# BANKING

## Lecture 3 – Principles of Risk Management

**Magda Pečená**
Institute of Economic Studies, Faculty of Social Sciences,
Charles University, Prague, Czech Republic

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# Key terms of Lecture 02 and Tutorial 02

- Banking sector structure
- Asset and Liabilities, P/L or Income statement, Cash flow statement, Interaction within the financial statements
- Operations of bank
- Key financial ratios, Capital ratio

# Content

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|---|---|
| 1. | Definition of Risk and Risk management |
| 2. | Risk categorization and ALM |
| 3. | Overview of Credit risk measurement/management |
| 4. | Overview of Market risk & Liquidity measurement/management – GAP Analysis |

# Definition of risk and risk management

**Risk** is …

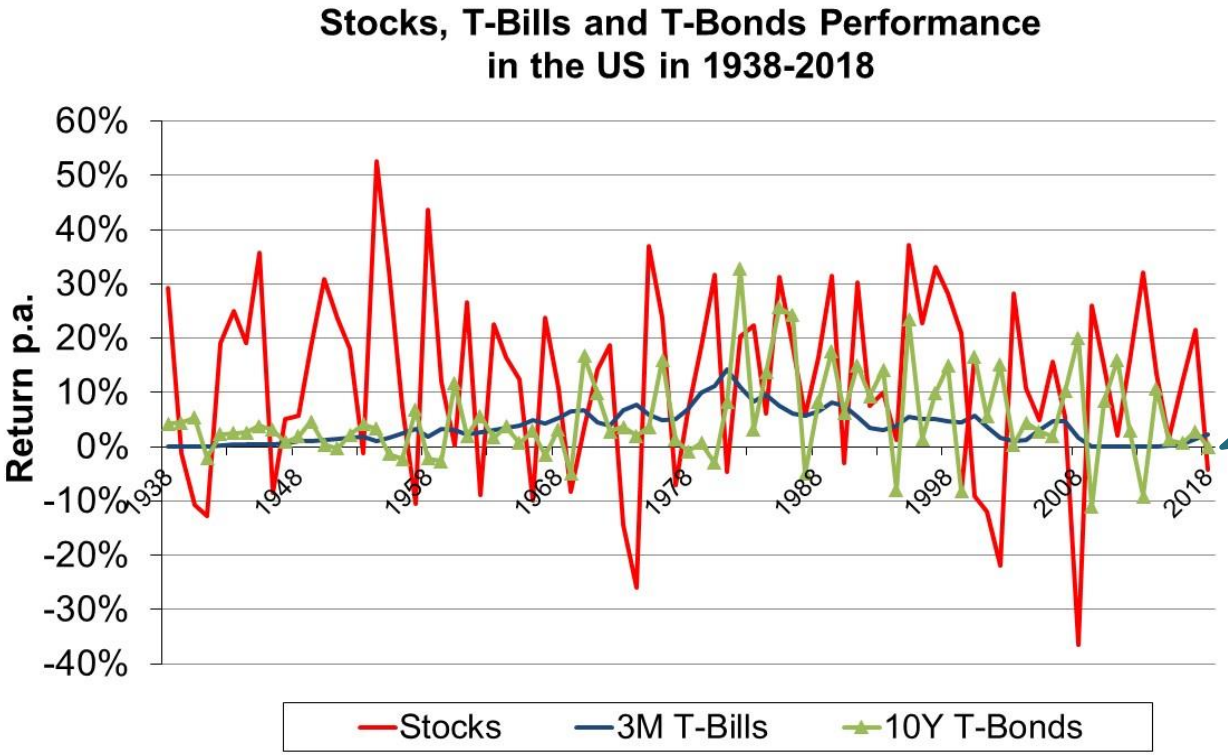
- the degree of uncertainty of future net returns.

The basic measurement tool is the volatility (standard deviation of price outcomes associated with an underlying asset).

**Risk management is …** (different sources)

- Measurement/evaluation and monitoring of risks and, where appropriate, the taking of action to limit the risks undertaken.
- A process involving the identification of the exposures to risk, the establishment of appropriate ranges for exposures, the continuous measurement of these exposures, and their execution.
- Structured asset and liability management as well as the management of off-balance sheet items (ALM). But usually we concentrate on the management of specific risks (specific stage of ALM).

# Risk vs return of securities in the 1928 -2018 period




Return

| | *Arithmetic Average of Risk Premium* | |
|---|---|---|
| | Stocks - T. Bills | Stocks - T. Bonds |
| 1928-2018 | 7.93% | 6.26% |
| Standard Error | *2.09%* | *2.22%* |
| 1969-2018 | 6.34% | 4.00% |
| Standard Error | *2.38%* | *2.71%* |
| 2009-2018 | 9.85% | 5.98% |
| Standard Error | *3.71%* | *5.50%* |

Risk (standard error)

Source: Author based on www.damodaran.com

# Content



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# Categorization of risks (besides systemic risk)

**Financial risks**

- credit risk
- market risk (interest rate risk, FX risk, equity risk, commodity risk)
- liquidity risk

**Non-financial risks**

- operational
- model
- settlement
- legal
- taxes
- regulation
- political
- reputational……

# Definitions of main risks + how are reflected in the balance sheet !!!

*Credit risk*

- risk to the bank of losses resulting from the failure of a counterparty to meet its obligations in accordance with the terms of a contract under which the bank has become a creditor of the counterparty,

Credit risk represents 50–80% of all banking risks.

| Assets | Liabilities and Equity |
|---|---|
| **Assets sensitive to credit risk (loans provided, securities purchased)** | Liabilities (generally not exposed to credit risk) |
| Assets non-sensitive to credit risk (tangible and non-tangible investments, cash, deposits at the central bank, sovereign debt (?)) | |
| | Equity |
| Off-balance sheet assets sensitive to credit risk (accepted guantantees) | Off-balance sheet liabilities sensitive to credit risk (guantantees provided) |

*Market risk*

- risks to the bank of losses resulting from changes in prices, exchange rates and interest rates on the financial markets. This is a summary term for interest rate risk, foreign exchange risk, equity risk and other risk associated with movements in market prices,
- Very roughly, 5–20% of all banking risks are accounted for as market risks.

| Assets | Liabilities and Equity |
|---|---|
| **Assets sensitive to interest rates, FX movements, stocks** | **Liabilities sensitive to interest rate and FX movements** |
| Assets non-sensitive to interest rate and FX movements | Liabilities sensitive to interest rate and FX movements |
| | Equity |
| Off-balance sheet assets sensitive to market risk | Off-balance sheet liabilities sensitive to market risk |

# Definitions of main risks + how are reflected in the balance sheet !!!

*Operational risk*

- risk to the bank of loss resulting from inadequate or failed internal processes, people and systems, or the risk to the bank of loss resulting from external events, including the legal risk. It excludes strategic and reputational risk.

Operational risk represents 5 – 30% of banking risks, depending also on the extent to which it overlaps with the definition of other risks (especially credit risk), examples (frauds, human failures - Barings, SoGe, UBS etc.)

*Liquidity risk*

- the risk that the bank will lose its ability to meet its financial obligations as they are due, or the bank will not be able to fund its assets,
- „maturity mismatch“
- potential loss due to insufficient market depth.

**!! The definitions may overlap; no single set of risks and definitions of risks exists.**

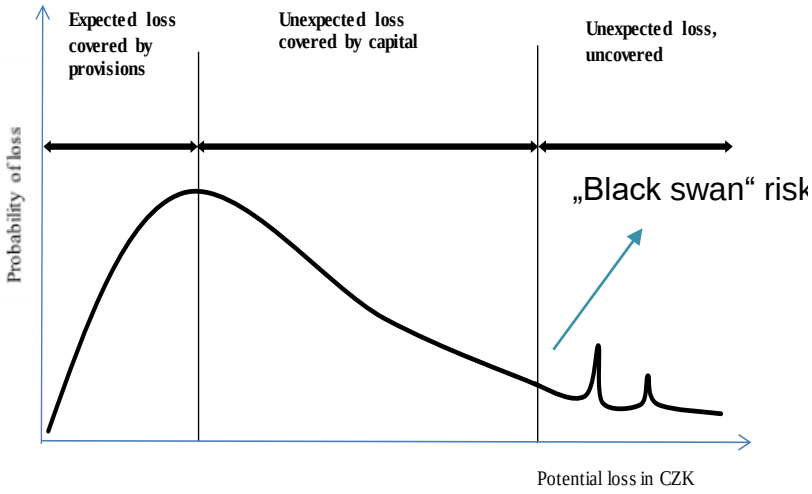
# Loss distribution of credit, operational and market risk

*More difficult to quantify*

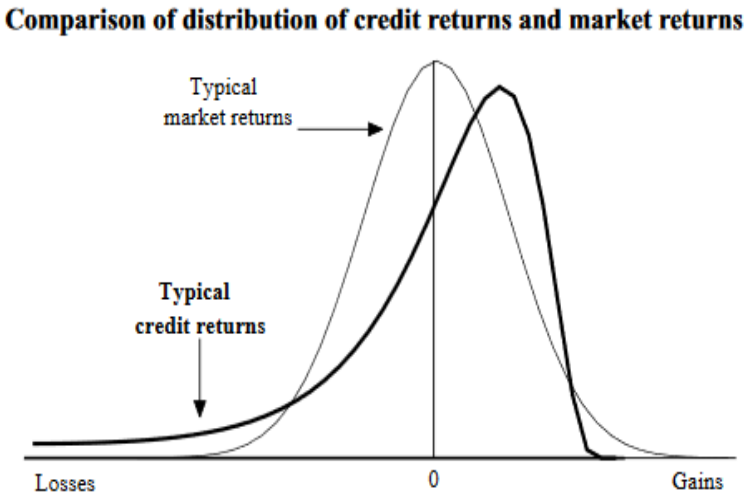
**Market risk**
**Credit risk**
**Liquidity risk**
**Operational risk**
**Legal risk**
**Political risk**
**Reputational risk**

*Easier to quantify*

~ Assymetry (credit risk, operational risk)




~ Symetry of losses (market risk)



# Market risk – interest rate, equity, FX and commodity risk

Interest rate risk

- of the Trading positions x of the Banking book
- Absolute risk, Relative risk (Yield curve risk, Spread risk) – more on that - Lecture Market risk

Equity risk

- Investment in equities of corporate or financial corporations
- (Insignificant positions in the Czech Republic)

FX risk

- Long or short open positions in foreign currencies
- (Limited FX positions in the Czech Republic)

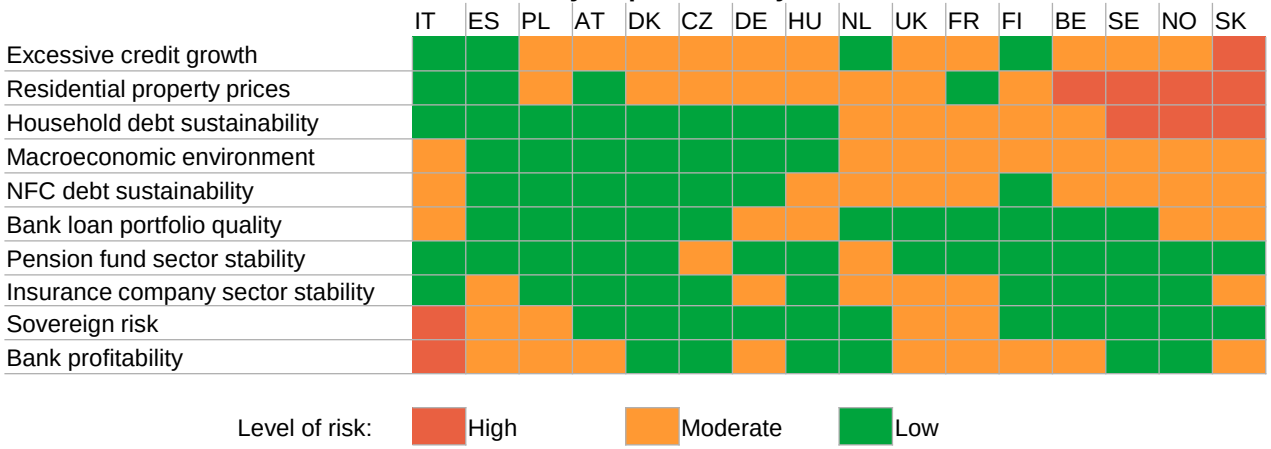
Commodity risk

- Gold, silver and other precious metal
- Energy, crude oil
- Derivatives on commodities
- (Insignificant positions in the Czech Republic)

# Risks from the point of view of financial stability

**Table II.1**

**Potential sources of risks to financial stability as perceived by selected national authorities**




Source: The relevant countries' latest financial stability reports, ESRB Risk Dashboard, CNB

Note: The assessment is based on a qualitative evaluation of the relevant countries' latest financial stability reports. Where a risk is not mentioned in the report, the assessment is based on the CNB's interpretation of the indicators used in the ESRB Risk Dashboard. The ordering of countries and risks in the table is obtained using a visual contrast-optimising algorithm.

NFC – non-financial corporations

What risk is perceived as the most crucial ?

**Risks in 2019**

**COVID-19**

**Risks in 2020**

# Task 1 - Risk identification in bank´s balance sheet

**Interest rate risk**

all items in the amount of 10 mio EUR

| *Asset* | | *Liability* | |
|---|---|---|---|
| Loan | 6M LIBOR + 1 % | Deposit | 6M LIBOR + 0,5 % |

| *Asset* | | *Liability* | |
|---|---|---|---|
| Loan | 3M LIBOR + 1 % | Deposit | 0,70% |

| *Asset* | | *Liability* | |
|---|---|---|---|
| Loan | 3% | Deposit | 3,50% |

| *Asset* | | *Liability* | |
|---|---|---|---|
| Loan | 3M LIBOR + 1 % | Deposit | 6M LIBOR + 0,5 % |

**FX Risk**

CZK reporting entity

| *Asset* | | *Liability* | |
|---|---|---|---|
| EUR Loan | 20 mio CZK equivalent | EUR Deposit A | 10 mio CZK equivalent |
| | | CZK Deposit B | 10 mio CZK |

| *Asset* | | *Liability* | |
|---|---|---|---|
| USD Loan | 20 mio CZK equivalent | USD Deposit | 20 mio CZK equivalent |

| *Asset* | | *Liability* | |
|---|---|---|---|
| USD Loan | 20 mio CZK equivalent | EUR Deposit | 20 mio CZK equivalent |

**Liquidity Risk**

| *Asset* | *Liability* |
|---|---|
| 5Y Loan | 2Y Term deposit |

| *Asset* | *Liability* |
|---|---|
| 1Y Loan | Sight deposit |

| *Asset* | *Liability* |
|---|---|
| 1Y Loan | 3Y deposit |

Now imagine, all combinations come together → ALM

# Task 2 - Risk identification in bank´s balance sheet

Identify and discuss the risks to which the bank is exposed to:

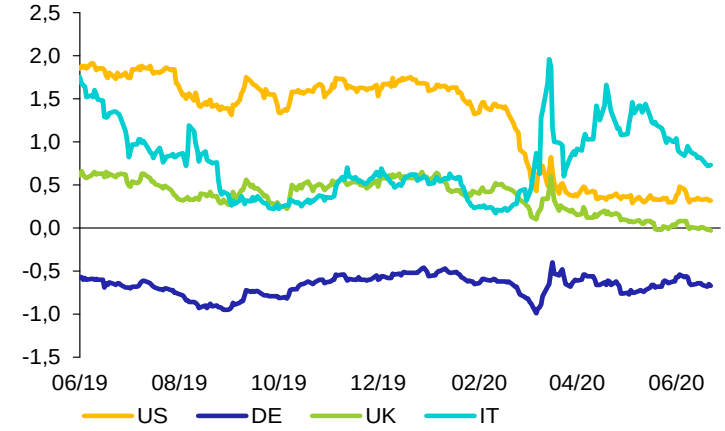
| As of Dec 31 | | | |
|---|---|---|---|
| **Assets** | | **Liabilities and Equity** | |
| Cash | **10** | Sight deposits | **120** |
| Overdrafts | **20** | 1 Y Term deposits (retail customers), fixed rate 2 % | **180** |
| Interbank loans (based on PRIBOR) | **30** | 3M Term deposits (large customers), PRIBOR + 1 % | **160** |
| Czech Government bills | **30** | Short term Interbank deposits, denominated in EUR | **215** |
| German Government bills, denominated in EUR | **15** | 5Y Bonds issued, USD denominated | **20** |
| 20Y Government bonds, fixed and floating | **25** | | |
| 6Y Commercial real estate loans (corporates) | **280** | | |
| 20Y Receivables (retail) | **320** | Equity | **80** |
| Equity Investments | **10** | | |
| Fixed assets | **35** | | |
| Total | **775** | Total | **775** |

Credit risk ?
Liquidity risk ?
Market risk ? (Interest rate risk ?, FX risk ?, Equity risk ?)
Operational risk ?
?

# Market risk – interest rate risk

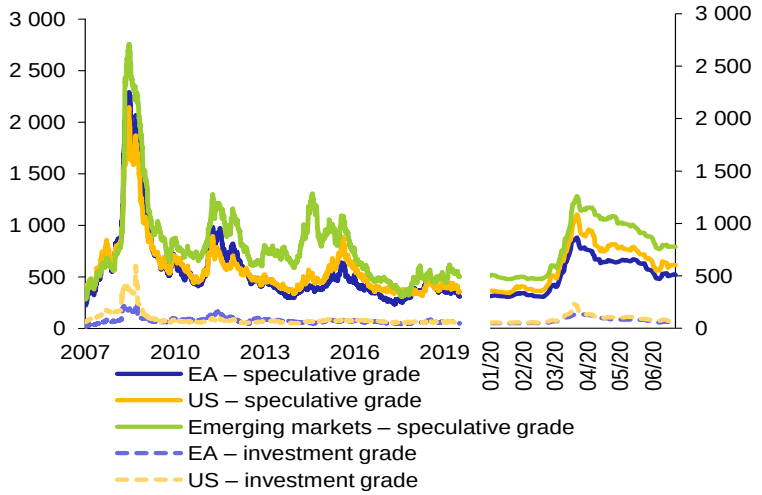
Interest rate risk of the Trading positions – bond yield relationship (all plays a role – absolute i.r. risk, relative i.r. risk)

**Chart II.3**
**Five-year government bond yields for selected countries**
(%)




Source: Refinitiv

**Chart II.2**
**Credit spreads on corporate bond yields**
(bp)



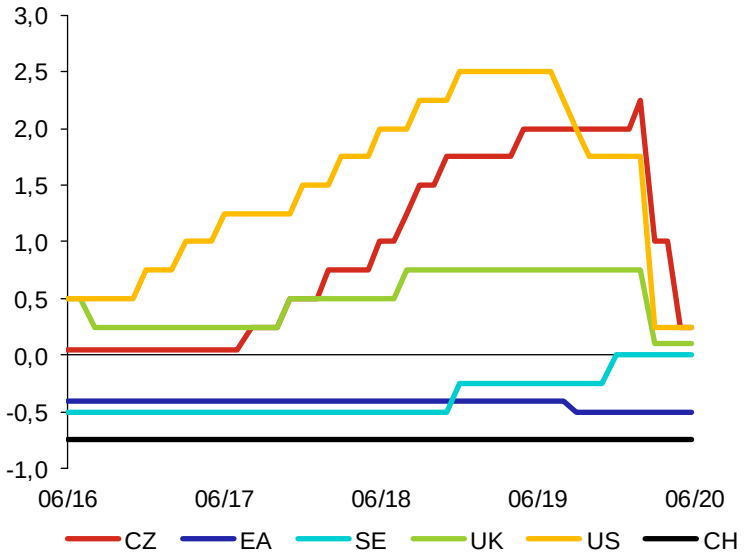

Source: Bank of America Merrill Lynch

Note: Credit spread means the yield spread over government bond yields adjusted for any embedded options (option-adjusted spread). Higher values represent a higher risk premium. Speculative grade is a rating of BB+ or lower.

Interest rate risk of the Banking book – modelling potential market value changes due to changes in interest rates or modelling impact on NI („NPV and NI effect"), for the positions held until maturity (incl. loans)

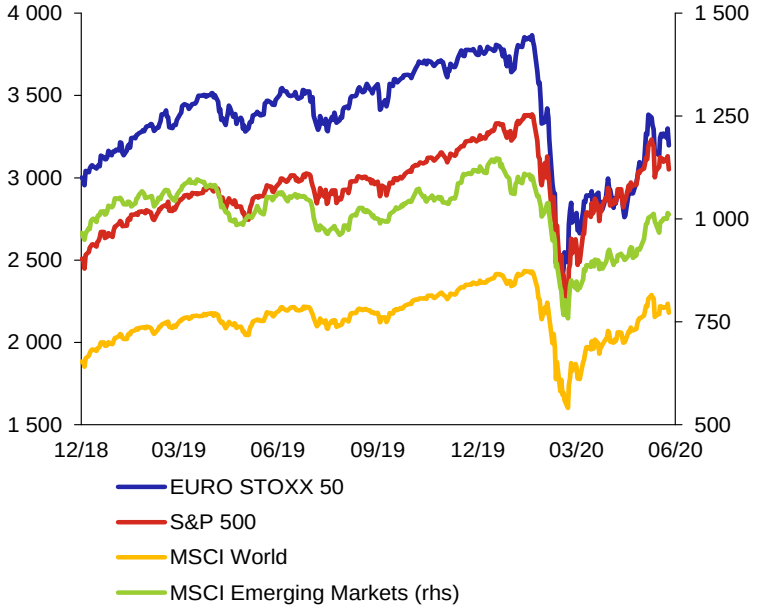
# Market risk – (1) interest rate risk (monetary rates (absolute risk)), (2) equity risk

**Chart II.8**
**Main monetary policy rates of selected central banks**
(%)




Source: Refinitiv
Note: In the case of EA, the chart shows the deposit rate.

**Chart II.1**
**Key global stock indices**
(indices in points)



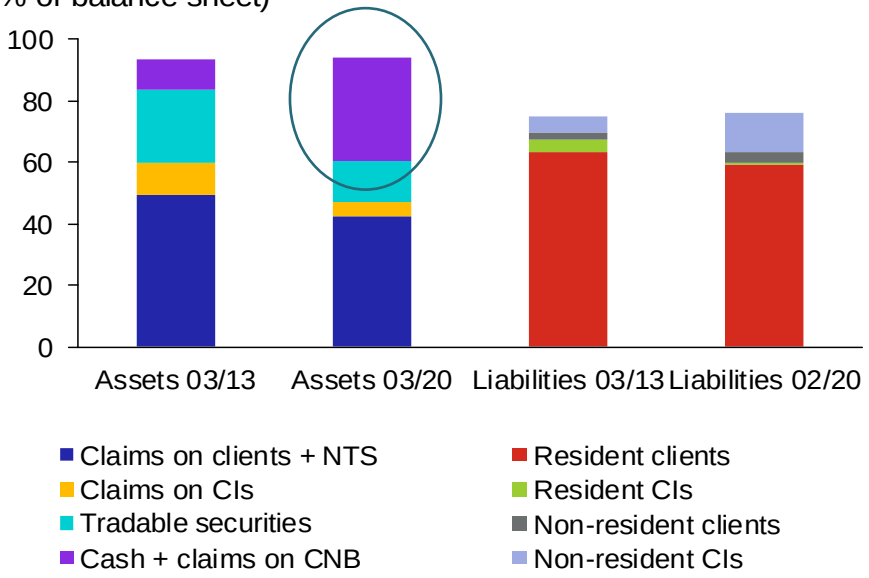

Source: Refinitiv

Source: Financial Stability Report 2019/20

# Liquidity risk

- The Czech banking sector has above-average liquidity by international comparison and a **significant excess of deposits over loans**
- Sufficient room for credit granting activity
- Liquidity must be asessed by an analysis of **maturity mismatch**
  - Above average LCR (liquidity coverage ratio), more on that Lecture Liquidity

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




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

Source: www.cnb.cz, Financial Stability Report, 2019/2020

# Managing all risks together and at the same time - Asset and liability management

**ALM - coordinated management of the balance sheet** using various development scenarios of interest rates, liquidity and payments.
ALM is managed through special banking units and/or Assets and Liabilities Committee (ALCO).
The objective of ALM is to assure a banks' **liquidity, solvency and efficiency** concerning:

- **capital and liabilities structure** in term of the management of capital and external sources; most of the external sources come from small depositors, but their influence on a bank is minimal, and on the other hand, the influence of management and big creditors is substantial,
- **assets structure**, their liquidity, return and risks,
- assets and liabilities and off-balance sheet item **relations**.

At this point liquidity risk and insolvency risk shall be mentioned especially because they might be in mutual contradiction when achieving an optimal assets and liabilities structure.

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# Credit risk – Basic credit/debt types

**Instruments**

- **Loans** - Non-standard contracts difficult to transfer to third parties
- **Securities** (Tradable securities) - Standard contract easy to transfer to third parties

**Counterparties**

- **Corporate** financing (corporate loans, securities)
- **Retail** financing (retail loans, loans to households = individuals + small trades)
    - Consumer credits
    - Mortgages
    - Etc.
- **Government** and **public** financing
- Loans to **financial institutions**
- **Project** financing and other structured financing (of corporate or public projects)
- Etc.

**Counterparty credit risk** (CCR) – counterparty risk arising from derivative deals (OTC derivatives, repo style transactions)

# Credit risk measurement

- Credit rating
- Credit scoring
- PD (probability of default)
- NPL (non-performing loans)
- LGD (loss given default)

Models (combining all of this)

- LTV (loan-to-value), in %
- DTI (debt-to-income), in number of years
- DSTI (debt-service-to-total-income), in %

# Credit risk management models

- Credit risk assessment
  - Scoring
    - Altman Z-score and alike
  - Rating
- Credit risk models
  - Credit Monitor Model (KMV Moody´s)
  - Credit Margin Models
  - CreditMetrics (based on VaR methodology)
  - RAROC

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# Market risk measures

**GAP analysis** (for measuring interest rate risk, liquidity risk, FX risk via GAPs - open positions)

**Volatility**

Another instrument for measuring risk is the **sensitivity** to adverse movements in the value of a key variable.

- **First-order** risk measures:
  - Beta (β),
  - Duration (D),
  - Delta (δ)
- **Second-order** risk measures (changes in sensitivities): Convexity, Gamma, Vega and others

**Models** (e.g. Value at risk)

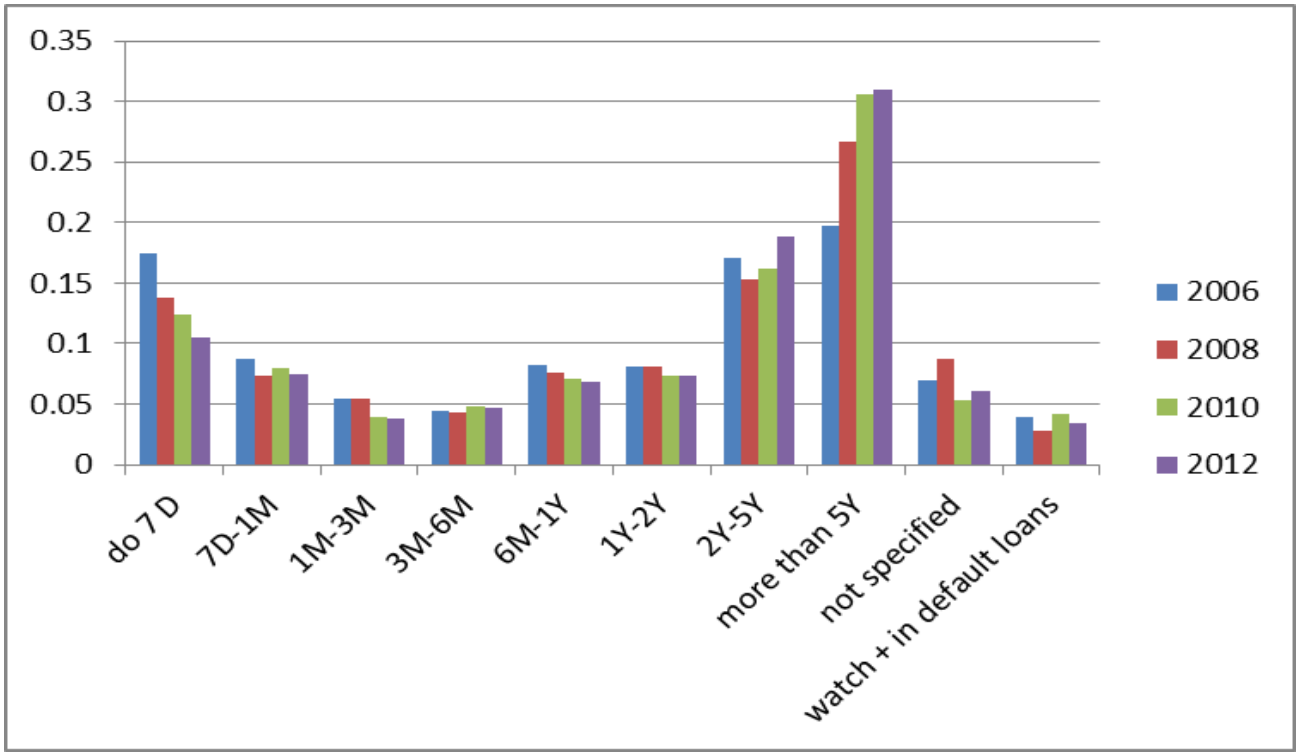
# GAP Analysis – Basic risk management model

**GAP analysis for measuring liquidity risk -** incremental GAP

- An incremental GAP analysis divides **all** institutions' assets and liabilities into different time buckets.
- The periodic (relative) incremental GAP is defined as the difference between assets and liabilities in each time bucket.

# GAP Analysis – Basic view on macroliquidity in the CZ (Balance sheet approach)

Time structure of all assets in the Czech banking sector (according to their agreed maturity) ≈ average commercial bank

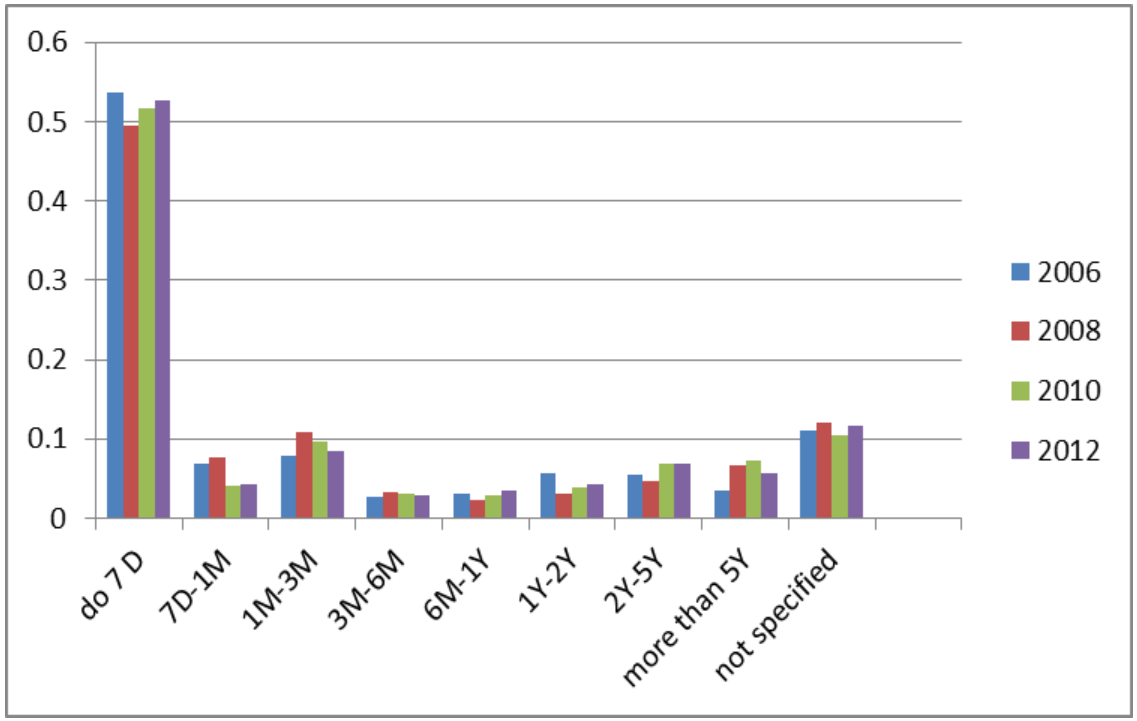



Source: www.cnb.cz

Today (2018 – 2020), the exposure toward CNB would imply higher 7D bucket

# GAP Analysis – Basic view on macroliquidity in the CZ (Balance sheet approach)

Time structure of all liabilities in the Czech banking sector (according to their agreed maturity)




Source: www.cnb.cz

**Conclusions ?**

Sight deposits, prepayment options etc.

# Illustration - Liquidity GAP Analysis

**GAP Analysis for Interest Rate Risk**

| | Interest rate sensitive items | | | | | | | Non-sensitive items |
|---|---|---|---|---|---|---|---|---|
| **Maturity** | **O/N - 90 days** | **91-180 days** | **181-270 days** | **271-365 days** | **1-2 years** | **2-5 years** | **6-15 years** | **N/A** |
| **Assets** | | | | | | | | |
| Cash | 80 | | | | | | | |
| Overdrafts | 20 | | | | | | | |
| Interbank loans | 50 | 30 | | | | | | |
| Treasury Bills | 20 | | | 50 | | | | |
| Government bonds | | | | | 50 | | | |
| Company loans | | | | | 20 | | 10 | |
| Property | | | | | | | | 80 |
| ***Total*** | ***170*** | ***30*** | ***0*** | ***50*** | ***70*** | ***0*** | ***10*** | ***80*** |
| **Liabilities** | | | | | | | | |
| Retail deposits | 100 | | 50 | 30 | | | | |
| Wholesale deposits | | 40 | 20 | 30 | | | | |
| Bonds issued | | | | | 40 | 40 | 20 | |
| **Equity** | | | | | | | | 40 |
| ***Total*** | ***100*** | ***40*** | ***70*** | ***60*** | ***40*** | ***40*** | ***20*** | ***40*** |
| ***Solution*** | | | | | | | | |
| **Periodical GAP** | **70** | **-10** | **-70** | **-10** | **30** | **-40** | **-10** | **40** |
| **Cumulative i.r. GAP** | **70** | **60** | **-10** | **-20** | **10** | **-30** | **-40** | |
| **Cumulative GAP** | | | | | | | | **0** |

** Calculated from short to long term*

Note, that if only balance sheet items are assigned to respective time buckets, the liquidity GAP must sum up to 0.
(If expected cash flows included, it does not sum up to 0, as expected cash inflows and cash outflows differ)

# Example 3 – Liquidity GAP

Below you see a simplified bank balance, which takes into account the expected cash flows by contractual maturity of each item. Therefore, it also contains expected future payments of interests and coupons, which makes it different from a real bank balance sheet. In this case the expected cash in-flows do not equal the expected cash out-flows. However, this is a more realistic view of a bank's liquidity situation than a simple breakdown of assets and liabilities.

Task is:

a) calculate GAPs for each time period;
b) interpret the results calculated;
c) calculate the cumulative GAP for 6 months and 1 year;
d) suggest how we could restructure this breakdown to better reflect the actual maturity of each item.

# GAP analysis

# Example 3 – liquidity GAP

| | | Expected Cash Flows | | | | | | | N/A |
|---|---|---|---|---|---|---|---|---|---|
| According to maturity | Total | O/N - 90 days | 91-180 days | 181-270 days | 271-365 days | 1-2 years | 2-5 years | 6-15 years | |
| **Assets** | | | | | | | | | |
| Cash | **10** | 10 | | | | | | | |
| Overdrafts | **10** | 10 | | | | | | | |
| Interbank loans (PRIBOR) | **55** | 40 | 15 | | | | | | |
| Czech Government bills | **90** | 25 | 0 | 2 | 63 | | | | |
| Government bonds, CZ, fixed and floating | **26** | | 1 | | 25 | | | | |
| Receivables (retail) | **96** | | 3 | 4 | 2 | 25 | 2 | 60 | |
| Receivables (corporates) | **280** | | | | | 60 | 80 | 20 | |
| Fixed assets | **83** | | | | | | | | 83 |
| Total inflows | **530** | 85 | 19 | 6 | 90 | 85 | 82 | 80 | 83 |
| **Liabilities and Equity** | | | | | | | | | |
| Sight deposits | **100** | | | | | | | | 100 |
| Deposits (small customers), fixed rate 2 % | **137** | 80 | 4 | 30 | 5 | 10 | 8 | | |
| Deposits (large customers), PRIBOR + 1 % | **96** | 6 | 40 | 20 | 30 | | | | |
| Interbank deposits, denominated in EUR | **100** | | | | 20 | 50 | 30 | | |
| Bonds issued, USD denominated | **50** | | | | | | | 50 | |
| Capital | **40** | | | | | | | | 40 |
| Total outflows | **523** | 86 | 44 | 50 | 55 | 60 | 38 | 50 | 140 |

Actually, if the bank is profitable, the expected cash inflows should be higher then cash outflows (here 530 > 523)

Solution to be provided in excel

# GAP Analysis – Basic risk management model

## GAP analysis for measuring interest rate risk

- The interest rate GAP analysis divides an institution's interest rate sensitive assets **(RSA)** and liabilities **(RSL)** into different time buckets. It measures the risk that arises from interest rate mismatch between the different time buckets.
- The basic methodology is the same as for liquidity GAP analysis, only not the maturity matters in the first place, but REPRICING of the position, on both the asset and liability side (new setting of interest rates)
- Examples ?

# GAP Analysis – effect of shock on NPV and NII – Lecture 05

Illustration of an interest rate change effect on an institution's market value balance sheet and income statement (inspired by Sinkey, 1998):

the basic premise is that a four-year fixed-rate asset of 100 at 3% is funded with a one-year liability of 90 with a floating interest rate and yearly repricing. The shock is simulated as an interest rate increase by 200 basis points (2%) immediately after the asset is funded.

# GAP Analysis – effect of shock on NPV and NII

Yield curve:

| | *1 Y* | *2 Y* | *3 Y* | *4 Y* |
|---|---|---|---|---|
| Spot rate | 2% | 3% | 3.50% | 3.80% |

Before the shock:

| | Spot rate | Discount Factor | Fwd Rates |
|---|---|---|---|
| 1 | 2% | 0.9804 | |
| 2 | 3% | 0.9426 | 4.01% |
| 3 | 3.50% | 0.9019 | 4.51% |
| 4 | 3.80% | 0.8614 | 4.71% |

After the shock:

| | Spot rate | Discount Factor | Fwd Rates |
|---|---|---|---|
| 1 | 4.00% | 0.9615 | |
| 2 | 5.00% | 0.9070 | 6.01% |
| 3 | 5.50% | 0.8516 | 6.51% |
| 4 | 5.80% | 0.7981 | 6.71% |

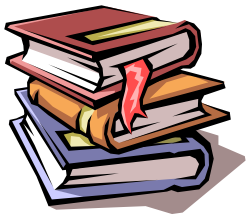
# GAP Analysis – effect of shock on NPV and NII

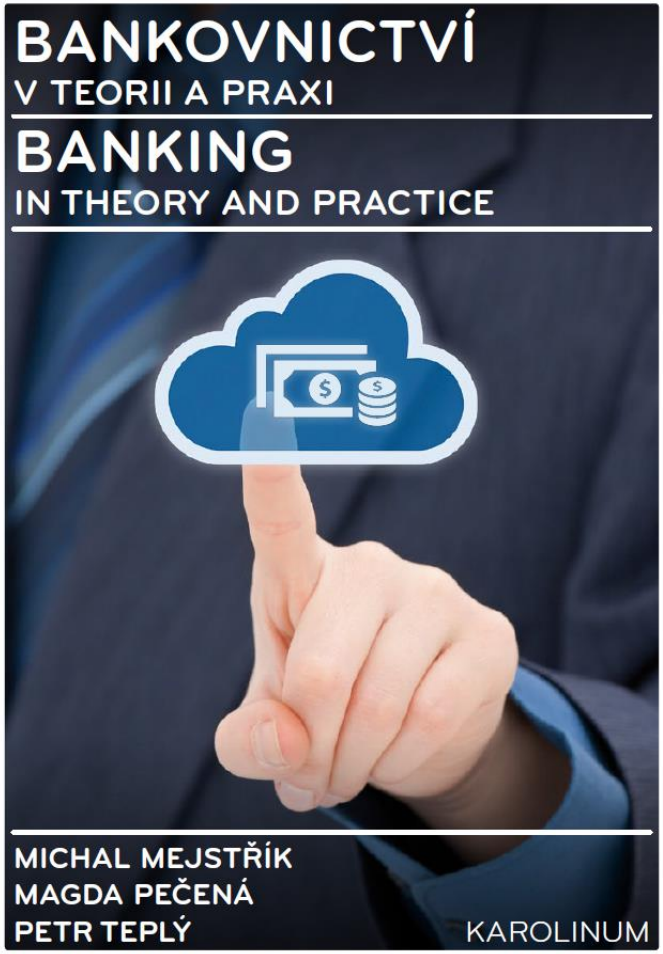
| ***Before the shock - interest income*** | | | | | | |
|---|---|---|---|---|---|---|
| | **Market value** | **Book value** | **Cash flow** | | | |
| | | | ***CF1*** | ***CF2*** | ***CF3*** | ***CF4*** |
| Asset | 97.20 | 100 | 3.0 | 3.0 | 3.0 | 103.0 |
| Liabilities | -90.0 | 90 | **-1.8** | **-3.6** | **-4.1** | **-94.2** |
| **Capital** | **7.20** | 10 | 1.2 | -0.6 | -1.1 | 8.8 |
| | | | | | | |
| ***Before the shock - fair value*** | | | | | | |
| | **Market value** | **Book value** | **Cash flow** | | | |
| | | | ***CF1*** | ***CF2*** | ***CF3*** | ***CF4*** |
| Asset | 97.20 | 100 | 3.0 | 3.0 | 3.0 | 103.0 |
| Liabilities | -90.0 | 90 | **-91.8** | | | |
| **Capital** | **7.20** | 10 | -88.8 | 3.0 | 3.0 | 103.0 |

# GAP Analysis – Basic risk management model, example

| *After the shock - parallel shift + 200 bps, interest income* | | | | | | |
|---|---|---|---|---|---|---|
| | **Market value** | **Book value** | **Cash flow** | | | |
| | | | ***CF1*** | ***CF2*** | ***CF3*** | ***CF4*** |
| Asset | 90.36 | 100 | 3.0 | 3.0 | 3.0 | 103.0 |
| Liabilities | -88.3 | 90 | **-1.8** | **-5.4** | **-5.9** | **-96.0** |
| **Capital** | **2.10** | 10 | 1.2 | -2.4 | -2.9 | 7.0 |
| | | | | | | |
| *After the shock - parallel shift + 200 bps, fair value* | | | | | | |
| | **Market value** | **Book value** | **Cash flow** | | | |
| | | | ***CF1*** | ***CF2*** | ***CF3*** | ***CF4*** |
| Asset | 90.36 | 100 | 3.0 | 3.0 | 3.0 | 103.0 |
| Liabilities | -88.3 | 90 | **-91.8** | | | |
| **Capital** | **2.10** | 10 | -88.8 | 3.0 | 3.0 | 103.0 |

# Reading for the this lecture






✓**Chapter IV – Risk measurement and risk management**