Quantitative Asset and Risk Management

UNIVERSITY OF APPLIED SCIENCES BFI VIENNA

Regulatory aspects for credit risk according Basel II and III

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UAS bfi Vienna

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Structure of ARIMA

˝ 1st and 2nd   mandatory lectures . fundamental
   Semester   and theoretical knowledge

˝ 3rd Semester   mandatory stay abroad . application oriented
                       - in (Prague) and Katowice
                       - twice three weeks
                       OR
                       - alternatively the whole semester at the
                       - University of Bologna (Double Degree)
                       - Xiamen University (student exchange), China
                       - HSE (Higher School of Economics, student
                         exchange) in Moscow

˝ 4th Semester   Master Thesis and Diploma Examination

˝ Title   Master of Arts in Business, MA

Programme Contents - Modules

- Fundamentals in Quantitative Methods and Finance
- Financial Econometrics
- Derivative Pricing
- Risk Measurement
- Asset Management
- Research Methods
- Asset Liability Management and Risk Management for Banks
- Asset Liability Management and Risk Management for Insurances and Pension Funds
- Applied Asset Management
- Applied Research in Asset and Risk Management

courses ARIMA

Regulatory aspects for credit risk according Basel II and III

- Introduction
- Regulatory capital
- RWA calculation and minimum capital requirements
- Different credit risk approaches
- Validation under Basel II/III
- Literature: BIS Basel III Paper, EU Directives (CRR & CRD IV),OeNB Guidelines on Credit Risk Management: Rating Models and Validation

Regulatory aspects for credit risk according Basel II/III

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Brief history of Basel II and III

Bank for International Settlements (BIS)

- Headquartered in Basel, Switzerland
- Represents the G10 central banks
- 1974 - Basel Committee on Banking Supervision (BCBS)

"Intended to align regulatory capital requirements more closely with underlying risks, and to provide banks and their supervisors with several options for the assessment of capital adequacy." **W.J. McDonough**

January, 1996
Amendment to incorporate Market Risk

January, 2001
Second Consultative Package

June, 2004
Final Version of the New Basel Accord

January, 2011
End of the transition period

July 1988
Introduction of B1 Accord

June, 1999
First Consultative Package on the New Accord

April, 2003
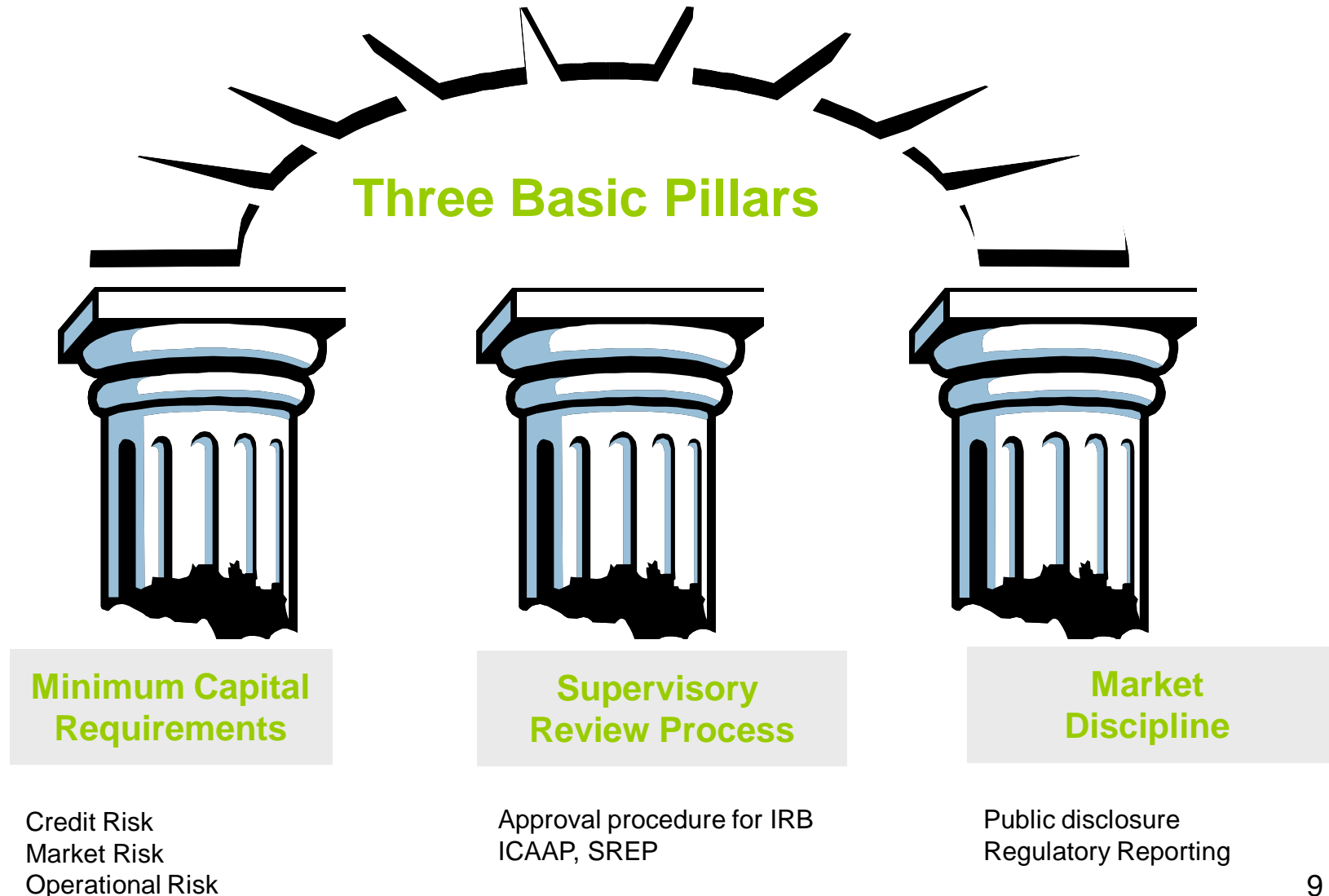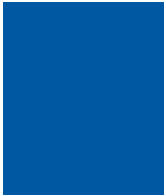Third Consultative Package & Final Accord

January, 2007/ 2008
Deadline for implementation

July 2013 Basel III passed: CRR and CRD IV of EU.

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Three pillar structure of Basel II/III

˝ **Three-pillar structure**

˝ **Pillar 1-Minimum Capital Requirements**

  ▪ Revised capital adequacy ratio (McDonough ratio)

  ▪ Menu of approaches for measuring credit, operational & market risk

  ▪ IRB approach implementation & Transitional arrangements

˝ **Pillar 2 . Supervisory Review Process**
  ICAAP, economic capital, SREP

˝ **Pillar 3 . Market Discipline**

Three Basic Pillars

Minimum Capital Requirements

Supervisory Review Process

Market Discipline

Credit Risk
Market Risk
Operational Risk

Approval procedure for IRB
ICAAP, SREP

Public disclosure
Regulatory Reporting

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A subsidiary of

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˝ **Regulatory capital**

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- **New definition of regulatory capital from B2 to B3**
- **Modifications to the denominator and enumerator of the risk-based capital ratios**

$$\frac{\text{Re}\,gulatory\ Capital}{Risk\ Weighted\ Assets} \geq 8\%$$

Tier 1: common equity tier 1, additional tier 1, Tier 2 capital and capital puffers

More restrictive compared to B2

RWA for credit & operational exposures result from complex calculations

$$CAR = \frac{\textbf{Tier 1 + Tier 2 +Tier 3}}{\text{RWA for } \textbf{CR} + 12.5*(\text{Capital charge for } \textbf{MR} + \textbf{OR})}$$

- Primarily covers credit, market & operational risks
- Increased flexibility & risk-sensitivity:
    - Menu of approaches for risk measurement
    - Incentives for improved risk management

Effects of capital conservation and anticyclical buffer on Minimum capital requirement

	Tier 1 - common equity less regulatory adjustments	Tier 1 capital	Total capital
Minimum requirement	4,5%	6,0%	8,0%

capital conservation buffer	2,5%		

Minimum requirement plus capital conservation buffer	7.0%	8,5%	10,5%

Margin for the countercyclical buffer	0-2,5%		

Basel III transition period

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Leverage Ratio (3.0%)	Supervisory monitoring		Parallel Run Phase (Public Disclosure as of January 2015)					Effective January 2018	
Minimum Common Equity Capital Ratio	2.0%	2.0%	3.5%	4.0%	4.5%	4.5%	4.5%	4.5%	4.5%
Capital Conservation Buffer	-	-	-	-	-	0.625%	1.25%	1.875%	2.5%
Minimum Common Equity plus Capital Conservation Buffer	2.0%	2.0%	3.5%	4.0%	4.5%	5.125%	5.75%	6.375%	7.0%
Phase-in of Deductions for FI Investments, MSRs and DTAs	-	-	-	20%	40%	60%	80%	100%	100%
Minimum Tier 1 Capital	4.0%	4.0%	4.5%	5.5%	6.0%	6.0%	6.0%	6.0%	6.0%
Minimum Total Capital	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
Minimum Total Capital plus Capital Conversion Buffer	8.0%	8.0%	8.0%	8.0%	8.0%	8.625%	9.25%	9.875%	10.5%
Capital Instruments Not Qualified for Tier 1 or Tier 2 Capital Treatment			Phased-Out (2013 through 2023)						

Characteristics of the two buffers

1. Capital Conservation Buffer: in good times profit is used to build this buffer.
In stress times used to absorb losses. Minimum requirements have to be kept also in bad times.
- ❖ **Fixed at 2,5%**
- ❖ Restrictions for dividends payouts and redemptions

2. Anticyclical Buffer: to limit excessiv loan growth
- ❖ variable based on macro ecomomic development (0 . 2,5%):
  e.g. deviation from the long-term tendency of the ratio loan volume to GDP
- ❖ If there is snormal%growth of loans the buffer = 0

Restructure of equity capital

˝ **Tier 1 Capital** of Basel II is now devided into
- ˝ ‚Common Equity Tier 1 Capital‰ of highest quality (share premium and retained earnings)

and
- ˝ ‚Additional Tier 1 Capital‰ with lower quality

GOING CONCERN

˝ **Tier 2 Capital**
(e.g. savings, and issued bonds)
GONE CONCERN

˝ ~~Tier 3 Capital~~ ~~for market risk is not applicable anymore under Basel III~~

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Calculation of RWA and MCR for credit risk regardless of approach

RWA = E x CCF x RW

MCR = RWA x 8%

- . E   Exposure
- . CCF   CCF for off balance sheet items
- . RW   Risk weight according to Basel II (from the regulator or own estimation)
- . 8%   solvability coefficient
- . RWA   Risk Weighted Assets
- . MCR   Minimum Capital Requirement

	86%	9%	5%
	Credit risk	**Operational risk**	**Market risk**
Simple	Standardised	Basic Indicator	Standardised
Intermediate	Foundation IRB	Standardised	
Advanced	Advanced IRB	Advanced Measurement	Internal VaR Models

Credit Risk Approaches

Increasing risk sensitivity & increasing internal data requirements

Standardised Approach

Foundation IRB Approach

Advanced IRB Approach

Standardised Approach
- Similar to 1988 Accord
- Increased risk sensitivity: use of external ratings to determine the risk weights
- Risk weights determined by category of borrower 0-150%
- Targeted at banks desiring a simplified capital framework
- Few credit risk mitigants (CRM) recognised
- Min capital requirement = **Exposure * RW% * 8%**

Foundation IRB Approach
- 5 exposures categories: corporates, sovereigns, retail, banks & equity
- Banks own estimate of probability of default (PD)
- Supervisors provide: the loss given default (LGD), exposure at default (EAD), maturity (M)
- Not available for retail exposures
- More CRM recognised, including the residential & commercial real estate (RRE/CRE) collateral

Advanced IRB Approach
- 5 exposures categories
- Banks own estimate for all credit risk parameters (PD, LGD, EAD & M)
- More restrictive minimum capital requirements
- Highly reflects a banks individual risk profile
- CRM recognised: physical & financial collateral, guarantees & credit derivatives, nettings
- Subject to supervisory validation and approval
- Appropriate for more complex institutions

Increasing minimum capital requirements

Operational Risk Measurement

Increasing risk sensitivity & increasing internal data requirements

Basic Indicator Approach	Standardised Approach	Advanced Measurement Approach

Basic Indicator Approach

- factor = 15%
- Fixed percentage for the entire entity
- Capital charges based on a single risk indicator: **gross income Ë** computed as an average over the previous 3 years of positive annual gross income
- $K_{BIA} = [^3 (GI_{1Å\ n}{}^{*}\ )]/n$

Standardised Approach

- factor [12 % - 18 %]
- Capital charges based on sum of 8 lines of business risks each calculated by industry standards (corporate finance, trading & sales, retail banking, commercial banking, payment & settlement, agency services, asset management & retail brokerage)
- Different fixed percentages for each business line, reflecting the size or volume of the activity
- **Alternative Standardised Approach (ASA)** . same except for 2 business lines: retail & commercial banking

Advanced Measurement Approach

- Capital charges by business line but internally calculated
- A bank$s internal operational risk measurement system must take into account the following elements:
  - internal & external data
  - scenario analysis
  - internal control and business environment factors
- Recognition of the risk mitigating impact of insurance
- Subject to supervisory approval and validation

Increasing minimum capital requirements

Market Risk Approaches

Increasing risk sensitivity & increasing internal data requirements

Standardised Approach

Internal Model Approach

- ‰Building block+approach
  - Interest rate risk
  - Equity risk
  - Foreign exchange risk
  - Commodity risk
- Specific & general risks separately calculated

- Uses proprietary models
- Qualitative standards to assure banks have sound risk management systems
- Quantitative conditions:
  - VaR computed daily
  - 99% confidence level
  - Min holding period: 10 days
  - Min sample period: 1 year
- Subject to approval of national supervisors

Increasing minimum capital requirements

Regulatory aspects for credit risk according Basel II/II

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˝ **Different credit risk approaches**

˝ Validation under Basel II/III

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17 asset classes in the Standardized Approach

- (a) exposures to central governments or central banks;
- (b) exposures to regional governments or local authorities;
- (c) exposures to public sector entities;
- (d) exposures to multilateral development banks;
- (e) exposures to international organisations;
- (f) exposures to institutions;
- (g) exposures to corporates;
- (h) retail exposures;
- (i) exposures secured by mortages on immovable property;
- (j) exposures in default;
- (k) exposures associated with particulary high risk;
- (l) exposures in the form of covered bonds;
- (m) items representing securitisation positions;
- (n) exposures to institutions and corporate with a short-term credit assessment;
- (o) exposures in the form of units or shares in collective investment undertakings (CIUs)
- (p) equity exposures NEW under Basel III
- (p) other items.

Calculation of RWA and MCR in the standardized approach

RWA = E x CCF x RW

MCR = RWA x 8%

- . E   Exposure
- . CCF   CCF for off balance sheet items
- . RW   Risk weight according to Basel II (defined by the regulator)
- . 8%   solvability coefficient
- . RWA   Risk Weighted Assets
- . MCR   Minimum Capital Requirement

General rules

- ″ Weighting after deduction of loan loss provisioning
  - ➔ net asset value

- ″ Used ratings

  - ■ From external rating agencies (Moody±s, Fitch, S&P)

Rating

Standard & Poor's	Moody's	Erläuterungen
AAA	Aaa	Bestmögliches Rating. Hervorragende Finanzkraft des Unternehmens, überdurchschnittliche Leistungsfähigkeit, attraktives und stabiles Geschäftsumfeld. Für den Kreditgeber besteht praktisch kein Ausfallrisiko.
AA+ AA AA-	Aa1 Aa2 Aa3	Sehr gutes Rating. Starke Finanzkraft des Unternehmens, gute Leistungsfähigkeit, attraktives und stabiles Geschäftsumfeld, geringes Insolvenzrisiko. Für den Kreditgeber besteht hohe Zahlungswahrscheinlichkeit.
A+ AA-	A1 A2 A3	Gutes Rating. Gute Finanzkraft des Unternehmens, gute Leistungsfähigkeit, aber mit problematischen Elementen, stabiles Geschäftsumfeld. Für den Kreditgeber angemessene Deckung von Zins und Tilgung.
BBB+ BBB BBB-	Baa1 Baa2 Baa3	Befriedigendes Rating. Angemessene Finanzkraft des Unternehmens, geringe Leistungsfähigkeit, wenig stabiles Geschäftsumfeld, mangelnder Schutz gegen wirtschaftliche Veränderungen. Für den Kreditgeber angemessene Deckung von Zins und Tilgung mit spekulativen Charakteristika.
BB+ BB BB-	Ba1 Ba2 Ba3	Ausreichendes Rating. Schwache Finanzkraft des Unternehmens, schwache Leistungsfähigkeit mit Problemen, instabiles Geschäftsumfeld. Für den Kreditgeber sehr mäßige Deckung von Zins und Tilgung, hohes Ausfallrisiko.
B+ BB-	B1 B2 B3	Mangelhaftes Rating. Sehr schwache Finanzkraft des Unternehmens, sehr schwache Leistungsfähigkeit mit großen Problemen, besonders instabiles Geschäftsumfeld. Für den Kreditgeber besteht nur eine geringe Sicherung von Zins und Tilgung, sehr hohes Ausfallrisiko.
CC CCC	Caa (1-3) Ca	Ungenügendes Rating. Sehr schwache Finanzkraft des Unternehmens, schlechte Leistungsfähigkeit mit schwerwiegenden Problemen, besonders instabiles Geschäftsumfeld, hohe Insolvenzgefahr. Für den Kreditgeber nicht vertretbares Ausfallrisiko, akute Gefahr des Zahlungsverzuges.
SD D	C	Zahlungsunfähigkeit des Unternehmens

AAA   A+   BBB+   Å
bis   bis   bis
AA-   A-   BBB-

Bonitätsstufe:	1	2	3	4	5	6

CCF for off balance sheet items

″ Credit Conversion Factors (CCF)

- High Credit Risk ➔ CCF 100%

- Medium Credit Risk ➔ CCF 50%

- Below average Credit Risk ➔ CCF 20%

- Low Credit Risk ➔ CCF 0%

˝ No Rating ➜ 100%

Rating:	1	2	3	4	5	6
Weight:	0%	20%	50%	100%	100%	150%

Exposures to regional governments or local authorities

˝   Claims on regional governments ➔ Financial institutions

˝   Claims on local authorities ➔ Central governments

˝   Claims on religious communities➔ Financial institutions

Exposures to public sector entities

Rating:	1	2	3	4	5	6
Weight:	20%	50%	50%	100%	100%	150%

Exposures to multilaterial development banks

˝ Exposures multilateral development banks ➔ 0%

˝ There is an exhaustive list in CRR:

˝ If a rating is existing then treated like financial institutions

Rating:	1	2	3	4	5	6
Weight:	20%	50%	50%	100%	100%	150%

Exposures to international organisations

˝ Exposures to international organisations ➔ 0%

(a) the Union;

(b) the International Monetary Fund;

(c) the Bank for International Settlements;

(d) the European Financial Stability Facility;

(e) the European Stability Mechanism;

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Exposures to institutions

˝   No Rating of institution ➔ 100%

˝   Institution has a rating and maturity > 3 months

Rating:	1	2	3	4	5	6
Weight:	20%	50%	50%	100%	100%	150%

˝   Institution has a rating and maturity <= 3 months

Rating:	1	2	3	4	5	6
Weight:	20%	20%	20%	50%	50%	150%

˝ With a rating

Rating:	1	2	3	4	5	6
Weight:	20%	50%	100%	100%	150%	150%

- No Rating ➜ 100%

Retail-Forderungen

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Criteria

˝ Borrower criterion

- Private individual
  Small/medium sized company (NEW: sme supporting factor=0,7619)

˝ Product and granularity criterion

- Claim is one of many claims with similiar features
  - ➢ Revolving credit (overdraft, credit card)
  - ➢ Private loan or leasing
  - ➢ Loans for small companies
  - ➢ Mortgage loans

˝ Small volume

- <= 1 Mio EUR

75%

˝ Claims secured by residential mortgage

  35%

˝ Claims secured by commercial mortgage

  50%

Exposures in default

˝ Not-secured part of the claim

˝ > 90 days past due or

˝ the institution considers that the obligor is unlikely to pay its credit obligations to the institution,

. provision >= 20% of overdue amount➔ 100%

. All other past due items➔ 150 %

. Residential and commerical mortgage ➔ 100%

Exposures associated with particulary high risk

″ These exposures get a weight of 150%

″ and includes the following exposures:

(a) investments in venture capital firms;
(b) investments in AIFs (alternative investmentfonds) as defined in Article
    4(1)(a) of Directive 2011/61/EU
(c) investments in private equity;
(d) speculative immovable property financing.

No rating for the covered bond is existing . the rating of the issuing institution is applied

Weight of the institution	20%	50%	100%	100%
Weight of the covered bond	10%	20%	50%	100%

If a rating for the covered bond is existing . the following table is used:

Rating:	1	2	3	4	5	6
Weight:	10%	20%	20%	50%	50%	100%

Exposures to institutions and corporates with a short-term credit assessment

Rating:	1	2	3	4	5	6
Weight:	20%	50%	100%	150%	150%	150%

In the case of institutions there is a conflict with exposures to institutions with a maturity <= 3months. In this case the most advantageous weight can be taken.

˝ No Rating ➔ 100%

Rating:	1	2	3	4	5	6
Weight:	20%	50%	100%	100%	150%	150%

Equity exposures

The following exposures shall be considered equity exposures:

(a) non-debt exposures conveying a subordinated, residual claim on the assets or income of the issuer;

(b) debt exposures and other securities, partnerships, derivatives, or other vehicles, the economic substance of which is similar to the exposures specified in point (a).

Risk weight = 100%

Other items

- ˝ Cash, legal curreny ➔ 0%

- ˝ Gold ➔ 0%

- ˝ Fixed assets ➔ 100%

- ˝ Trusts ➔ 0%

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Credit Risk Mitigation - Collaterals

″ Minimum Requirements

″ Risk controlling

″ Enforceable by law

″ No positive correlation between credit worthiness of the counterparty and the value of the collateral

″ Quick legal procedure for realisation

″ Re-evaluation of financial collaterals: all 6 months at minimum

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Two approaches for mitigation

Option

Simple Method

˝The risk weight of the counterparty is replaced by the risk weight of the collateral for the secured part of the claim.

Comprehensive Method

˝The exposure claim is reduced by the calculated value of the collateral.
˝ Haircuts
˝ maturity mismatches between claim and security are allowed

Recognized financial collaterals

- **Simple Method**

  - Cash and cash-similar instruments

  - bonds

  - Shares belonging to a main share index

  - Mutual funds

  - Gold

- **Comprehensive Method (additionally)**

  - Shares on a recognized stock exchange

  - Mutual funds containing shares

Simple method

- Maturity mismatch is not allowed! Collaterals must be pledged for the duration of the claim

- Market value of the collateral has to be re-evalutated every 6 months.

- The risk weight of the counterparty is replaced by the risk weight of the collateral for the secured part of the claim.

- Secured part = market value of the collateral

Simple method – risk weights

- cash ➜ 0% if currency mismatch➜ 20%

- Bonds depending on the quality ➜ between 0% and 20% (collateral is treated like a direct claim of the creditor)

- Gold: 0%

Formula for RWA calculation in the simple approach

Unsecured claim x risk weight of the claim
+ secured claim x risk weight of the collateral

Example:
Retail client has a loan in the amount of 1000 (weight =75%)
Available as collateral is cash in the amount of 500 (weight = 0%).

Result:
RWA = (1000-500) x 0,75 + 500 x 0
RWA= 500 x 0,75 = 375

MCR= 375 x 0,08 = 30

Comprehensive method – financial collaterals

- Use of Haircuts

  - According to regulator
  - Own estimation of the haircut

- Maturity mismatch is allowed

Comprehensive method – financial collaterals

- Formula for RWA calculation in the comprehensive approach

$$E^* = \max \{0, [E \times (1 + He) - C \times (1 - Hc - Hfx)]\}$$

  - E^* … Claim after credit risk mitigation
  - E … current amount of the claim
  - He … Haircut for the claim
  - C … current value of the collateral
  - Hc … Haircut for the collateral
  - Hfx … Haircut for currency mismatch
- E^* is multiplied by the risk weight of the counterparty
- ➜ risk weighted assets (RWA)

Haircuts according to CRR

Table 1

Credit quality step with which the credit assessment of the debt security is associated	Residual Maturity	Volatility adjustments for debt securities issued by entities described in Part 1, point 7 (b) Central bankes and states			Volatility adjustments for debt securities issued by entities described in Part 1, point 7 (c) and (d) Institutes and other emittents		
		20-day liquidation period (%)	10-day liquidation period (%)	5-day liquidation period (%)	20-day liquidation period (%)	10-day liquidation period (%)	5-day liqui-dation per-iod (%)
1	≤ 1 year	0,707	0,5	0,354	1,414	1	0,707
	>1 ≤ 5 years	2,828	2	1,414	5,657	4	2,828
	> 5 years	5,657	4	2,828	11,314	8	5,657
2-3	≤ 1 year	1,414	1	0,707	2,828	2	1,414
	>1 ≤ 5 years	4,243	3	2,121	8,485	6	4,243

Lending: 20 day liquidation period
Securities lending: 5 days
10 days for all other transactions

Source:
 REGULATION (EU) No 575/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
 of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012

Credit quality step with which the credit assessment of the debt security is associated	Residual Maturity	Volatility adjustments for debt securities issued by entities described in Part 1, point 7(b)			Volatility adjustments for debt securities issued by entities described in Part 1, point 7 (c) and (d)		
		20-day liquidation period (%)	10-day liquidation period (%)	5-day liquidation period (%)	20-day liquidation period (%)	10-day liquidation period (%)	5-day liquidation period (%)
	> 5 years	8,485	6	4,243	16,971	12	8,485
4	≤ 1 year	21,213	15	10,607	N/A	N/A	N/A
	>1 ≤ 5 years	21,213	15	10,607	N/A	N/A	N/A
	> 5 years	21,213	15	10,607	N/A	N/A	N/A

Haircuts according to CRR – Table 3 and 4

Table 3

Other collateral or exposure types			
	20-day liquidation period (%)	10-day liquidation period (%)	5-day liquidation period (%)
Main Index Equities, Main Index Convertible Bonds	21,213	15	10,607
Other Equities or Convertible Bonds listed on a recognised exchange	35,355	25	17,678
Cash	0	0	0
Gold	21,213	15	10,607

Table 4

Volatility adjustment for currency mismatch		
20-day liquidation period (%)	10-day liquidation period (%)	5-day liquidation period)
11,314	8	5,657

- Example: Corporate has a rating of „2" and a loan in the amount of 10.000. The loan is secured by a debt security (bond) in the amount of 7.000. For the debt security a haircut of 2,828% is used.

- E* = max {0, [E x (1 + He) – C x (1 – Hc – Hfx)]}
  E*: 10.000 – (7.000*(1-0,02828))= 3.198

- RWA: 3.198*0,5=1.599

- How would the calculation look like in the simple approach?

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Collateral Optimization

Example:

Details:
A Company with a long-term rating of 3 and a short-term rating of 2 has **two loans** with a bank:

4-year loan (partial use of standby credit (off-balance) of 500.000)	300.000
Short-term loan	400.000
Standby credit	500.000

The following **collaterals** are used by the debtor:
A debt security (bond) (issue rating =2, residual maturity=3years) of

a german bank (institute rating=1) with the market value of	300.000
Cash	290.000
Gold	150.000

Additional information:
No maturity or currency mismatches apply.
The standby credit has a CCF of 50%

Solution with the simple collateral approach

Simple Approach for collaterals			
	EUR	Deduction of risk weight	weight
4-year loan	300.000	long term rating =3	100%
short-term loan	400.000	short term rating=2	50%
not used standby credit	200.000	long term rating =3	100%
debt security (bond) of a bank	300.000	bank rating=1	20%
cash	290.000		0%
gold	150.000		0%

The value for the not used standby credit of 200.000 is calculated from the total standby loan minus the partial use for the 4-year loan: 500.000 . 300.000 = 200.000. For this 200.000 a CCF of 50% is used.

Solution:

RWA for 4-year loan including not used standby loan:

$(300.000 + 100.000) \times 0 = 0$.

RWA for short term loan:

$40.000 \times 0 + 300.000 \times 0{,}2 + 60.000 \times 0{,}5 = 90.000$.

Comprehensive Approach for collaterals				
	EUR	Deduction of risk weight	weight	haircut
4-year loan	300.000	long term rating =3	100%	
short-term loan	400.000	short term rating=2	50%	
not used standby credit	200.000	long term rating =3	100%	
debt security (bond)	300.000	issue rating=2, residual maturity=3 years; issuer: a german bank; liquidation period: 20 days		8,485%
cash	290.000			0%
gold	150.000	liquidation period: 20 days		21,213%

Solution:
E* and RWA for 4-year loan:
RWA = E* = (300.000 - 290.000 . 10.000 × 1 / (1 - 0,08485) × (1 - 0,08485)) = 0
E* und RWA for the not used standy credit belonging to the 4-year loan:
RWA = E* = (200.000 - (200.000 × 1 / (1-0,08485)) x (1-0,08485)) = 0.
E* for short-term loan:
E* = 400,000 . 70.529,42 × (1 - 0,08485) . 150.000 × (1 - 0,21213) = 217.274,50.
RWA for short-term loan:
RWA = 217.274,50 × 0,5 = 108.637,25.

- 7 asset classes: Sovereigns, Institutes, Corporates, (Retail), Investments, Securitization, other assets
- PD is estimated by the bank
- Regulator: LGD, maturity (M)
- Not available for retail claims
- More collateral are recognized (e.g. car pool of a company)
- The value of the LGD can be reduced by the bank when using the comprehensive collateral approach

Collaterals in the Foundation IRB

- In the Foundation IRB the comprehensive method for evaluating the collaterals has to be used

- Foundation-IRB
  comprehensive collateral approach ➔ reduced LGD

- Advanced IRB
  bank internal estimation ➔ reduced LGD (see later)

CRR – Article 161...

˝ Credit institutions shall use the following LGD values:

˝ (a) Senior exposures without eligible collateral: 45 %;

˝ (b) Subordinated exposures without eligible collateral: 75 %

Reduced LGD using eligible collaterals

- The LGD given by the regulator can be reduced when using eligible collaterals:

  $LGD* = LGD \times E*/E$

  meaning:

  LGD: loss given default at default if the claim would be unsecured.

  E: the net value of the claim

  E* the adjusted value of the claim taking into consideration the risk mitigation of collaterals

  E* is calculated:

  net value of the claim – market value of the collateral adjusted by volatility

Example for calculating reduced LGD by using collaterals

˝ A client (Senior exposure with a volume of 10 Mio Euro; Maturity 6 years) is securing his loan with gold amounting to 5 Mio Euro.

˝ What is the applicable LGD?

˝ Solution:

Gold has a haircut of 21,213%.

A senior exposure has a given LGD of 45%.

E^* : 10 Mio . (5*(1-0,21213))= 10 . 3,94 =6,06

$LGD^* = LGD \times E^*/E = 45\% \times 6,06/10 = 27,27\%$

Internal Rating Based Approach

˝ Risk quantification

. Definition of default

. Probability of Default (PD)

. Loss Given Default (LGD)

. Exposure at Default (EAD)

. Reference data

˝ Implementation (RWA, MCR)

˝ Validation of rating model

˝ Documentation & corporate oversight

Risk Quantification: PD, LGD & EAD

PD Definition: The likelihood that a debt instrument will default within a stated timeframe. i.e. one year time horizon under Basel II.

EAD Definition: The value of the bank's exposure at the time of the borrower's default. EAD is the gross amount due at default, which is the amount by which regulatory capital would be reduced if the exposure were to be fully written off.

LGD Definition: The loss on a credit instrument after the borrower has defaulted. It is a **percentage** of the EAD which the bank expects to lose.

Historical Data   Estimation Point (PD, EAD, LGD)   12 months   Default Point   Non-Default   Default   Loss

A default is considered to have occurred with regard to a particular obligor when either or both of the two following events have taken place:

1. The bank considers that the obligor is **unlikely to pay** its credit obligations in full, without recourse by the bank to actions such as realising security

2. The obligor is past due more than **90 days** on any material credit obligation to the banking group

3. **Remark: under Basel III the definition of default was defined more in detail Ë please check CRR 178.**

Non-Default

Default

Historical Data   Estimation Point   12 months   Default Point   Loss

(PD, EAD, LGD)
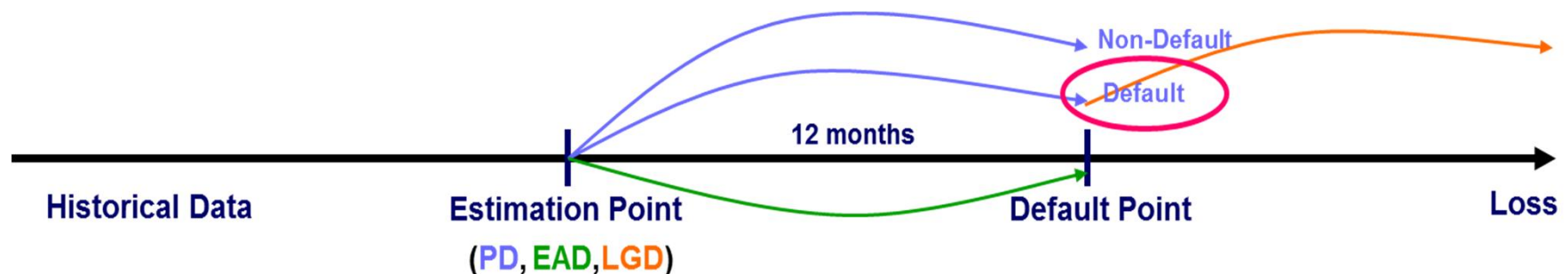
Risk Quantification: Exposure at Default (EAD)

EAD Definition: The value of the banks exposure at the time of the borrowers default. EAD is the gross amount due at default, which is the amount by which regulatory capital would be reduced if the exposure were to be fully written off. It <u>includes all accrued, but unpaid interests & fees</u>.
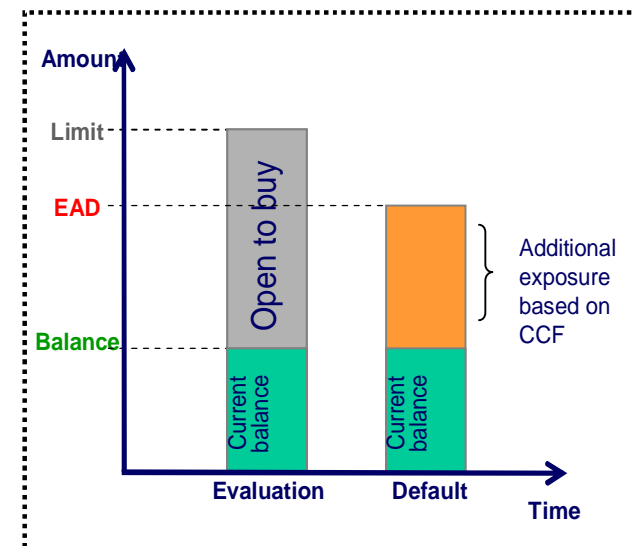
On balance sheet items:

EAD must be no less than the current drawn amount, subject to recognising the effects of on-balance-sheet netting.

Off balance sheet items:

Banks estimates should reflect the possibility of additional drawings by the borrower up to and after the time a default event is triggered.

EAD = On balance + CCF * Off balance
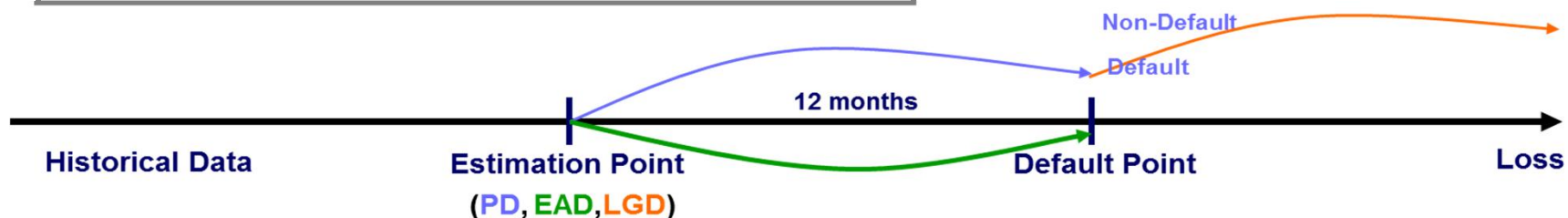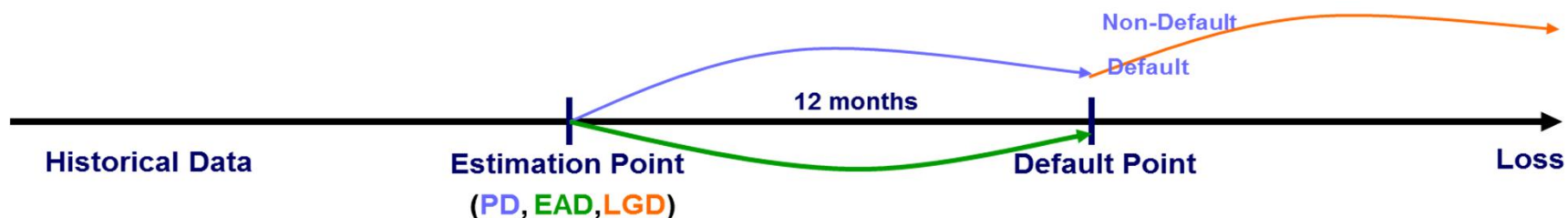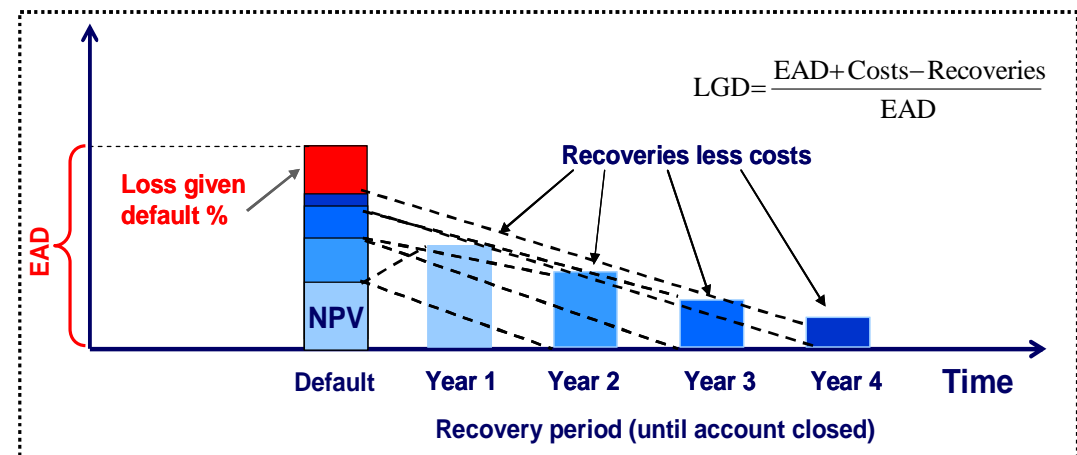
IRB Approach - Loss Given Default (LGD)

LGD Definition: The loss on a credit instrument after the borrower has defaulted. It is a **percentage** of the EAD which the bank expects to lose.

LGD is the account/ pool credit-related economic losses net of discounted recoveries divided by the account/ pool EAD, all measured during <u>a period of high credit losses</u> for a particular portfolio.

LGD should reflect the loss expected in economic downturn conditions, and it can not be less than the long-run default weighted average LGD.

LGD must reflect the concept of "economic loss", more inclusive than the accounting measures of loss.

- The mark-to-market loss value of the loan & collateral
- All direct & indirect costs of workout and collections, net of recoveries (including late fees and interest)
- Losses, recoveries, and costs should all be discounted to the time of default

$$LGD = \frac{EAD + Costs - Recoveries}{EAD}$$

Loss given default %

Recoveries less costs

EAD

NPV

Default · Year 1 · Year 2 · Year 3 · Year 4 · **Time**

Recovery period (until account closed)

Non-Default

Default

12 months

Historical Data · **Estimation Point** · **Default Point** · **Loss**

(**PD**, **EAD**, **LGD**)

Risk Quantification: Predictive Data

Minimum 5 years data are required to build model
- The less data a bank has, the more conservative it must be its estimation
- Internal estimates must incorporate all relevant, material & available data, information and methods. A bank may utilise internal data and data from external sources (including pooled data)
- A bank need not give equal importance to historic data if it can convince its supervisor that more <u>recent data</u> are a better predictor of risk.
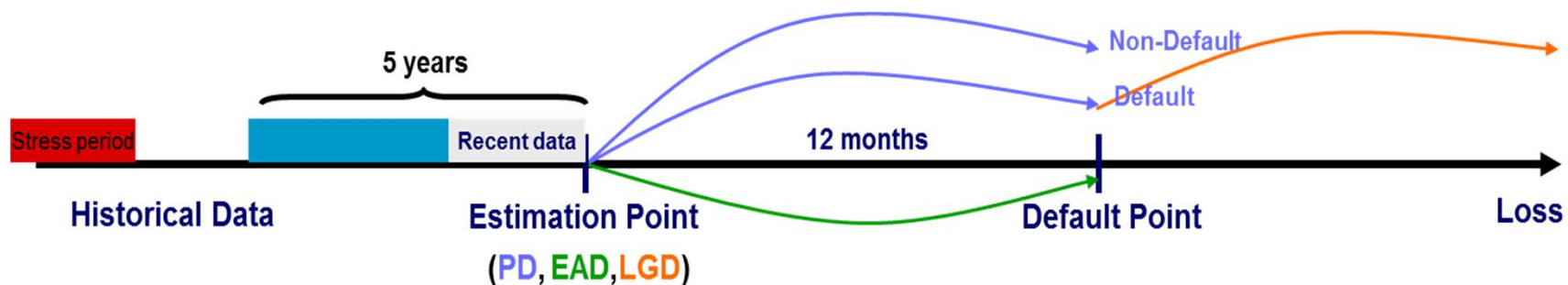
IRB Approach - Risk Weighted Assets (RWA) and Minimum Capital Requirement (MCR)

Each of the three retail risk categories (residential mortgages, revolving credit and other retail) has a separate risk-weight function.

The functions differ from one another only by the supervisor . specified asset value correlation **(R)**. The **unexpected loss risk weight (RW)** for each retail segment of **non-defaulted assets** is calculated using the following general formula:

Risk Weight (RW) = LGD × N[(1 - R)^-0.5 × G(PD) + (R / (1 - R))^0.5 × G(0.999)] Ë PD*LGD

Where:

N is the cumulative standard normal distribution and G is the inverse cumulative standard normal distribution

R - the asset value correlation

˝ For residential mortgages, **R = 0.15**

˝ For qualifying revolving exposures, **R = 0.04**

˝ For other retail exposures, R varies between 0.03 and 0.16, based on the following formula:
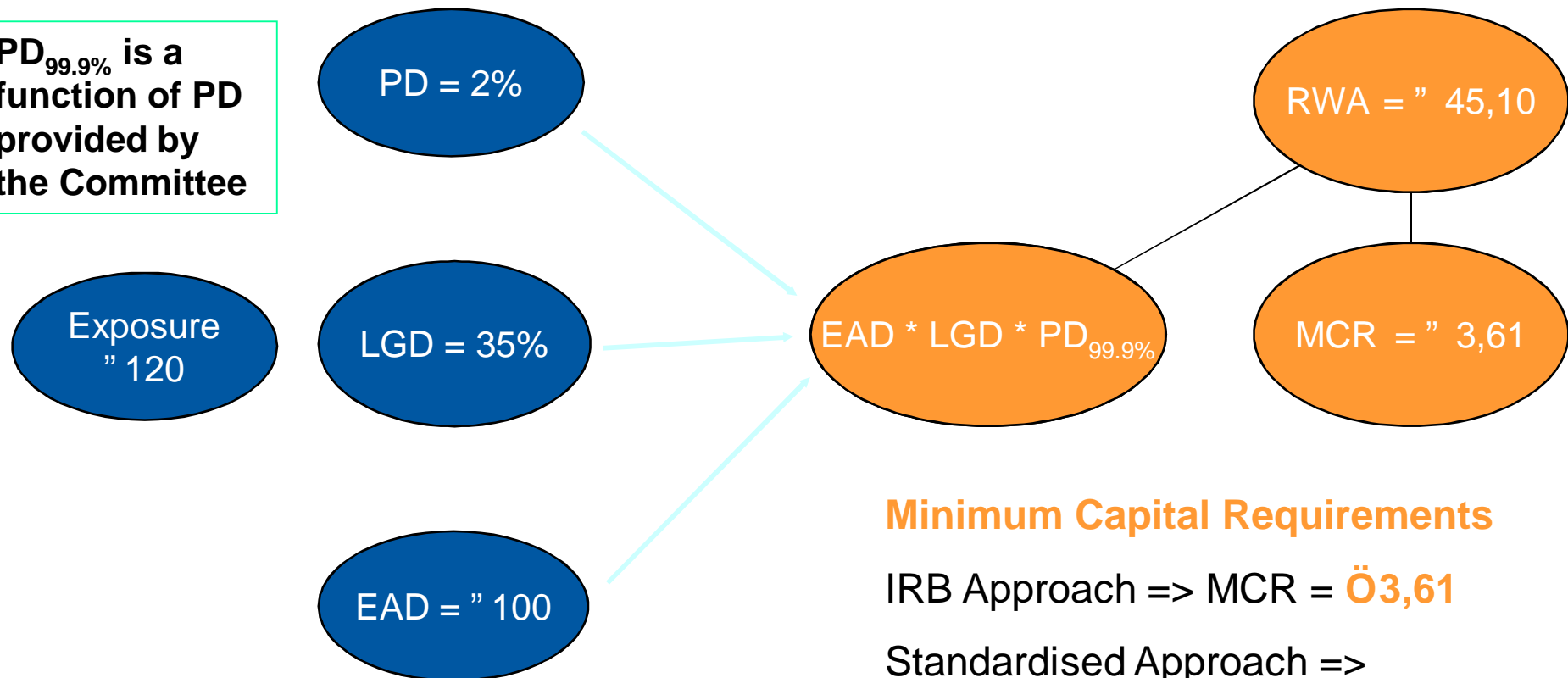
Correlation (R) = 0.03 × (1 - EXP(-35 × PD)) / (1 -EXP(-35)) + 0.16 × [1 - (1 - EXP(-35 × PD))/(1 - EXP(-35))]

Risk-weighted assets (RWA) = RW x 12.50 x EAD x 1.06

Minimum Capital Requirements (MCR) = RWA x 8%

IRB Approach Ë MCR Example for other retail

PD$_{99.9\%}$ **is a function of PD provided by the Committee**

PD = 2%

Exposure ” 120

LGD = 35%

EAD * LGD * PD$_{99.9\%}$

EAD = ” 100

RWA = ” 45,10

MCR = ” 3,61

Minimum Capital Requirements

IRB Approach => MCR = **Ö3,61**

Standardised Approach =>
75% * 8% * ” 120 = **Ö7,2**

%Old+B1 Accord =>
100% * 8% * ” 120 = **Ö9,6**

Implementation of the formula into excel

IRB RW Formula

Regulatory aspects for credit risk according Basel II/III

˝ Introduction

˝ Regulatory capital

˝ RWA calculation and minimum capital requirements

˝ Different credit risk approaches

˝ **Validation under Basel II/III**

˝ Literature: BIS Basel III Paper, EU Directives (CRR & CRD IV),OeNB Guidelines on Credit Risk Management: Rating Models and Validation

Validation of PD/Ratingmodels
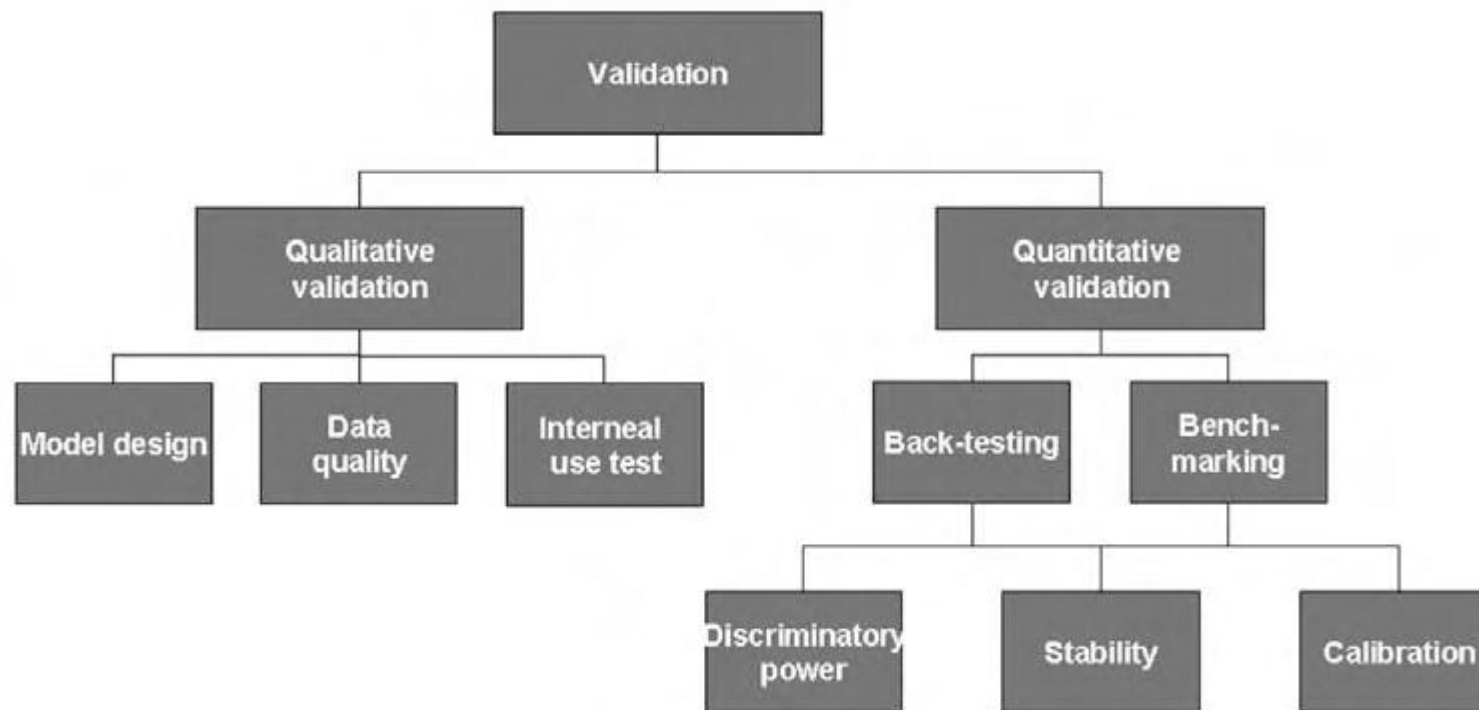
Adapted from DEUTSCHE BUNDESBANK, Monthly Report for September 2003, Approaches to the validation of internal rating systems.

Dimensions of quantitative Validation
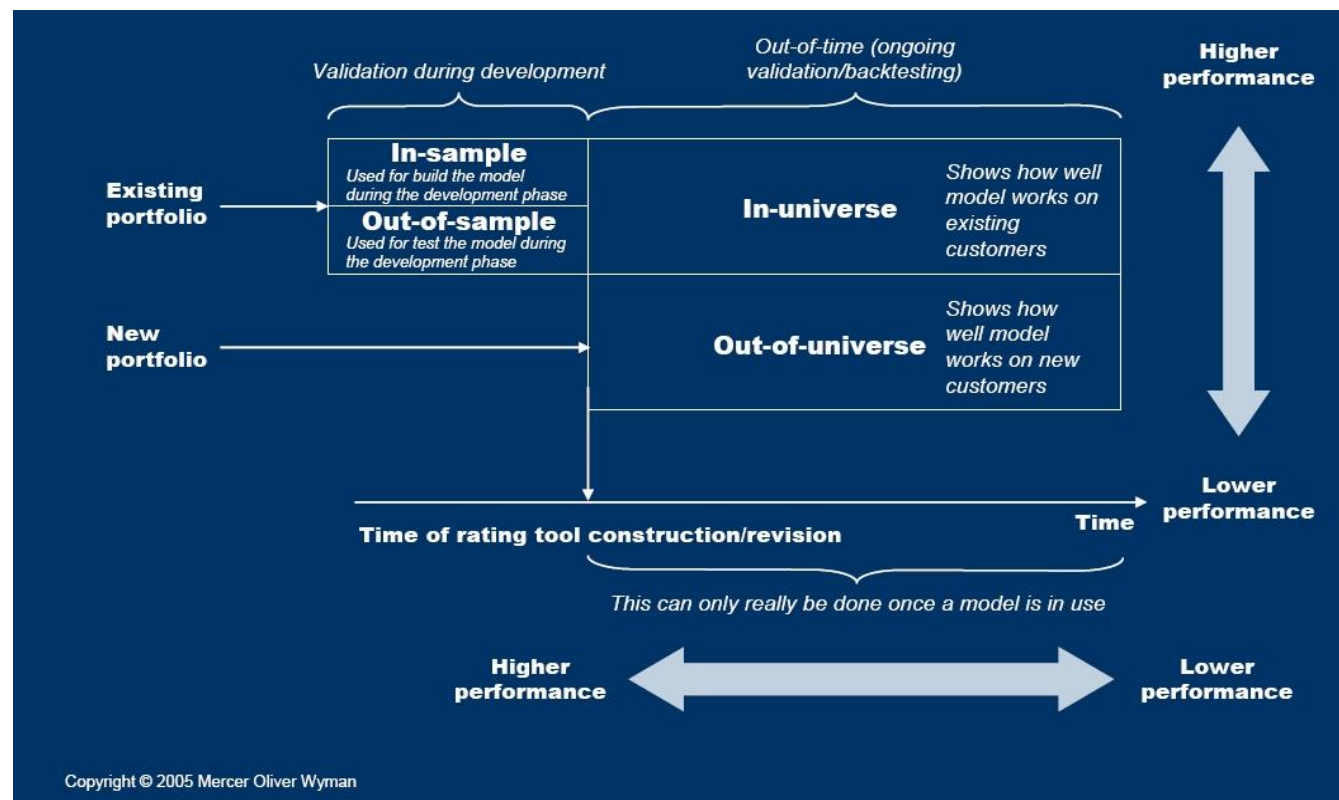
Source: Mercer Oliver Wyman (2005)

Possible measures for discriminatory power

- ˝ Classical Scoredistribution - descriptive
- ˝ ROC-curve and Area under ROC: Gini-coefficient (Accuracy Ratio, AR, Powerstat, Somers D in SAS)
- ˝ CAP-Kurve (similiar the ROC-curve)
- ˝ KS (Kolmogorov-Smirnov Test)
- ˝ Weight of Evidence (WE) and Information Value (IV)
- ˝ Brier-Score
- ˝ Chi-Quadrat Test
- ˝ Pietra Index
- ˝ Bayessche Error rate
- ˝ Entropy-Based Measures of Discriminatory Power

Most of them can be found in: OeNB Guidelines on Credit Risk Management: Rating Models and Validation: Chapter 6 Validating Rating Models

Validation of PD under Basel II

One part of backtesting is the evaluation of the **Discriminatory Power*** of a rating model.
Exemplary I have picked the following:

- Classical score distribution (descriptive)

- Gini-coefficient and KS-Test (statistical)

*The term discriminatory power refers to the fundamental ability of a rating model to differentiate between good and bad cases.

Example of a rating model /scorecard

A scorecard is typically made of 10 to 20 characteristics

Characteristic	Attribute & Score			
Telephone given	*No phone* *-42*	*Mobile only* *0*	*Home phone* *+27*	
Residential status	*Owner* *35*	*Rent* *-20*	*With Parents* *0*	
Education level	*University* *+30*	*Secondary* *0*	*Primary* *-19*	
Employment status	*Employee* *0*	*Housewife* *0*	*Under-empl.* *-36*	*Businessman* *-24*
Marital status	*Married* *+17*	*Single* *0*	*Divorced* *-17*	*Widower* *0*

The score of an applicant is simply the sum of its points in each characteristics:

An applicant giving his mobile phone only, who is a owner, has a university degree, employed and divorced will therefore have a score of: 0 + 35 + 30 + 0 . 17 = 48

At every individual score corresponds a bad rate estimate which will drive the decision to accept or decline the customer.

Customers are grouped into scorebands or scoreranges

Score distribution

scoreband		# goods	% good	# bads	% bads	# total	% total	G/B Odds	G/B Index	Badrate
462	772	312	3,9%	123	17,1%	435	5,0%	2,5	438 B	28,3%
773	826	358	4,5%	94	13,1%	452	5,2%	3,8	292 B	20,8%
827	876	779	9,7%	125	17,4%	904	10,4%	6,2	178 B	13,8%
877	902	724	9,1%	101	14,0%	825	9,5%	7,2	155 B	12,2%
903	922	815	10,2%	74	10,3%	889	10,2%	11,0	101 B	8,3%
923	938	856	10,7%	68	9,4%	924	10,6%	12,6	113 G	7,4%
939	950	769	9,6%	40	5,6%	809	9,3%	19,2	173 G	4,9%
951	962	849	10,6%	37	5,1%	886	10,2%	22,9	207 G	4,2%
963	970	838	10,5%	26	3,6%	864	9,9%	32,2	290 G	3,0%
971	980	861	10,8%	20	2,8%	881	10,1%	43,1	387 G	2,3%
981	985	408	5,1%	8	1,1%	416	4,8%	51,0	459 G	1,9%
986	997	430	5,4%	4	0,6%	434	5,0%	107,5	968 G	0,9%
Total		7999	100,0%	720	100,0%	8719	100,0%	11,1	100 B	8,3%

There is a good discrimination between good and bad loan.
See G/B odds, G/B Index, bad rate

score distribution

ROC*-curve and Area under ROC: Gini-coefficient
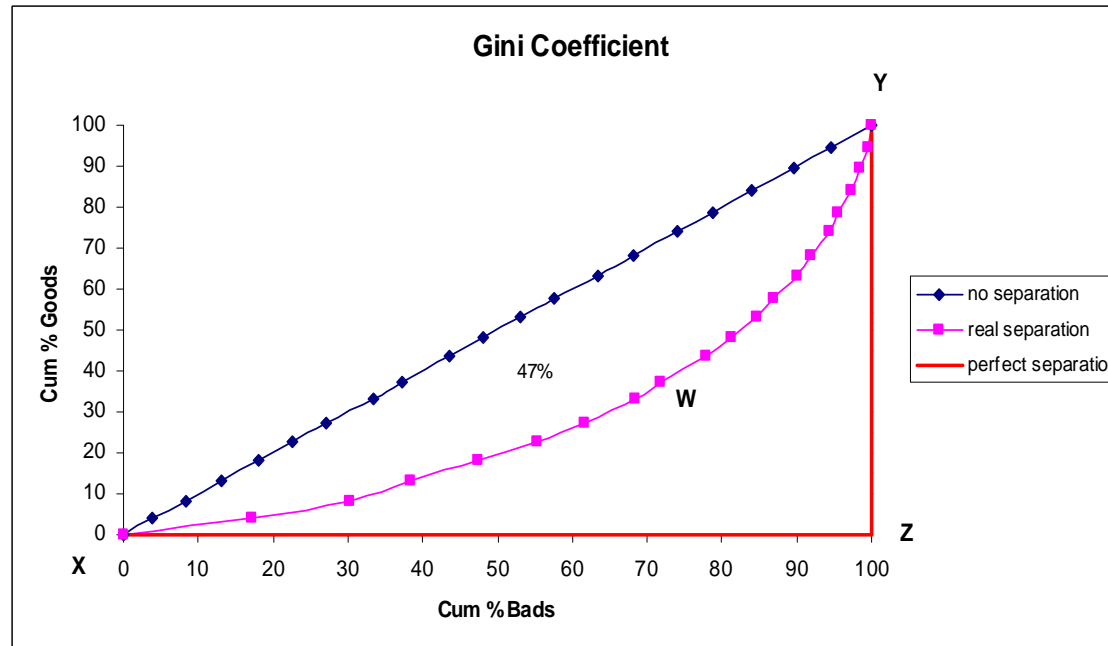
Gini Coefficient

The Gini coefficient is calculated by comparing the cumulative good and bad cases per scoreband.
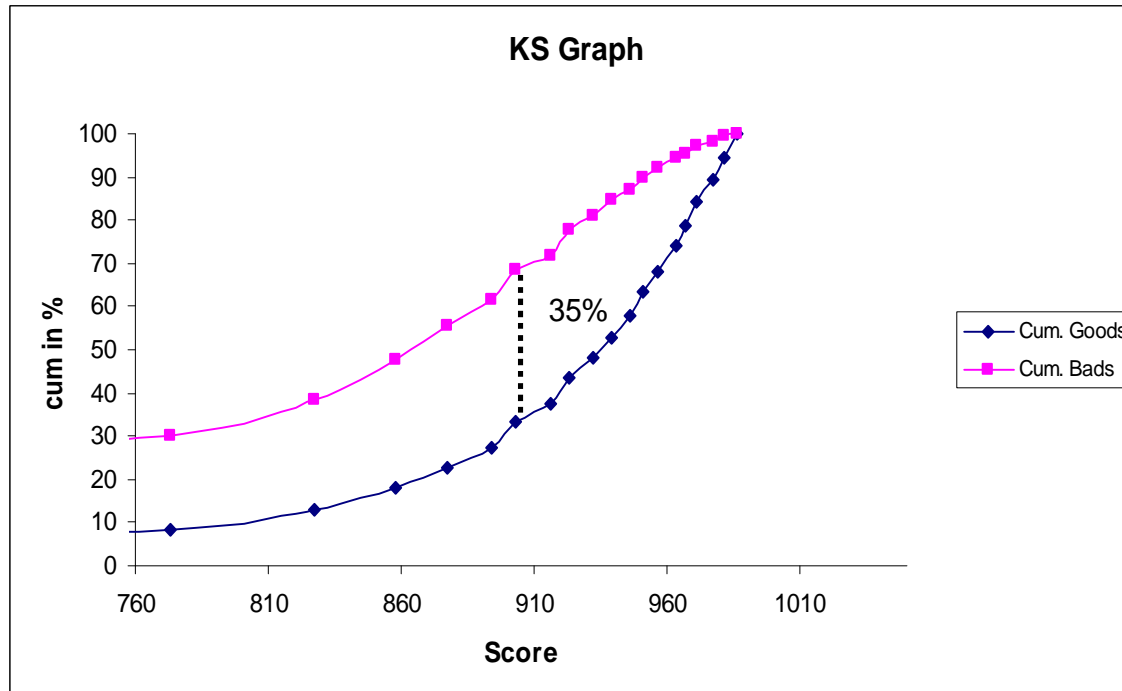
The Gini coefficient is the area between XYW as part of the total area of the triangle XYZ expressed as percentage.

Discriminatory power	Gini-coefficient application scorecard	Gini-coefficient behaviour scorecard
bad	<40%	<55%
average	40% bis 55%	55% bis 70%
Good/very good	> 55%	> 70%

gini

80

* Receiver Operating Characteristic

KS (Kolmogorov-Smirnov Test)

KS Graph

KS-Test is evaluating the difference between cumulative good and bad cases at each score band.

The more the two lines separated the higher is the discriminatory power of the model. The KS-Test measures the highest marging between cumulative good and bad cases.

KS Test

Trennschärfe	KS Antragsscorekarte	KS Verhaltensscorekarte
Schlecht	<30%	<45%
Mittel	30% bis 45%	45% bis 60%
Stark	> 45%	> 60%

Thank you for your attention