

# BANKING



## Lecture 8 – Liquidity risk

**Petr Teplý**

Institute of Economic Studies, Faculty of Social Sciences,  
Charles University, Czech Republic

2 December 2020



# Key terms from Lecture 7/Bank capital

- Four types of bank's capital (accounting, economic, regulatory, market value)
- Layers of regulatory capital: Tier 1 (high quality capital) vs Tier 2 (supplementary capital)
- Capital to (risk-unweighted) assets versus risk-weighted capital ratio (capital adequacy)
- Changes in risk weighting, especially between Basel I (1988) and Basel II (2007) STA and IRB
- Understanding the IRB approach: capital requirements as credit VaR minus expected loss based on credit risk parameters (PD, LGD, EAD)
- Sovereign exposures (RW=0% possible)-> low capital requirements
- Basel III (2010/2017): higher Tier 1 capital required, capital buffer regime, obligatory leverage ratio as a backstop

# Contents

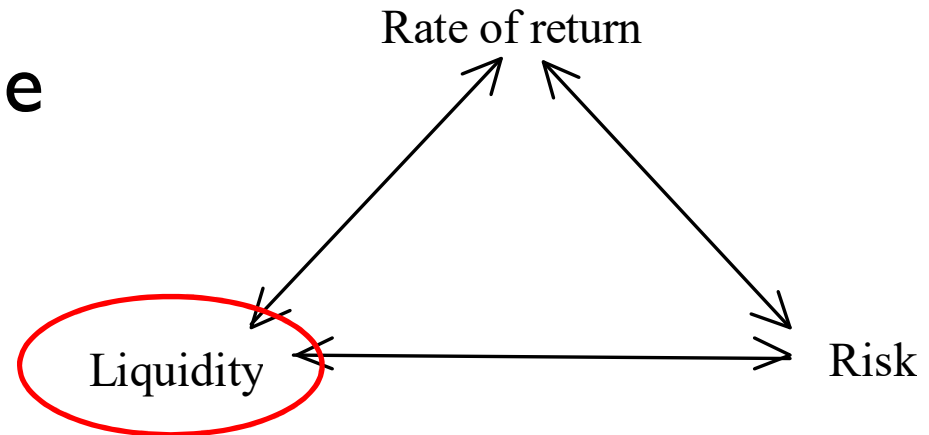
1. Basic terms
2. Liquidity risk and Basel III
3. Liquidity risk management and crises
4. Bank deposit products in the CR
5. Excess liquidity in the CR
6. Case study - savings accounts



## I. Basic terms

# Magicle triangle and ALM

- **Magical triangle**



- **Asset-Liability Management (ALM)**

Total Assets	Total Liabilities
Assets	Liabilities
	Equity



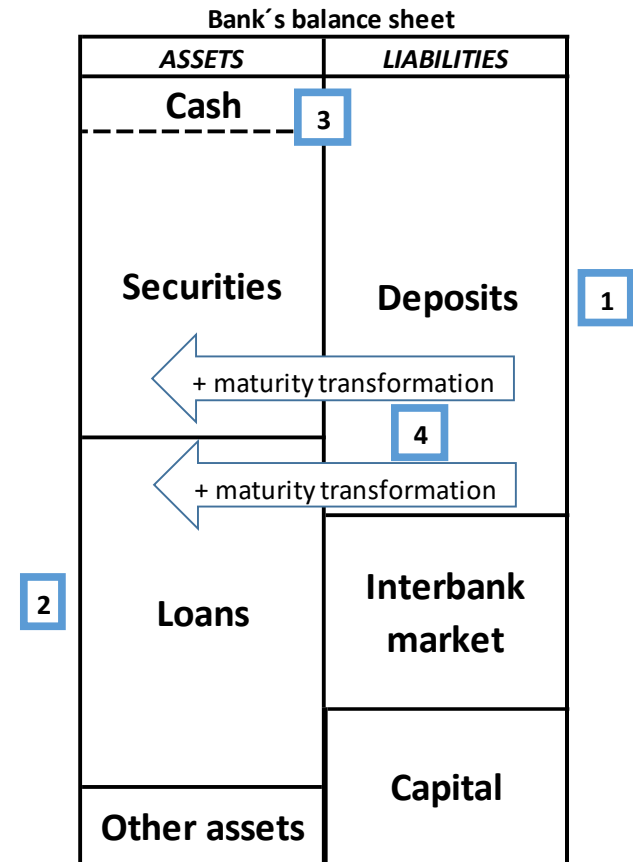
**I. What two bank functions are relevant to liquidity risk?**



## I. Basic terms

# Four main functions of a bank

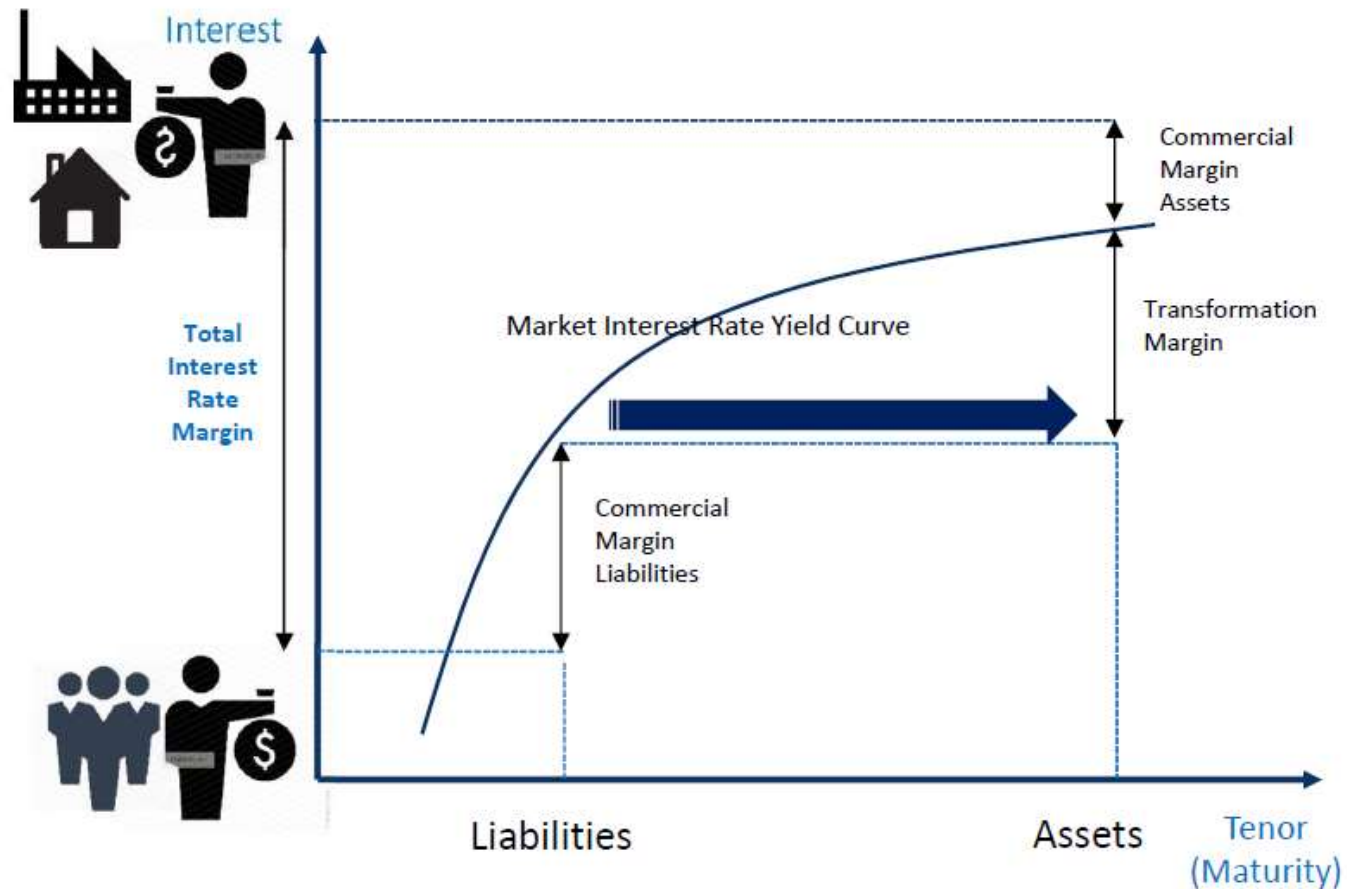
- 1) accepting deposits
- 2) granting loans
- 3) providing payments
- 4) providing maturity transformation\*



\* Banks borrow short and lend long, i.e. from short-term deposits they provide long-term loans and investments (=positive maturity transformation, unlike insurers that provide negative maturity transformation).

## I. Basic terms

# Transformation margin through ALM



Source: KBC Bank (2020). ALM basics. Internal document



## I. Basic terms

# Liquidity risk in theory

---

- Liquidity risk is the probability of a situation when a bank cannot meet its proper (both cash and payment) obligations as they become due or the bank will not be able to fund its assets,
- Potential loss due to insufficient market depth
- Liquidity risk arises from the different timing of the cash flows of assets and liabilities.





## I. Basic terms

# Why is liquidity risk important in banking?

---

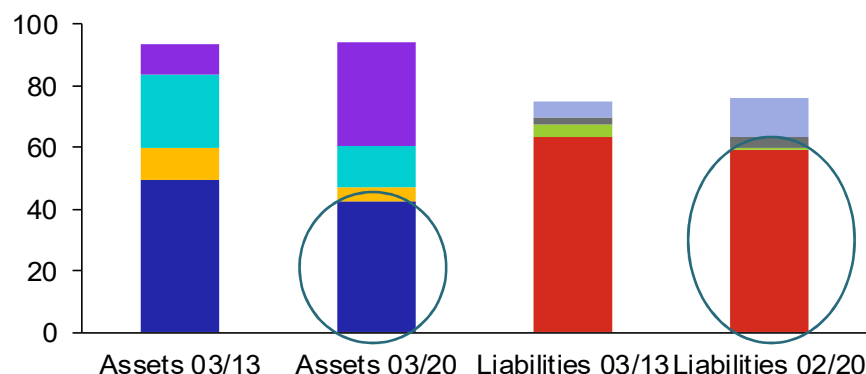
- Banks seek liquidity (quick assets) to cover the need to withdraw deposits and to grant the loans of clients.
- Unexpected changes in the interest income from credits can result in a rise of the liquidity problem for a bank.
- A bank's need for liquidity can be satisfied by creating either liquid reserves of assets or by their purchase of money or deposits markets
- Banks are very liquid in theory, but not so much in reality (*see a case study below*), what implies importance of deposit insurance



## I. Basic terms

# Liquidity risk in practice

**Chart III.15**  
**Selected balance-sheet items of the domestic banking sector**  
(% of balance sheet)



■ Claims on clients + NTS  
■ Claims on CIs  
■ Tradable securities  
■ Cash + claims on CNB  
■ Resident clients  
■ Resident CIs  
■ Non-resident clients  
■ Non-resident CIs

Source: CNB

Note: CIs = credit institutions. NTS = nontradable securities.

- The Czech banking sector reports **low liquidity risk** and a significant excess of deposits over loans (a high **deposit-loan** ratio – see *below*)  
-> Sufficient funding for granting loans
- Measures of liquidity risk: the Liquidity Coverage Ratio (LCR), an analysis of maturity mismatch / **liquidity gap analysis** (see *below*)

## I. Basic terms

# Liquidity gap analysis – a case study

Table VII-2: Gap analysis of UniCredit Bank Czech Republic as of December 31, 2012

CZK billions	Up to 1 month	1-3 months	3 months - 1 year	1-2 years	2-3 years	3-4 years	4-5 years	Over 5 years	Unspecified	Total
Cash in hand and balances with central banks	4,473	-	-	-	-	-	-	-	1,657	6,130
Financial assets hed for trading	121	122	730	817	732	355	2,232	2,556	19	7,684
Receivables from banks	26,112	3,959	91	629	-	-	1,257	-	125	32,173
Receivables from clients	19,388	13,309	26,264	24,589	18,797	17,114	13,426	48,586	3,242	184,715
Financial investments	2,707	8,598	16,445	2,320			29,590	20,460		80,120
Property and equipment	-	-	-	-	-	-	-	-	1,085	1,085
Intangible assets	-	-	-	-	-	-	-	-	2	2
Deferred tax asset	-	-	-	-	-	-	-	-	385	385
Other assets	54	24	151	251	548	652	519	2,508	1,890	6,597
Non-current assets held for sale	-	-	18	-	-	-	-	-	-	18
Celkem	52,855	26,012	43,699	28,606	20,077	18,121	47,024	74,110	8,405	318,909
Deposits from banks	17,642	3,958	4	10	3,604	-	1,429	7,583	-	34,230
Deposits from clients	172,344	7,791	8,316	3,766	389	268	106	32	2,108	195,120
Debt securities issued	1,160	235	2,858	5,730	-	-	22,682	3,006	523	36,194
Financial liabilities held for trading	112	167	421	761	927	457	189	2,922	-	5,956
Provisions	-	-	-	-	-	-	-	-	1,027	1,027
Deferred tax liability	-	-	-	-	-	-	-	-	970	970
Other liability	185	-	160	89	460	143	-	1,864	3,574	6,475
Equity	-	-	-	-	-	-	-	-	38,937	38,937
Total	191,443	12,151	11,759	10,356	5,380	868	24,406	15,407	47,139	318,909
Gap	-138,588	13,861	31,940	18,250	14,697	17,253	22,618	58,703	-38,734	-
Cumulative gap	-138,588	-124,727	-92,787	-74,537	-59,840	-42,587	-19,969	-	-	

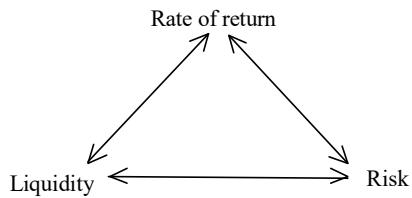
- GAP (< 1 month) = 52,855 – 191,433 = -138,588

**2. Is a cash-total asset ratio of banks low or high? Why?**



# I. Basic terms

## A low share of cash (<1%) on commercial bank's balance sheet: no 'real' money in banks



**Commercial bank's balance sheet**

Assets	Liabilities
<b>Cash</b>	<b>Deposits</b>
<b>Claims on central bank</b>	
<b>Securities</b>	<b>Interbank market</b>
<b>Loans</b>	
<b>Other assets</b>	<b>Capital</b>

## I. Basic terms

# Bank's confidence function

- Used for modelling **the public's trust** in an individual bank or the banking system
- Importance of **deposit insurance** – helps to keep the trust in banks (banks are illiquid, see *a case study above*)

$$\text{Confidence function} = f(\text{NW}, \sigma_{\text{ROA}}, \text{IQ}, \text{L}(\text{G}, \sigma_{\text{dcr}}, \sigma_{\text{dep}}))$$

NW – economic net worth (bank capital)

$\sigma_{\text{ROA}}$  – stability of earnings as the standard deviation of ROA

IQ – the information quality (transparency) regarding the bank's earnings and asset quality

L – liquidity as a function of 3 variables

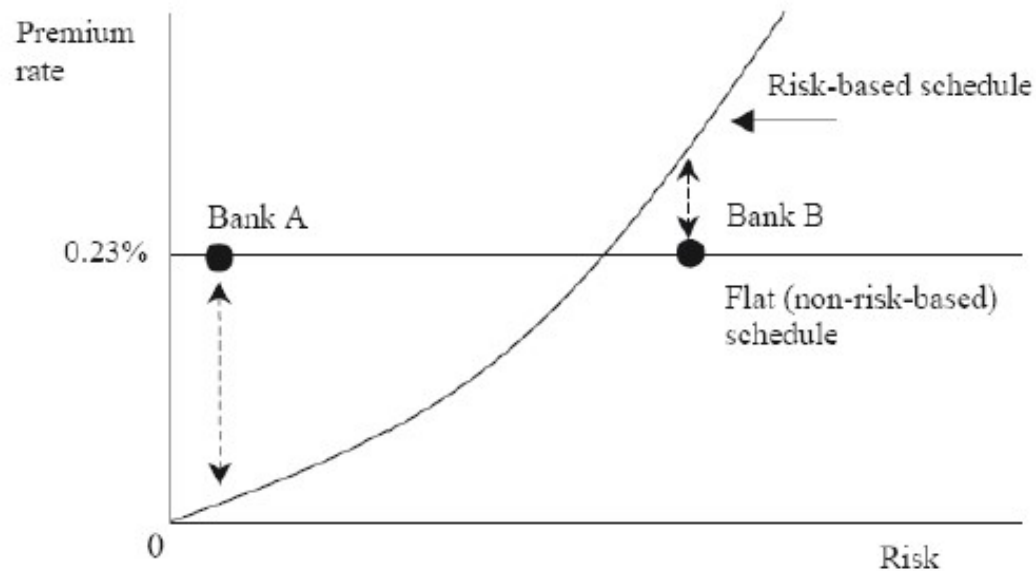
- 1) **G** – **state guarantees** such as the too-big-to-fail doctrine (TBTF), lender of the last resort, and deposit insurance;
- 2)  $\sigma_{\text{dcr}}$  – the variability of loan demand
- 3)  $\sigma_{\text{dep}}$  – the variability of deposit/liability flows

## I. Basic terms

# Deposit insurance

- **Deposit insurance** – usually flat and capped per depositor (EU: 100%, max. EUR 100,000, US: 100%/max. USD 250,000; New Zealand: NZD 0!)
- 1) 100% deposit insurance for a client = institutionalized moral hazard (depositors don't care about the bank's creditworthiness)
  - 2) non-risk based flat deposit premium - moral hazard for "risky" banks

Figure VI-10: The problem of a flat deposit premium in the US



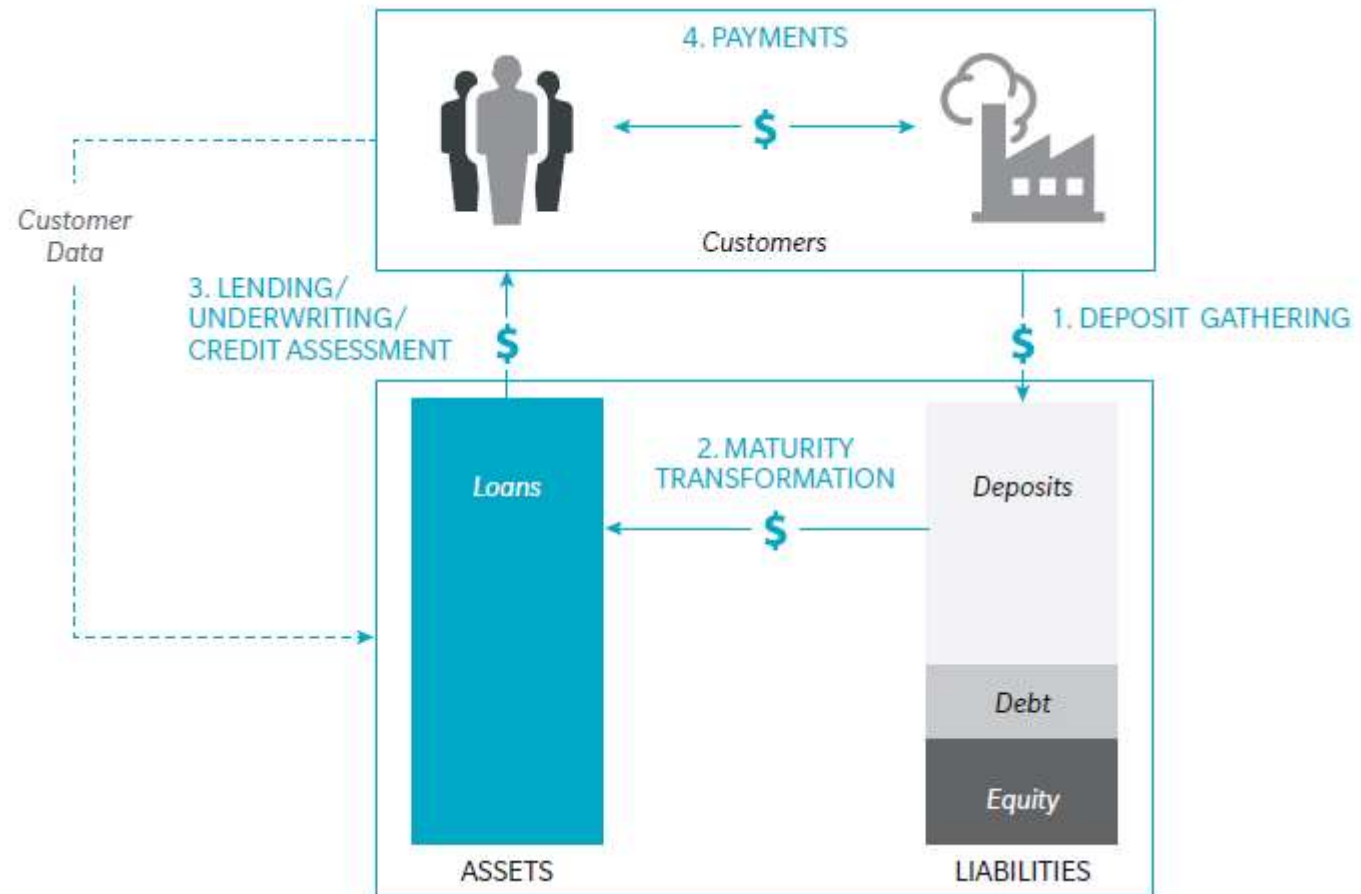
### 3. Why is deposit insurance important for bank future?





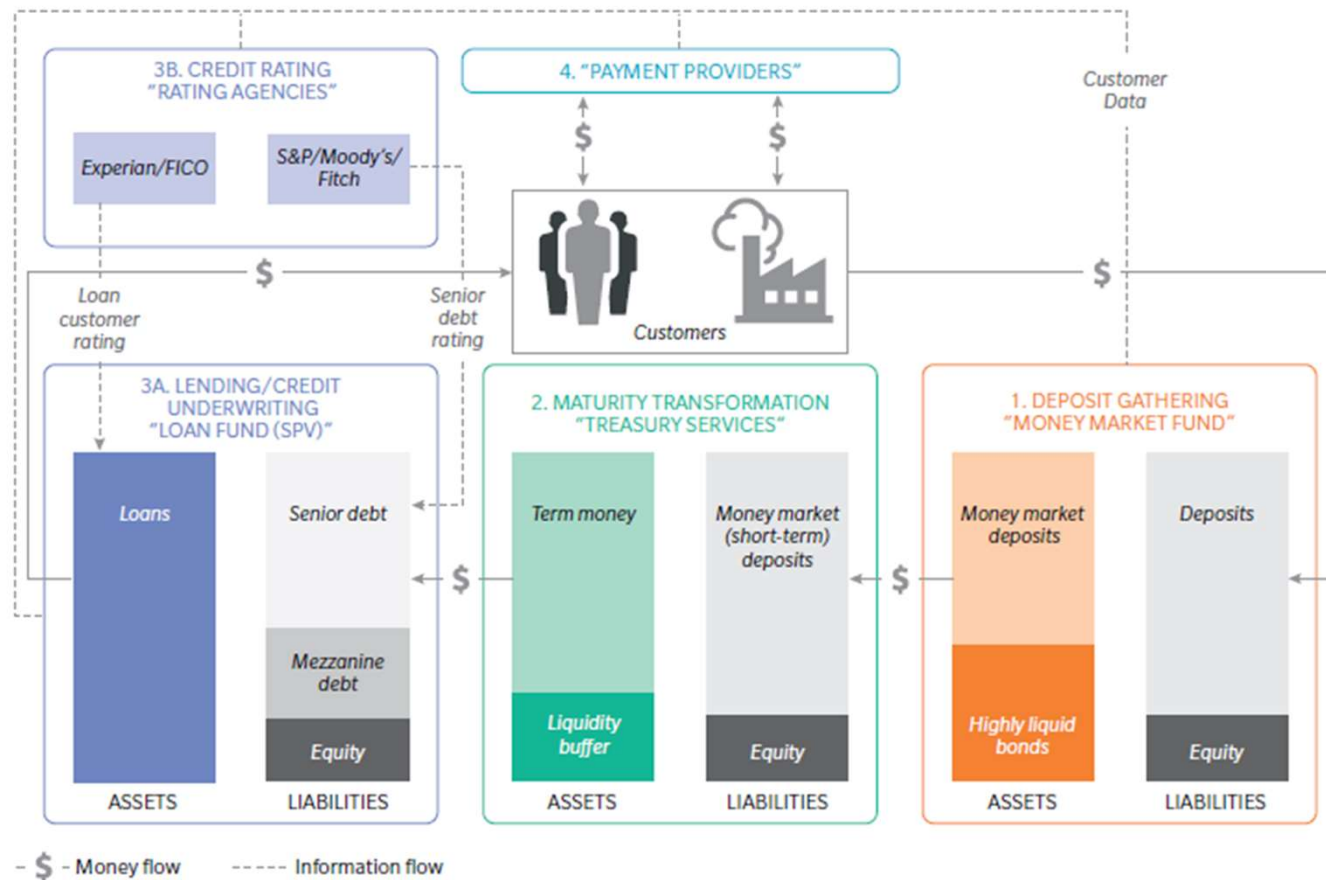
## I. Basic terms

# Traditional bank branch-based model (one-stop-shop for all banking services)



# I. Basic terms

## Total unbundling banks is not possible yet...



...since no (non-bank) institution can provide positive maturity transformation – importance of deposit insurance and government for the future of banking!

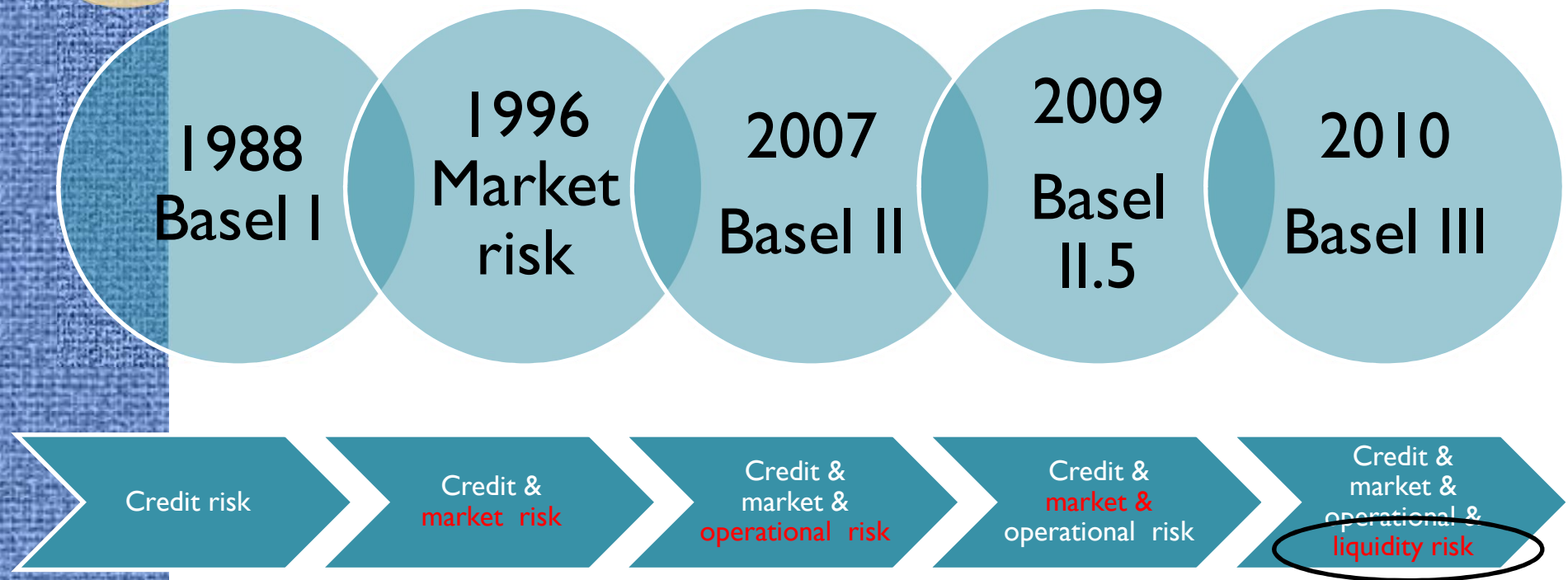
# Contents

1. Basic terms
2. Liquidity risk and Basel III
3. Liquidity risk management and crises
4. Bank deposit products in the CR
5. Excess liquidity in the CR
6. Case study - savings accounts



## 2. Liquidity risk and Basel III

Liquidity risks was added to Basell III in 2010



## 2. Liquidity risk and Basel III

# Liquidity risk under Basel III

- The liquidity framework concentrates on two complementary objectives differing in time frame.
  - 1) Short term resilience is covered by the **Liquidity Coverage Ratio (LCR)** – originally min. 60% from 2015
  - 2) Medium to long term resilience by **the Net Stable Funding Ratio (NSFR)** – originally set at 100% from 2018

## 2. Liquidity risk and Basel III

# The Liquidity Coverage Ratio (LCR)

$$\text{LCR} = \frac{\text{stock of high-quality liquid assets}}{\text{total net cash outflows over the next 30 days}} \geq 100\%$$

- LCR -> a bank is required to maintain a pool of highly liquid assets which is sufficient to meet the forecast net cash outflows over a 30-day period
- The observation period 2012-2013 and in force since 2015
- BCBS (2010) proposed the min. LCR=100% but it updated liquidity requirements in January 2013 and lowered the min. LCR value to 60% from 2015

### LCR in a Nutshell

Assets	Liabilities
Ineligible Assets	Other Liabilities
Eligible Assets	Net 30-day outflows

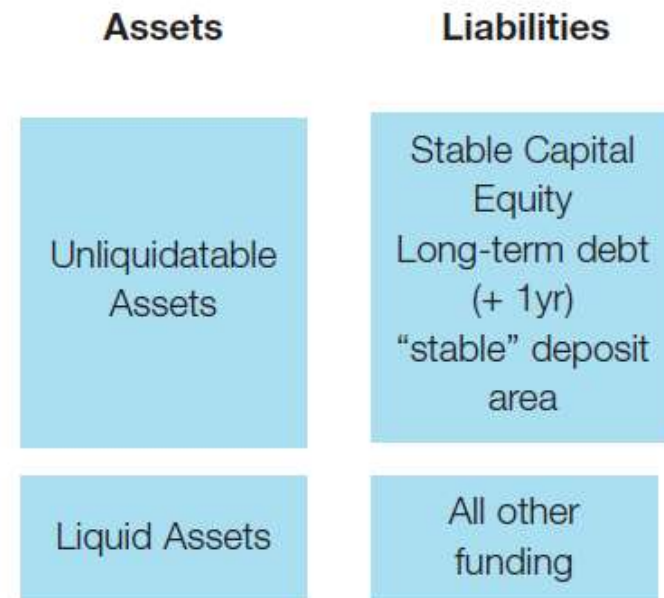
## 2. Liquidity risk and Basel III

# The Net Stable Funding Ratio (NSFR)

$$\text{NSFR} = \frac{\text{available amount of stable funding}}{\text{required amount of stable funding}} \geq 100\%$$

- NSFR requires a bank to fund the illiquid portion of its asset book with funding of more than one year residual maturity
- Stable funding is required to finance illiquid assets (not liquidated within 12 months)
- The observation period 2012-2017 and in force since 2018
- Impact: higher bank funding costs

### NSFR in a Nutshell



# Contents

1. Basic terms
2. Liquidity risk and Basel III
3. Liquidity risk management and crises
4. Bank deposit products in the CR
5. Excess liquidity in the CR
6. Case study - savings accounts

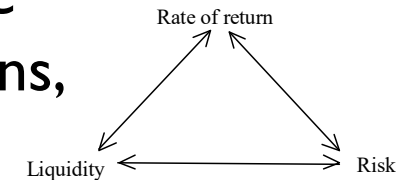




### 3. Liquidity risk management and crises

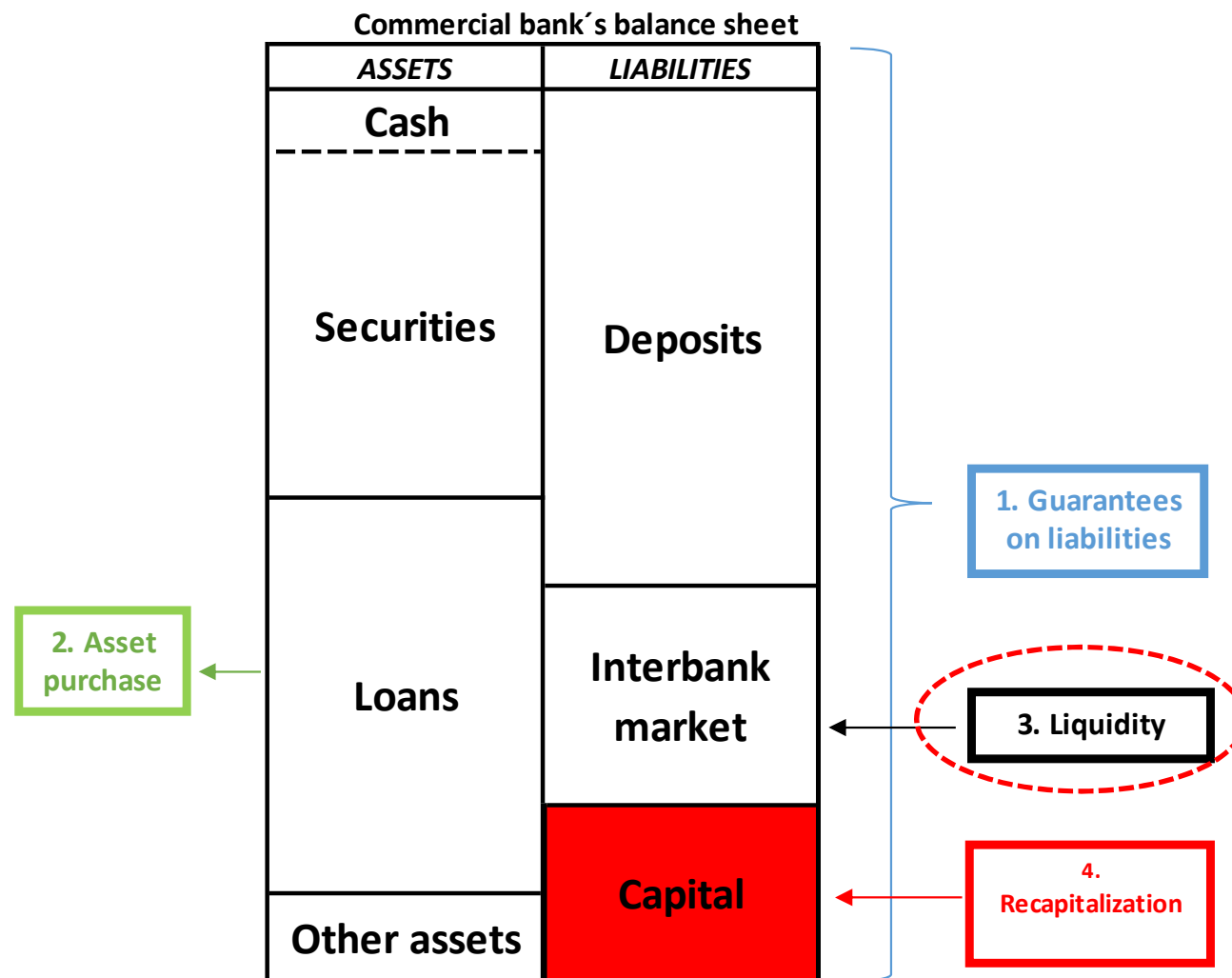
## Liquidity risk management in practice

- Liquid instruments bear low interest, but are needed for during market turmoils (bank runs, wholesale market withdrawals etc.)
- Banks seek liquidity (quick assets) to cover the need to withdraw deposits and to grant the loans of clients.
- Unexpected changes in the interest income from credits can result in a rise of the liquidity problem for a bank.
- A bank's need for liquidity can be satisfied by creating either liquid reserves of assets or by their purchase of money or deposits markets
- Liquidity risk management -> a pond (optimum level of liquidity: sufficient but not redundant)



### 3. Liquidity risk management and crises

# Liquidity injection as 1 out of 4 types of bank's rescues (from a central bank)



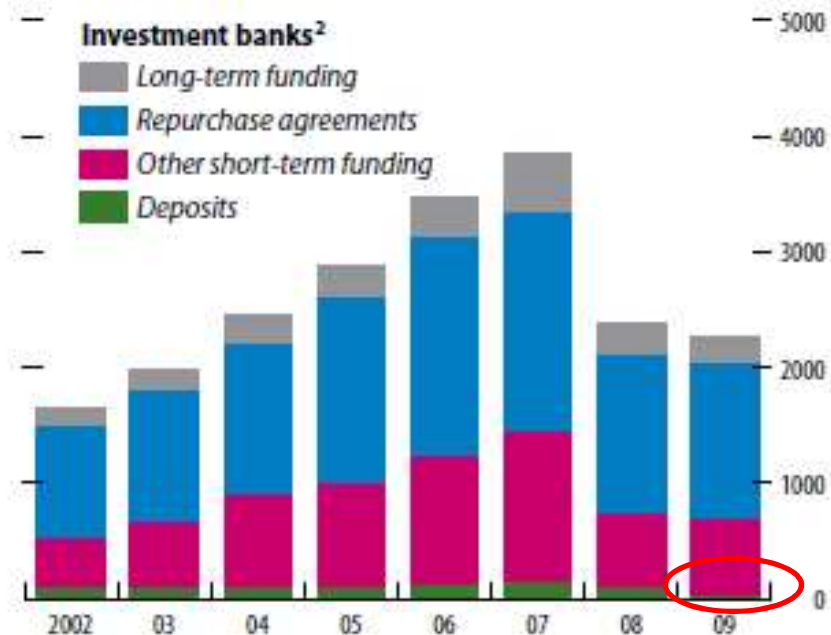
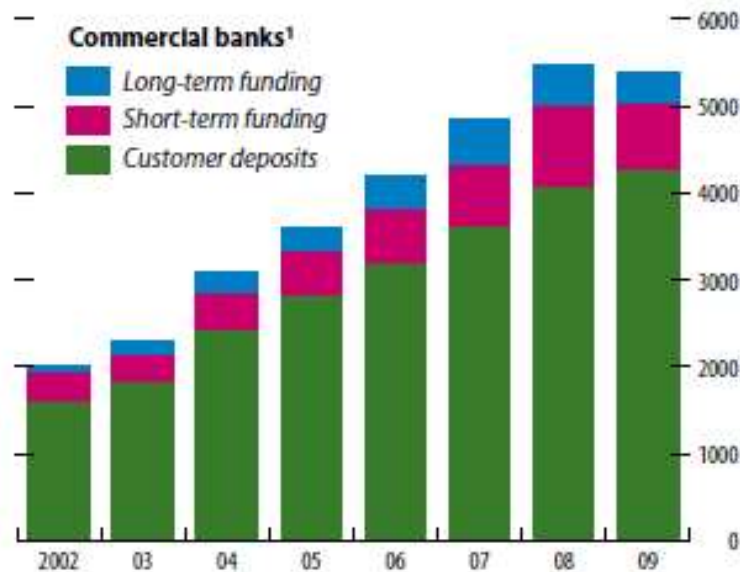
4. What happened to  
global investment banks  
during the 2007-9 global  
financial crisis (GFC)?



### 3. Liquidity risk management and crises

Investment banks reported a low share of stable deposits -> high liquidity risk during the GFC

**Figure 2.11. United States: Funding Structure of Selected Largest Commercial and Investment Banks**  
(In billions of U.S. dollars)



Source: ©2003 Bureau van Dijk Electronic Publishing-Bankscope.

Note: Short-term funding is funding with maturity less than one year.

<sup>1</sup>Top 10 commercial banks in terms of total assets.

<sup>2</sup>Data for investment banks capture 60 percent of total investment bank assets as reported by Bankscope. For 2008 and 2009, data exclude Lehman Brothers and Bear Stearns.

Source: IMF (2010). Global Stability Report, April 2010

### 3. Liquidity risk management and crises

## The GFC = end of an era of investment banks

- **Lehman Brothers'** bankruptcy
- **Merrill Lynch** taken over by Bank of America
- **Morgan Stanley** and **Goldman Sachs** applied to become regulated banks (broker-dealers became banks)
- **Deutsche Bank** has survived but recently in huge problems

### 3. Liquidity risk management and crises

## Liquidity support to banks due to the Covid-19 pandemic

Policy measure	United States	Euro area	United Kingdom
<b>Liquidity support</b>	<p>Plan to purchase \$75 billion Treasury securities and \$50 billion GSE MBS</p> <p>PDCF lending to security firms and MMLF to assist MMFs in meeting demand for redemptions</p> <p>Provide up to \$2.3 trillion in loans, mainly through the PPP, MSLP and TALF</p>	<p>Additional LTROs and new PELTROs to safeguard money market conditions</p> <p>TLTRO III can be as low as 50 basis points below the average deposit facility rate</p> <p>PEPP to purchase public and private securities of €1.35 trillion until at least June 2021</p>	<p>Introduction of TFSME, financed by the issuance of central bank reserves</p> <p>CCFF will purchase commercial paper to provide support to firms with liquidity shortages</p>

*Notes:* CCB: Capital Conservation Buffer. CCFF: Covid Corporate Financing Facility. CSPP: Corporate Sector Purchase Programme. CTRF: Contingent Term Repo Facility. EBA: European Banking Authority. FIMA: Foreign and international monetary authorities. FPC: Financial Policy Committee. GSE: Government Sponsored Enterprise. IFRS: International Financial Reporting Standards. LCR: Liquidity Coverage Ratio. LTROs: Long Term Refinancing Operations. MBS: Mortgage-Backed Security. MMF: Money Market Fund. MMLF: Market Mutual Fund Liquidity Facility. MSLP: Main Street Lending Program. NPL: Non-performing loans. PELTROs: Pandemic Emergency Long Term Refinancing Operations. PEPP: Pandemic Emergency Purchase Program. PDCF: Primary Dealer Credit Facility. PRA: Prudential regulatory authority. PPP: Paycheck Protection Program. P2G: Pillar 2 Guidance. TALF: Term Asset-Backed Securities Loan Facility. TFSMF: Term Funding for Small and Medium-sized Enterprises. TLAC: Total Loss Absorbing Capacity. TLTRO III: Targeted Longer-Term Refinancing Operations.

Source: Carletti, E., Claessens, S., Fatás, A. & Vives, X. (2020): The Bank Business Model in the Post-Covid-19 World. London: Centre for Economic Policy Research.

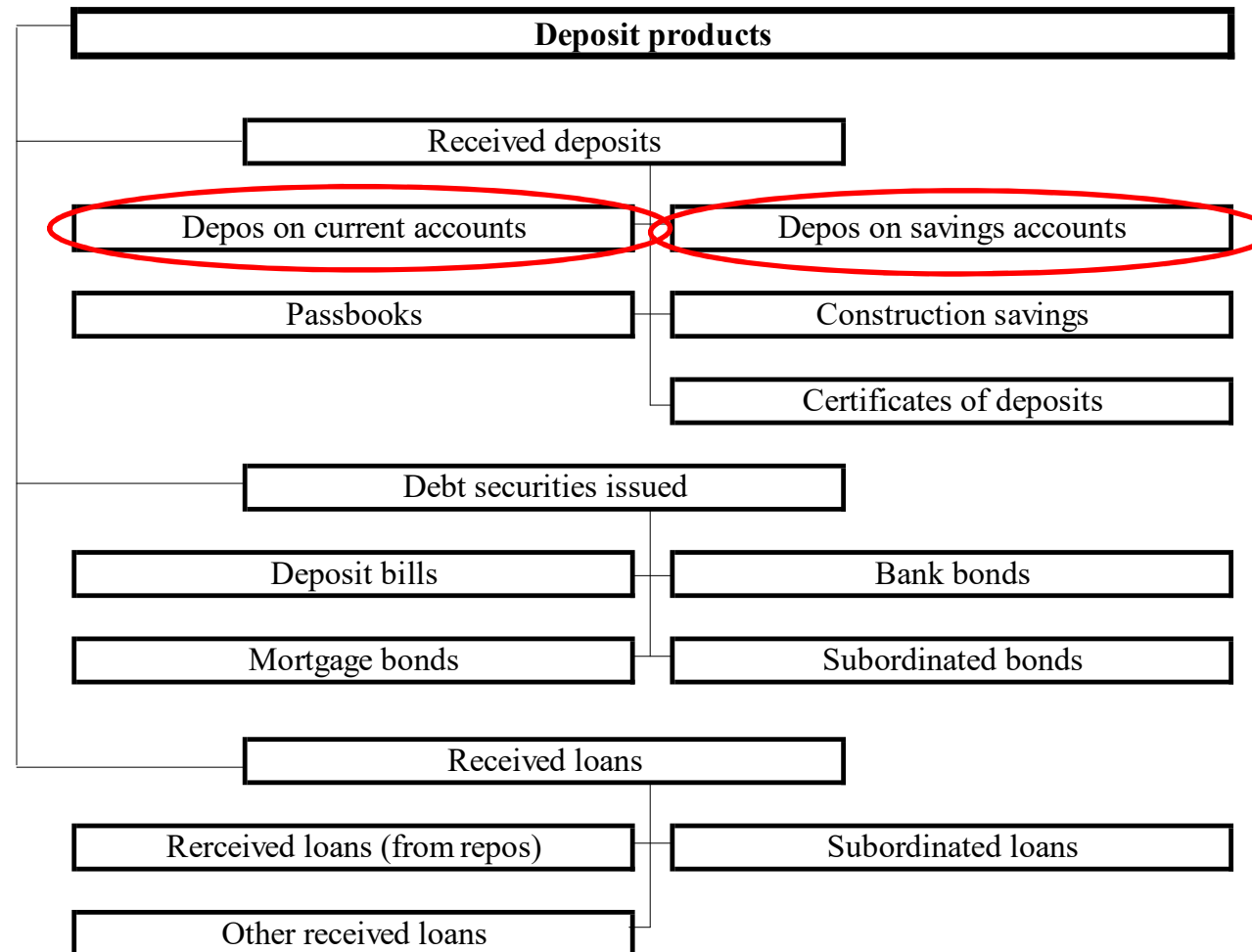
# Contents

1. Basic terms
2. Liquidity risk and Basel III
3. Liquidity risk management and crises
4. Bank deposit products
5. Excess liquidity in the CR
6. Case study - savings accounts



## 5. Bank deposit products in the CR

# Deposit products



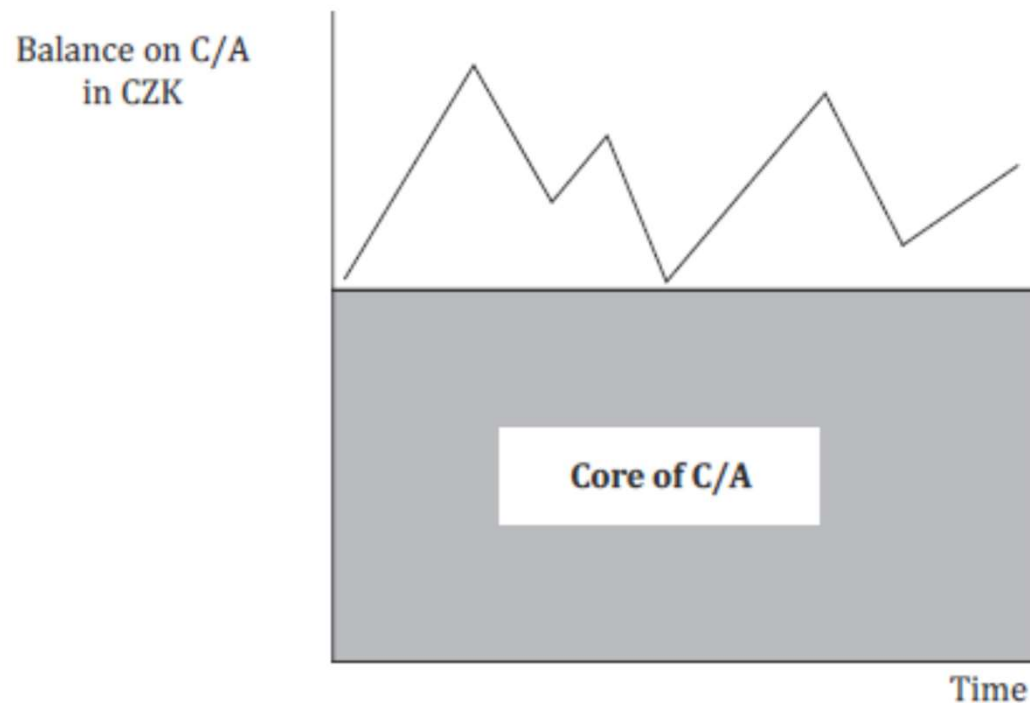


5. Contractual maturity of current accounts is 1 day (overnight “O/N”). What is their real maturity?



## 5. Bank deposit products in the CR

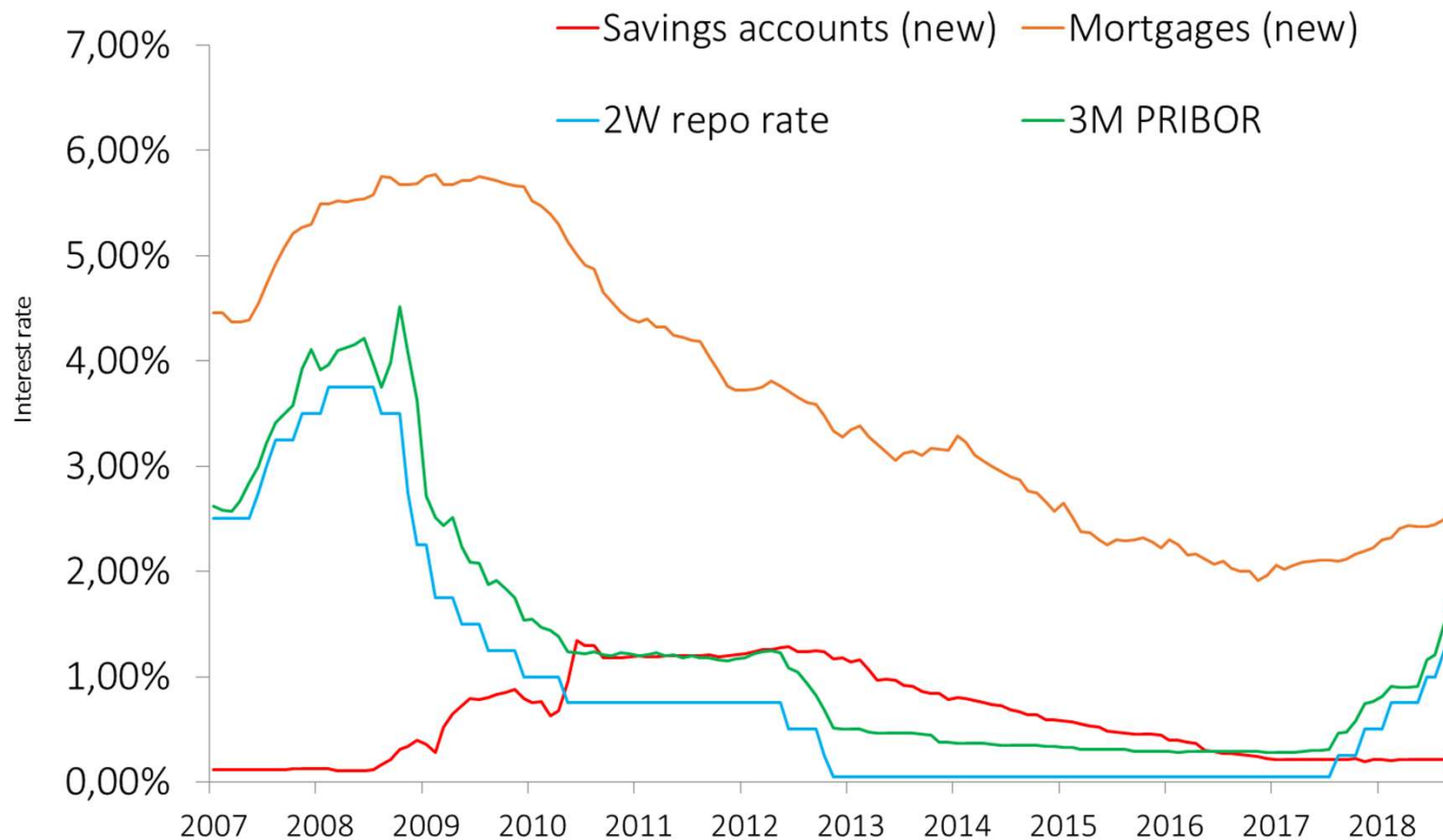
# 80% core of deposits on current account (CA) balances



- The core of deposits (80%) can be invested in long-term investments (CA's real maturity is about 4-5 years in contrast to their contractual maturity of 1 day (O/N))

## 5. Bank deposit products in the CR

# Low interest rates prevails on savings accounts vs increasing rates on mortgages



Source: Author based on CNB' database ARAD

# Contents

1. Basic terms
2. Liquidity risk and Basel III
3. Liquidity risk management and crises
4. Bank deposit products in the CR
- 5. Excess liquidity in the CR**
6. Case study - savings accounts





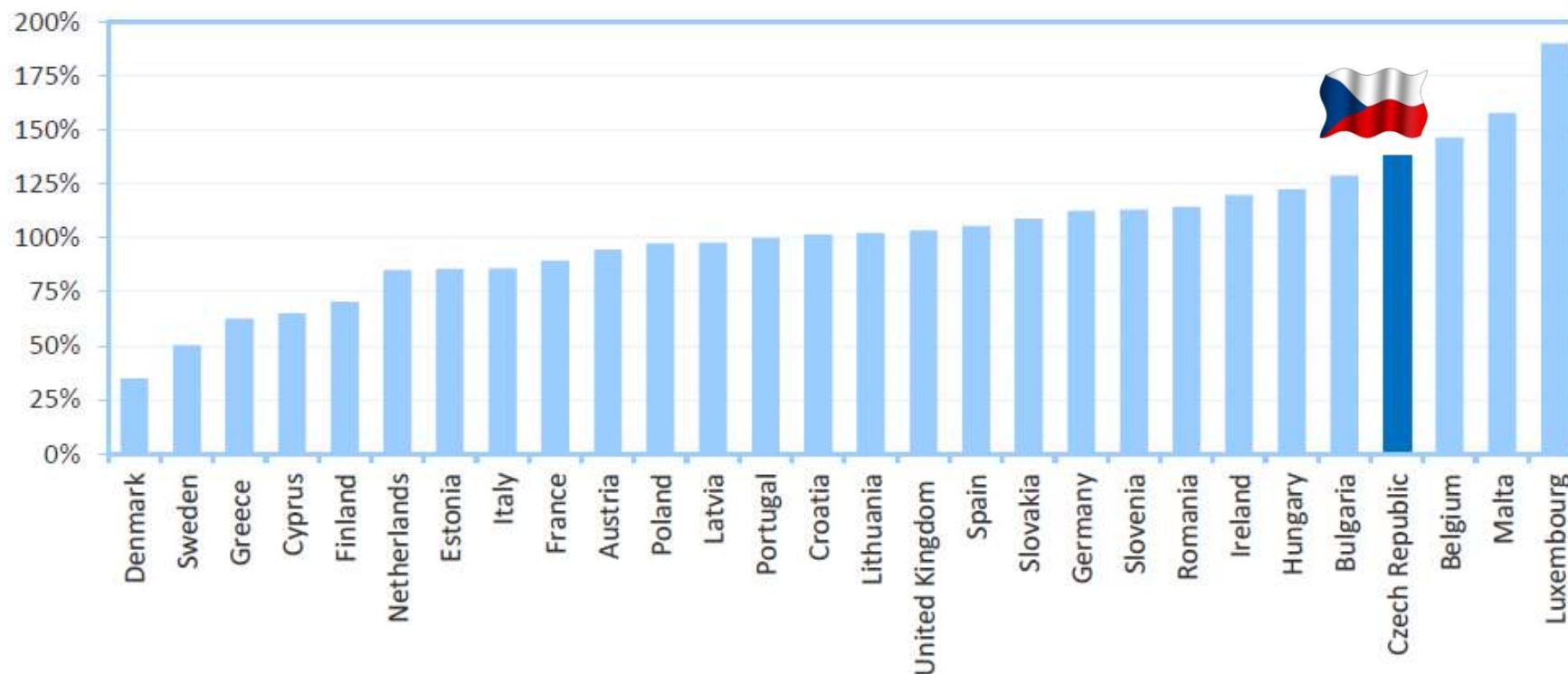
## 6. Are Czech banks liquid compared to their EU peers?



## 5. Excess liquidity in the CR

# A high deposit-loan ratio implies excess cushion of liquidity of Czech banks...

Graph 5.1: Client bank deposits to loans ratio in 2015 in EU member states



Source: Ministry of Finance (2020). REPORT ON FINANCIAL MARKET DEVELOPMENTS IN 2019



# 5. Excess liquidity in the CR

## ...banks place their liquidity surplus to the CNB

Czech National Bank's balance sheet

ASSETS	LIABILITIES
FX reserves	Currency & banknotes
	Liabilities to banks
Other assets	Other liabilities
	Capital

Classic REPO + depos

Bank's balance sheet

ASSETS	LIABILITIES
Cash	Deposits
Claims on CNB	
Securities	Interbank market
Loans	
Other assets	Capital

## 7. What are liquid bank's assets?







## 5. Excess liquidity in the CR

# Quick (liquid) assets

- 1) Cash
  - 2) Receivables from credit institutions payable on demand
  - 3) Cash balances with central banks
  - 4) Bonds issued by central government
- Statistics in the CR (2019)
    - Quick assets / total assets (%) = 42%
    - Quick assets / client deposits (%) = 63%

# Contents

1. Basic terms
2. Liquidity risk and Basel III
3. Liquidity risk management and crises
4. Bank deposit products in the CR
5. Excess liquidity in the CR
6. Case study - savings accounts



## 8. What is a saving account?



## 6. Case study - savings accounts

# Basics of a saving account

- Savings accounts = non-maturing accounts bearing a relatively high rate of return and two embedded options:
  - i) a customer's option to withdraw money at any time and
  - ii) a bank's option to set the deposit as it wishes.
- Almost impossible to provide appropriate risk management
- 6 main involved risks: liquidity risk, systemic risk, reputational risk, model risk, concentration risk and market (interest rate) risk



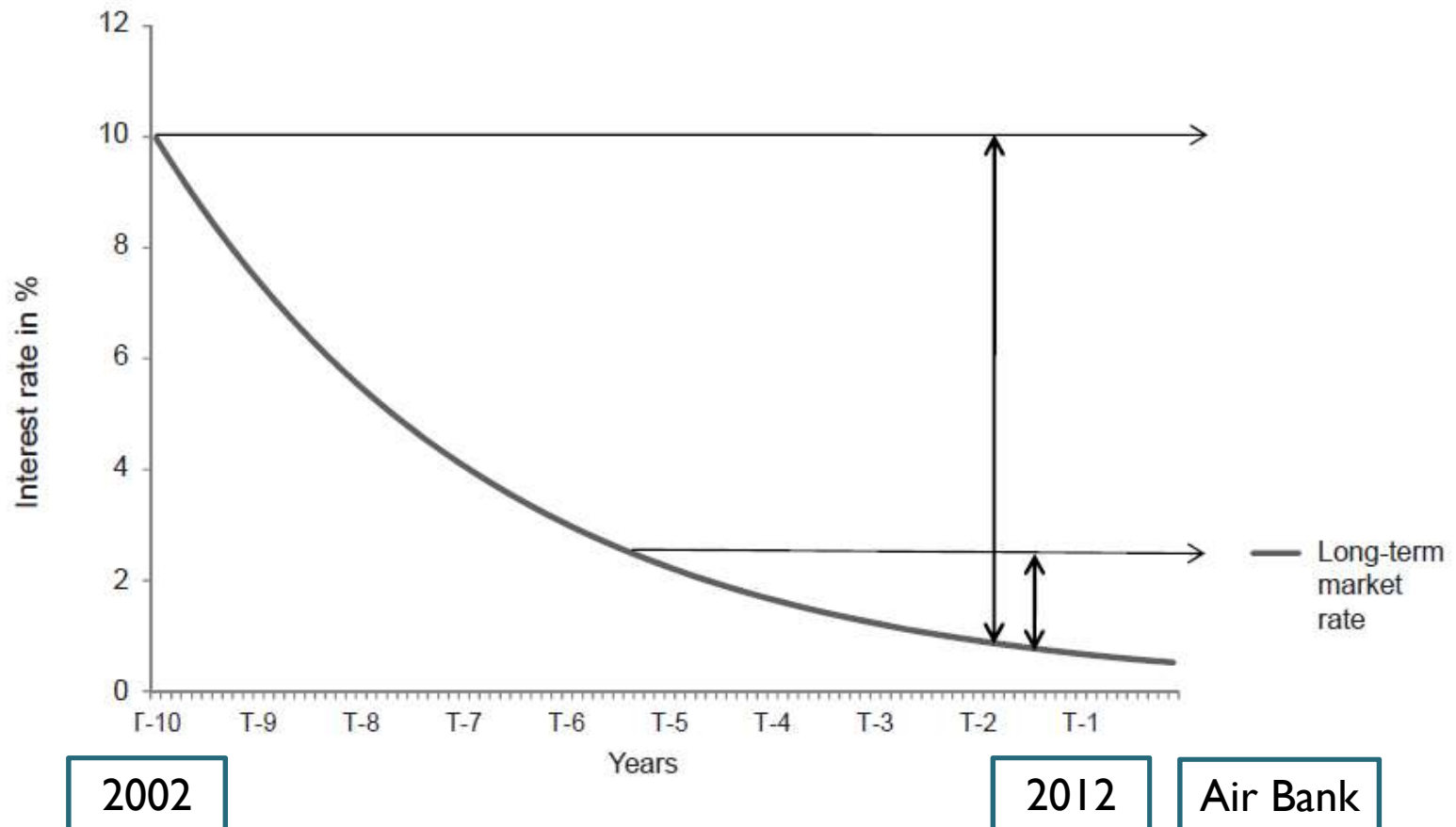
## 6. Case study - savings accounts

# Liquidity risk of savings accounts

- Liquidity risk is mainly represented by a possible inability to cover massive withdrawals of active clients. During low market rates, a liquidity risk of savings accounts is moderate.
- On the contrary, when market rates increase, the increasing competition will lead to an increase in the liquidity risk of savings accounts as active clients will move their savings to banks that offer high deposit rate savings accounts.
- Therefore, liquidity risk would result in unstable balances on savings accounts, what would drive a bank to reinvest savings accounts only into low-yield bearing assets that would not cover a high deposit rate expense.
- Maes and Timmermans (2005) stress that savings deposits raise stability issues in Belgium due to difficult risk mitigation stemming from embedded options

## 6. Case study - savings accounts

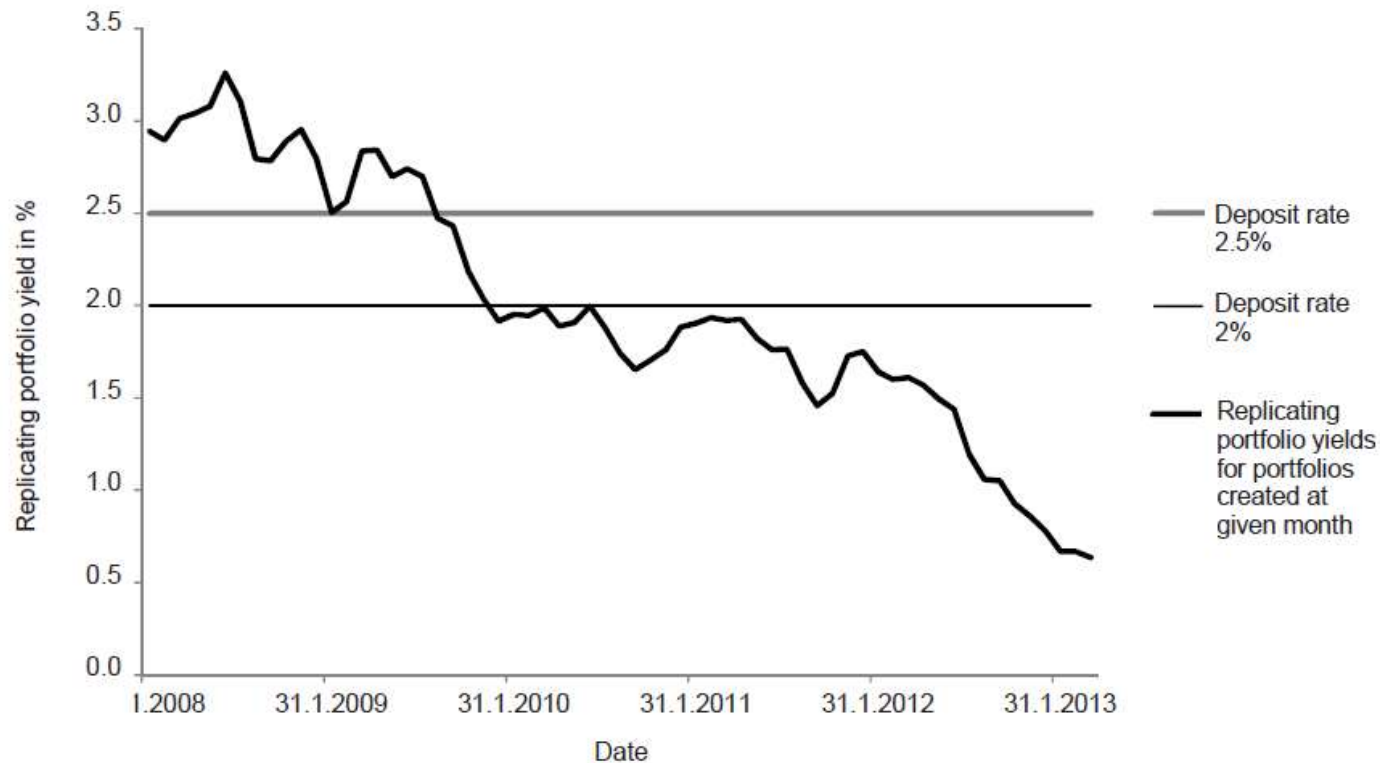
# Theory: bank's yield under low and high market rates



Source: Džmuráňová, H., Teplý, P. (2016), "Why Are Savings Accounts Perceived as Risky Bank Products?". Prague Economic Papers, DOI 10.18267/j.pep.578

## 6. Case study - savings accounts

# Practice: the yield achievable on the market in 2008-2013 (based on the replication portfolio yield)



The replicating portfolio yield is calculated as:

$$\text{yield}_t = 13.33\% * \text{ON}_t + 13.33\% * \text{PRIBOR3M}_t + 13.33\% * \text{PRIBOR6M}_t + 13.33\% * \text{PRIBOR1Y}_t \\ + 23.33\% * \text{GB5Y}_t + 23.33\% * \text{GB10Y}_t$$

Source: Džmuráňová, H., Teplý, P. (2016), "Why Are Savings Accounts Perceived as Risky Bank Products?". Prague Economic Papers, DOI 10.18267/j.pep.578

## 6. Case study - savings accounts

# Applied methodology: replication portfolio

- The replicating portfolio is a portfolio of instruments with given maturities and interest rate behaviour into which a bank reinvests savings accounts
- Replication portfolio: optimization problem

$$M = \left( II_{RP} - C_{i,t} \right) \quad (1)$$

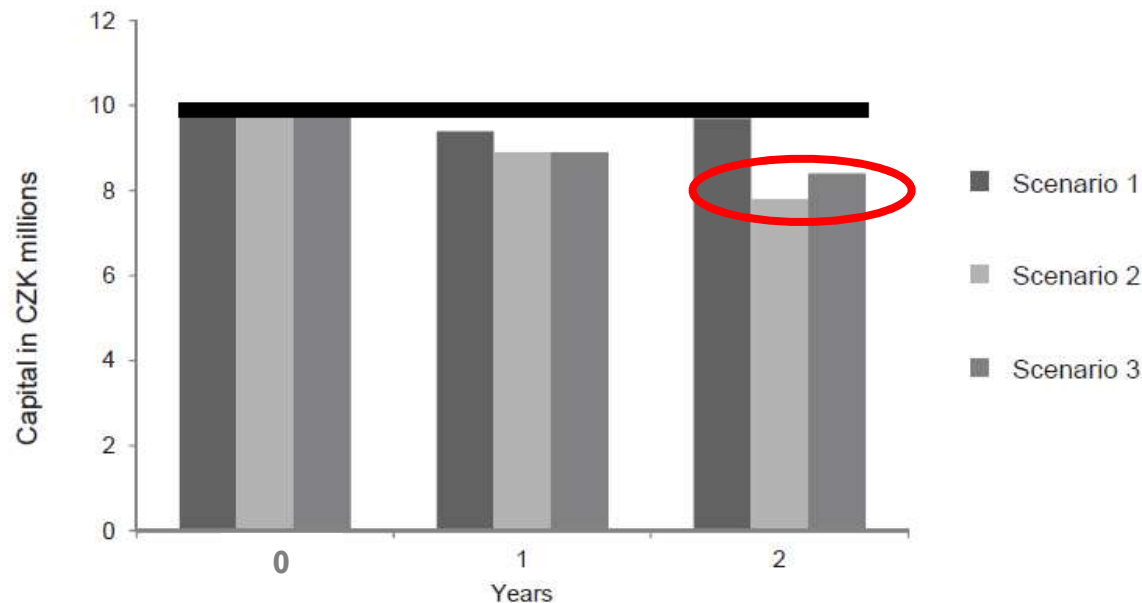
$$s. t. : \sum_{i=1}^n II_i w_i = II_{RP}, \sum_{i=1}^n w_i = 1, w_i \geq 0, \forall i, V_{i,t,not\ invested} = 0, t = 1, \dots, T,$$

In the Equation 1 we either minimize the standard deviation of the margin  $\sigma_M$  or maximize margin  $M$ .  $II_{RP}$  is the interest income from the replicating portfolio that equals to the sum of interest incomes of all individual investments and  $w_i$  is the weight of each investment and as no short-selling is allowed, its value is always positive or zero.  $C$  is the interest expense paid to clients and  $V$  is the outstanding volume on savings accounts. The last condition is that all volumes are perfectly replicated for the whole observed period. The client rate and outstanding volumes define  $C$  process. Banks adjust deposit rates to market rates to secure margin or to account for marketing and management strategies.



## 6. Case study - savings accounts

Impact on banks' capital for new digital banks under three scenarios (capital ratio=10% for simplicity)



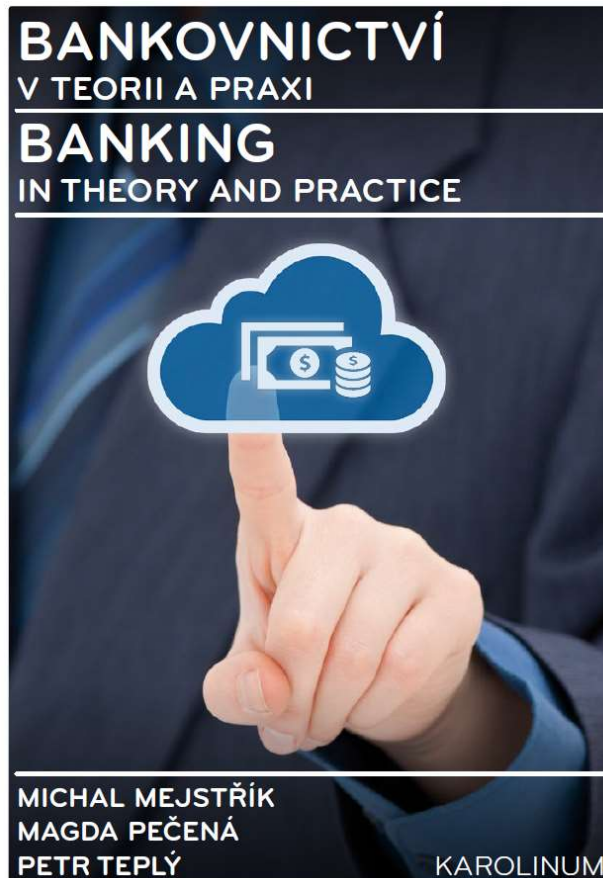
$$P = \sum_{t=1}^T \frac{C_t}{(1+r)^t} + \frac{M}{(1+r)^T}$$

$$\uparrow r = \downarrow P$$

- The risk of higher interest rates on micro-level (revaluation of bonds resulting in bank's loss), might be applied on macro-level (market-to-market losses stemming from bonds' revaluation for financial institutions)

Source: Džmuráňová, H., Teplý, P. (2016), "Why Are Savings Accounts Perceived as Risky Bank Products?". Prague Economic Papers, DOI 10.18267/j.pep.578

# Reading for the this lecture



- ✓ **VII. Liquidity risk**
- ✓ **VI. Bank regulation**

# Discussion

Thanks for your attention.  
Let's discuss it now!





## Contact

---

**Prof. PhDr. Petr Teplý, Ph.D.**

Professor of Finance

Institute of Economic Studies

Faculty of Social Sciences

Charles University

Opletalova 26

110 00 Prague

Czech Republic

Tel: +420 222 112 326

e-mail: [petr.teply@fsv.cuni.cz](mailto:petr.teply@fsv.cuni.cz)

<http://ies.fsv.cuni.cz>