

- 1 Credit risk models to fulfill regulatory requirements and prevent the bank from failure
- 2 Reevaluating the profitability of activities taking credit risk into account

Objectives of the lecture

Teaching objectives

At the end of this lecture, you will:

- ▶ Understand the role and differences of **provisions and capital requirements** for banks;
- ▶ Know the **model-origin of the credit risk capital requirements** in details;
- ▶ Have a clear view of the **different profitability indicators** of business lines, their limits and how to appreciate them with regards to other indicators.

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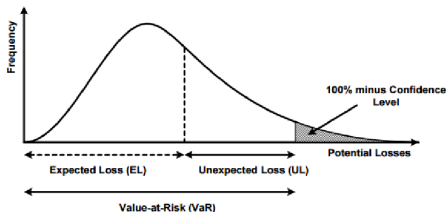
- 1 Credit risk models to fulfill regulatory requirements and prevent the bank from failure
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Expected and Unexpected

The loss distribution of a bank is often split in two parts: the expected loss, from 0 to the average loss, and the unexpected loss above the average up to a percentile

Expected Loss and Unexpected Loss

- ▶ **Expected Loss (EL)**: the average loss, that is the normal cost of doing business covered by provisioning and pricing policies;
- ▶ **Unexpected Loss (UL)**: potential unexpected loss for which capital should be held.



Provisions

Provisions are required by accounting rules and are designed to cover expected losses (the ECL: Expected Credit Loss)

- ▶ **IASB**: International Accounting Standards Board;
- ▶ a liability on **incurred losses** (on **Non Performing Loans**, NPL);
- ▶ that is **estimated**;
- ▶ and **adjusted** when closing the case.

IFRS9 – New provisioning rules

- ▶ A **non procyclical** rule for provisioning;
- ▶ A **forward looking, Point-In-Time**, provisions on all the loans (**IFRS 9**).

▶ Website

Basel Accords 1 (1988)

Capital must be set aside to cover unexpected losses since Basel Accords 1 in 1988

Basel Accords 1 (1988)

- ▶ **Basel Committee on Banking Supervision (BCBS)** – 27 countries;
- ▶ **Cook ratio** is a **standard** and simple computation of regulatory capital:
 - on the **banking book**:

$$\text{Regulatory Capital} = 8\% \times \text{Weights by counterparty type} \times \text{EAD}$$

- on the **trading book** (since 1996) too.

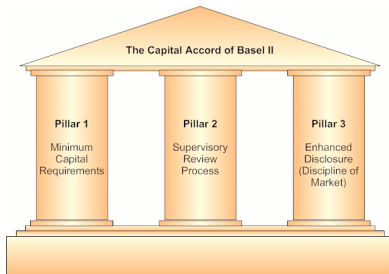
Weights depended on the **nature** of the counterparty: Sovereign OECD : 0 %; Bank OECD: 20 %; Mortgages: 50 %; Other: 100 %.

Basel Accords 2 (2006)

Basel Accords 2 were designed to increase the readability for a supervisor of banks activities and risks (i.e. better alignment between risk and capital levels)

Basel Accords 2 (2006)

- ▶ **Pillar 1:** Minimal Capital Requirements: capital for credit + market + operational risk;
- ▶ **Pillar 2:** Supervisory Review Process;
- ▶ **Pillar 3:** Enhanced Disclosure.

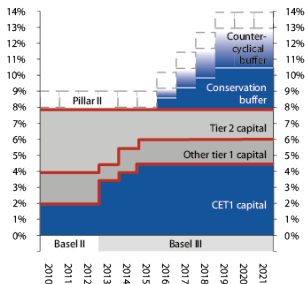


Basel Accords 3 (2014-2019)

Basel Accords 3 is more refined as for capital definitions and is more macro-prudential as it requires liquidity and funding requirements and treats differently systemic banks

Basel Accords 3 (2014-2019)

- ▶ **Liquidity Ratios:** Liquidity Coverage Ration (**LCR**) and Net Stable Funding Ratio (**NSFR**);
- ▶ **Leverage Ratio** (3 %);
- ▶ New definitions of **capital**.



The Standard Approach for Credit risk

The regulator lets banks with several options to fulfill capital requirements: from a standard model-free approach, to more complex internal models approaches

Rating	> AA-	> A-	> BBB-	> BB-	> B-	< B-	NR
Sovereign	0%	20%	50%	100%	100%	150%	100%
Banks	20%	50%	100%	100%	100%	150%	100%
Corporates	20%	20%	100%	100%	150%	150%	100%

Weighted Assets

$$RWA = \text{Weights} \times \text{EAD}$$

Not just based on the **nature** of the counterparty but on its **rating** too.

The Internal Rating Based – IRB

Credit RWA, even with more advanced approaches, rely upon a regulatory model, and the banks only have PD, LGD, and EAD at their hands

The Internal Rating-Based Approach

- ▶ IRB **Fondation**: modeling of PD only;
- ▶ IRB **Advanced**: modeling of PD, LGD and EAD.

$$RWA = f_{\text{regulatory}}(\text{PD}, \text{LGD}, \text{EAD})$$

IRB Approach – The formula

The IRB Approach estimates the unexpected loss on a portfolio of loans thanks to a modified version of the Vasicek model

IRB Approach – The formula

Under the IRB Approach, the **Risk-Weighted Assets** are:

$$RWA = LGD \times \left(\Phi \left(\frac{\Phi^{-1}(PD) + \sqrt{\rho} \Phi^{-1}(0.999)}{\sqrt{1-\rho}} \right) - PD \right) \times MA \times SF \times MCR \times EAD$$

- ▶ The Maturity Adjustment, $MA = \frac{1+(M-2.5) \times b}{1-1.5 \times b}$ with $b = (0.11852 - 0.05478 \times \log(PD))^2$;
- ▶ The Scaling Factor, $SF = 1.06$;
- ▶ The Minimal Capital Requirements, $MCR = 12.5$.

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IRB Approach – The correlation parameter

The correlation parameter

The **correlation parameter** depends on the type of the counterparty:

Type	Value for ρ
Large Corporates Institutions	$0.24 - 0.12 \times \frac{1 - e^{-50 \times PD}}{1 - e^{-50}}$
SME with turn over <5 MEUR	$0.20 - 0.12 \times \frac{1 - e^{-50 \times PD}}{1 - e^{-50}}$
SME	$0.24 - 0.12 \times \frac{1 - e^{-50 \times PD}}{1 - e^{-50}} - 0.04 \times \left(1 - \frac{T-5}{45}\right)$
Residential Mortgages	0.15
Revolving	0.04
Other retail exposure	$0.16 - 0.13 \times \frac{1 - e^{-35 \times PD}}{1 - e^{-35}}$

In the tutorial, we will study in details this formula and its relationship with the Vasicek model.

► Website

► Tutorial

Economic capital and stress testing

As regulatory capital is arbitrary, banks also calculate an economic capital to develop a complementary understanding of their resilience

Economic Capital

- ▶ Regulatory capital does not take into account **correlation risk**, **concentration risk** and has other limits;
- ▶ Thus, banks have their **own internal models to steer their activity**.

They can compute a so-called **economic capital**.

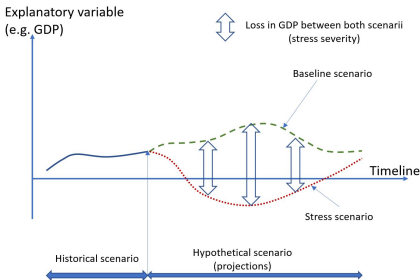
Economic capital – as a adverse risk measure – is however often replaced by stress tests.

Economic capital and stress testing

The objective of stress testing is to forecast the financial and solvability trajectory of the bank along two scenarios: a baseline scenario and a stressed scenario. They can either be on the whole bank (global stress test) or on sub-perimeters or specific risk factors.

Stress testing

- ▶ Global stress tests aims at ensuring that the minimal capital requirement and/or financial KPI are respected even during a **remote crisis scenario**. There are also required by regulators (e.g. EBA);
- ▶ **The dependence between the different risks is taken into account through the design of the scenario.**



Conclusion

Credit risk models to fulfill regulatory requirements and prevent banks failures

- ▶ **Provisions** are **accounting requirements** that aims at covering **expected losses** of the bank;
- ▶ **Capital requirements** are buffers designed to prevent banks from failure in case of **unexpected losses**;
- ▶ **Basel Accords** are at the origin of the current capital requirements framework and are based, for the most advanced approach, on the **Vasicek model**.

▶ Quiz

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 - ▶ Reevaluating activities' rentability taking credit risk into account

Return On Equity – ROE

The ROE is a basic profitability indicator, that fail to grasp specificities of the banking sector

Return On Equity – ROE

The **Return On Equity** of a Business Line is:

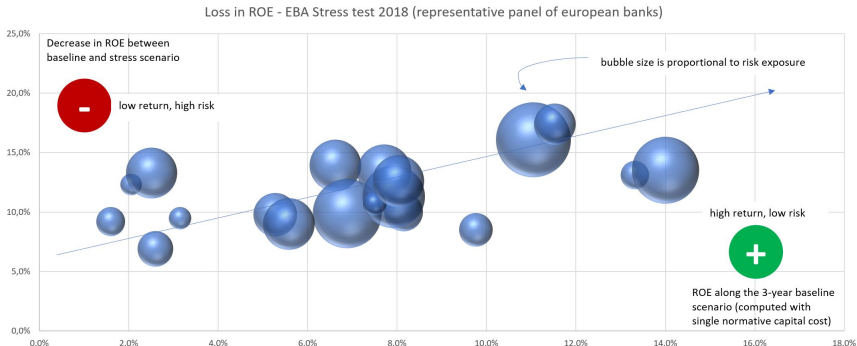
$$\text{ROE} = \frac{\text{Net Income of the BL}}{\text{Regulatory Capital allocated to the BL}}$$

ROE's limits

- ▶ **In the numerator:** does **not** take into account the **expected future risks**;
- ▶ **In the denominator:** does not take into account the **diversification effect** of the BL and suffers from **arbitrary and discretionary regulation choices**.

Return On Equity – ROE

Comparing the ROE sensitivity of major European banks to a stressed scenario: the example of EBA stress tests. Depending on their business mix and risk exposures, European banks' ROE react very differently to a stressed scenario



EBA Website (2018 Stress tests results) and own simplified computations

Risk Adjusted Return On Capital – RAROC

As RAROC accounts for future risks, it can be more appropriate in the banking sector

Risk Adjusted Return On Capital – RAROC

The **Risk Adjusted Return On Capital** of a Business Line is:

$$\text{RAROC} = \frac{\text{Net Income of the BL} - \text{Average expected loss of the BL}}{\text{Economic Capital allocated to the BL}}$$

RAROC's limits

What should it be compared to?

Hurdle rate and Weighted Average Cost of Capital – WACC

Profitability indicators can be compared to WACC as it is the hurdle rate of a business

Weighted Average Cost of Capital – WACC

The **Weighted Average Cost of Capital** is:

$$WACC = (r + k_1)T_1 + (r + k_2)T_2 + (r + k_d)D$$

where, T_1/r_1 , T_2/r_2 and D/r_D is the proportion / the cost (spread) of Tier 1 capital, Tier 2 Capital and debt in the liabilities of the bank and r the risk free rate.

Hurdle rate and WACC

The WACC is the **hurdle rate**, that is, the minimum return necessary to be profitable.

Economic Value Added – EVA

EVA offers an opportunity to measure profitability in absolute terms

Economic Value Added – EVA

The **Economic Value Added** for a bank is:

$$\begin{aligned} \text{EVA} = & \text{Net Income of the bank} - \text{Average expected loss of the bank} \\ & - \text{WACC} \times \text{Liabilities} \end{aligned}$$

Economic Value Added 2 – EVA 2

The **Economic Value Added 2** for a bank is:

$$\begin{aligned} \text{EVA 2} = & \text{Net Income of the bank} - \text{Average expected loss of the bank} \\ & - k \times \text{Economic Capital} \end{aligned}$$

where k is the cost of capital, that is: $k = (r + k_1)T_1 + (r + k_2)T_2$.

Risk Adjusted Return On Risk Adjusted Capital – RARORAC

To be tractable, these profitability measures require to know the cost of capital of the bank: CAPM is an option to estimate that cost

Risk Adjusted Return On Risk Adjusted Capital – RARORAC

The **Risk Adjusted Return On Risk Adjusted Capital** for a bank is:

$$\text{RARORAC} = \text{RAROC} - k$$

Risk Adjusted Return On Risk Adjusted Capital 2 – RARORAC 2

The **Risk Adjusted Return On Risk Adjusted Capital 2** for a bank is:

$$\text{RARORAC 2} = \text{RAROC} - k \times \frac{\text{Allocated Economic Capital}}{\text{Used Economic Capital}}$$

► Notebook

► Tutorial

How to make from the theoretical Cost of capital k , a practical tool?

- How to estimate k , the cost of capital?
- Can we use a unique k for all the business lines?

How to estimate the cost of capital?

Cost of capital of the bank using the CAPM

CAPM and the cost of capital

The **Capital Asset Pricing Model** [Sharpe, 1964], states that the shareholder's expected return for the firm i ($k = \mathbb{E}(r_i)$) is equal to the risk free rate, plus a market premium multiplied by a factor, β_i :

$$k = \mathbb{E}(r_i) = r_f + \beta_i \times \underbrace{(\mathbb{E}(r_M) - r_f)}_{\text{Market premium}}$$

where $\beta_i = \rho_{i,M} \frac{\sigma_i}{\sigma_M}$, $\rho_{i,M}$ being the correlation between the share of the firm i and the market (M), σ_i and σ_M being the volatility of the share of i and the market, r_f being the risk free rate.

How to estimate the cost of capital using CAPM?

Estimated β on the markets by [Matten, 1996]

Universal Bank	0.97
Investment Banks	1.16
Asset Management	1.21
Retail Bank	1.09
Banking Sector	1.11

The cost of capital for banks seems to have declined over the last decades

According to [King, 2009], the cost of capital for banks has declined due (i) the decrease in risk-free rates over this period, and (ii) a decline in the sensitivity of bank stock returns to market risk (the CAPM beta) in all countries except Japan.

How to estimate the cost of capital ?

Gordon-Shapiro formula is an alternative to measure the cost of capital

Gordon-Shapiro formula and the cost of capital

The **Gordon-Shapiro equation**, [Gordon, 1959], states that the market capitalization of a firm, P , is equal to the sum of the expected future dividends:

$$P = \sum_{t=1}^{\infty} \frac{D_t}{(1+k)^t} = \sum_{t=1}^{\infty} \frac{D_1(1+g)^t}{(1+k)^t} = \frac{D_1}{k-g}$$

where D_t is the expected dividend distributed in year t by the firm, k is the cost of capital (the discount rate adequate given the risk born by the shareholder) and g is the expected annual dividend growth rate.

Limits of Gordon-Shapiro method?

The estimation of k , the cost of capital, using the Gordon-Shapiro equation is often considered too **volatile** as the equity market and the market capitalization of individual firms.

Conclusion

Reevaluating activities' rentability taking credit risk into account

- ▶ The basic **Return On Equity (ROE)** profitability indicator **lacks to grasp future credit risk** in its appreciation of value creation;
- ▶ **RAROC and RARORAC** thus offer a more **refined** profitability appreciation;
- ▶ These profitability indicators can be compared to the **cost of capital** and the **Weighted Average Cost of Capital (WACC)** which values can be extracted from markets valuations;
- ▶ Alternatively, ROE can be compared between a **baseline and stressed scenarios**.

▶ Quiz

Conclusion

Risk modeling and Bank Steering

- ▶ Given their sizes and their risks, **banks are required to set aside provisions and capital** to face expected and unexpected losses;
- ▶ **These potential losses and these requirements** must be taken into account to assess **the profitability of business lines**.

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