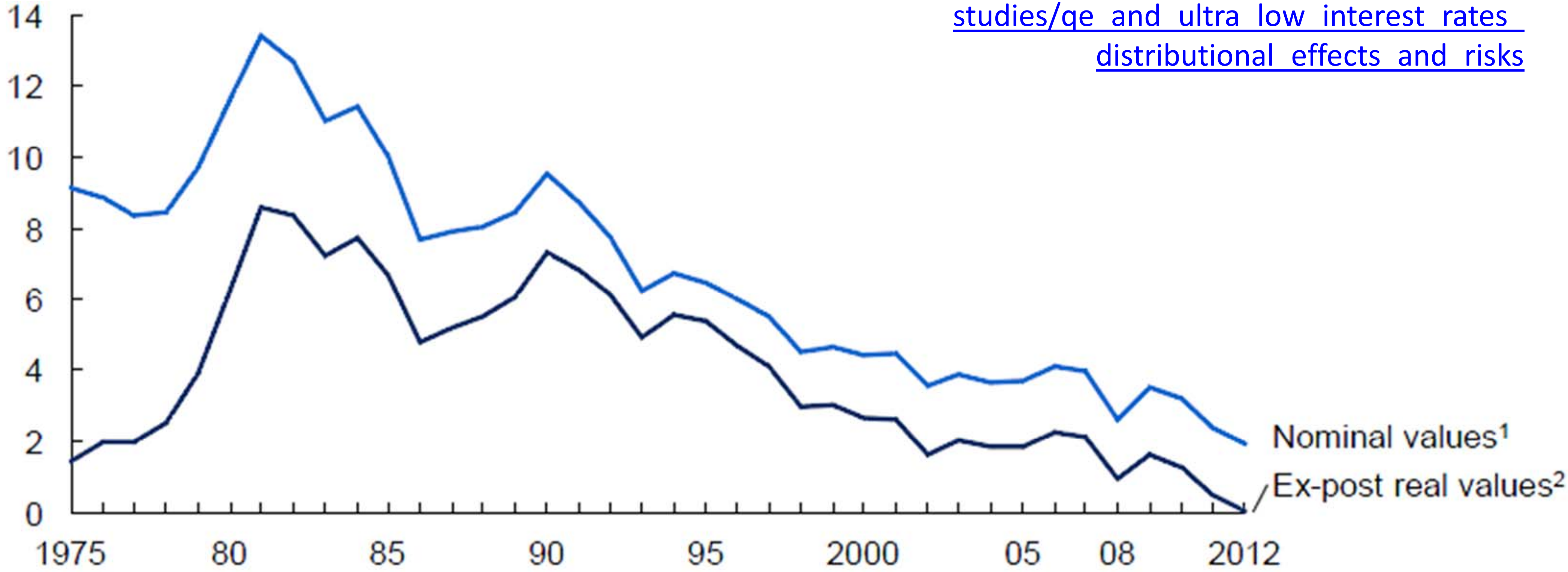
Central bank action has come at the end of a 30-year period of declining real and nominal interest rates

Long-term interest rates in developed economies

Yield to redemption on long-term government bonds, 1975–2012

%, GDP-weighted average

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



1 Ten-year government bonds, where available, for Australia, Canada, France, Germany, Italy, Japan, South Korea, Spain, the United Kingdom, and the United States.

2 Ex-post real values calculated as nominal yield on ten-year bonds in current year minus average realized inflation over next ten years. IHS Global Insight inflation estimates used for 2012–22.

SOURCE: International Monetary Fund International Financial Statistics; IHS Global Insight; Bloomberg; Organisation for Economic Co-operation and Development; McKinsey Global Institute analysis

The Fisher equation

- The Fisher equation provides an approximation of the relationship between i and r.

$$i = r + \pi \quad \text{or equivalently} \quad r = i - \pi$$

- This says that the real interest rate is the difference between the nominal interest rate and the inflation rate.

- In the previous example, $i = 10\%$ and $\pi = 7.84\%$ (as P jumps from 204 to 220). According to the Fisher equation, $r = i - \pi \approx 10 - 7.84 = 2.16$, which is close to the correct value of 2%.

Negative real interest rates

- Negative real interest rates may arise in practice: it suffices to have $\pi > i$. Although negative nominal interest rate might appear to be impossible, see http://uk.reuters.com/article/2012/07/05/denmark-rates-idUKL6E8I5A8520120705: investors were willing to accept a negative i to shelter their money.

- In the previous example, if the price level raised to, say, 269.28 instead of 220, then 673.2 EUR could only buy 2.5 baskets. Hence, after the loan is repaid one can purchase fewer baskets than the initial 3. In this case, $r = i - \pi = 10\% - 32\% = -22\%$ (from 3 to 2.5 baskets the actual loss is 16.6%).

The Fisher effect

- The Fisher hypothesis holds that the real interest rate is approximately constant.
- The Fisher effect is an implication of the Fisher hypothesis and asserts that there is a one-to-one relationship between i and π: every additional point of the inflation rate becomes an additional point of the nominal interest rate.
- The Fisher effect is consistent with the empirical evidence: economies with high inflation rates tend to be economies with high nominal interest rates.

Why the Fisher effect? /1

- When the inflation rate rises, it is natural to expect that lenders will demand a higher (nominal) interest rate to get back the purchasing power lost due to the increase in prices.

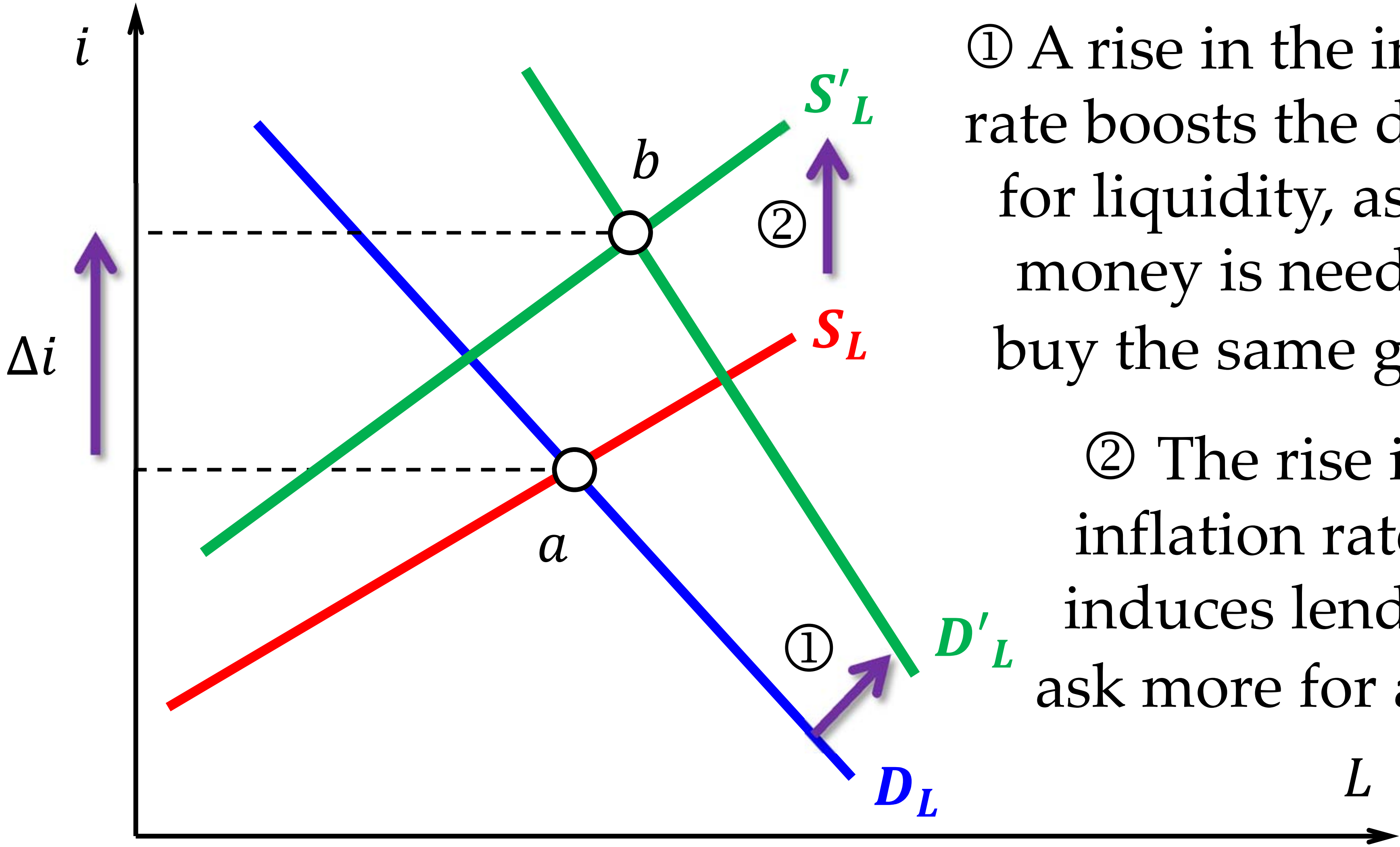
- Let $P_0 = 100$, $P_1 = 110$, and $P_2 = 132$, so $\pi_1 = 10\%$ and $\pi_2 = 20\%$. Suppose $r_1 = 5\%$: from period 0 to 1 lenders get a 5% increase in purchasing power. So for each equivalent to 1 basket lent in period 0, the equivalent of 1.05 baskets should be received in period 1. That is, if 100 EUR are lent in period 0, 115.5 EUR must be received in period 1.

Why the Fisher effect? /2

- Using the Fisher equation, the i_1 ensuring that $r_1 = 5\%$ when $\pi_1 = 10\%$ is $i_1 = r_1 + \pi_1 = 15\%$.
- If the Fisher hypothesis holds, $r_2 = r_1 = 5\%$. If r_2 remained at 15%, by lending €110 (the value of the basket in period 1), in $t = 2$ the amount received would be $110 \cdot (1 + i_2) = 110 \cdot (1 + 0.15) = 126.5$. Given $P_2 = 132$, the purchasing power of €126.5 is 0.958 baskets: there is a loss of purchasing power.
- By the Fisher equation, the i_2 needed to preserve the purchasing power of a money loan is $i_2 = r_2 + \pi_2 = 5\% + 20\% = 25\%$: from $t = 1$ to $t = 2$, π goes up 10 points and i also goes up 10 points.

The Fisher effect in the liquidity market model

(in the typical section of the supply function)



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.