INTRODUCTORY BANKING

Lecture 8 – Principles of Risk Management

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Key terms of Credit risk - Lecture 06 and Tutorial 06

- Credit risk as a key risk in banking
- Credit risk measurement tools and management
  - Credit rating
  - Credit scoring
  - PD (probability of default)
  - NPL (non-performing loans)
  - LGD (loss given default)
  - EAD
  - Provisioning
  - 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 registers
- Capital requirement quantification – risk weights
- Provisions quantification, IFRS 9

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 …

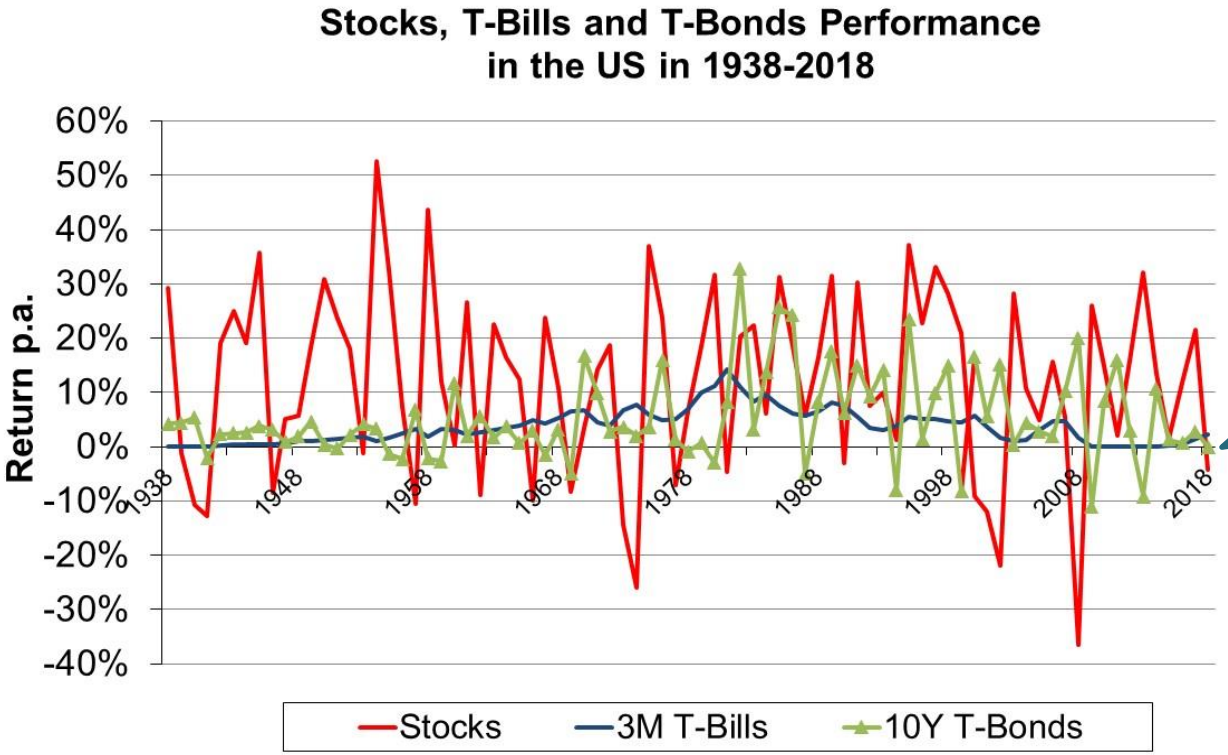
- the degree of uncertainty of future net returns.

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

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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 insensitive 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.

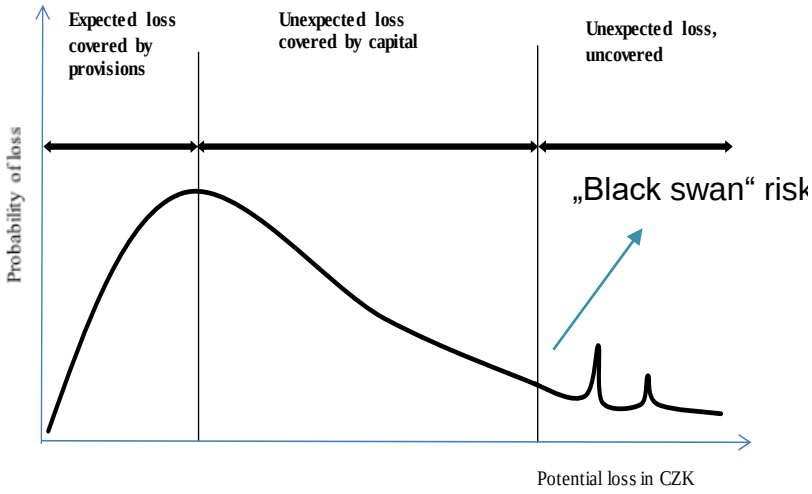
Loss distribution of credit, operational and market risk

More difficult to quantify

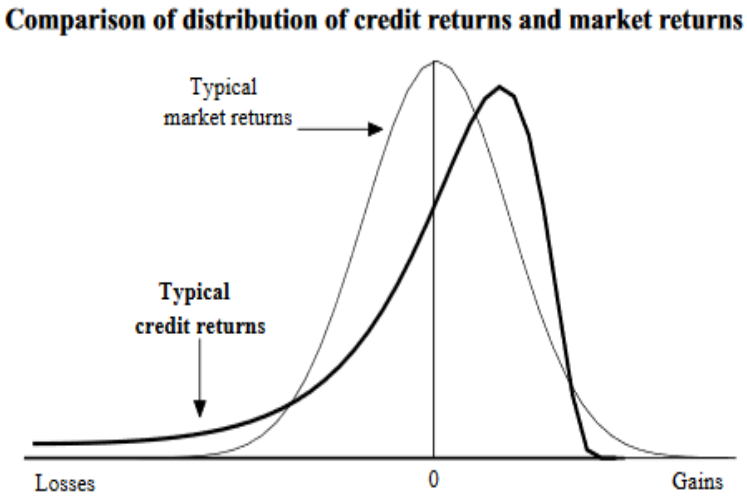
Market risk
Credit risk
Liquidity risk
Operational risk
Legal risk
Political risk
Reputational risk

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 or the next Tutorial

Equity risk

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

FX risk (more on FX risk in the Tutorial)

- 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)

Market risk - Interest rate risk arises from the Banking book (IRRBB) and Trading Book

The **trading book** refers to assets held by a bank that are available for sale and hence regularly traded.
The **trading book** is required (under Basel II and III) to be marked-to-market on a daily basis.
The **banking book** refers to assets on a bank's balance sheet that are expected to be held to maturity or a longer period.

Any instrument a bank holds for one or more of the following purposes must, when it is first recognized on its books, be designated as a **trading book instrument:**

(1) short-term resale;
(2) profiting from short-term price movements;
(3) locking in arbitrage profits; or
(4) hedging risks that arise from instruments meeting 1, 2 or 3 above.

General Banking book features	General Trading book features
-Medium and long term	-Short term
-More simple instruments	-More complex instruments
-Higher volumes	-Lower volumes
-Lower cash flows	-Higher cash flows
Valuation approach – at amortised costs and (to limited extent) fair/market value	Valuation approach – fair value/market value (marked-to-market on a daily basis)

Interest rate risk in the banking book (IRRBB)

IRRBB – where does IRRBB arise ?

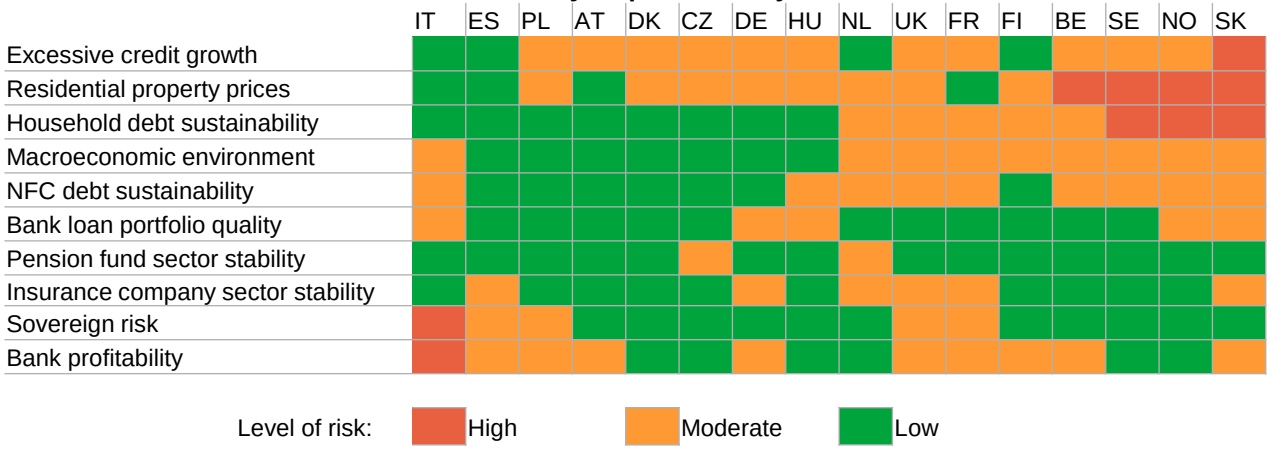
Assets	Liabilities and Equity
Financial assets held for trading (Trading portfolio)	**Liabilities (generally exposed IRRBB - deposits, bonds issued, money market obligations)**
Banking book instruments exposed to IRRBB (loans (all types), bond investments) * Non-trading financial assets mandatorily at fair value through profit or loss * Financial assets at fair value through other comprehensive income *** Financial assets at amortised cost (debt securities, loans and advances)**	
Fixed investment (e.g. property) and other IRRBB insensitive items (e.g. equity investments)	Equity
Off-balance sheet assets sensitive to IRRBB	**Off-balance sheet liabilities sensitive to IRRBB**

More on the topic in the Tutorial

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

Example 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

Example 2 - Risk identification in bank´s balance sheet

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

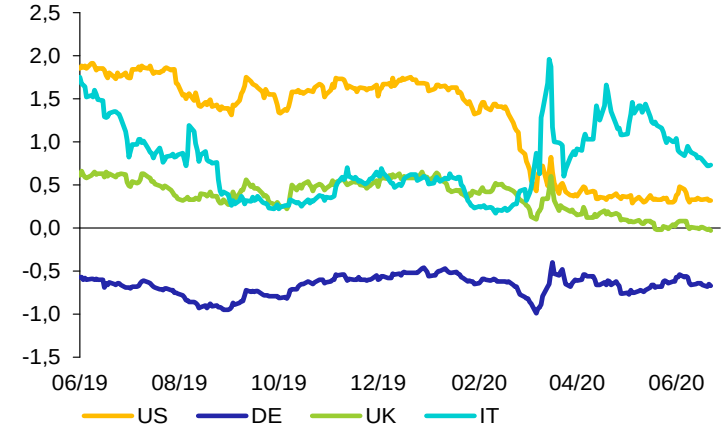
As of Dec 31			
Assets		**Liabilities and Equity**	
Cash	**10**	Sight deposits	**120**
Overdrafts	**20**	1 Y Term deposits (retail customers), fixed rate 2 %	**180**
Interbank loans (based on PRIBOR)	**30**	3M Term deposits (large customers), PRIBOR + 1 %	**160**
Czech Government bills	**30**	Short term 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

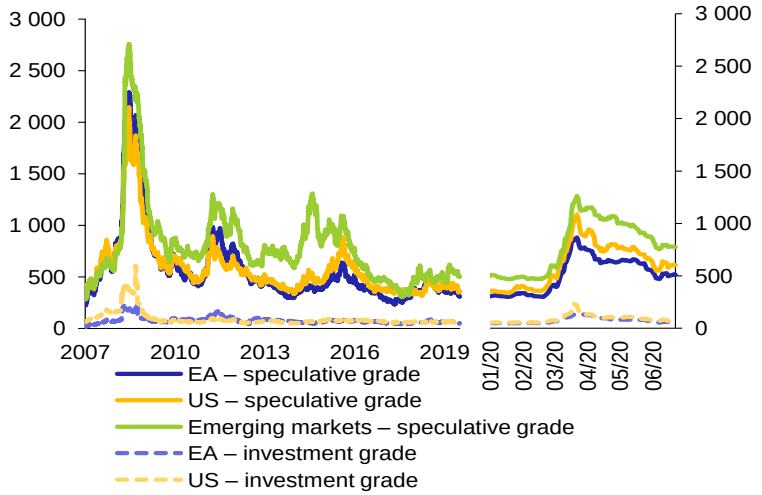
Interest rate risk of the Trading positions – bond yield relationship (all plays a role – absolute i.r. risk, relative i.r. risk)

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



Source: Refinitiv

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



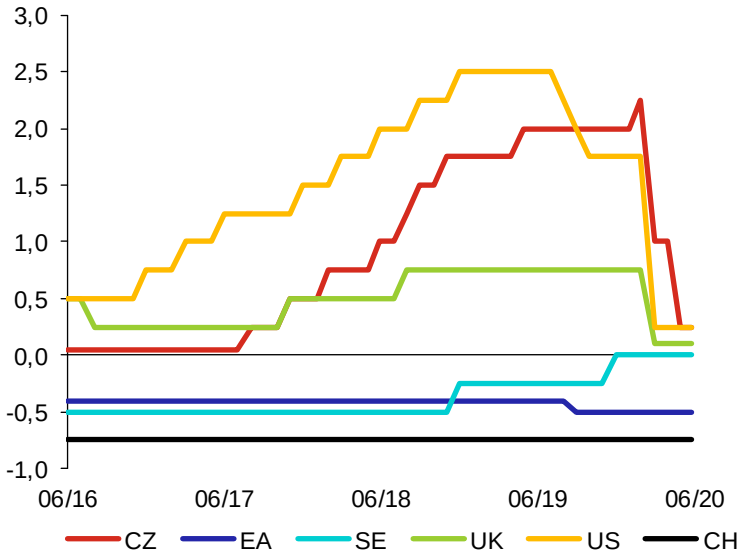
Source: Bank of America Merrill Lynch

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)

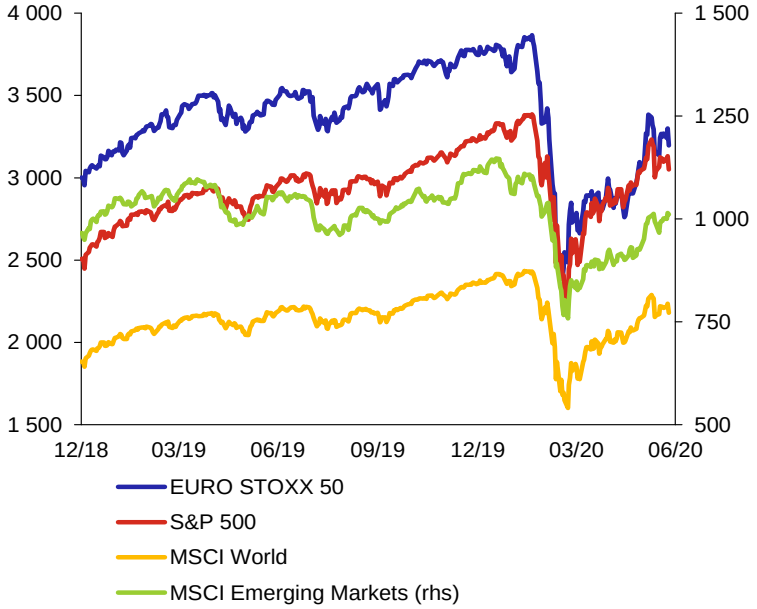
Market risk – (1) interest rate risk (monetary rates (absolute risk)), (2) equity risk

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)



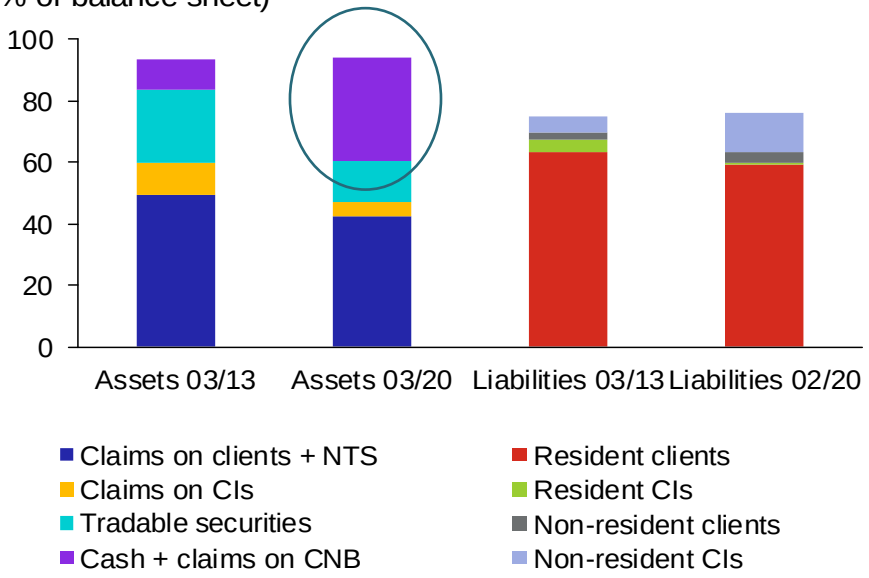
Source: Refinitiv

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 – see L06, T06 on credit risk

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)

Measurement tools:

- **Credit rating**
- **Credit scoring**
- **PD (probability of default)**
- **NPL (non-performing loans)**
- **LGD (loss given default)**
- **IFRS 9, provisioning**
- **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 %**

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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)

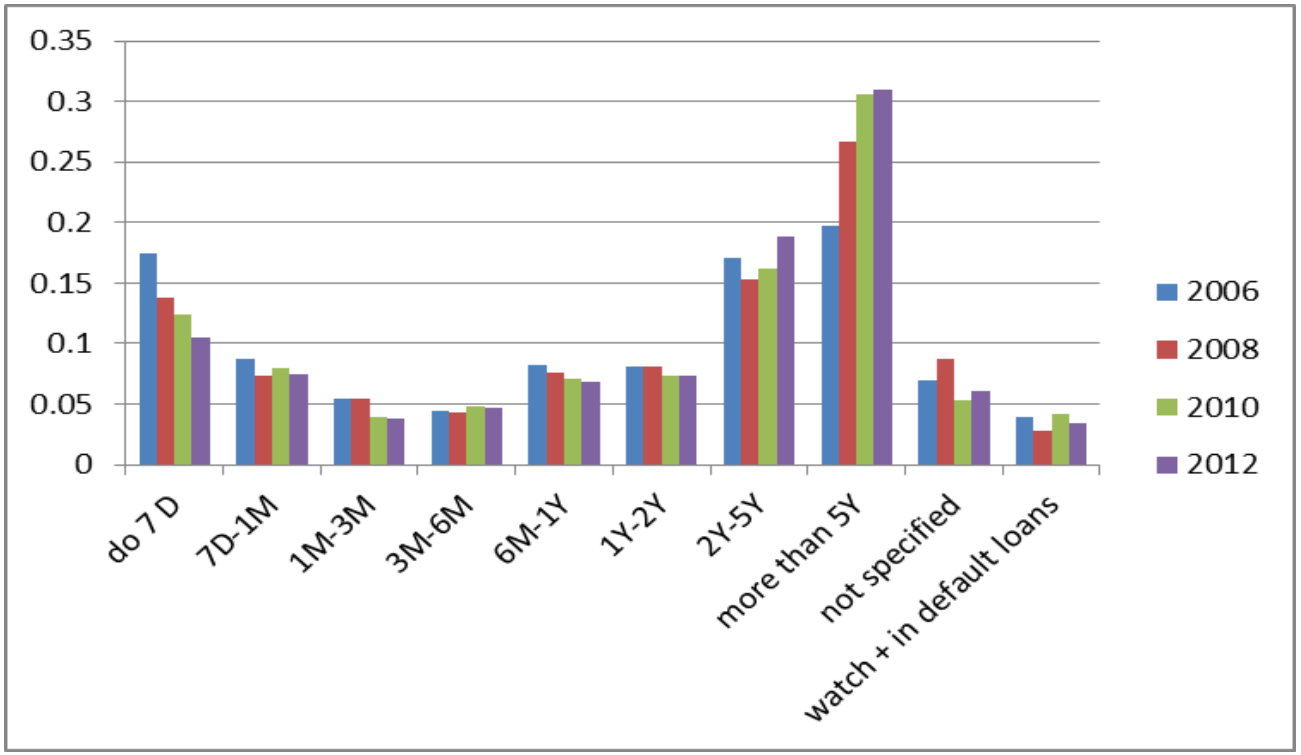
GAP Analysis – Basic risk management model

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

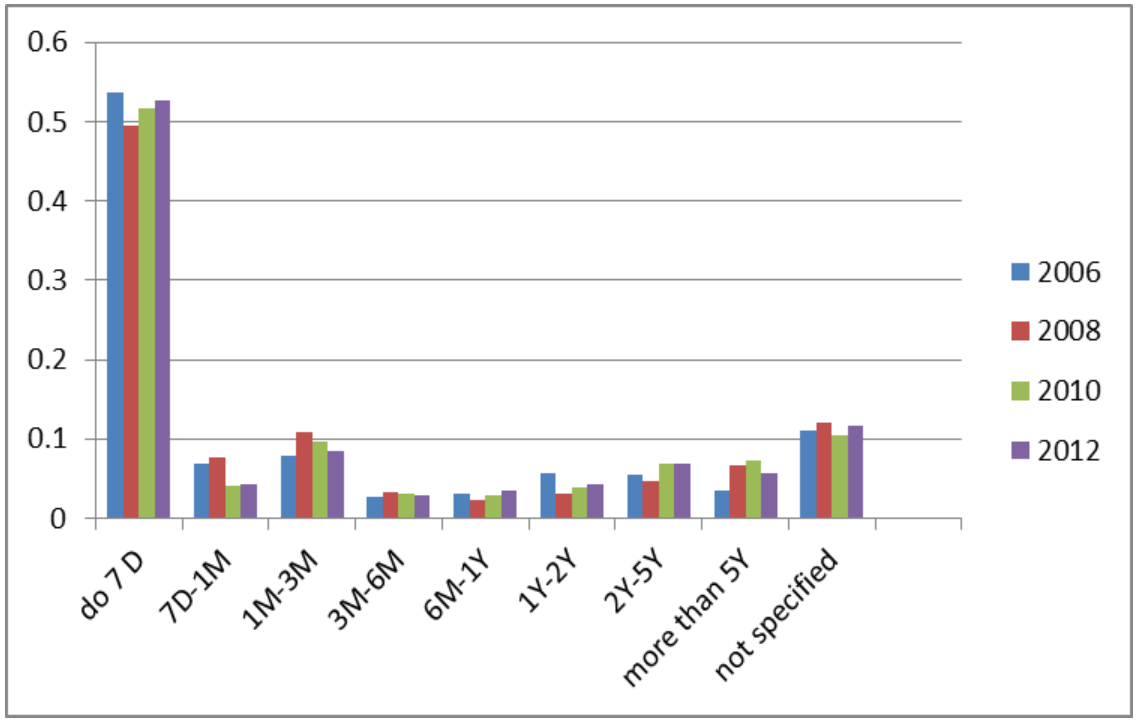


Source: www.cnb.cz

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 for 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

Example 4 - interest rate risk - floating vs. fixed rates – effect of interest rate change on NII

Here see a simplified balance sheet with pricing of assets and liabilities. You see interest income and interest cost over a one-year horizon (-IBOR rate of 0,4%) and recalculation when short term interest rates are changing/rising – sensitivity.

The overall impact is dependent upon the pricing structure of different types of assets and liabilities

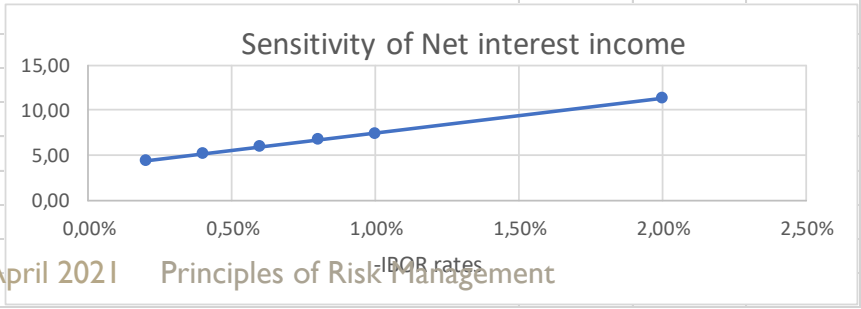
Note, that the example is simplified (no differentiation among different short-term rates (e.g. -IBORs (1W, 1M, 3M, 6M…..)), only annual frequency of interest rate, etc…..

	-IBOR	*0,40%*

As of Dec 31 **Assets**	**Pricing**	**Asset amount**	***App. annual i.r.income***	**Liabilities and Equity**	**Pricing**	**Liab. and Equity amount**	***App. annual i.r. costs***
Cash	0%	**80**	*0*	Sight deposits (-IBOR-0,2%)	0,20%	**120**	*0,24*
Overdrafts (-IBOR + 1%)	1,40%	**20**	*0,28*	1 Y Term deposits (retail customers), fixed rate 2 %	2,00%	**180**	*3,60*
Interbank loans (based on -IBOR)	0,40%	**30**	*0,12*	3M Term deposits (large customers), fixed rate 1,5%	1,50%	**160**	*2,40*
Government bills (fixed 0,1%)	0,1%	**30**	*0,03*	Short term EUR deposits	0,30%	**215**	*0,65*
20Y Government bonds, (fixed 3 %)	3%	**25**	*0,75*	5Y Bonds issued, USD denominated, fixed 3,3%	3,30%	**20**	*0,66*
6Y Commercial real estate loans (corporates), -IBOR + 2,5'	2,90%	**200**	*5,8*				
20Y Receivables (retail), -IBOR +1,9%	2,30%	**250**	*5,75*				
Equity Investments		**10**	*0*	Equity		**80**	
Fixed assets		**130**	*0*				
Total		**775**		Total		**775**	

Annual income			**12,73**	**Annual costs**	**7,55**
Interest rate profit			**5,19**		

	-IBOR rate	***NII***
-IBOR rate sensitivity	***0,20%***	**4,43**
(with this structure of the balance sheet - short term rates are rising -> profit is	***0,40%***	**5,19**
	0,60%	**5,95**
	0,80%	**6,71**
	1,00%	**7,47**
	2,00%	**11,27**



GAP Analysis – for measuring interest rate risk

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 ?

Example 5 GAP Analysis – effect of shock on NPV and NII

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%

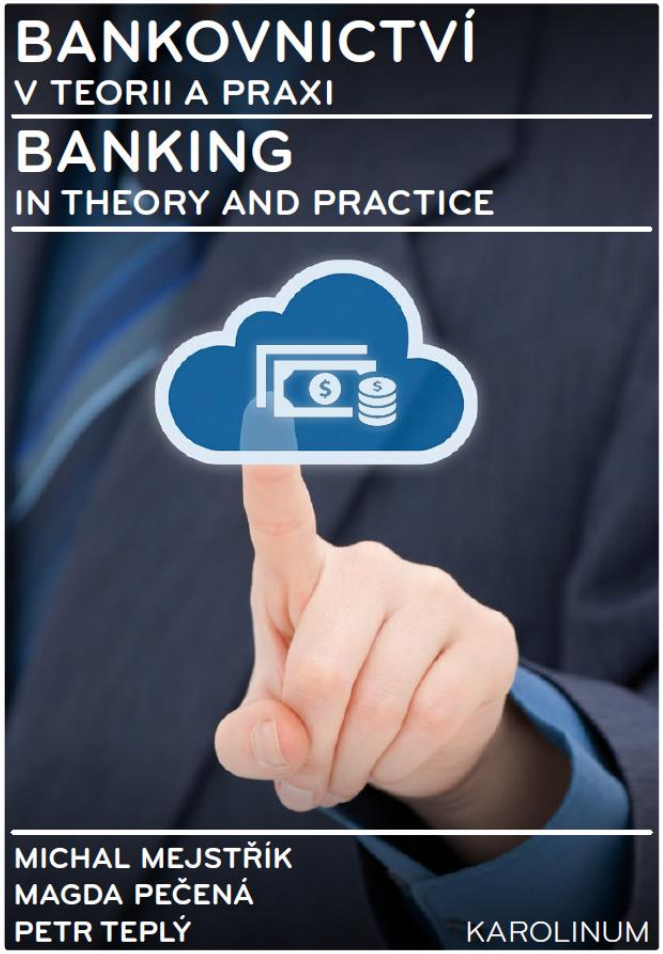
GAP Analysis – effect of shock on NPV and NII

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**