

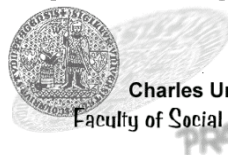
# INTRODUCTORY BANKING



## Lecture 6 and Tutorial 6 Credit risk

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# Key terms of Lecture 5

- B/S structure of banks, specific features
- Financial ratios
  - Profitability, RoA, RoE
  - Liquidity
  - Activity (Efficiency)
  - Marketability (Market ratios, P/E ratio)
  - Leverage (indebttness),
- Financial ratios specific to banks
  - Capital adequacy ratios (Tier I capital ratio)
  - NPL ratio
  - Liquidity ratios - LCR, NSFR

# High level risk categorization

## 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.....



# Content – Credit risk

1. Credit risk and basic instruments
2. Macro assessment of credit risk
3. Credit registers
4. Assessment of credit risk
5. Micro assessment - loan granting process
6. Loan pricing



# Credit risk - definition

## 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 (CNB)

- risk that the borrower fails to make required payments (payments of principal and interest), disruption to cash flows, and increased collection costs

## Main products exposed to credit risk

**Loans** - Non-standard contracts difficult to transfer to third parties, contract between a bank and a customer

**Securities** (Tradable securities) - Standard contract easy to transfer to third parties

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

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

Assets	Liabilities and Equity
<p>→ <b>Assets sensitive to credit risk (loans provided, securities purchased)</b></p>	Liabilities (generally not exposed to credit risk)
tangible investments, cash, deposits at the central bank, sovereign debt (?)	
	Equity
Off-balance sheet assets sensitive to credit risk (accepted guarantees)	<b>Off-balance sheet liabilities sensitive to credit risk (guarantees provided), loan commitments</b>



# Credit risk – Basic debt instruments and segments, different views

## DEBT AND LOAN INSTRUMENTS

- **LOANS**
- Short-term loans (revolving loans, operating financing, interbank loans, pre-investment financing)
- Medium (consumer loans, medium-term corporate financing)
- Long-term loans (investment loans, mortgages)
  
- **DEBT INSTRUMENTS**
- Short-term instruments (T-bills („PP CNB“, „SPP“), commercial papers, bills of exchange)
- Medium- and Long-term bonds (e.g. Corporate bonds, covered bonds, subordinated debt, sovereign debt)

## SEGMENTS

- **Corporate** financing (corporate loans, securities)
- **Retail** financing (retail loans, loans to households = individuals + 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.

# Credit risk – Basic debt instruments and segments, different views

## REPAYMENTS SCHEDULES

- Annuity repayments (mortgages)
- Fixed principal repayments
- Bullet and Balloon repayments – large payment of principal at maturity (small or no repayment during the life of the loan) (commercial real-estate development projects); bonds actually follow bullet repayment schedule (zero-coupon bonds are extreme example of „bullet“ repayment)
- Repayments as of certain date (revolving loans, credit card loans)

## INTEREST PRICING

- Fixed rate (  $\approx$  suitable for SME and retail segment)
- Floating rate (  $\approx$  suitable for corporate segment)
- Repricing yes/no and when ?

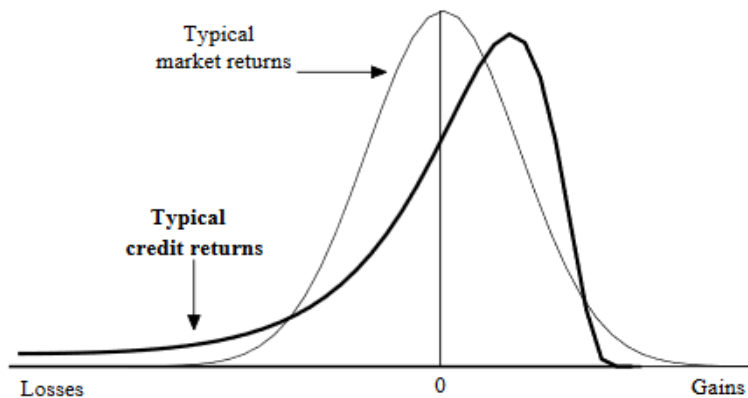
# Credit risk measurement terminology

- Credit rating
- Credit scoring
- Default
- PD (probability of default)
- NPL (non-performing loans), NPE (non-performing exposures)
- Impaired assets
- LGD (loss given default)
- EAD (exposure at default)
- Provisioning
- RWE (risk weighted exposures, regulatory vs. internal)
- Capital requirement to credit risk
  
- 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 %



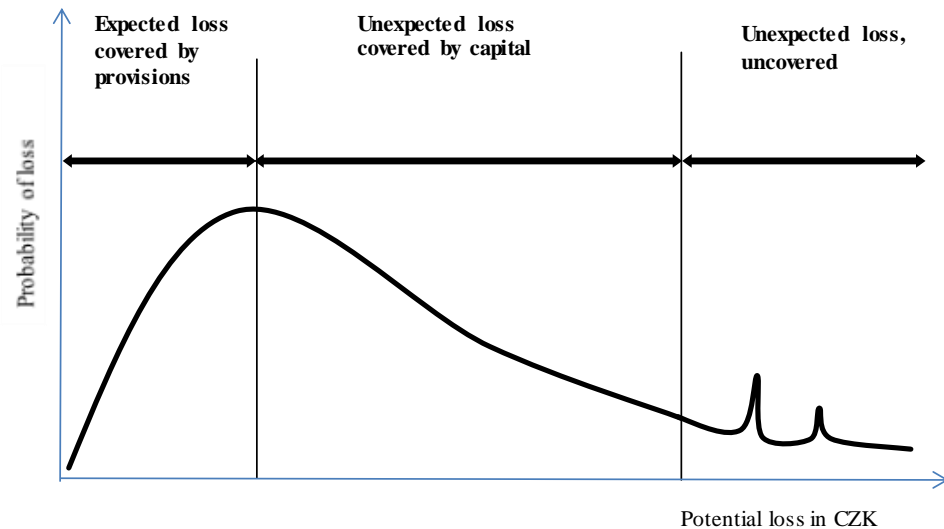
# Typical loss distribution of credit risk

## Comparison of distribution of credit returns and market returns



This long downside tail of the distribution of credit returns is caused by defaults. Credit returns are characterized by a **fairly large likelihood of earning a (relatively) small profit** through net interest earnings (NIE), coupled with a (relatively) **small chance of losing large amount of investment**. Across a large portfolio, there is likely to be a blend of these two forces creating the smooth but skewed distribution shape above. The second problem is the difficulty of modeling correlations. For equities, the Source: CreditMetrics Technical Document, 2007

Expected loss is a function of PD (probability of default)



# Content

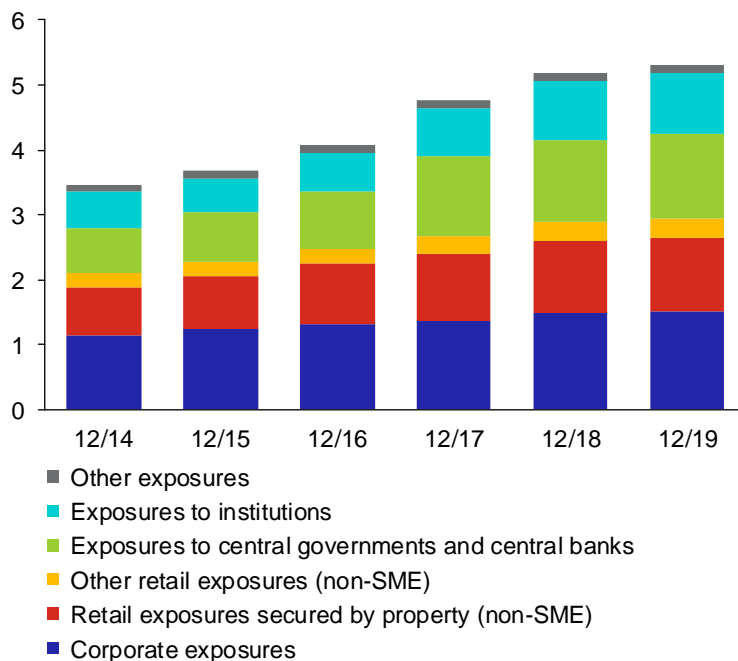
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# Credit risk – Loan portfolio structure, CZ

**Chart III.5**  
Size of the main categories of exposures under the IRB approach  
(CZK trillions)

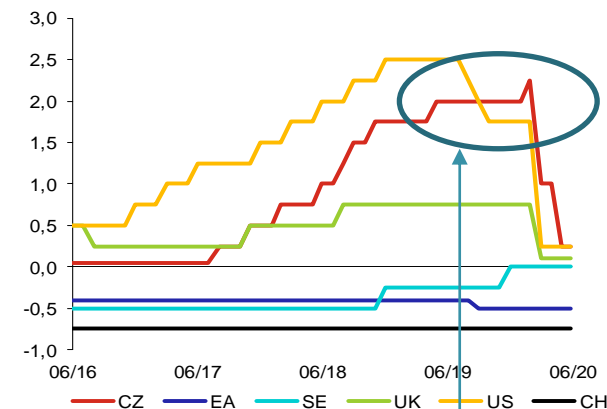


Source: CNB

- Slight change in the proportion of corporate and retail financing

Source: Financial Stability Report 2019/2020

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



Source: Refinitiv

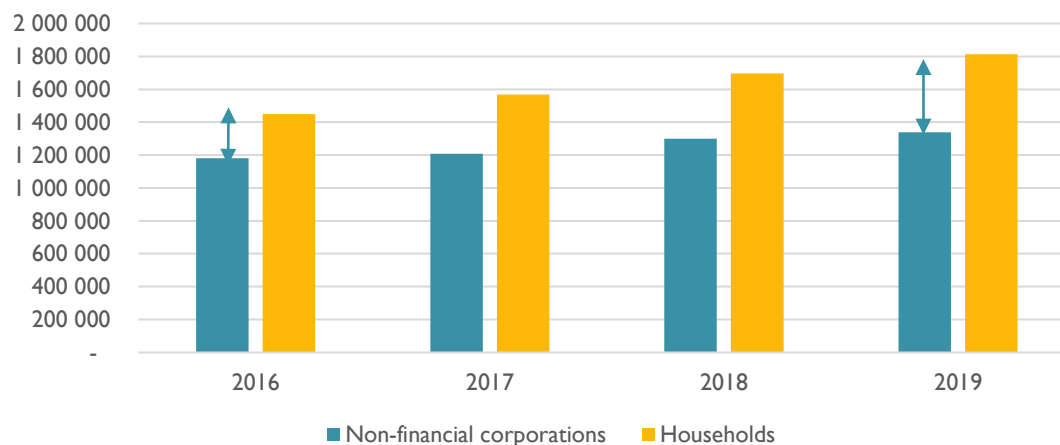
Note: In the case of EA, the chart shows the deposit rate.

- Increased of exposure toward CNB (2017 – 2019) due to high 2W Repo rate („risk free profit“)



# Credit risk – Loan portfolio structure, CZ

Growth of corporate and household financing 2016 - 2019,  
in mil CZK



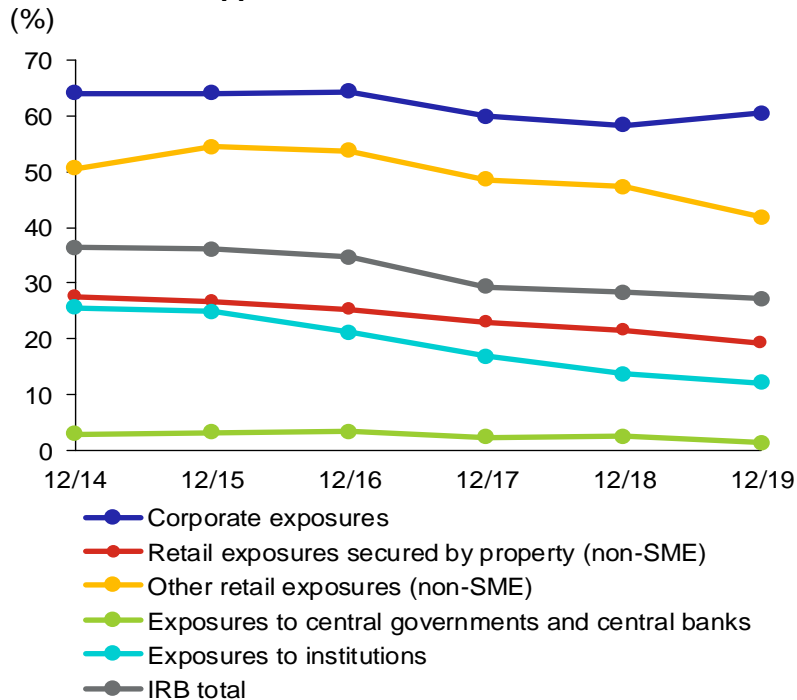
- Another volume boom of loan market between 2017 and 2019
  - **Continuing increase of household financing (residential mortgages)**
  - Total **housing loans** represent ca 3/4 of all loans provided to individuals/households
- Out of these **almost 90 % are mortgages**, the portion of mortgages is slightly increasing.

Source: own calculations, based on [www.cnb.cz](http://www.cnb.cz)



# Credit risk – Risk weights across segments, CZ

**Chart III.4**  
**Average risk weights of the main categories of exposures under the IRB approach**  
(%)



Source: CNB

Risk weight reflects riskiness of the exposure and is directly (positively) translated into capital requirements.

„Decreasing riskiness“ until 2018/2019

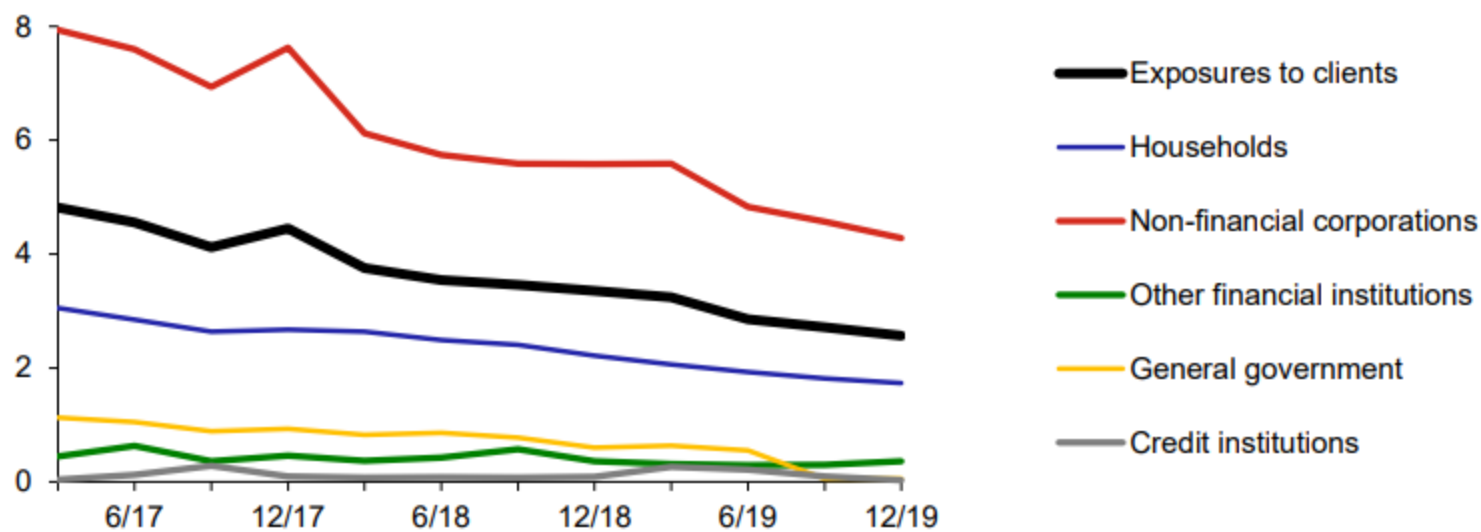
Will be discussed further in more detail, also within the Lecture on Banking regulation and Banking capital





# Credit risk – NPLs across segments, CZ

**Chart A.2 Non-performing exposures**  
(in % of bank credit exposures to the given sector)

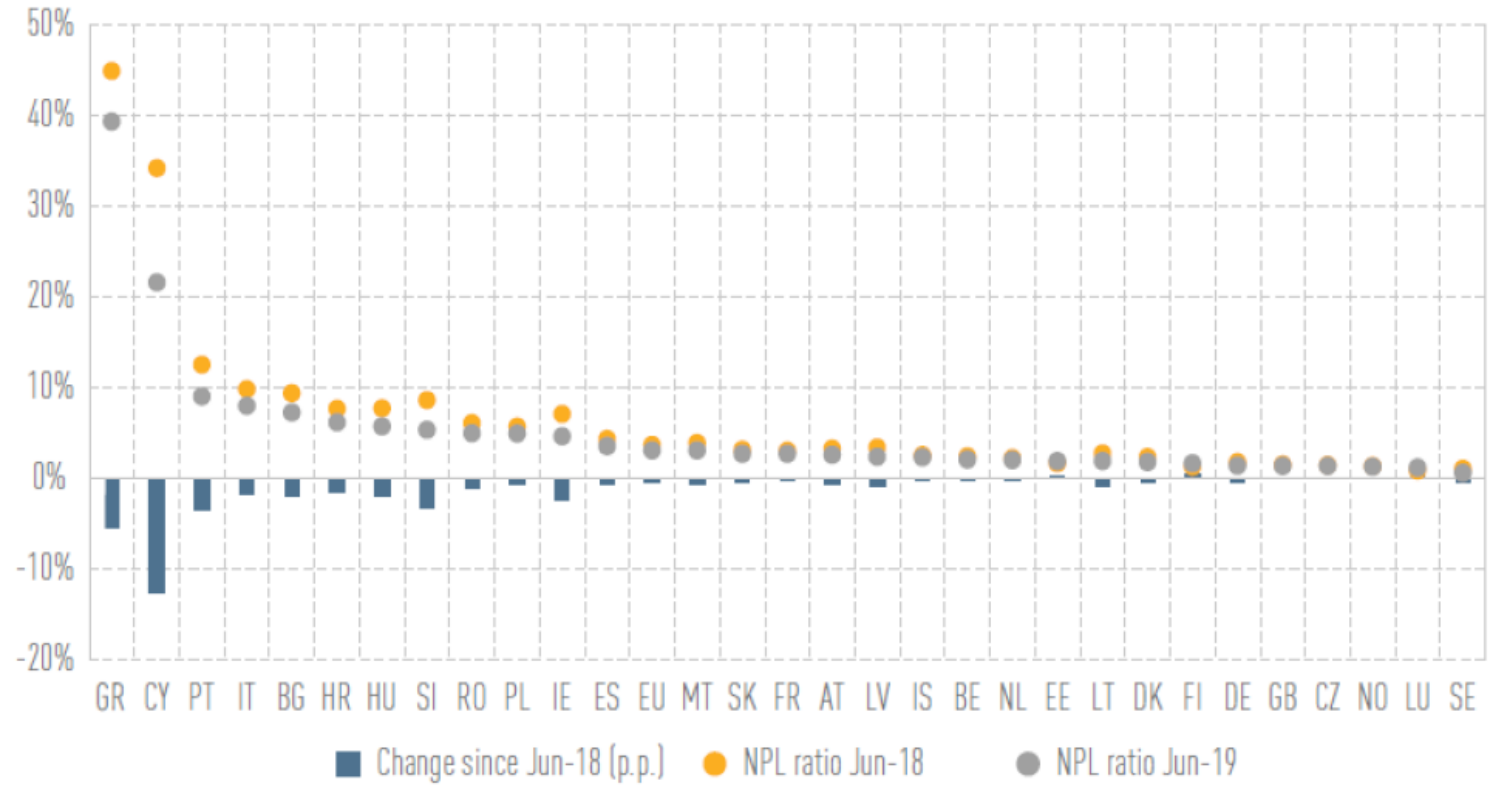


NPL ratio in 2019 – all time low of ca 2,5 % but picking up since spring 2020 ?

# Credit risk - NPLs in the EU

Figure 17: NPL ratios by country in June 2018 and June 2019 (%) and pp change between June 2018 and June 2019

Source: EBA supervisory reporting data



Source: EBA (2019). Risk Assessment Report. European Banking Authority

# Spring COVID 19 credit related measures (CZE)

## *Credit risk mitigating measures*

- Loan moratorium - postponement of regular monthly instalments for max 6 months (till end October 2021), no „reclassification requirement“ by the regulator, hence lower provisioning requirement)
  - For retail lending - principal and interest payments postponed (but interest for postponed payments is charged (and will be payed later))
  - For entrepreneurs – only principal repayments postponed
- Retail lending measures
  - Relaxation of LTV ratio (from max 80 % to max 90 %), *loan-to-value*
  - Relaxation of DSTI ratio (from max 45 % to max 50 %), since July 2020 – no limit on DSTI, *debt-service-to-total income*
  - No limit on DTI (9 years previously), *debt-to-total income*

*Can you think of other measures introduced by governments and central institutions? (not specifically credit related)*

# Spring COVID 19 credit related measures (CZE) and their impact

Impact of loan moratorium as of 31.12.2020

Approximately 80 % of requests were approved by the banks

<i>as of 31.12.2020</i>	Households segment				Segment of Non-financial corporations			TOTAL
	Households total	Loans secured by residential property	Consumer loans	Households other	Total NFC	SME	other	
Ratio (in %)	<b>10,98%</b>	10,22%	17,32%	6,65%	<b>12,84%</b>	17,02%	10,76%	11,74%

- Impact on NPLs and NPL ratio will be revealed in the near future
- The moratorium helped but.... but for many only postponed the problem

For the list of all measures see e.g.

[Financial Stability Report 2019/2020 - Czech National Bank \(cnb.cz\)](#)

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# Credit registers

Banking sector – significant exposure to risk due to high information asymmetry (moral hazard and adverse selection)

One of the way to reduce credit risk is to improve the information background of banks – to **share information among institutions (not only banks)** - with the help of registers of credits

# Credit registers

- ✦ **Central Register of Credits (CRC)** - pools information on the credit commitments of individual entrepreneurs and legal entities, in operations since 2002 (created, operated and guaranteed by CNB)
- ✦ **AnaCredit (Analytical Credit Datasets)** project was set up at the initiative of the European Central Bank to establish a cross-border database of detailed (individual) credit and credit risk data. The Czech part will be operated by the CNB and will replace CRC. Not operating yet.

CRIF –  
Czech  
Credit  
Bureau

- ✦ **REPI – Payment information register, 29 members sofar (as of 09/2020)**
- ✦ **Banking Register of Client information (BRCI, operated by CBCB)** – mutual information exchange between banks regarding the payment prospects and credibility of their clients, founded and used by commercial banks (09/2020 – 26 banks (incl. branches), (banks and branches with retail exposures))
- ✦ **Non-Banking Register of Client Information (NBRCI, operated by CNCB)** – for non-banking creditor entities (leasing companies and companies providing consumer loans), (09/2020 – 41 users)
  - ◆ the databases of CIBR and NBCIR are independent)
- ✦ **SOLUS** (Association for the Protection of Leasing and Loans to Consumers), founded in 1999 (banks and other non-banks creditors (leasing, energy distributors, telecommunication operators, insurance companies), (09/2020 - 53 members)

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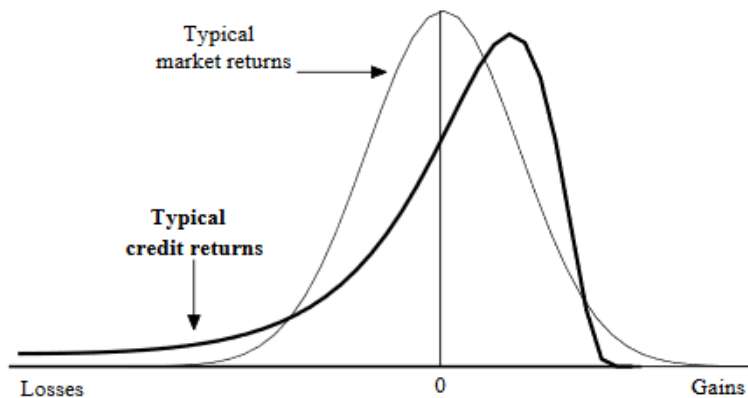


# Credit risk management models - overview

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

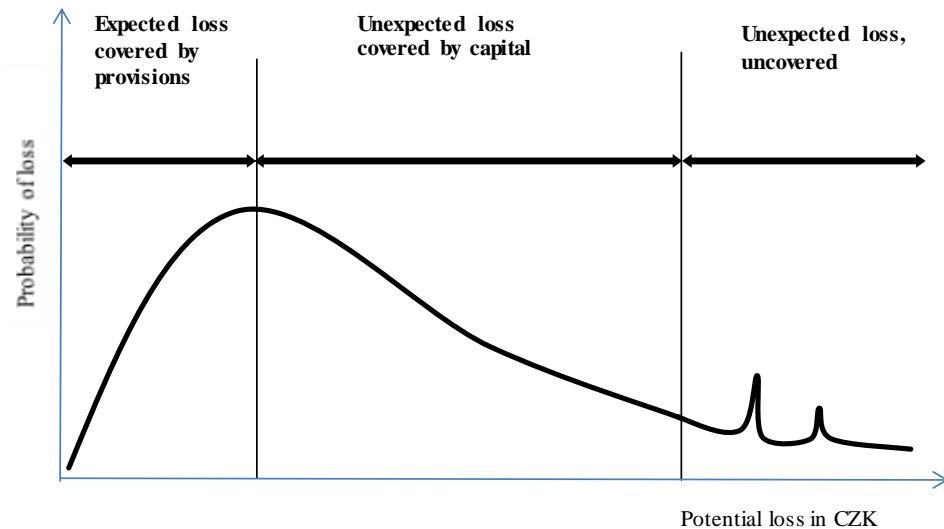
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Expected loss is a function of PD (probability of default)





Another view.....



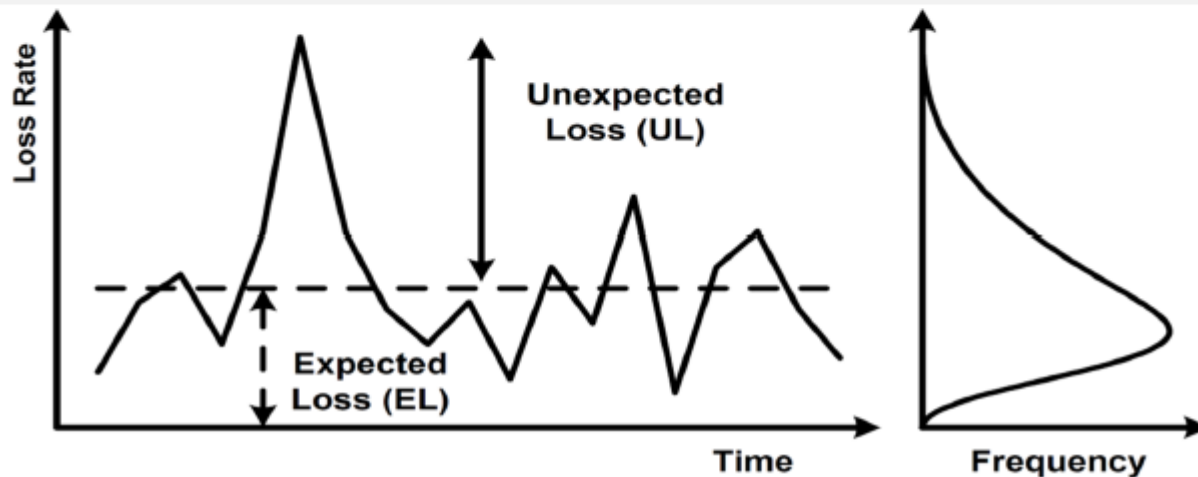
## Definitions

### Expected Loss:

- A mean value
- Not considered a „risk“
- $EL = PD \times LGD \times EAD$
- Additive in a portfolios

### Unexpected Loss:

- A deviation from the mean
- Considered a „risk“
- Sub-additive, skewed, fat tails
- systematic component and tails hinder diversification, thus priced by market (main component of credit spread)



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Notes: EL = Expected Loss, PD = Probability of Default, LGD = Loss Given Default, EAD = Exposure at Default

# Credit risk assessment - Scoring

- **Scoring (scoring models, scoring functions)**
  - Used for the credit assessment of small companies or individuals
  - Credit risk of individuals is assessed using more or less simple scoring function with independent variables such as income, age, number of children etc. Scoring functions are used for products like consumer credit or mortgage.
  - Credit risk of small companies is (usually) based on scoring function with financial ratios as independent variables
  - Scoring does not look at qualitative issues, as it would be inefficient (large number of credits with relatively low nominal value).
  - Banks (and other non-bank loan providers) build their own scoring functions
  - Results of scores translated to the probability of default (scoring result and the corresponding PD)

# Credit risk management models

Original Altman Z-score:

$$Z = 0,012X_1 + 0,014X_2 + 0,033X_3 + 0,006X_4 + 0,999X_5$$

where

- $X_1$  Working capital/Total assets
- $X_2$  Retained earnings/Total assets
- $X_3$  EBIT/Total assets
- $X_4$  Market value of equity/Book value of total liabilities
- $X_5$  Sales/Total assets

The model was revised several times and plenty versions based on original model exist, but the ratios used are more or less similar



# Credit risk assessment - Rating

**Rating** (more qualitative issues included in comparison to Scoring)

**Rating system of a bank** – internally built or adoption of external ratings

**Rating agencies – Moody's, Standard & Poor's, FITCH**

**Short-term rating** (for debt instruments with a maturity less than one year)

Moody's	Standard & Poor's	
Prime-1	A-1	<b>Investment grade</b>
Prime-2	A-2	
Prime-3	A-3	
Not Prime	B C D	<b>Speculative grade</b>

**Long-term rating** (maturity of more than 1 year)

Standard & Poor's (AAA, AA, A, BBB, BB.....D), or with + - refinements

Moody's (Aaa, Aa, ....Baa, Ba, ....)

Note: It is worthwhile to recall that there is a big jump between a rating of BB– and BBB+. It is a small difference in rating, but as it divides the rating scale between **investment** and **speculative** grade, it receives special attention from the investor community.

# Credit risk – default

## Default

A debtor is in default at the moment when it is probable that he will not repay his obligations in a proper and timely manner, or when at least one repayment of principal is more than 90 days past due

**The lower the rating the higher the probability of default**

Categorization of receivables according to CNB until end 2017 (Decree No. 163/2014 Coll.)

- Standard, watch – „loan without obligor default“, **since 1.1.2018  $\approx$  „performing loan“ (Decree No 392/2017 Coll.)**
- Substandard, doubtful and loss loans – „loan with obligor default“, **since 1.1.2018  $\approx$  non-performing loan (Decree No 392/2017)**

**Non-performing asset = Regulatory approach**

$\approx$

**Impaired assets = Accounting approach**

**Starting 1.1.2018 – IFRS 9 standard is effective, replaced IAS 39**



Credit risk – **expected provisions** vs. **unexpected loss capital requirement**

**Provisioning** – „**expected**“ loss of the receivables (non-performing)

Since 2005, banks have been able to use the portfolio-based approach (*statistically based*) to calculate provisions (allowances) for certain loan types (particularly in the small business and retail banking segment (e.g. mortgage loans segment)).

IFRS 9 requires the bank to create provisions for non-performing loans as well as **performing loans, as they have non-zero PD as well**

**Capital adequacy** – capital buffer for covering „**unexpected**“ losses of receivables (incl. defaulted receivables net of provisions)

➔ **The assets (loans) are weighted according to their riskiness; RWE (risk weighted exposures) are calculated**

➔ **Capital requirement is determined as  $RWE * 8 \%$**

# Credit risk – expected loss calculation

**Expected loss** is the sum of the values of all possible losses, each multiplied by the probability of that loss occurring.

$$\text{Expected loss} = \text{PD} * \text{LGD} * \text{EAD} = \text{PD} * (1 - \text{RR}) * \text{EAD}$$

PD – probability of default of the homogenous group of the clients with the same rating

LGD – size of the loss, amount of money that is not recovered (RR)

EAD – exposure at default, may differ from the current exposure (example ?)

*Table 1.8*  
**One-year transition matrix (%)**

Initial rating	Rating at year-end (%)							
	AAA	AA	A	BBB	BB	B	CCC	Default
AAA	90.81	8.33	0.68	0.06	0.12	0	0	0
AA	0.70	90.65	7.79	0.64	0.06	0.14	0.02	0
A	0.09	2.27	91.05	5.52	0.74	0.26	0.01	0.06
BBB	0.02	0.33	5.95	86.93	5.30	1.17	0.12	0.18
BB	0.03	0.14	0.67	7.73	80.53	8.84	1.00	1.06
B	0	0.11	0.24	0.43	6.48	83.46	4.07	5.20
CCC	0.22	0	0.22	1.30	2.38	11.24	64.86	19.79

Source: Standard & Poor's CreditWeek (15 April 96)

Here 1-year PD (relevant for Stage 1 provision calculation),

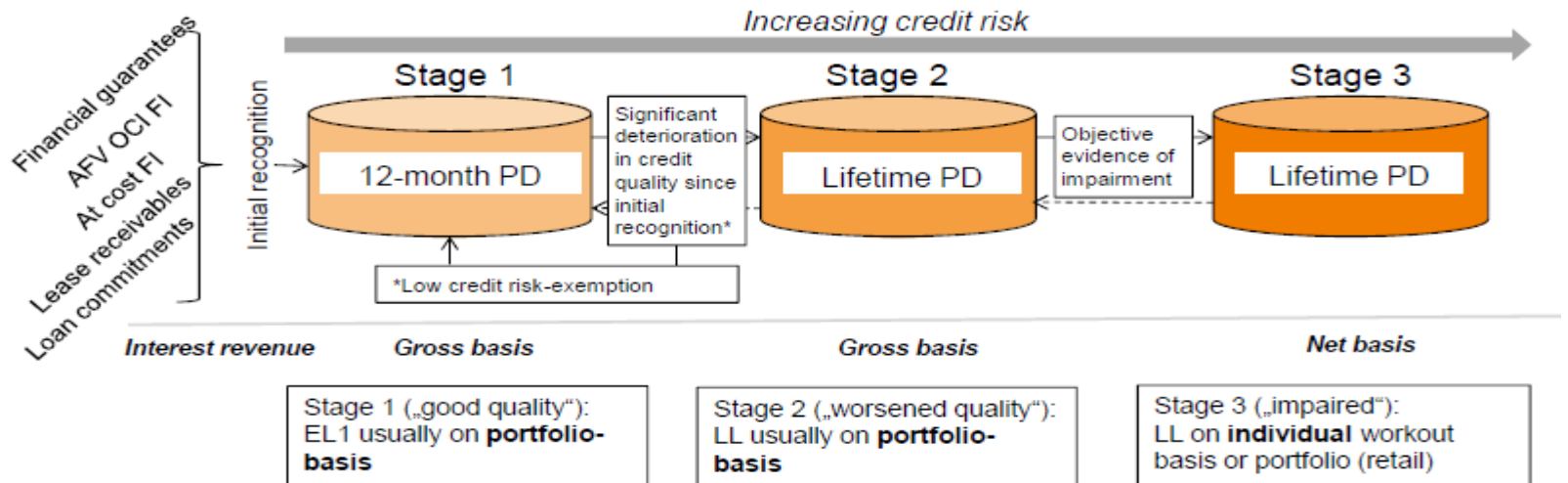
PD (lifetime) – Stage 2 provisions calculation

# Credit risk - Staging

- **Staging since 1.1.2018**
- **No major recategorization of assets**
- Stage 1 and Stage 2 ≈ performing loans (loans without default)
- Stage 3 (impaired assets) ≈ non-performing loans (loans with default)



## The new Impairment Approach at a glance



### Purchased/Originated Credit Impaired – POCI

- Never included in the staging, always use present value and credit adjusted EIR
- Both gains and losses after purchase will be shown, value of collateral strongly influences book value

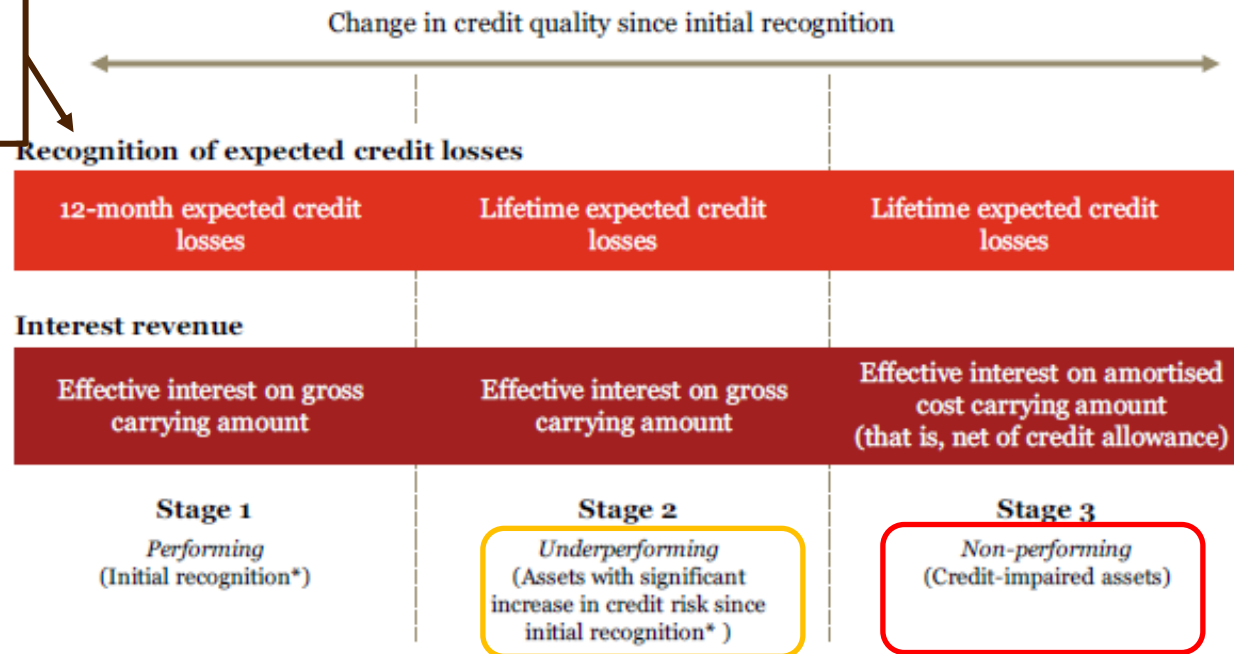
### Finance lease and trade receivables

- May choose 3S or LL-Approach
- Trade receivables with no finance component: only LL (IFRS 15)

# IFRS 9: expected credit loss (ECL) concept

- replaces the incurred loss model with a forward-looking ECL model
- earlier recognition of credit losses by using forward-looking information
- A **three-stage model** based on changes in credit quality since initial recognition:

Basically general provisions?



For example: loans past due 30+ days - basically “watch” loans?

Typically NPLs = loans past due 90+ days + other criteria of borrower’s weakness

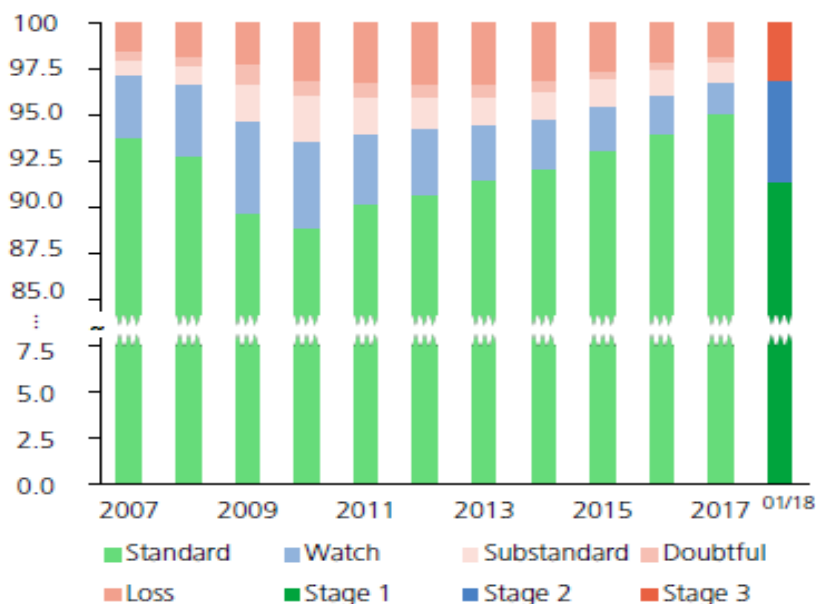


# Credit risk – Loan structure by categorization

Under IFRS 9, which has been in force internationally since 1 January 2018, banks should, when provisioning, take into account all available information about current and future macroeconomic developments and their effects on the credit risks of relevant exposures. Under this assumption, banks should thus create sufficient provisions to cover their expected credit losses before the business and financial cycle changes, i.e. in the period of still favourable economic conditions, when they are usually profitable. In contrast to the previous IAS 39 standard, which was based on an inherently procyclical concept of incurred losses,<sup>44</sup> IFRS 9 should thus have a positive impact on the stability of banks during crises.

## Loan structure by categorisation

(%)



Source: Financial stability report 2018/2019, page 43

## IFRS 9 vs IAS 39

The biggest uncertainty with Stage 2 classification

Source: CNB

Note: Standard loans are bank receivables in respect of which there is no doubt that they will be repaid (loans usually no more than 30 days past due). Watch loans are bank receivables in respect of which repayment is highly probable (loans usually 30–90 days past due). Substandard loans are receivables in respect of which repayment in full is uncertain (loans usually 91–180 days past due). Doubtful loans are receivables in respect of which repayment is very improbable (loans usually 181–360 days past due). Loss loans are receivables with the highest risk rate, in respect of which repayment is practically impossible (loans usually more than 360 days past due). The Stage 1, Stage 2 and Stage 3 categories correspond to the IFRS 9 exposure classification.

Source: Financial stability report 2017/2018



# Example 1 – Credit risk quantification



A bank granted a loan to a client in the amount of 100 mil CZK, with a collateral of 30 mil CZK (commercial property), performing loan in Stage 1.

After 1 year the client defaulted on his obligations and made the bank clear, he will not be able to repay the loan from the operating cash flow, so the bank expects to recover the loan out of the sale of the commercial property.

Show the effect of this situation on the balance sheet of the bank, its P/L and capital ratio.

Important issues

- Provisions are cost items, reduce profit and hence the capital.
- Non-performing loan changes its risk weight when transferred from performing to non-performing loan (non-performing loans are generally assigned a risk weight of 150 %)

# Example - Credit risk quantification

31.12.2018

Asset				Liability	
	Brutto	Provisions	Netto		
<b>Loan (@ RW of 100 %)</b>	100	0,01	99,99	Deposits	1929,99
Other loans (@ RW of 50 %)	2000	20	1980	Capital	150
			<b>2079,99</b>		<b>2079,99</b>

## Risk weighted exposure calculation

<b>Loan</b>	$99,99 * 100 \%$	99,99
Other loans	$198 * 50 \%$	990
<b>RWA total</b>		<b>1089,99</b>

<i>Minimum capital requirement @ 8 %</i>	<b>87,20</b>
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<b>Capital ratio</b>	<b>13,762%</b>
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31.12.2019

Asset				Liability	
	Brutto	Provisions	Netto		
<b>Loan (@RW of 150 %)</b>	100	<b>70</b>	30	Deposit	1929,99
Other loans (@ RW of 50 %)	2000	20	1980	Capital	<b>80,01</b>
			<b>2010</b>		<b>2010</b>

## Risk weighted exposure calculation

<b>Loan</b>	45
Other loans	990
<b>RWA total</b>	<b>1035</b>

<b>Capital ratio</b>	<b>7,730%</b>
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Capital = 150 – loss of 70

# Example - Credit risk quantification

What if the collateral can not be sold immediately ?

- The bank should prove prudential behaviour by discounting the expected cash flows, add all addition legal and work-out costs and adjust the provisions accordingly
- this adjustment further influences the P/L and capital ratio

<b>Collateral</b>		
expected value		30
<b>will be sold in 2 years time</b>	<b>discount rate 3 %</b>	
		<b>28,28</b>
<b>work out costs</b>		<b>0,50</b>
<b>current value</b>		<b>27,78</b>

<b>provisions</b>		<b>72,22</b>
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31.12.2019

Asset				Liability	
	Brutto	Provisions	Netto		
<b>Loan (@RW of 150 %)</b>	100	<b>72,22</b>	<b>27,78</b>	Deposit	1929,99
Other loans (@ RW of 50 %)	2000	20	1980	Capital	<b>77,8</b>
			<b>2007,8</b>		<b>2007,8</b>

Risk weighted asset calculation

<b>Loan</b>	41,667
Other loans	990,000
<b>RWA total</b>	<b>1031,667</b>

<b>Capital ratio</b>	<b>7,540%</b>
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NPL coverage ratio ?

# Concentration of credit portfolio

Concentration in terms of:

- large exposures (large exposure (LE) is an exposure that represents more than 10 % of capital)
  - limit for LE set in regulation is 25 % of capital
- economically connected group and so becoming a LE
- industry exposure (e.g. automotive, construction, commercial real estate)
- country exposure
- repayment structure exposure (e.g. high concentration in bullet payments)

Client and industry concentration can be measured by e.g. HH (Herfindahl-Hirschman) Index (defined as the sum of the squares of the client/industry share of the portfolio)

No regulatory capital requirement for concentration risk, regulation rather assumes diversified portfolio

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# Loan granting process

- Strategic level
  - Credit strategy (approved by Board of Directors)
  - Organizational issues (departments involved in credit process)
  - Internal norms
  - Credit limits
  - Credit risk management
  - Controlling and audit
- Individual loan level
  - Loan/client acquisition
  - Loan/client valuation
  - Collateral valuation
  - Credit approval
  - Regular loan/client monitoring (quarterly basis ?)
  - Collateral valuation update (every 3 years ?)
  - Loan/client classification and provisioning
  - (Work-out)

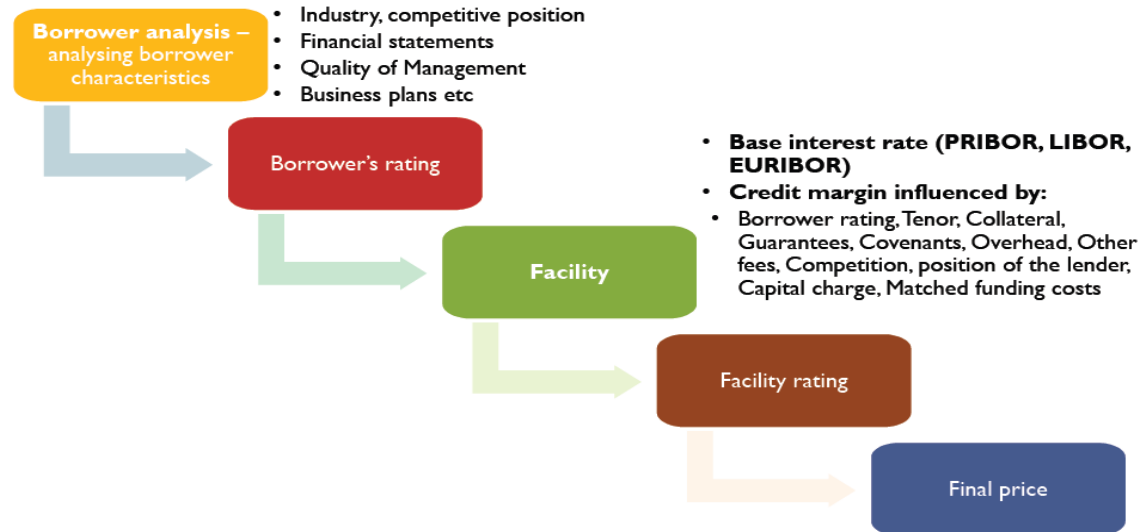
# Content

1. Credit risk and basic instruments
2. Macro assessment of credit risk
3. Credit registers
4. Assessment of credit risk, country risk
5. Micro assessment - loan granting process
6. Loan pricing



# Loan pricing

- Traditional approach (Cost-plus-profit approach)
  - Based on cost-plus-profit approach



- RAROC (Risk-adjusted return on capital (risk adjusted profitability measure where the volatility of losses is taken into account))



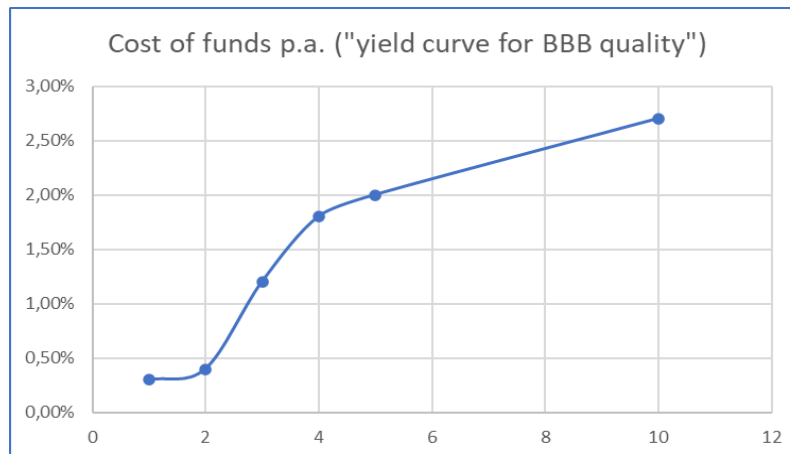
## Example 2 - Loan pricing

What is the minimum margin the bank shall charge a BBB client to meet its minimal costs.

The overhead costs (administrative, personal, IT...) are on average 0,3 % of the outstanding amount

Assumptions	
Borrower risk rating	BBB
Loan maturity	5
Capital ratio (min. capital requirement)	8%
Hurdle rate (min ROE)	10%
Loan amount	2 000 000

Rating	Historical 5-Year default rate (%)
AAA	0,01
AA	0,6
A	1,22
BBB	2,5
BB	8,69
B	18,63
...	



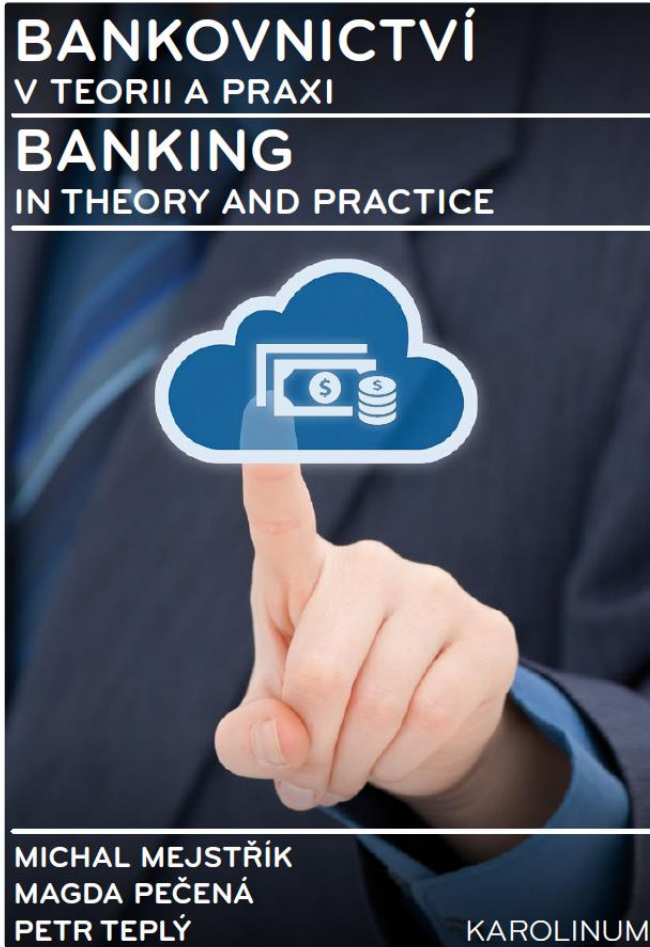
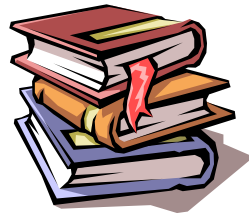
Maturity (years)	Cost of funds p.a. ("yield curve for BBB quality")
1	0,30%
2	0,40%
3	1,20%
4	1,80%
5	2%
10	2,70%
...	

# Loan pricing - example

Item	Calculation	Amount
<i>Assumptions</i>		
Borrower risk rating		BBB
Loan maturity		5
Default rate		2,50%
Min. Capital ratio (capital adequacy)		8%
Hurdle rate (min. ROE)		10%
Loan amount		2 000 000
Overhead costs (as % of outstanding amount)		0,30%
<i>Calculation</i>		
Capital required	$2\,000\,000 * 0,08$	160 000
Annual capital charge	$160\,000 * 0,1$	16 000
Annual funds costs	$1\,840\,000 * 0,02$	40 000
Annual loan loss allowance	$2\,000\,000 * 0,025 / 5$	10 000
Overhead costs	$2\,000\,000 * 0,003$	6 000
Break-even annual interest income		72 000
Loan Interest Rate (with no funding risk)		3,60%
<b>Minimum spread (over funding)</b>		<b>1,6%</b>
We also assume that capital (capital adequacy requirement) is equal to equity		



# Reading for the lecture



## ✓ Chapter VIII – Credit risk