

2.2. Capital Requirements

Basel II

- **2 approaches in the calculation of Pillar 1 capital requirements for credit risk:**
 - (i) **Standardized** – corresponds roughly to Basel I, added by the differentiation of capital requirements as a function of the external ratings of counterparties:
 - non-rated companies kept a risk weight of 100%;
 - preferential treatment of mortgage loans was also kept (now with a risk weight of 35%, vis-à-vis 50% before);
 - the differentiation between OECD member countries and others was eliminated.
 - (ii) **IRB** – involves the integration of internal credit risk models in the loan granting decisions processes for the different portfolios, with these models supplying estimates for PD and LGD (for the corporate segment, there are two IRB sub-approaches – basic and advanced, with the former requiring only the PD estimation). Banks have to subject their models and the corresponding integration in the decision processes (**use test**) to approval by the supervisor.

Standardized approach

□ Risk weights for exposures to sovereigns, banks and non-financial companies:

Basel II

	Sovereigns	Banks	Non Financial Companies
AAA to AA	0%	20%	20%
A+ to A-	20%	50%	50%
BBB+ to BBB-	50%	100%/50%	100%
BB+ to B-	100%	100%	100%
<B-	150%	150%	150%
Non-rated	100%	100%/50%	100%

CEBS

Credit Quality Step	Fitch's assessments	Moody's assessments	S&P assessments	Corporate	Institution (includes banks)			Sovereign
					Sovereign method	Credit Assessment method		
						Maturity > 3 months	Maturity 3 months or less	
1	AAA to AA-	Aaa to Aa3	AAA to AA-	20%	20%	20%	20%	0%
2	A+ to A-	A1 to A3	A+ to A-	50%	50%	50%	20%	20%
3	BBB+ to BBB-	Baa1 to Baa3	BBB+ to BBB-	100%	100%	50%	20%	50%
4	BB+ to BB-	Ba1 to Ba3	BB+ to BB-	100%	100%	100%	50%	100%
5	B+ to B-	B1 to B3	B+ to B-	150%	100%	100%	50%	100%
6	CCC+ and below	Caa1 and below	CCC+ and below	150%	150%	150%	150%	150%

Notes:

- Exposures to the ECB shall be assigned a 0 % risk weight.
- Since Jan19, at national discretion, a lower risk weight may be applied to banks' exposures to their sovereign (or central bank) denominated in domestic currency and funded in that currency. Where this discretion is exercised, other national supervisory authorities may also permit their banks to apply the same risk weight to domestic currency exposures to this sovereign (or central bank) funded in that currency => Currently, Exposures to Member States' central governments and central banks denominated and funded in the domestic currency of that central government and central bank are assigned a risk weight of 0 %.
- Risk weights to regional and local governments and banks may be calculated according two alternative methodologies:
 - Risk weights immediately above the one applicable to the respective government (100% if non-rated or central banks from countries rated between BB+ and B-);

Standardized approach

- Exposures to the following multilateral development banks have a 0 % risk weight:
 - (a) International Bank for Reconstruction and Development (IBRD);
 - (b) International Finance Corporation (IFC);
 - (c) Inter-American Development Bank (IADB);
 - (d) Asian Development Bank;
 - (e) African Development Bank;
 - (f) Council of Europe Development Bank;
 - (g) Nordic Investment Bank;
 - (h) Caribbean Development Bank;
 - (i) European Bank for Reconstruction and Development (EBRD);
 - (j) European Investment Bank (EIB);
 - (k) European Investment Fund (EIF);
 - (l) Multilateral Investment Guarantee Agency;
 - (m) International Finance Facility for Immunization;
 - (n) Islamic Development Bank.

Standardized approach

- **Exposures to the following international organizations also get a 0 % risk weight:**
 - (a) EU
 - (b) International Monetary Fund (IMF);
 - (c) Bank for International Settlements (BIS);
 - (d) European Financial Stability Facility;
 - (e) European Stability Mechanism;

- A risk weight of 20 % shall be assigned to the portion of unpaid capital subscribed to the European Investment Fund.

Standardized approach

- Some changes in the coefficients of the standardized approach were decided afterwards, to be implemented in 1.1.2022 (later postponed in 1 year, with a phasing-in period of 5 years), trying to decrease excessive variability of RWAs (e.g. BCBS (2017), “Basel III: Finalising post-crisis reforms”, Dec.).

Corporate exposures:

External rating of counterparty	AAA to AA-	A+ to A-	BBB+ to BBB-	BB+ to BB-	Below BB-	Unrated
"Base" risk weight	20%	50%	75%	100%	150%	100%

100% previously

- Corporate SME** (annual consolidated sales ≤ 50 M€ for the most recent year) – risk weight = 85% (between investment and speculative grade corporates, due to higher risk, but also higher granularity).

Interbank exposures:

External rating of counterparty	AAA to AA-	A+ to A-	BBB+ to BBB-	BB+ to B-	Below B-
"Base" risk weight	20%	30%	50%	100%	150%
Risk weight for short-term exposures	20%	20%	20%	50%	150%

50% previously

Standardized approach

□ Subcategories of Specialised lending:

- (i) **Project finance** - the lender looks primarily to the revenues generated by a single project, both as the source of repayment and as security for the loan, being usually for large, complex and expensive installations such as power plants, chemical processing plants, mines, transportation infrastructure, environment, media, and telecoms.
- (ii) **Object finance** - funding of the acquisition of equipment (e.g. ships, aircraft, satellites, railcars, and fleets) where the repayment of the loan is dependent on the cash flows generated by the assets that have been financed and pledged or assigned to the lender;
- (iii) **Commodities finance** - short-term lending to finance reserves, inventories, or receivables of exchange-traded commodities (e.g. crude oil, metals, or crops), where the loan will be repaid from the proceeds of the sale of the commodity and the borrower has no independent capacity to repay the loan.

Standardized approach

□ Risk Weights

(i) Specialised lending

- Object and commodities finance - 100%;
- Project finance - 130% during the pre-operational phase, 100% during the operational phase, and 80% during the operational phase of projects deemed to be high quality, i.e. able to meet their financial commitments in a timely manner and its ability to do so is assessed to be robust against adverse changes in the economic cycle and business conditions.

(ii) commercial real estate:

If repayment doesn't depend on cash-flows generated by the property (depends on LTV and the borrower's risk):

	LTV ≤ 60%	LTV > 60%
Risk weight	Min (60%, RW of counterparty)	RW of counterparty

If repayment depends on cash-flows generated by the property
(depends only on the LTV, with higher weights, due to higher risk):

Source: BCBS (2017), "Basel III: Finalising post-crisis reforms", Dec.

	LTV ≤ 60%	60% < LTV ≤ 80%	LTV > 80%
Risk weight	70%	90%	110%

Standardized approach

(iii) Retail exposures - 75%

□ Definition:

- (i) revolving credits and lines of credit (including credit cards, charge cards and overdrafts), personal term loans and leases (eg instalment loans, auto loans and leases, student and educational loans, personal finance) and small business facilities and commitments.
- (ii) exposure \leq 1M€
- (iii) granularity requirement - aggregated exposure to a counterparty cannot exceed 0.2% of the overall regulatory retail portfolio (unless national supervisors have determined another method to ensure satisfactory diversification of the regulatory retail portfolio).

Standardized approach

(iv) **Risk weights for residential mortgage loans** (after Basel III, which brought a set of several risk weights, instead of the former differentiation between LTV > or < 75%, with risk weights of 75% and 35%, respectively):

- **if repayment doesn't depend on cash-flows generated by the property:**

	LTV ≤ 50%	50% < LTV ≤ 60%	60% < LTV ≤ 80%	80% < LTV ≤ 90%	90% < LTV ≤ 100%	LTV > 100%
Risk weight	20%	25%	30%	40%	50%	70%

- **if repayment depends on cash-flows generated by the property:**

	LTV ≤ 50%	50% < LTV ≤ 60%	60% < LTV ≤ 80%	80% < LTV ≤ 90%	90% < LTV ≤ 100%	LTV > 100%
Risk weight	30%	35%	45%	60%	75%	105%

Source: BCBS (2017), "Basel III: Finalising post-crisis reforms", Dec.

IRB Approach

- Basel II allowed banks to estimate Capital Requirements for Credit and Operational Risk by using internal methodologies (for Market Risk it had already been allowed by Basel I in 1996).

- **For Credit Risk, pre-established formulas are set in the Basel Agreement, based on the parameters for the EL – PD and LGD.**

- **For corporate exposures, there are 2 IRB approaches:**
 - **Foundation** – only the PD (and the EAD, for revolving exposures) has to be estimated

 - **Advanced** – PD, LGD and EAD have to be estimated

IRB Approach

□ **In IRB Foundation, the LGD is pre-defined according to the type of exposure:**

- Loans with receivables as collaterals - 20%
- Loans with real estate collaterals - 20%
- Loans with other eligible physical collaterals – 25%
- Non-collateralized loans to non-financial companies – 40%
- Subordinated assets – 75%
- Other assets - 45%

IRB Approach

- The LGD applicable to a collateralized transaction (LGD*) must be calculated as the exposure weighted average of the LGD applicable to the unsecured part of an exposure (LGD_U) and the LGD applicable to the collateralized part of an exposure (LGD_S):

$$LGD^* = LGD_U \cdot \frac{E_U}{E \cdot (1 + H_E)} + LGD_S \cdot \frac{E_S}{E \cdot (1 + H_E)}$$

E - current value of the exposure (in the case of securities lent, the exposure value has to be increased by applying the appropriate haircuts - H_E).

- For different types of collaterals:

$$LGD^* = LGD_U \cdot \frac{E_U}{E \cdot (1 + H_E)} + \sum_i LGD_{Si} \cdot \frac{E_{Si}}{E \cdot (1 + H_E)}$$

E_S – collateralized part of the exposure, i.e. the current value of the collateral received after the application of the haircut applicable for the type of collateral (H_C) and for any currency mismatches between the exposure and the collateral. E_S is capped at the value of . E*(1+E_H).

E_U – uncollateralized part of the exposure.

E_{Si} –the current value of the collateral *i* received after the application of the haircut applicable for that type of collateral (H_C)

LGD_{Si} – LGD applicable to that type of collateral (H_C).

IRB Approach

□ Haircuts (H_C):

Type of collateral	LGD _s	Haircut
Eligible financial collateral	0%	As determined by the haircuts that apply in the comprehensive formula of the standardised approach for credit risk (paragraph 163 for jurisdictions that allow the use of ratings for regulatory purposes and paragraph 164 for jurisdictions that do not). The haircuts have to be adjusted for different holding periods and non-daily remargining or revaluation according to paragraphs 169 to 172 of the standardised approach.
Eligible receivables	20%	40%
Eligible residential real estate / commercial real estate	20%	40%
Other eligible physical collateral	25%	40%
Ineligible collateral	N/A	100%

IRB Approach

□ Floors for LGD in IRB Advanced:

LGD parameter floors		
	LGD	
	Unsecured	Secured
Corporate	25%	Varying by collateral type: <ul style="list-style-type: none"> • 0% financial • 10% receivables • 10% commercial or residential real estate • 15% other physical

- The LGD floor for a partially secured exposure is calculated as a weighted average of the unsecured LGD floor for the unsecured portion and the secured LGD floor for the secured portion:

$$\text{Floor} = \text{LGD}_{U \text{ floor}} \cdot \frac{E_U}{E \cdot (1 + H_c)} + \text{LGD}_{S \text{ floor}} \cdot \frac{E_S}{E \cdot (1 + H_c)}$$

PDs

- **In the old times, banks didn't estimate PDs** - retail traditional banking was very much an “expert system”, where bankers decided credit using subjective judgements, following the popular “five C's” – character, capital, capacity, collateral, and cycle.
- **PDs are usually estimated by econometric models, providing internal rating classifications characterized by different term structures of PDs.**
- Ratings are the basis for bank credit approval, pricing, monitoring and loan loss provisioning.

PDs

- **Estimated from a range of sources. The simplest and most widely used throughout the world is rating agency ratings, available for some companies and Governments.**

- **Additionally, internal models are also used, being usually employed 3 techniques for non-financial companies:**
 - ***middle market (non-listed medium to large size companies)*** – models relate financial ratios to past loan behavior based on the FI's credit experience or representative external databases, with no structural background, just resulting from the statistical results.
 - **listed companies** – besides the same type of non-structural models based on stock prices, also using data from financial statements (for a shadow PD or to get data on the liabilities).
 - **small business** – similar to middle market, but including variables related to the entrepreneur.

PDs

- **Statistical methods to estimate PDs include:**
 - Linear regression;
 - Discriminant analysis;
 - Logit and Probit models;
 - Panel models;
 - Cox proportional hazards model;
 - Neural Networks.
- **Credit analysts can override internal ratings** in the corporate segment, following the qualitative assessment of management, business perspectives, quantitative information still not reflected on financial statements or from the customer relationship with the bank (e.g. sudden increase in the utilization of credit lines), or from external sources (e.g. commercial information, central credit risk database).
- PDs in individual loans tend to differ for different types of loans, while for corporate PDs tend to be the same.

LGD

- **There are 3 LGD estimation methods:**
- (i) **Market LGD** - observed from market prices of defaulted bonds and marketable loans soon after default events. The main benefit is that actual prices can be used. This is the methodology used most by the rating agencies.
- (ii) **Workout LGD** - which is estimated cash flows from the workout process, based on estimated exposure and a discount rate.
- (iii) **Implied Market LGD** - derived from prices of bonds deemed to be high risk. This is the least developed of the methods, but has the benefit of a large pool of market data.
- Different LGDs are usually associated with different collateral types or debt seniority, being also correlated with PDs, as higher ratings exhibit lower LGDs.
- LGD also fluctuates with the business cycle.
- LGD of bonds are measured as $1 - \text{Price}$ (as a % of EAD) in a given period after default (often 1 month).
- LGD for loans corresponds to the workout $\text{LGD} = 1 - \text{NPV of recoveries}$

EAD

- **Fixed-credit facilities** (e.g. term loans): amount outstanding (although EADs slightly above 100% are not uncommon given interest accrual).
- **Revolving facilities** (e.g. credit lines, liquidity facilities and overdrafts):
= drawn amount + estimate of the amount of the remainder of the commitment likely to be drawn at the time of default (often referred to as either the Credit Conversion Factor or Loan Equivalent).

Exposure classes for IRB

- **Corporate** – includes specialized credit:
 - (i) project finance - cash-flows generated by a single project;
 - (ii) object finance - cash-flows generated by a single asset;
 - (iii) commodity finance - cash-flows generated by the sale of goods whose acquisition is financed;
 - (iv) income-producing real estate
 - (v) high-volatility commercial real estate
- **Sovereign**
- **Banks**

Exposure classes for IRB

□ **Retail**

(i) Residential Mortgage Loans

(ii) Revolving Loans:

- credit lines

- credit cards

- overdrafts

(iii) Other:

- Small business with exposure $\leq 1\text{M€}$

- Consumer loans.

Exposure classes for IRB

- All IRB formulas are based on the Gaussian copula model of time to default, providing the Worst Case Default Rate (WCDR):

$$\text{WCDR} = N\left[\left(N^{-1}(\text{PD}) + \sqrt{p}N^{-1}(0.999)\right) / \sqrt{1-p}\right]$$

- This is a model where the joint distribution of 2 loans is a bivariate normal and the defaults are triggered by a common factor (single-factor Vasicek formula).
- As the capital requirement corresponds to the Unexpected Loss, i.e. the difference between the loss under a very unlikely scenario and the expected loss, **IRB formulas result from multiplying WCDR by LGD and deducting this by the Expected Loss.**
- Additionally, maturity and debtor size adjustments are made for corporate exposures, while the correlation coefficient either depend on the PD and LGD, or is fixed, according to the level of the portfolio granularity (e.g. higher correlation for residential mortgage loans than for revolving exposures).

Corporate

Risk-weights:

$$\text{Correlation (R)} = 0.12 \cdot \frac{(1 - e^{-50 \cdot PD})}{(1 - e^{-50})} + 0.24 \cdot \left(1 - \frac{(1 - e^{-50 \cdot PD})}{(1 - e^{-50})} \right)$$

$$\text{Maturity adjustment (b)} = [0.11852 - 0.05478 \cdot \ln(PD)]^2$$

$$\text{WCDR} = N \left[\left(N^{-1}(PD) + \sqrt{p} N^{-1}(0.999) \right) / \sqrt{1-p} \right]$$

$$\text{Capital requirement}^{13,14}(K) = \left[LGD \cdot N \left[\frac{G(PD)}{\sqrt{1-R}} + \sqrt{\frac{R}{1-R}} \cdot G(0.999) \right] - PD \cdot LGD \right] \cdot \frac{(1 + (M - 2.5) \cdot b)}{(1 - 1.5 \cdot b)}$$

$$\text{Risk-weighted assets (RWA)} = K \cdot 12.5 \cdot EAD$$

being $N[x]$ the standardized normal distribution value in x , $G(z)$ the inverse of $N[x]$, R the correlation coefficient between exposures and M the maturity (in years).

Size adjustment for corporates:

$$\text{Correlation (R)} = 0.12 \cdot \frac{(1 - e^{-50 \cdot PD})}{(1 - e^{-50})} + 0.24 \cdot \left(1 - \frac{(1 - e^{-50 \cdot PD})}{(1 - e^{-50})} \right) - 0.04 \cdot \left(1 - \frac{(S - 5)}{45} \right)$$

Banks

Risk weights:

- similar to Corporate, but with a multiplier of 1.25 applied to the correlation parameter:

$$\text{Correlation (R_FI)} = 1.25 \cdot \left[0.12 \cdot \frac{(1 - e^{-50 \cdot PD})}{(1 - e^{-50})} + 0.24 \cdot \left(1 - \frac{(1 - e^{-50 \cdot PD})}{(1 - e^{-50})} \right) \right]$$

- For these exposures, as well as for corporates, PD is subject to a floor of 0.03%, LGD is set at 45% for senior claims and 75% for subordinated claims.

Residential Mortgages

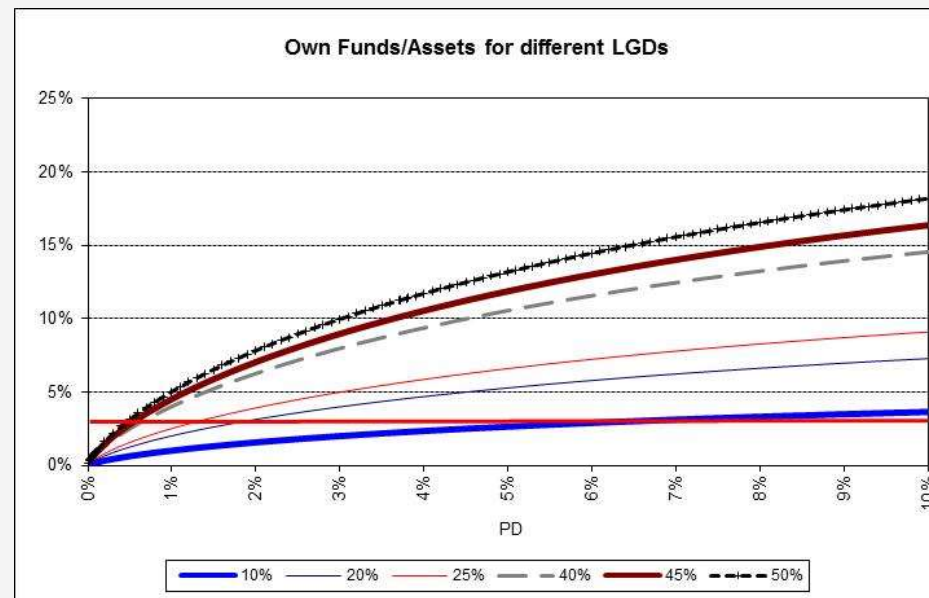
Risk-weights:

Correlation (R) = 0.15

$$\text{Capital requirement (K)} = \left[LGD \cdot N \left[\frac{G(PD)}{\sqrt{1-R}} + \sqrt{\frac{R}{1-R}} \cdot G(0.999) \right] - PD \cdot LGD \right]$$

Risk-weighted assets = $K \cdot 12.5 \cdot EAD$

$$WCDR = N \left[\left(N^{-1}(PD) + \sqrt{p} N^{-1}(0.999) \right) / \sqrt{1-p} \right]$$



Retail Revolving

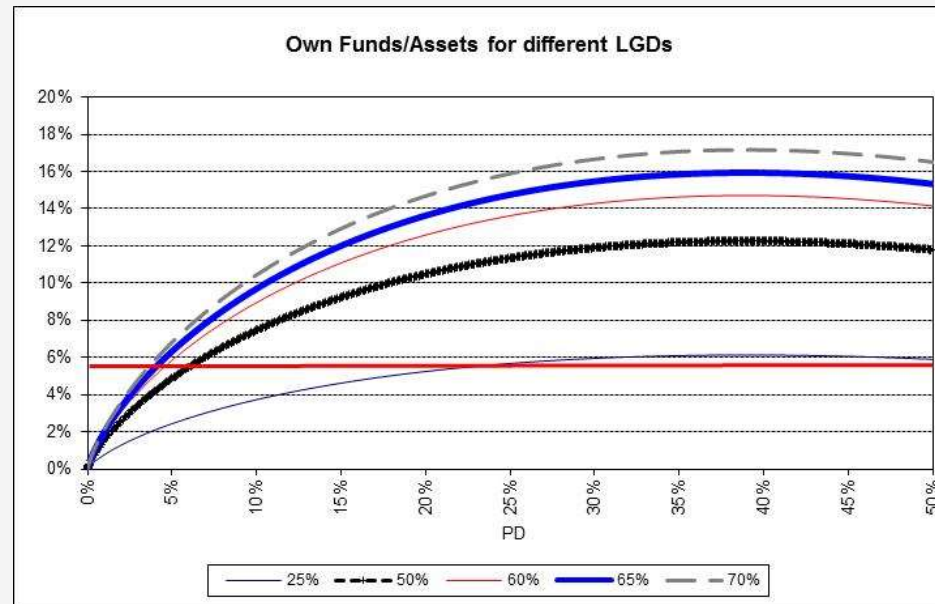
Risk-weights:

$$WCDR = N \left[\left(N^{-1}(PD) + \sqrt{p} N^{-1}(0.999) \right) / \sqrt{1-p} \right]$$

Correlation (R) = 0.04

$$\text{Capital requirement (K)} = \left[LGD \cdot N \left[\frac{G(PD)}{\sqrt{1-R}} + \sqrt{\frac{R}{1-R}} \cdot G(0.999) \right] - PD \cdot LGD \right]$$

Risk-weighted assets = $K \cdot 12.5 \cdot EAD$



Other Retail

Risk-weights:

$$\text{Correlation (R)} = 0.03 \cdot \frac{(1 - e^{-35 \cdot PD})}{(1 - e^{-35})} + 0.16 \cdot \left(1 - \frac{(1 - e^{-35 \cdot PD})}{(1 - e^{-35})} \right)$$

$$\text{Capital requirement (K)} = \left[LGD \cdot N \left[\frac{G(PD)}{\sqrt{(1-R)}} + \sqrt{\frac{R}{1-R}} \cdot G(0.999) \right] - PD \cdot LGD \right]$$

$$\text{Risk-weighted assets} = K \cdot 12.5 \cdot EAD$$

Risk Weight Floors

- Floors to credit risk weights are being imposed to banks using IRB, to avoid capital requirements to fall below 72,5% of the capital requirements derived under the standardised approach.
- There is a phasing-in period (2022-2027), starting with a floor of 50%.

	Pre-floor RWAs	Standardised RWAs	72.5% of standardised RWAs
Credit risk	62	124	89.9
- of which Asset Class A	45	80	58
- of which Asset Class B	5	32	23.2
- of which Asset Class C (not modelled)	12	12	8.7
Market risk	2	4	2.9
Operational risk (not modelled)	12	12	8.7
Total RWA	76	140	101.5

Date	Output floor calibration
1 Jan 2022	50%
1 Jan 2023	55%
1 Jan 2024	60%
1 Jan 2025	65%
1 Jan 2026	70%
1 Jan 2027	72.5%

Source: BCBS (2017), “Basel III: Finalising post-crisis reforms”, Dec.

Credit Risk Mitigation

- Exposures may be collateralised by cash or securities, a guarantee provided by a third party or a credit derivative:

(1) Collateralized transactions:

- **simple approach** - replaces the risk weight of the counterparty by the risk weight of the collateral for the collateralised portion of the exposure (with a 20% floor), for a set of eligible collaterals (that have to be revalued at least every 6 months and be pledged for at least the life of the exposure);
 - (i) **comprehensive approach** - more precise reduction of exposures by the collateral, considering a volatility-adjusted value of the collateral.

(2) On-balance sheet netting - capital requirements based on credit exposures, net of the collateral value.

(3) Guarantees and credit derivatives - replaces the risk weight of the debtor by the risk weight of the guarantor or the credit derivative counterparty.

Credit Risk Mitigation

□ Simple approach - Eligible collaterals:

- (i) Cash
- (ii) Gold
- (iii) Debt securities
 - Government Debt: rating \geq BB-
 - Other entities: rating \geq BBB-
 - Short-term debt: rating A-3/P-3
 - Non-rated debt: senior debt issued by a bank, listed on a recognized exchanged, with similar debt issued with an investment grade rating and liquidity considered by the supervisor as adequate.

Credit Risk Mitigation

- **Comprehensive approach – exposure amount after risk mitigation, taking into account currency risk and the market risk of the collateral:**

$$E^* = \max \{ 0, E \cdot (1 + H_e) - C \cdot (1 - H_c - H_{fx}) \}$$

E^* = the exposure value after risk mitigation

E = current value of the exposure

H_e = haircut appropriate to the exposure

C = the current value of the collateral received

H_c = haircut appropriate to the collateral

H_{fx} = haircut appropriate for currency mismatch between the collateral and exposure

Credit Risk Mitigation

□ Supervisory haircuts (Hc and He):

Supervisory haircuts for comprehensive approach

Jurisdictions that allow the use of external ratings for regulatory purposes Table 14

Issue rating for debt securities	Residual maturity	Sovereigns ⁷³			Securitisation exposures ⁷⁵
		Sovereigns ⁷³	Other issuers ⁷⁴	Securitisation exposures ⁷⁵	
AAA to AA-/A-1	≤ 1 year	0.5	1	2	
	> 1 year, ≤ 3 years	2	3	8	
	> 3 years, ≤ 5 years		4		
	> 5 years, ≤ 10 years	4	6	16	
	> 10 years		12		
A+ to BBB-/A-2/A-3/P-3 and unrated bank securities per para. 148(c)(ii)	≤ 1 year	1	2	4	
	> 1 year, ≤ 3 years	3	4	12	
	> 3 years, ≤ 5 years		6		
	> 5 years, ≤ 10 years	6	12	24	
	> 10 years		20		
BB+ to BB-	All	15	Not eligible	Not eligible	
Main index equities (including convertible bonds) and gold		20			
Other equities and convertible bonds listed on a recognised exchange		30			
UCITS/mutual funds		Highest haircut applicable to any security in which the fund can invest, unless the bank can apply the look-through approach (LTA) for equity investments in funds, in which case the bank may use a weighted average of haircuts applicable to instruments held by the fund.			
Cash in the same currency ⁷⁶		0			

□ $H_{fx} = 8\%$

Supervisory haircuts for comprehensive approach

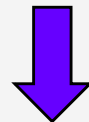
Jurisdictions that do not allow the use of external ratings for regulatory purposes Table 15

	Residual maturity	Issuer's risk weight (only for securities issued by sovereigns ⁷⁷)			Other investment-grade securities, consistent with paragraphs 148(d)(iii) ⁷⁸	
		0%	20% or 50%	100%	Non-securitisation exposures	Senior securitisation exposures with risk weight < 100%
Debt securities	≤ 1 year	0.5	1	15	2	4
	> 1 year, ≤ 3 years	2	3	15	4	12
	> 3 years, ≤ 5 years				6	
	> 5 years, ≤ 10 years	4	6	15	12	24
> 10 years	20					
Main index equities (including convertible bonds) and gold		20				
Other equities and convertible bonds listed on a recognised exchange		30				
UCITS/mutual funds		Highest haircut applicable to any security in which the fund can invest, unless the bank can apply the look-through approach (LTA) for equity investments in funds, in which case the bank may use a weighted average of haircuts applicable to instruments held by the fund.				
Cash in the same currency ⁷⁹		0				
Other exposure types		30				

Credit Risk Mitigation

□ Example:

- Exposure = 800M€
- Debtor rating: B- => risk-weight =150%
- Collateral: 700 M€ of BBB bonds with a maturity = 12 years => risk-weight =100%
- **RWA – simple approach:**
 - the risk-weight corresponding to the debtor will be replaced by the risk-weight of the collateral, in the collateralized amount
 - in the remaining amount, the risk-weight keeps unchanged (150%)



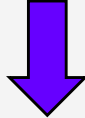
- **$RWA = 100\% \times 700M + 150\% \times 100M = 850M€$**

Credit Risk Mitigation

- **RWA – comprehensive approach:**

$$E^* = \max\{0, E \cdot (1 + H_e) - C \cdot (1 - H_c - H_{fx})\}$$

$$\text{RWA} = 150\% \times [800\text{M} - 700\text{M} \times (1 - 0,2)] = 360\text{M}\text{€}$$

- Non- collateralized: $\text{RWA} = 150\% \times 800 \text{ M€} = 1200 \text{ M€}$
 - Collateralization with cash: $\text{RWA} = 0\% \times 700\text{M} + 150\% \times 100 = 150\text{M€}$
- 
- Collateralization allowed a reduction of the RWA between 840 M€ (with B- bonds) and 1050M€ (with cash).