EE431: Lecture 7 (Spring 2012)

Risk Management in Banking (1): Introduction & Credit Risk in Basel II

Risk v.s. Uncertainty

- In his seminal work *Risk, Uncertainty, and Profit*, Frank Knight (1921) established the distinction between risk and uncertainty;

  "... Uncertainty must be taken in a sense radically distinct from the familiar notion of Risk, from which it has never been properly separated. The term "risk," as loosely used in everyday speech and in economic discussion, really covers two things which, functionally at least, in their causal relations to the phenomena of economic organization, are categorically different. ... The essential fact is that "risk" means in some cases a quantity susceptible of measurement, while at other times it is something distinctly not of this character; and there are far-reaching and crucial differences in the bearings of the phenomenon depending on which of the two is really present and operating. ... It will appear that a measurable uncertainty, or "risk" proper, as we shall use the term, is so far different from an unmeasurable one that it is not in effect an uncertainty at all. We ... accordingly restrict the term "uncertainty" to cases of the non-quantitive type."

- Thus, uncertainty is immeasurable, not possible to calculate, while risk is measurable.

Risk in Our Context

- **Risk is the unexpected variability of asset earnings/prices.**

  - **Business Risk**: risk that is encountered in everyday operations, management decisions, including macroeconomic risk.
  - **Financial Risk**: risk resulted from firm's financial activities (e.g., banks' lending, owning stocks, etc.)

Systemically Important Events

- **Extreme events caused significant increases to volatility resulting in huge financial losses;**
  - 1973: Oil shock
  - 1987: Black Monday
  - 1989: Japanese stock market bubble deflated
  - 1997: Asian crisis
  - 1998: Russian debt default (LTCM crisis)
  - 2001: 9-11
  - 2007-2009: Subprime Credit crisis
  - 2009-now: European sovereign crisis

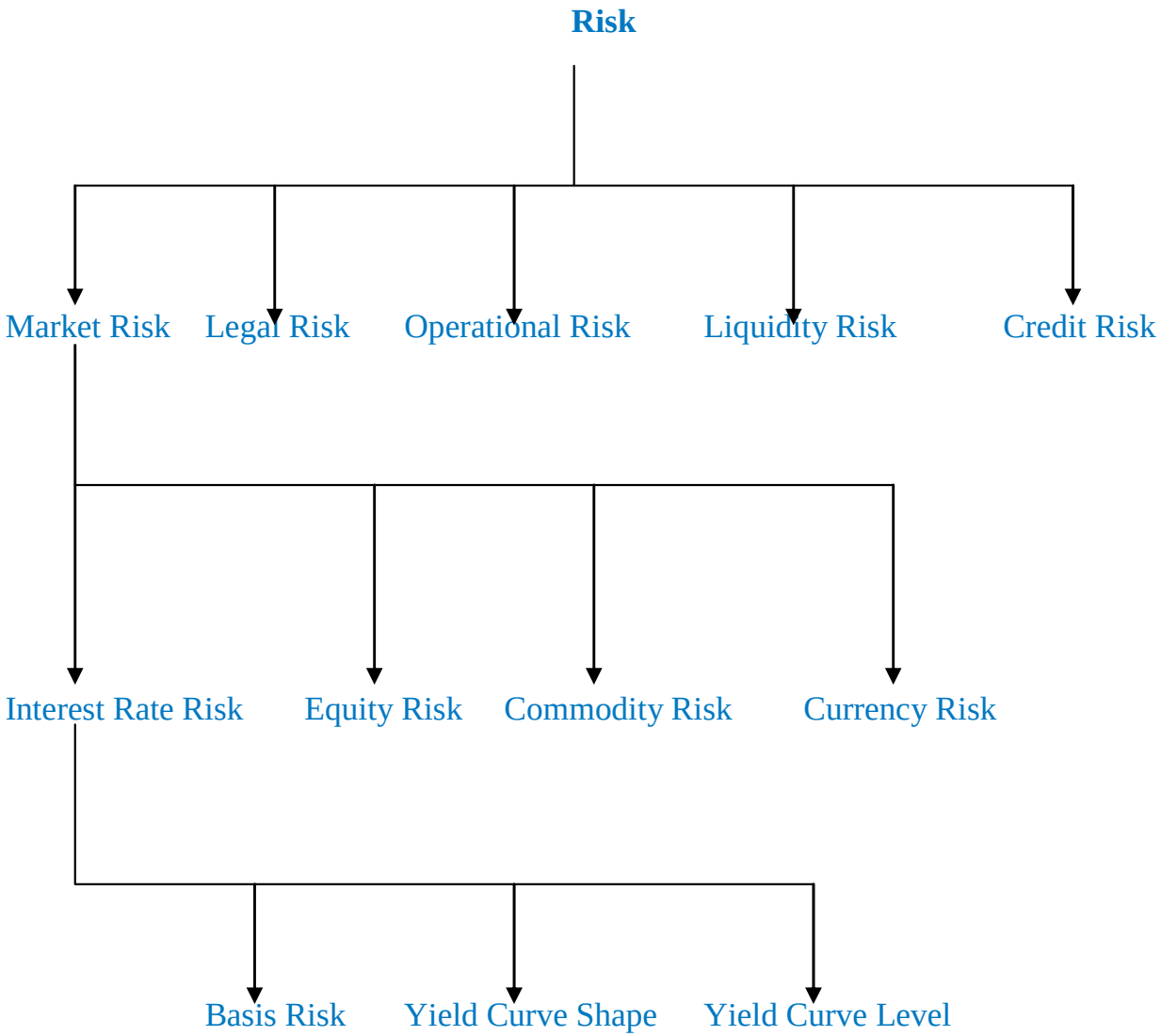
- **Deregulation and globalization increase sensitivity of financial system worldwide.**

Digression: Derivative Contract

- **Securities are issued to raise capital for firms.**
- **Derivatives derives its value from an underlying security with important characteristics:**
  - Finite and predefined life
  - Predefined reference rate or price (not necessarily fixed)
  - Predefined notional amount (not necessarily fixed)

- **Derivatives are always zero-sum games.**
- **Leverage allows derivatives to be used to hedge risk, but it is also ‘double-edged sword’.**

Risk Typology (1)



Risk Typology (2)

- **Market Risk**
  - Risk from changes in prices or volatility of prices in financial market, resulting in loss or profit.
- **Liquidity Risk**
  - Loss could occur from inability to sufficiently liquidate a position at a fair price.
- **Credit Risk**
  - Risk from default probability of counterparty.
- **Operational Risk**
  - Loss from inadequate monitoring systems, management failure, defective control, and human factors.

Roles and Types of Capital in Banks

- Absorb large unexpected losses
- Protect depositors and other claim holders
- Provide enough confidence to external investors and rat agencies on the financial heath and viability of the institution.

  - Economic Capital (EC) or Risk Capital.

    An estimate of the level of capital that a firm requires to operate its business.

  - Regulatory Capital (RC).

    The capital that a bank is required to hold by regulators in order to operate.

  - Bank Capital (BC)

    The actual physical capital held

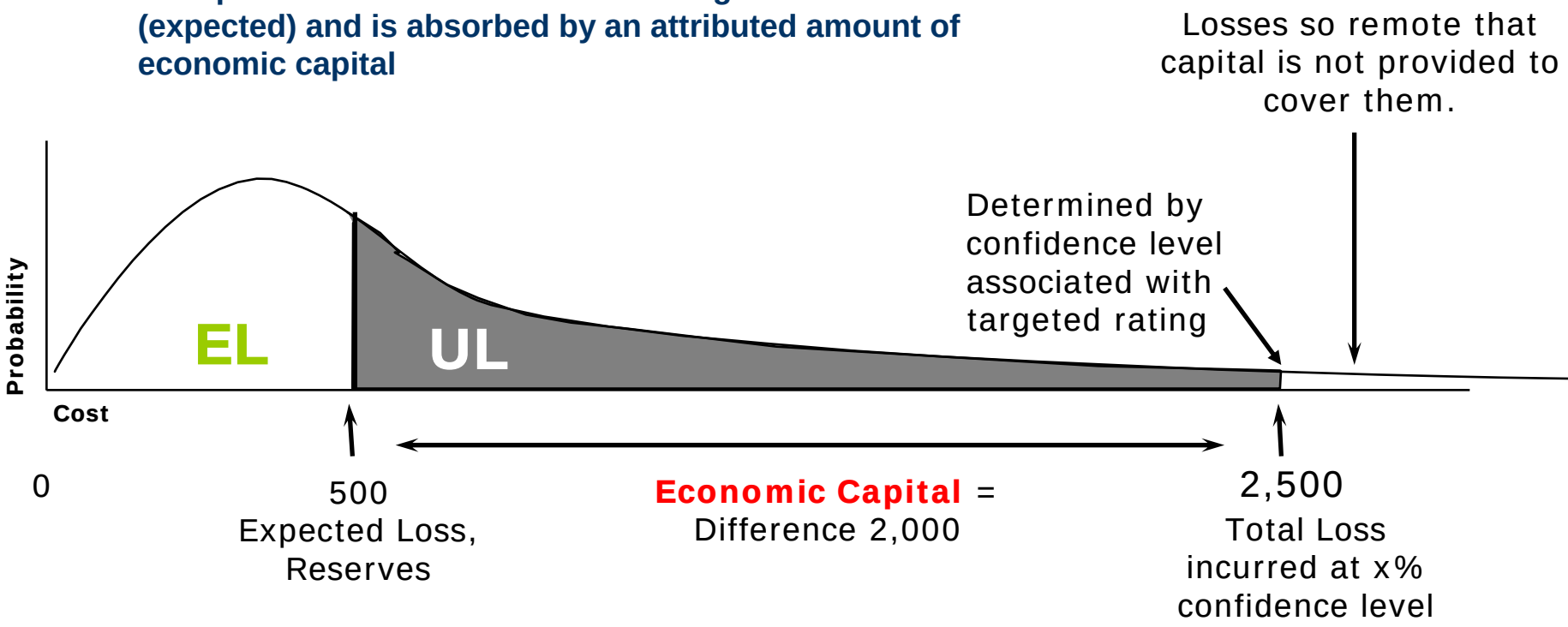
Economic Capital

- **Economic capital acts as a buffer that provides protection against all the credit, market, operational and business risks faced by an institution.**
- **EC is set at a confidence level that is less than 100% (e.g. 99.9%), since it would be too costly to operate at the 100% level.**

Risk Measurement: Expected v.s. Unexpected Loss

Aggregate Loss Distribution for a Bank

- **The Expected Loss (EL) and Unexpected Loss (UL) framework may be used to measure economic capital**
  - **Expected Loss: the mean loss due to a specific event or combination of events over a specified period**
  - **Unexpected Loss: loss that is not budgeted for (expected) and is absorbed by an attributed amount of economic capital**



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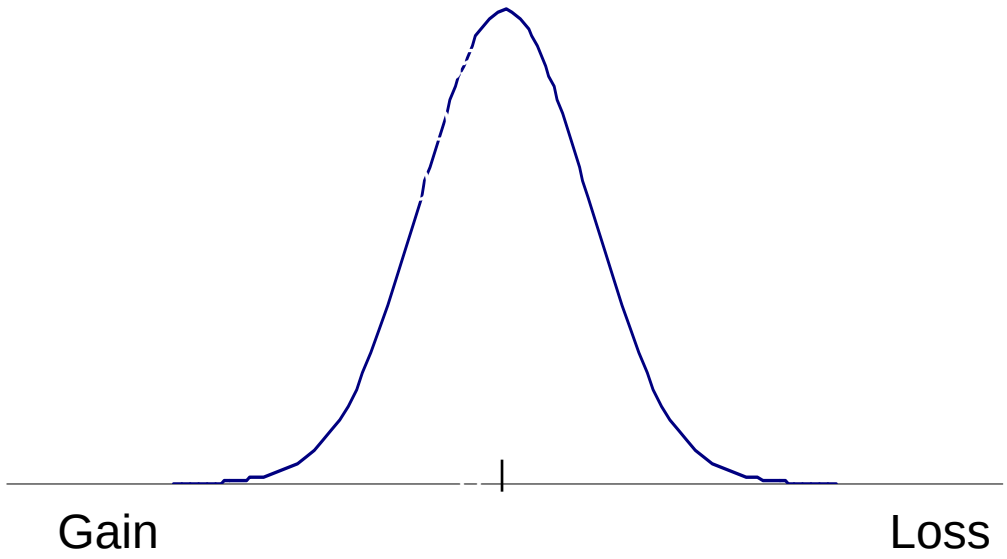
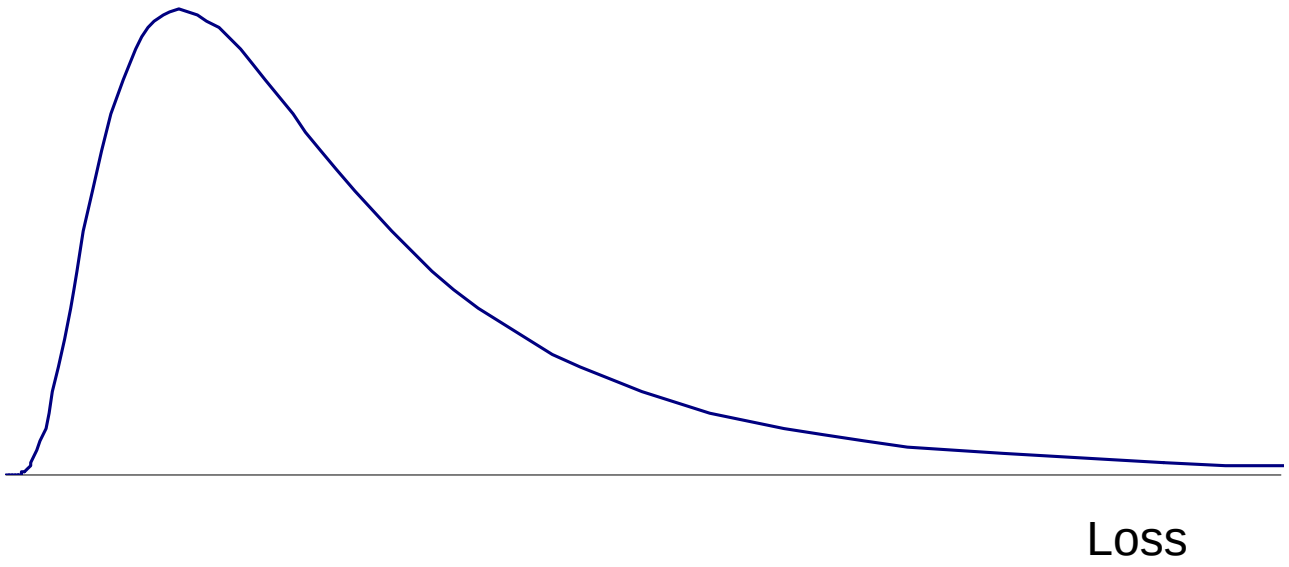
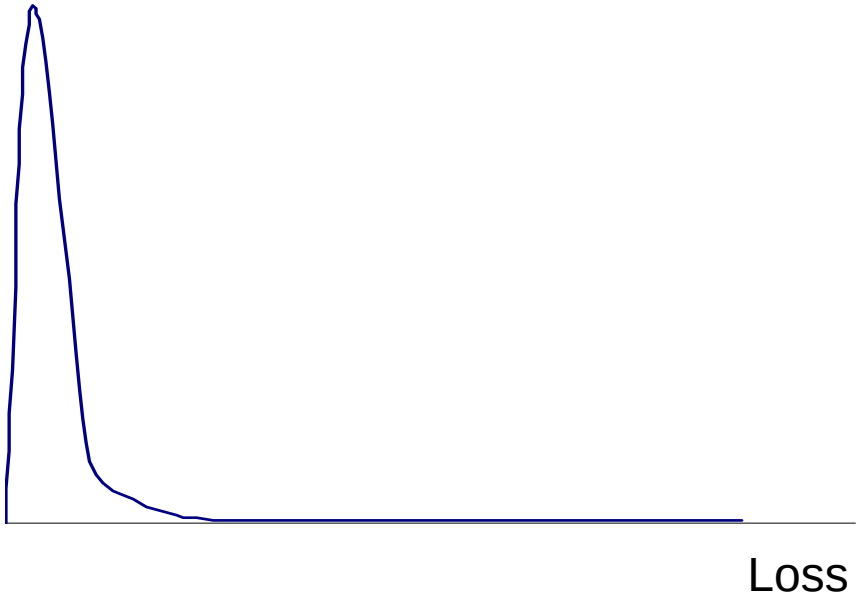
Example: One-year Market Risk Gains/Loss Distribution



Example: One-year Credit Risk Loss Distribution



Example: One Year Operational Risk Loss Distribution



Characteristics of Distributions

	Second Moment (Variance)	Third Moment (Skewness)	Fourth Moment (Kurtosis)
Credit Risk	**Moderate**	**Moderate**	**Moderate**
Market Risk	**High**	**Zero**	**Low**
Operational Risk	**Low**	**High**	**High**

Risk Adjusted Return on Capital (1)

- RAROC is the return on economic capital for a business unit
- The denominator is the economic capital allocated to the business unit
- The numerator is the expected profit. This can be before or after tax and can include a interest at the risk-free rate on the economic capital
- It is sometimes also referred to as RORAC

Risk Adjusted Return on Capital (2)

What is RAROC ?

RAROC = Risk Adjusted Return / Risk Adjusted Capital or Economic Capital

Risk Adjusted Return:
Revenues
-Expenses
-Expected Losses
+ Return on economic capital
+ transfer values / prices

Risk Adjusted Capital or Economic Capital:
Capital required for
- Credit Risk
- Market Risk
- Operational Risk

The concept of RAROC (Risk adjusted Return on Capital) is at the heart of Integrated Risk Management.

Example: RAROC

- When lending in a certain region of the world an AA-rated bank estimates its average losses from defaults as 1% of outstanding loans per year
- The 99.97% worst case loss is 5% of outstanding loans
- Economic capital per $100 of loans is therefore $4
- The bank's spread between cost of funds and interest charged is 2.5% and administrative costs are 0.7%

$$RAROC = \frac{.0.025 \times 100 - 0.01 \times 100 - 0.007 \times 100}{4.0} = 20\%$$

If interest on the economic capital is included and the risk free rate is 2% this becomes

$$\frac{0.88}{4.0} = 22\%$$

Minimal Capital Requirement (Regulatory)

Basel II

=

Minimal Capital Requirement

Bible of Banks' Risk Management: Basel

Objectives of the Basel Capital accord ("Basel") are:

- To promote safety and soundness in the financial system
- To continue to enhance competitive equality
- To constitute a more comprehensive approach to addressing risks
- To render capital adequacy more risk-sensitive
- To provide incentives for banks to enhance their risk measurement capabilities

Where Do We Stand on Basel?

- 1974: Basel Committee on Banking Supervision was formed (in response to the liquidation of a Frankfurt bank Herstatt) under the auspices of the Bank of International Settlements (BIS) in Basel, Switzerland

- 1988: Basel Capital Accord ("Basel I") was initiated with primary focus on credit risk (Banks with international presence are required to hold capital equal to 8 % of the risk-weighted assets).

- 1992: Basel I was implemented by G-10 (now 13 members) and many other countries' central banks

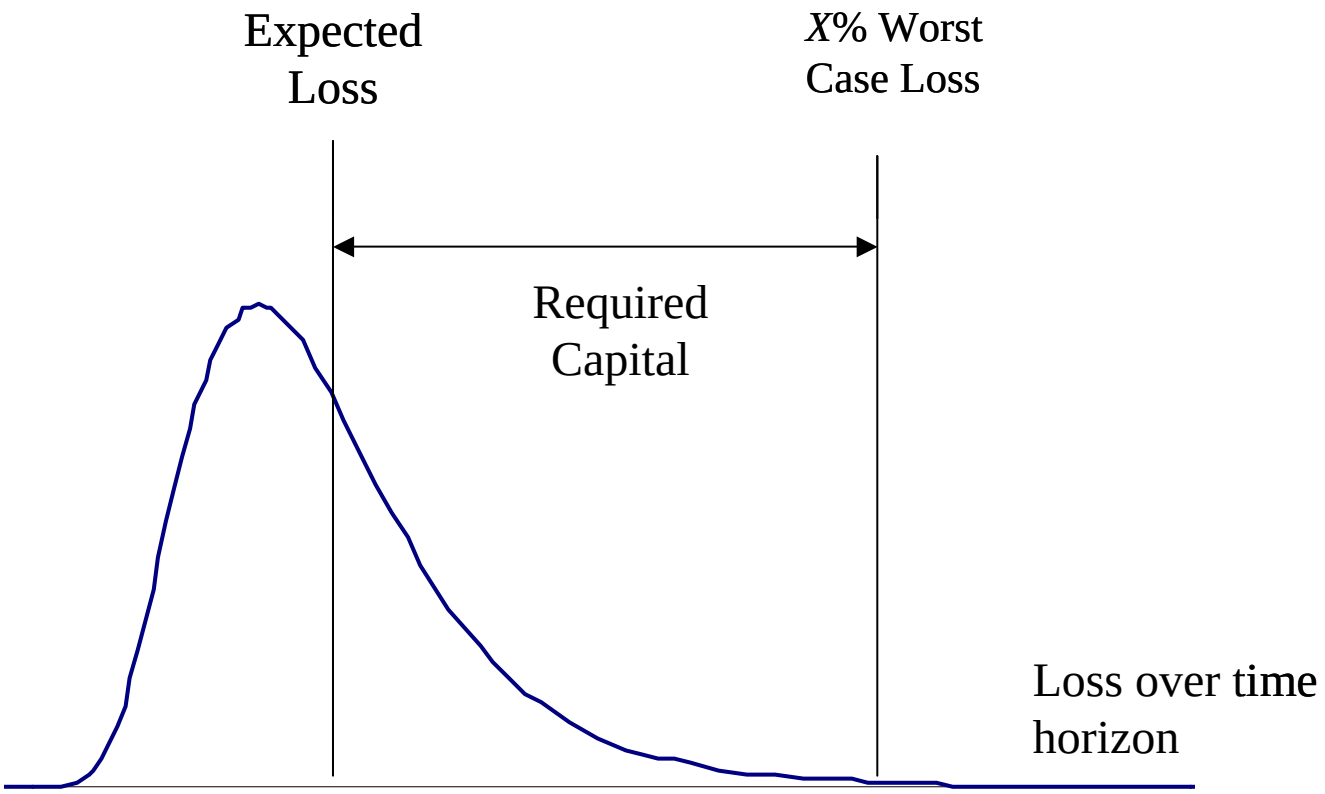
- 2004/06: Basel Committee on Banking Supervision endorsed Basel II framework

- 2007: Basel II has become effective for EU member states

- 2009: Basel II on target to become effective in USA

- Currently, most banks have parallel use of both Basel I & II and implementing Basel III.

Min. Requirement Capital of Basel in Nutshell



Pre-1988: Before Basel I

- Banks were regulated using balance sheet measures such as capital:assets
- Definitions and required ratios varied from country to country
- Enforcement of regulations varied from country to country
- Bank leverage increased in 1980s
- Off-balance sheet derivatives trading increased
- Third world debt was a major problem
- Basel Committee on Bank Supervision set up

1988: BIS Accord (Basel I)

- Assets:Capital must be less than 20. Assets includes off-balance sheet items that are direct credit substitutes such as letters of credit and guarantees
- Cooke Ratio: Capital must be 8% of risk weighted amount. At least 50% of capital must be Tier 1.

Types of Regulatory Capital under Basel

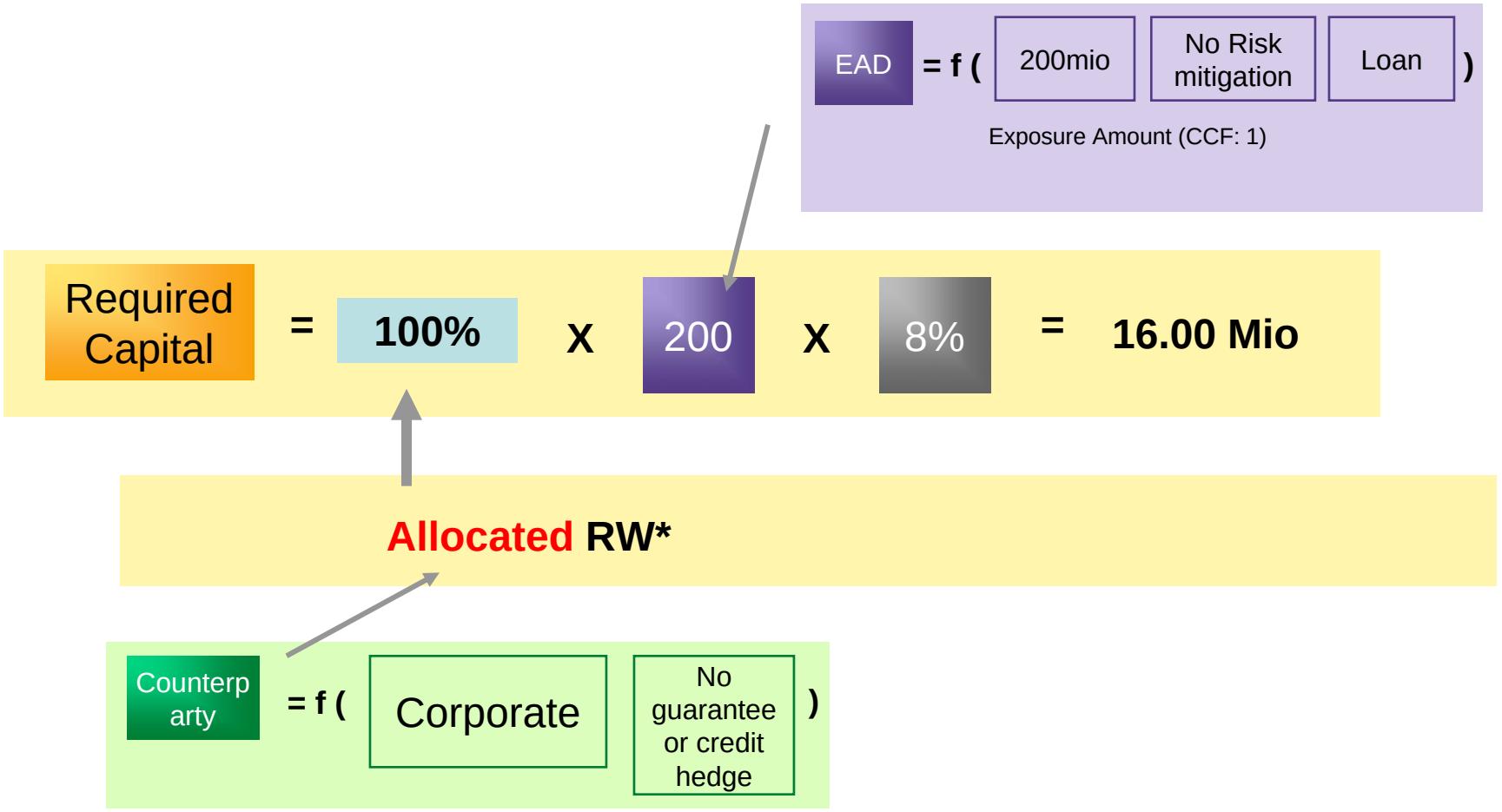
- Tier 1 Capital: common equity, non-cumulative perpetual preferred shares, minority interests in consolidated subsidiaries less goodwill
- Tier 2 Capital: cumulative preferred stock, certain types of 99-year debentures, subordinated debt with an original life of more than 5 years

Risk-Weighted Capital: Denominator of Cooke's Ratio

- A risk weight is applied to each on-balance- sheet asset according to its risk (e.g. 0% to cash and govt bonds; 20% to claims on OECD banks; 50% to residential mortgages; 100% to corporate loans, corporate bonds, etc.)
- For each off-balance-sheet item we first calculate a credit equivalent amount and then apply a risk weight
- Risk weighted amount (RWA) consists of
  - sum of risk weight times asset amount for on-balance sheet items
  - Sum of risk weight times credit equivalent amount for off-balance sheet items (derivatives & guarantees)

Standard Loan Capital Calculation, Basel I

Example: Banking book loan of 200 Mio (Exposure At Default – EAD) with a Corporate (Ext. Rating A-, Int. Rating C3) of 3 years Original Maturity and 2.5 years Residual Maturity, covered with a AAA Corporate Bond, Market Value 90 Mio.



* Riskweighting allocated based on Counterparty

Risk Weighted Assets: The Math

$$RWA = \sum_{i=1}^{N} w_i L_i + \sum_{j=1}^{M} w^*_j C_j$$

On-balance sheet items: principal times risk weight

Off-balance sheet items: credit equivalent amount times risk weight

For a derivative $C_j = \max(V_j,0)+a_jL_j$ where V_j is value, L_j is principal and a_j is add-on factor

1996 Basel Amendment

- Implemented in 1998
- Requires banks to measure and hold capital for market risk for all instruments in the trading book including those off balance sheet (This is in addition to the BIS Accord credit risk capital)

- Tier 3 capital = short-term subordinated debt with original maturity of at least two years (eligible to cover market risk)

Advent of Basel II

- Enhance competitive equality.
  - Abandon the one-size-fits-all approach of Basel I
- Ensure that capital allocation is more risk sensitive: Flexible framework, responsive to future developments in risk management practices.
- Recognize improvements in risk measurement
- Address financial innovations. Separating operational risk from credit risk, and quantifying both.
- Improve risk sensitivity of regulatory capital. Attempting to align economic and regulatory capital more closely to reduce the scope for regulatory arbitrage (take advantage of regulation differences across nations)

Basel Capital Accord II

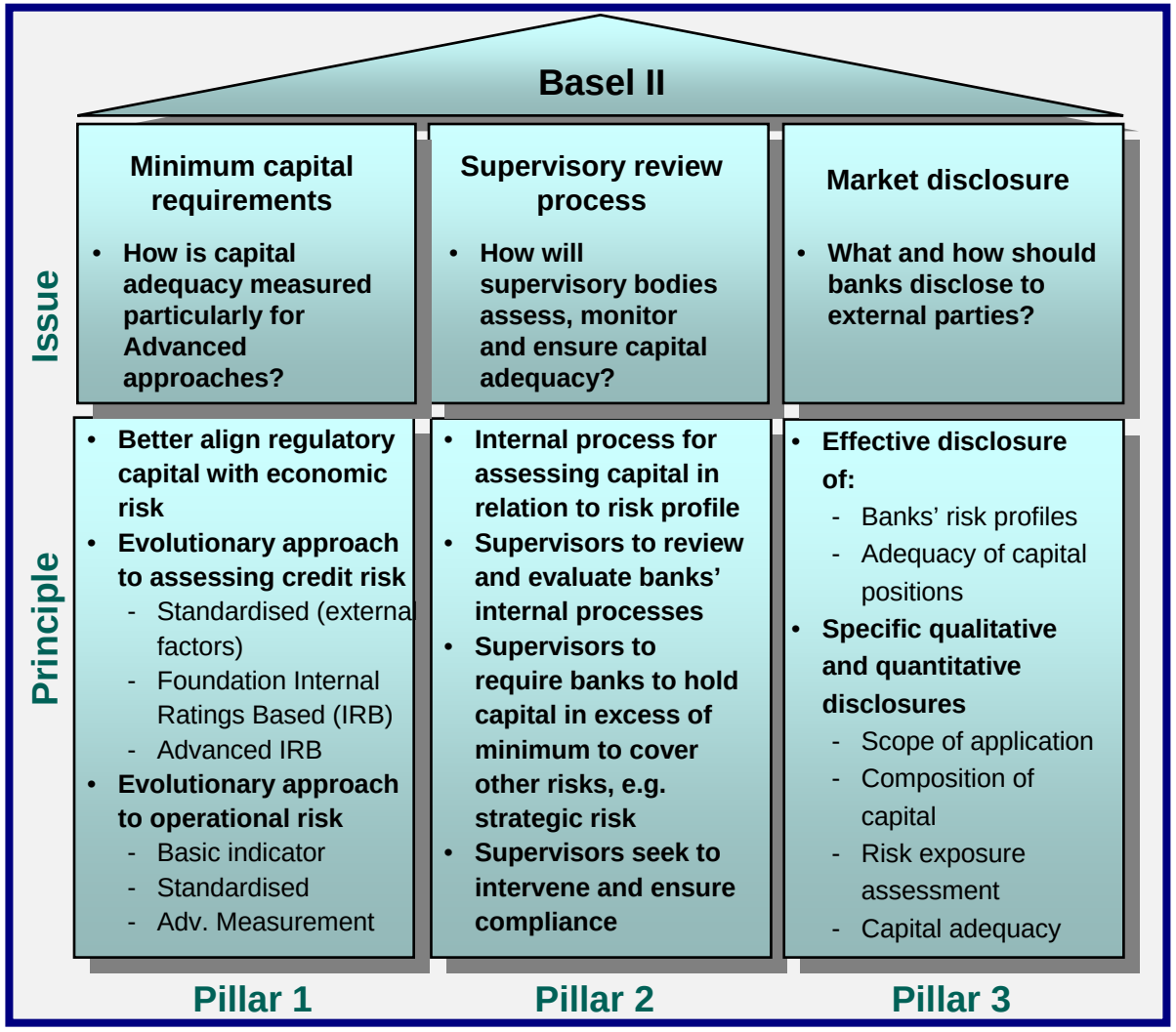
- Main purpose: to promote convergence of regulatory capital and economic capital
- Three pillars:
  - New minimum capital requirements for credit and operational risk
  - Supervisory review: more thorough and uniform
  - Market discipline: more disclosure
- Regulatory capital =
  credit risk capital requirement
  + market risk capital requirement
  + operational risk capital requirement
- In April 2003 the Committee issued a third consultative paper (CP3)
- New capital adequacy framework released by the end of June 2004
- Expected to be implemented in 2007

New Capital Requirements: Basel II

- Risk weights will be based on on either external credit rating (standardized approach) or a bank's own internal credit ratings (IRB approach)
  - Implementation of the standardized and foundation approaches to take effect in member countries by year-end 2006
  - Implementation of the advanced approach to take effect by year-end 2007
- Recognition of credit risk mitigants (CRMs)
- Separate capital charge for operational risk

Development of a revised capital adequacy framework
Components of Basel II

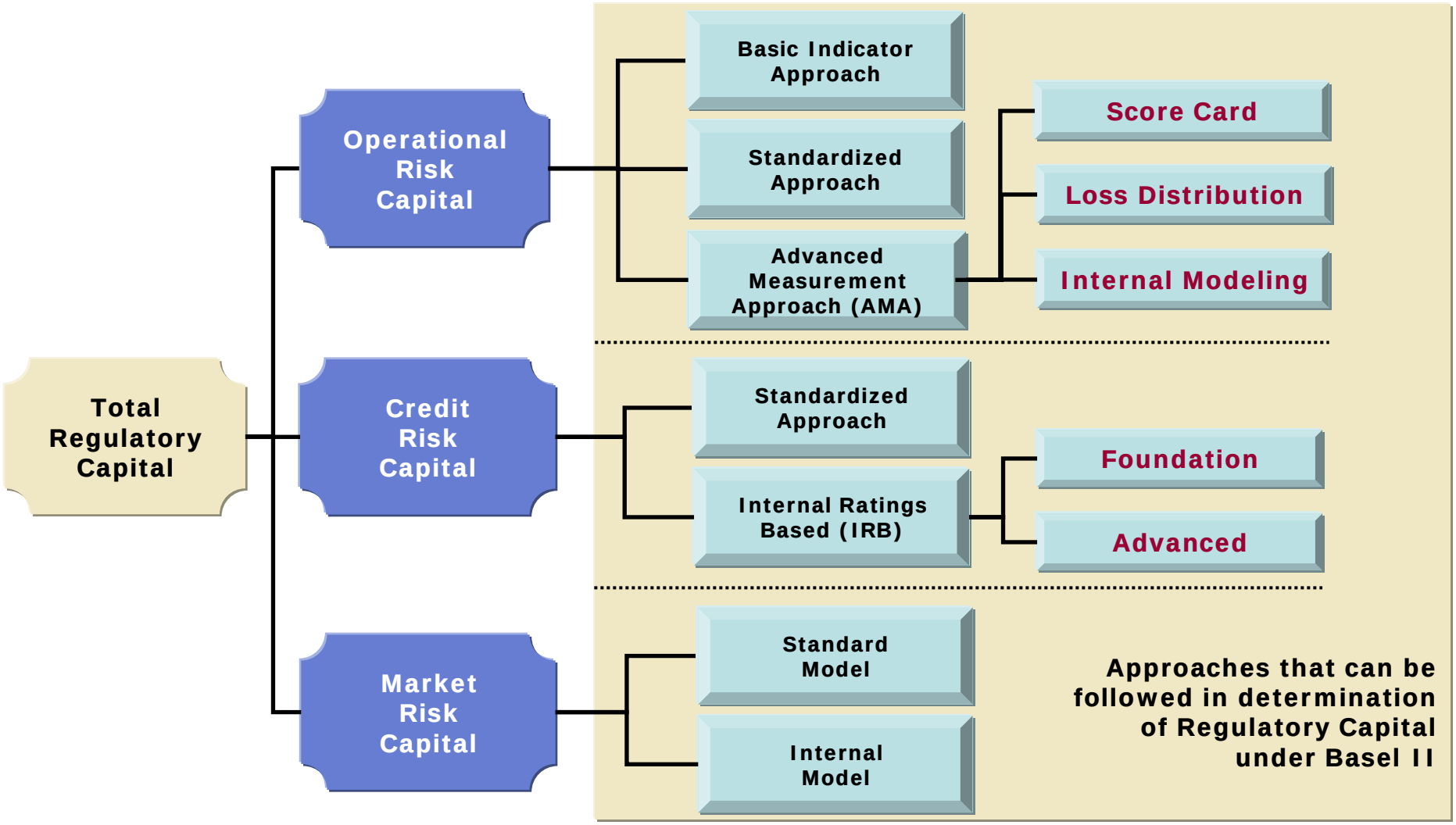
The three pillars of Basel II and their principles



Objectives

- Continue to promote safety and soundness in the banking system
- Ensure capital adequacy is sensitive to the level of risks borne by banks
- Constitute a more comprehensive approach to addressing risks
- Continue to enhance competitive equality

Overview of Basel II Approaches (Pillar I)



Basel II: Three Pillars

- Pillar 1 (minimum capital requirements): maintenance of regulatory capital calculated for three major components of risk that a bank faces
  - Credit risk: Standardized Approach, Foundation Internal Rating Based Approach (IRB) and Advanced IRB
  - Operational risk: Basic Approach, Standardized Approach, and Advanced Measurement Approach (AMA)
  - Market risk: VaR

- Pillar 2 (supervisory review): the regulatory response to the first pillar with many improved tools
  - Also provides a framework for dealing with residual risk including reputation risk, liquidity risk and legal risk

- Pillar 3 (market discipline): greatly increases the disclosures that the bank must make
  - Designed to allow the market to have a better picture of the overall risk position of the bank and to allow the counterparties of the bank to price and deal appropriately

Basel II: Pillar 1 – Min. Capital Requirement

$$\frac{\text{Eligible capital}}{\begin{array}{c}\textbf{ON-BALANCE-SHEET}\\ \textbf{CREDIT RISK}\\ +\\ \text{Off-balance-sheet credit risk}\\ +\\ \text{Market risk}\\ +\\ \textbf{OPERATIONAL RISK}\end{array}} = 8\%$$

Four out of six parameters basically unchanged

Basel II: Pillar 1

Three different regulatory approaches for credit risk under pillar I

New Basel Capital Accord for credit risk

Standardized Approach	Foundation Internal Ratings based Approach	Advanced Internal Ratings based Approach
standardized regulatory risk weights External Ratings	internal PD's and standardized regulatory EAD/LGDs	internal PD's, LGDs and EADs
accepted collateral: – residential real estate – financial collateral	accepted collateral: – residential and commercial real estate – financial collateral	all types of collateral are accepted as long as a bank can provide LGD estimates

Enhanced Risk Sensitivity of Basel II

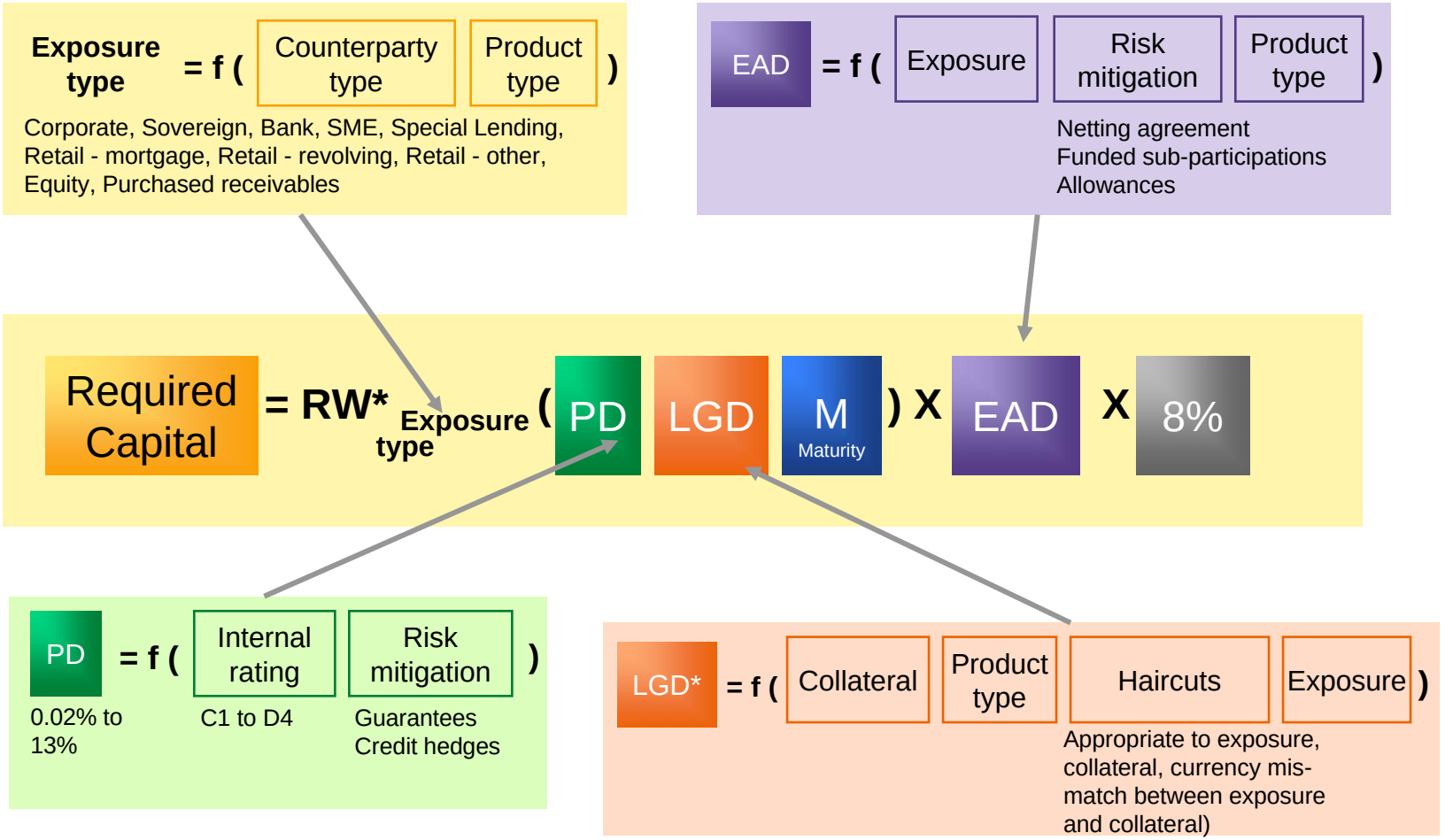
- BCBS (Basel Committee on Banking Supervision) major objective: more risk sensitivity
- Implies a judgment on risk
  - Basel I: judgment made by supervisors
  - Standardized Approach: judgment by third parties
  - IRB Approach: judgment by banks themselves
    - Foundation IRB (FIRB)
    - Advanced IRB (AIRB)
- Better risk management implies lower capital requirements

Increasing risk sensitivity

USA vs European Implementation

- In US Basel II will apply only to large international banks
- Small regional banks required to implement "Basel 1A'' (similar to Basel I), rather than Basel II
- European Union requires Basel II to be implemented by securities companies as well as banks

Inputs for Credit Risk Calculation



* Formula for risk weighting is derived from statistical distribution for a standard normal random variable.

New Capital Requirements
Standardized Approach – Risk Weights

Claim		Assessment					
		AAA - AA-	**A+ - A-**	**BBB+ - BBB-**	**BB+ - B-**	**Below B-**	**Unrated**
Sovereigns (Export credit agencies)		**0%** (1)	20% (2)	50% (3)	100% (4-6)	150% (7)	100%
Banks	**Option 1**[1]	**20%**	50%	100%	100%	150%	100%
	Option 2[2]	20% (20%)[3]	50% (20%)[3]	50% (20%)[3]	100% (50%)[3]	150% (150%)[3]	50% (20%)[3]
Corporates		20%	50%	100%	**BB+ - BB-** 100%	**Below BB-** 150%	100%
Retail	**Mortgages**						35%
	Other retail						75%

1 Risk weighting based on risk weights of sovereign in which the bank is incorporated, but one category less favourable.

2 Risk weighting based on the assessment of the individual bank.

3 Claims on banks of an original maturity of less than three months generally receive a weighting that is one category more favourable than the usual risk weight on the bank's claim.

Main Changes from Basel I

- Risk weights more sensitive to inherent riskiness
- Based on external credit assessment institutions (ECAIs)
- Introduction of 150% category
- 20% credit conversion factor (CCF) for short-term commitments
- 0% risk weight for certain multilateral development banks
- Preferential treatment for short-term claims on banks in local currency
- Recognition of export credit agencies (ECAs) proposed
- 50% risk weight for A-rated claims on corporates

New Capital Requirements
IRB Approach for corporate, banks and sovereign exposures

- Basel II provides a formula for translating PD (probability of default), LGD (loss given default), EAD (exposure at default), and M (effective maturity) into a risk weight
- Under the Advanced IRB approach banks estimate PD, LGD, EAD, and M
- Under the Foundation IRB approach banks estimate only PD and the Basel II guidelines determine the other variables for the formula

Foundation IRB Approach

- PD is based on the bank's own estimate, a conservative view of long-run average PD for the grade in question.
  - PD = max(internal 1-year PD, 0.03%) for corporate/bank exposures
- EAD = usually notional value; for undrawn loan commitment, it is the expected drawdown (= 75%)
- LGD = 45% for senior unsecured, 75% for subordinated claims on corporates, sovereigns and banks; LGD can be reduced using collaterals.
- Path to the AIRB approach: gradual migration to use internal estimates for the risk components

Advanced IRB Method and Maturity

- Maturity plays a role in the determination of capital under the advanced IRB method
- Benchmark maturity for the foundation IRB approach is 2.5 years
- A shorter maturity will reduce the capital requirement under the advanced IRB method
- Under the AIRB approach,

  M = max(1 year, remaining effective maturity)

  where M is the effective maturity