



An Introduction to Interest Rate Risk Management

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Agenda

- 1 Background
- 2 Types of Interest Rate Risk
- 3 Measuring Interest Rate Risk
- 4 Additional Topics
- 5 Key Takeaways
- 6 Q&A

1. Background



What is Interest Rate Risk?

Basic Definitions

Interest Rate Risk (in short, IR Risk) is the current or prospective risk that adverse movements in the market interest rates may affect a financial institution's **value, capital** or **earnings**.

When interest rates change, the present value, as well as the timing and the level, of future cash flows change.

This in turn changes the underlying value of a financial institution's assets, liabilities and off-balance sheet items and hence its (net) **Economic Value** (in short, **EV**).

Changes in interest rates also affect a financial institution's earnings by altering its interest rate-sensitive income and expenses, thus affecting its **Net Interest Income** (in short, **NII**).

It is an important risk that arises from normal banking activities, and is encountered by all banks, therefore the management of interest rate risk is **critical to the stability of banking corporations**.

Why Interest Rate Risk matters?

The Savings and Loans crisis (1986-1995) and the current low-interest rate environment

- The **Savings and Loans** (in short, S&Ls) **crisis** is a long-lasting financial crisis, occurred in the US in the 1980s, that was mainly caused by **unmanaged interest rate risk**:
 - S&L Associations were specialized small banks, whose core business was to accept retail deposits and to make residential mortgages to their members.
 - The S&Ls balance sheet was particularly vulnerable to increases in interest rates, given their business based on fixed-rate mortgages as assets, coupled with deposits with short maturities for their funding.
 - As interest rates began to rise in the late 1970s, the rates that S&Ls had to pay to attract deposits rose sharply, but the amount earned on long-term fixed-rate mortgages didn't change; they began to suffer extensive losses.
 - From 1986 to 1995, the number of active S&Ls in the United States fell dramatically; the ultimate cost of the crisis to taxpayers (as S&Ls were insured by the Federal Reserve) was estimated to be about \$124 billion.
- In recent times, Interest Rate Risk has become again a concern to banks, as the current **low-interest rate environment** causes a shrink in banks' traditional intermediation margins, hence **reducing their earnings**.

How is Interest Rate Risk managed?

Main references from banking regulation



2016 – Standards on interest rate risk in the banking book

Measurement of Interest Rate Risk should be based on outcomes of both **economic value** and **earnings**-based measures, arising from a wide and appropriate range of interest rate shock and stress scenarios.



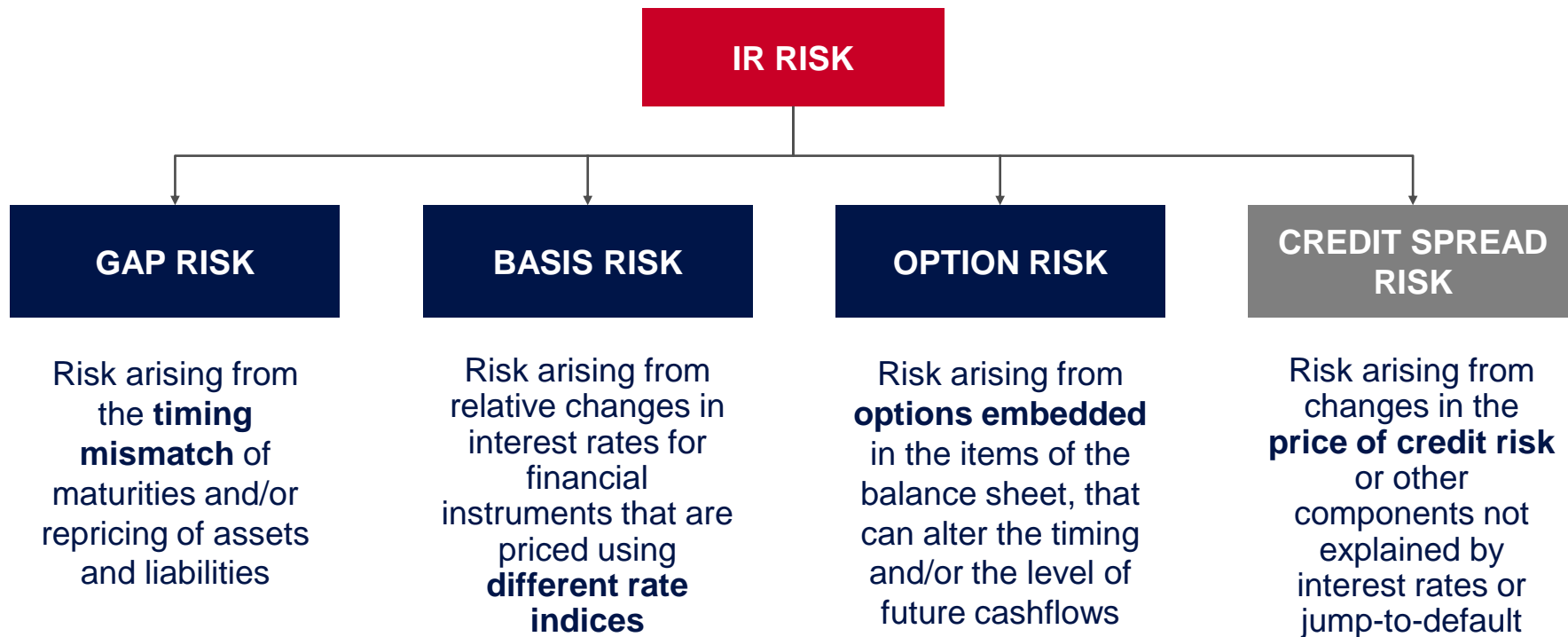
2018 – Guidelines on the management of interest rate risk arising from non-trading activities

Institutions should measure their exposure to Interest Rate Risk in terms of potential changes to both the **economic value (EV)** and **earnings**. Institutions should use complementary features of both approaches to capture the complex nature of IRRBB over the short-term and long-term time horizons.

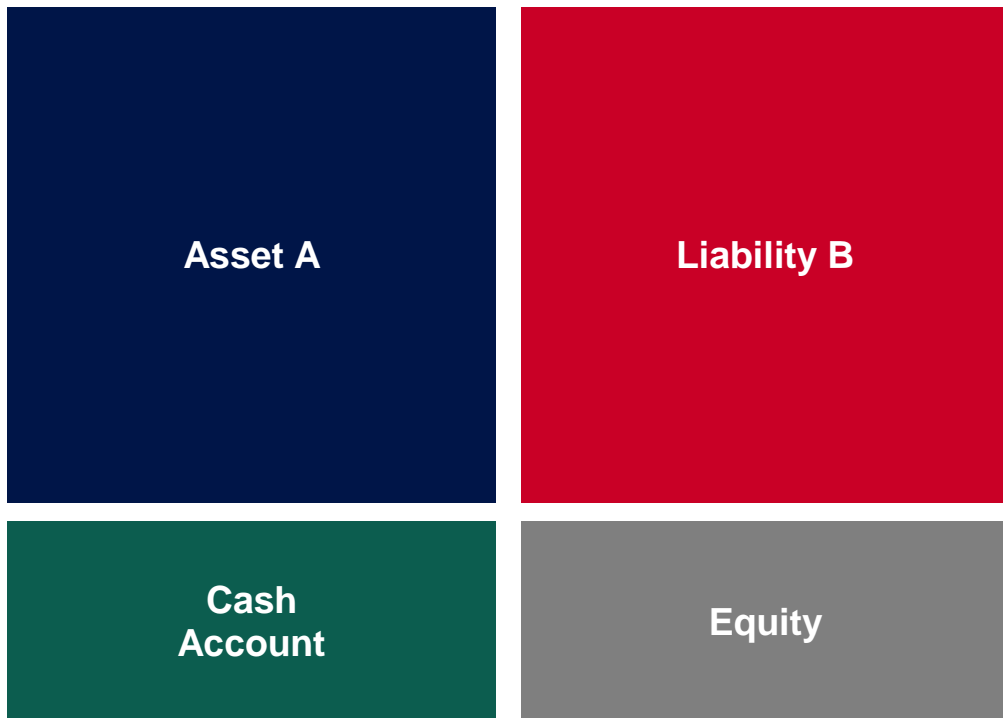
2. Types of Interest Rate Risk



Types of Interest Rate Risk



A (very) simple bank model



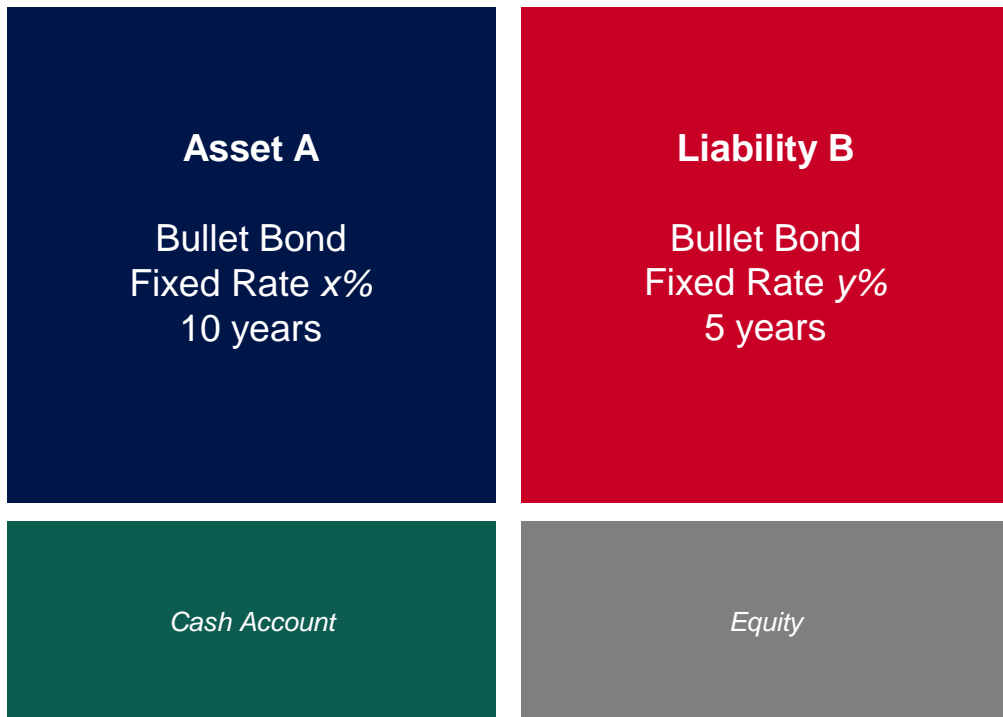
A **simplified bank model** is used in order to explain the various occurrences of Interest Rate Risk.

This bank's balance sheet is made of:

- a cash account (*reserves*)
- one interest-sensitive Liability (B): *the bank borrows money at some rate $y\%$*
- one interest-sensitive Asset (A) of the same amount: *the banks lends money at some rate $x\% > y\%$*

Gap Risk: Example 1

Fixed Rate Balance Sheet



For the first 5 years:

- $x\% > y\%$ → **Positive NII** 😊

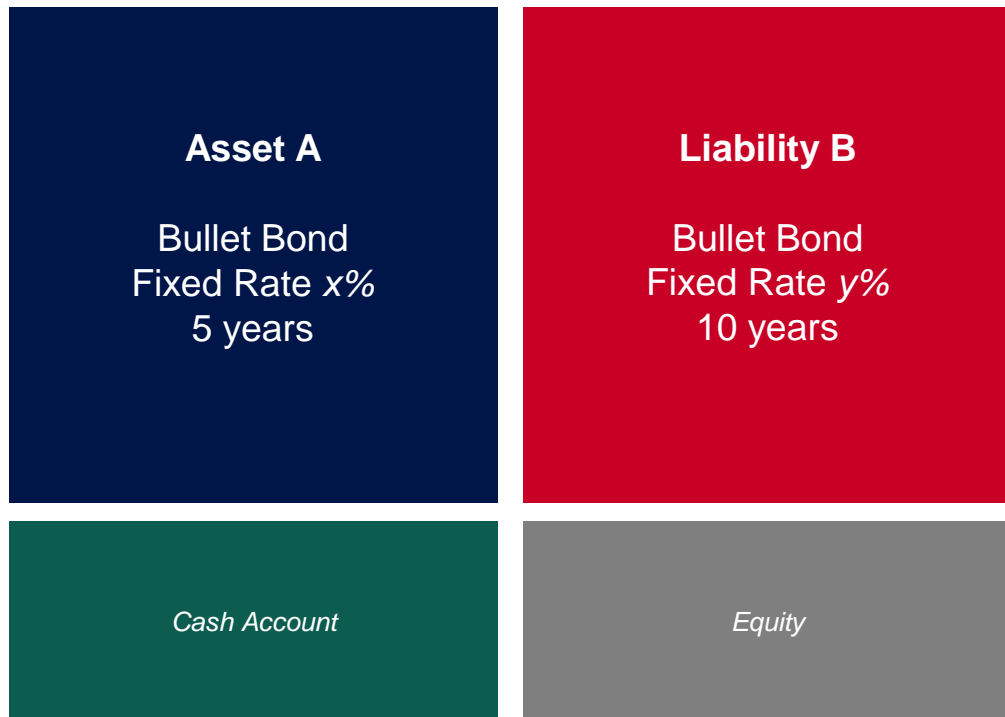
After 5 years:

- Liability B expires
- the bank has to refinance itself for other 5 years at fixed market rate $z\%$ (new Liability C)
- if $z\% < x\%$ → **Positive NII** 😊
- if $z\% \geq x\%$ → **Negative NII** 😞 ?

Gap Risk

Gap Risk: Example 2

Fixed Rate Balance Sheet



For the first 5 years:

- $x\% > y\%$ → **Positive NII** 😊

After 5 years:

- Asset A expires
- the bank has to reinvest money for other 5 years at fixed market rate $z\%$ (new Asset D)
- if $z\% > y\%$ → **Positive NII** 😊
- if $z\% \leq y\%$ → **Negative NII** 😞 ?

Gap Risk

No Gap Risk: Example 3

Fixed Rate Balance Sheet

Asset A

Bullet Bond
Fixed Rate $x\%$
10 years

Liability B

Bullet Bond
Fixed Rate $y\%$
10 years

Cash Account

Equity

For all the 10 years:

- $x\% > y\%$ → **Positive NII**
- **Positive EV**

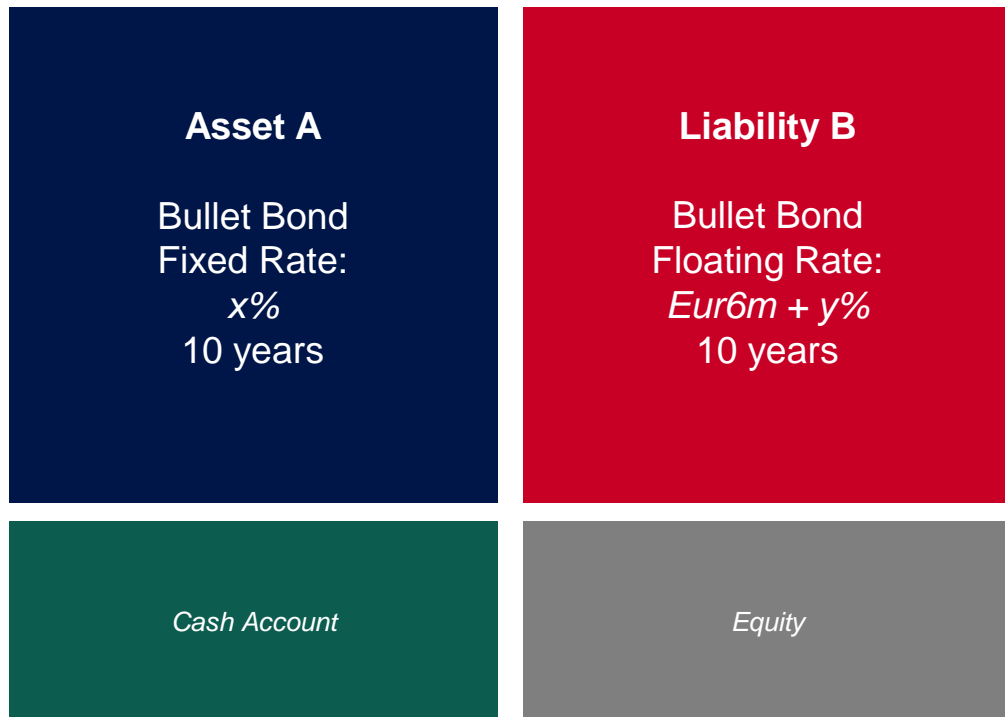


This is a desirable configuration of the balance sheet from the IR Risk point of view:

- **lengths** of assets and liabilities **match**
- **earnings** are **pre-determined**
- the **net economic value** of the balance sheet is always **positive**

Gap Risk: Example 4

Mixed Rate Balance Sheet



Probably at inception:

- $x\% > Eur6m + y\% \rightarrow$ Positive NII

But, every 6 months, this balance sheet is exposed to fluctuations of market interest rates (e.g. *Eur6m*).

This is **equivalent** to a fixed rate balance sheet with a 10-year asset and a 6-month liability (e.g. see Example 1)

Gap Risk

Basis Risk: Example 5

Floating Rate Balance Sheet

<p>Asset A</p> <p>Bullet Bond Floating Rate: <i>Eur6m + x%</i> 10 years</p>	<p>Liability B</p> <p>Bullet Bond Floating Rate: <i>Eur3m + y%</i> 10 years</p>
<p><i>Cash Account</i></p>	<p><i>Equity</i></p>

As length of asset and liability match and $x\% > y\%$, this may look like the case with no gap risk (Example 3).

However:

- the market indices *Eur3m* and *Eur6m* refix periodically and may diverge
- **positive earnings are not guaranteed**
- **positive net economic value is not guaranteed**

Basis Risk

Option Risk: Example 6

Automatic Option Risk

Asset A

Bullet Bond
Floating Rate:
 $Eur6m + x\%$
10 years

CLAUSE: Cap at $z\%$

Liability B

Bullet Bond
Floating Rate:
 $Eur6m + y\%$
10 years

CLAUSE: Floor at 0%

Cash Account

Equity

Since $x\% > y\%$, one may expect that earnings are positive and fixed.

However:

- if rates go up in a way such that $Eur6m + x\% \geq z\%$, Asset A pays $z\%$ (the Cap option activates) and net earnings decrease
- if rates go down in a way such that $Eur6m + y\% \leq 0\%$, Liability B pays 0% and –again- net earnings decrease

Automatic Option Risk

Option Risk: Example 7

Behavioural Option Risk

Asset A

Bullet Loan
Fixed Rate: $x\%$
10 years

CLAUSE: Prepayment in
favour of the borrower

Liability B

Bullet Bond
Fixed Rate: $y\%$
10 years

CLAUSE: Prepayment in
favour of the lender

Cash Account

Equity

The balance sheet here seems totally matched, not considering the embedded prepayment clauses.

If -at some point in time- the borrower of Asset A or the lender of Liability B exercise their prepayment clauses, the balance sheet remains unmatched and the bank has to reinvest or refinance at new market rates.

Behavioural Option Risk

Check-Point

A balance sheet is made of a **fixed rate 10 year asset** paying $x\%$ and a **non maturing liability** paying a fixed rate $y\% < x\%$.

Which types of interest rate risk is the bank facing?

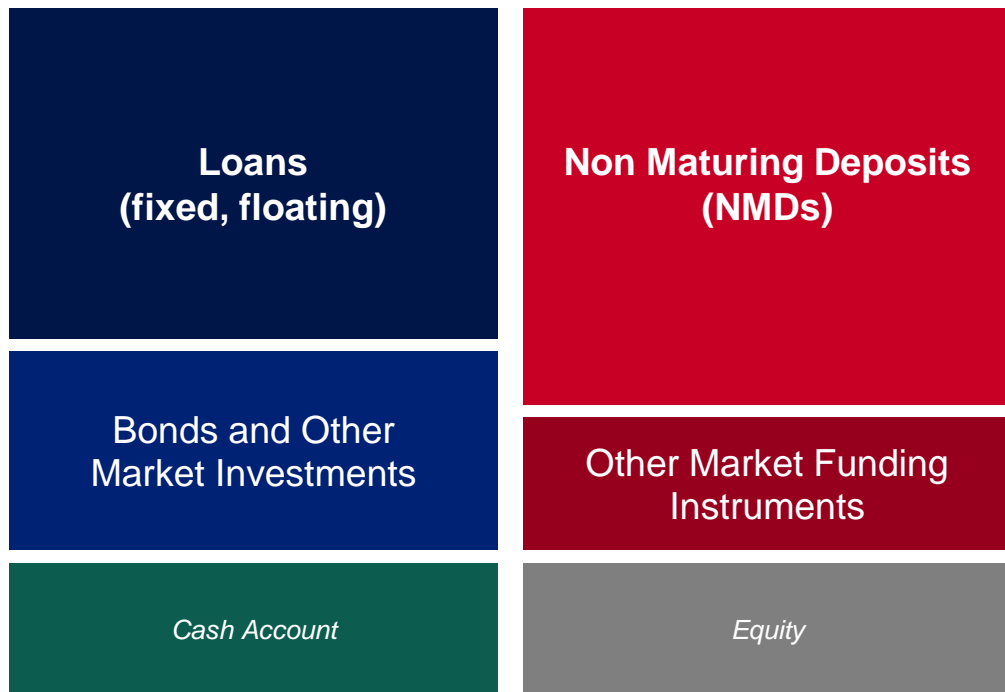
Check-Point

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Which types of interest rate risk is the bank facing?

Gap Risk + (Behavioural) Option Risk

A typical bank's balance sheet



Given its typical feature of maturity transformation, a bank's balance sheet naturally faces IR Risk in its various forms. For example:

- **Loans:** Gap Risk, Basis Risk, Automatic Option Risk (caps/floors), Behavioural Option Risk (prepayment)
- **Non Maturing Deposits:** Gap Risk, Option Risk

Treatment of NMDs is crucial in managing IR Risk

3. Measuring Interest Rate Risk

Interest Rate Risk: two different perspectives

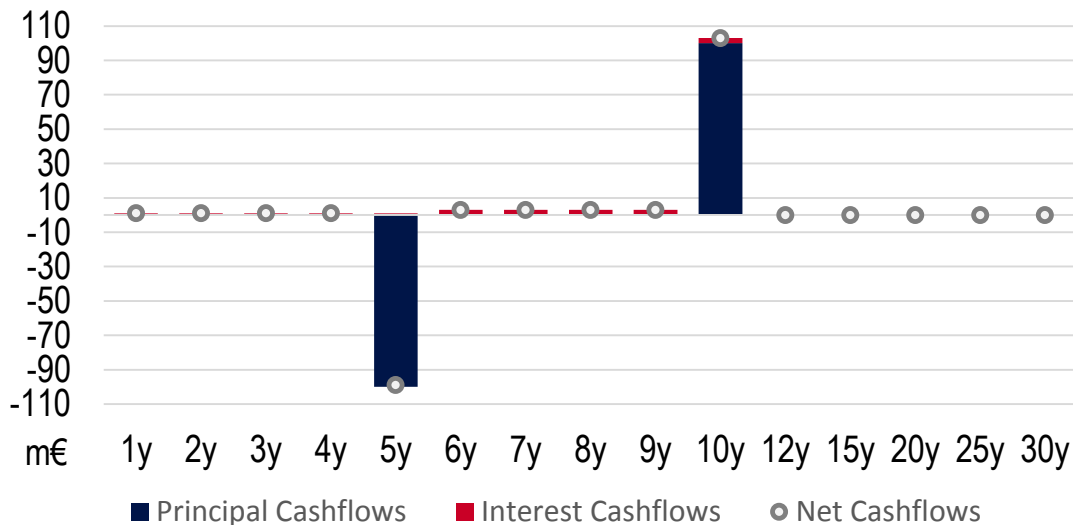
Interest rate risk can be measured under two mutual perspectives:

- **Economic Value Perspective:** evaluation of the impact on the present value of cash flows arising from changes in interest rates
- **Earnings Perspective:** evaluation of the impact on earnings of changes in interest rates

Both methods share common assumptions, however they have complementary uses:

- since EV is the discounted present value of **all expected cashflows**, EV measures reflect changes in the net economic value **over the remaining life of the balance sheet**, i.e. until complete run-off
- earnings-based measures typically work well on a **short to medium term time horizon** (one to five years), and therefore do not capture in full those risks that will continue to impact the balance sheet beyond the analysis horizon

A first qualitative overview: Maturity Gap



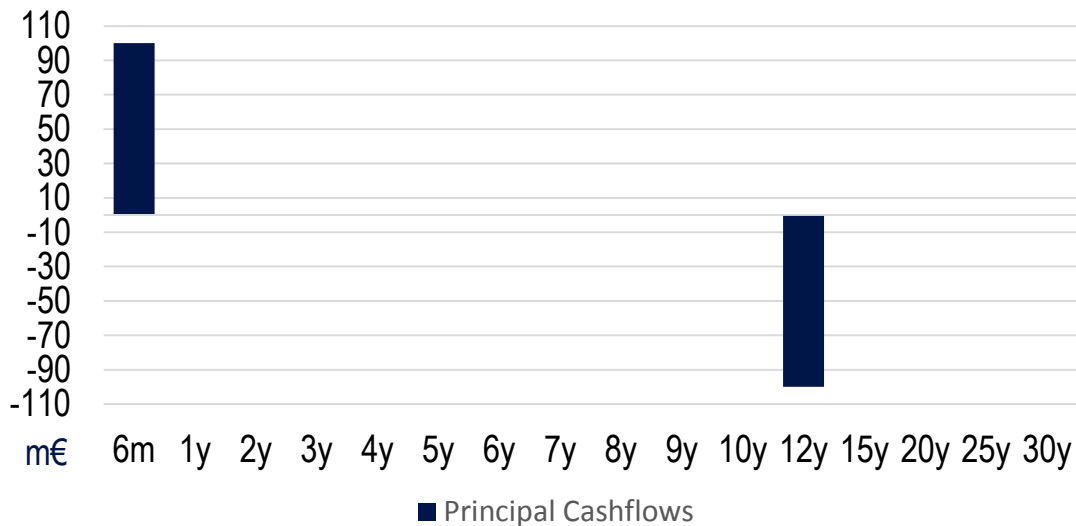
Asset: 100 millions, 10y bullet
Liability: 100 millions, 5y bullet

Maturity Gap: represents the allocation of principal and interest cashflows into given maturity buckets

It is a useful tool for measuring liquidity risk (e.g. it enlightens liquidity lacks).

For the purpose of Interest Rate Risk Management, it gives a qualitative overview of how the balance sheet is distributed, but no information on the rate types.

Earnings Perspective: Repricing Gap



*Asset: 100 millions, 10y bullet, floating rate (Eur6m)
Liability: 100 millions, 10y bullet, fixed rate*

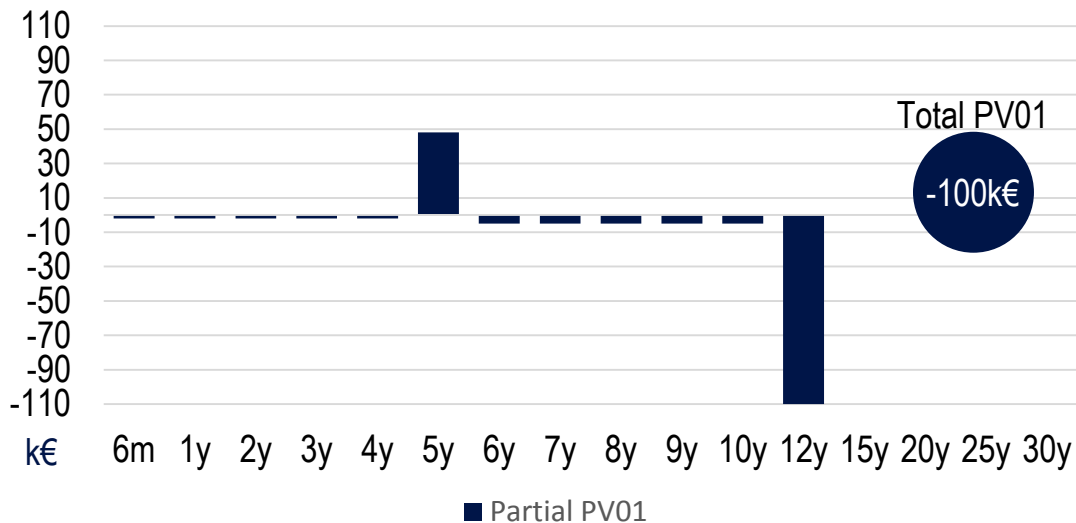
Repricing Gap: represents the allocation of principal cashflows to the next contractual reset dates

It represents the principal maturities from the Earnings point of view, i.e. it enlightens when new funding or new reinvestment are needed.

PRO: It captures Gap and Basis Risk

CON: Visualization of Option Risk is not possible

EV Perspective: partial Duration Gap (PV01)



Asset: 100 millions, 10y bullet, fixed rate
Liability: 100 millions, 5y bullet, fixed rate

Partial Duration Gap: represents the allocation of first-order partial sensitivities (PV01) to given time buckets

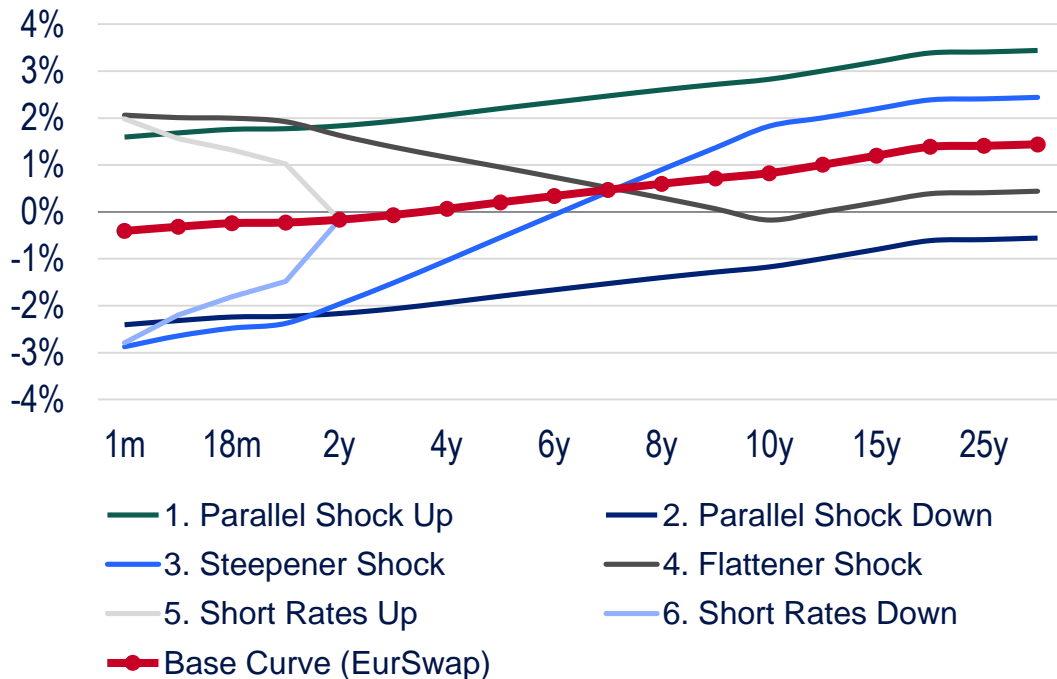
PV01: represents the impact on Economic Value of 1 basis point perturbation of the discount curve

PRO: It captures Gap and Option Risk

CON: Needs exact computation of EV on large portfolios; doesn't cover Basis Risk

Stress Testing

Standard Regulatory Scenario Set



The effect of the **six regulatory scenarios**, as described in the picture, has to be evaluated **both on net Earnings and EV**.

Of course, banks are encouraged to run **entity-specific scenarios**, selected according to the particular structure of the balance sheet and to historical evidences.

EV Perspective: Value at Risk (VaR)

- **Value at Risk** is a statistical technique, used to gauge the potential loss in Economic Value
 - on a given time horizon (typically one day or ten days)
 - at a given confidence level (e.g. 99%)
- When Value at Risk is computed using historical simulation methods or Montecarlo methods, it includes in one single value the effect of a **wide range of market scenarios** and the consequences of the **complex features of the balance sheet** (correlations, optionalities, asymmetries, etc.).
- Value at Risk can be easily back-tested by comparing realized PLs with predicted PLs (VaR) on the given time horizon.

Dynamic measures

The measures described in the previous slides are all «**static**», i.e. they are evaluated at a cutoff date assuming that interest rate shocks are instantaneous and affect a given balance sheet.

They can be extended and simulated over time, by making «**dynamic**» assumptions on the evolution of volumes, for example:

- constant balance sheet, i.e. automatic reinvestment of expiring principal cashflows at market rates
- full run-off of the balance sheet, i.e. no replacement of expiring cashflows
- new business, i.e. volumes evolve according to the bank's expectation on new business

As dynamic assumptions generally become weak on a time horizon longer than one/two years, they are **mainly adopted on Earnings perspective measures.**

4. Additional Topics

Use of Derivatives for Hedging IR Risk

Interest Rate Derivatives (futures, FRAs, IRS, caps, floors) are extensively used by banks for the purpose of hedging, for example:

- to **lock future earnings** or **limit potential losses**
- to **rebalance** a bank's **Repricing Gap**
- to **achieve a target IR profile**, coherent with the bank's risk appetite framework.

However, derivatives should be used carefully as **other risks** may appear:

- **liquidity risk**, due to the potential cash collateral requests if their MTM decreases
- **replacement costs**, in case of unexpected changes in the underlying balance sheet
- **counterparty risk**

Non Maturing Deposits (NMDs)

Non Maturing Deposits (in short, NMDs) represent the **most common contract** in a bank's balance sheet.

The absence of a contractual maturity and the discretionality of the coupon rate make this liability very risky from the IR point of view, in particular to **behavioural option risk** (*recall the S&Ls case*).

Therefore, the entire interest risk measurement framework is strongly impacted by the **modelling assumptions** made to treat this type of contract:



Positive rate
(contractually not allowed to go below 0%)

Elasticity of the rate
(slower response to market rate movements)



Identification of a core amount
(portion of deposits stable over time)

Persistence of volumes
(future expected cashflow profile)

Credit Spread Risk

Every interest rate earned by a bank on its assets, or paid on its liabilities, is a composite of a number of price components -some more easily identified than others :

- one of them is the risk-free component, which is the object of the Interest Rate Risk analysis;
- all the other components, including liquidity risk and credit worthiness, are the main driver of the Credit Spread Risk analysis

Credit Spread Risk **may have a direct effect on the balance sheet** in the presence of items that are accounted «at fair value».

Credit Spread Risk can be measured by combining EV techniques:

- **sensitivities and scenario analysis** (e.g. **CS01**, the effect of 1 basis point perturbation in the credit spread)
- **historical simulations**, such as **Credit Spread VaR**

5. Key Takeaways



Key Takeaways

- Interest Rate Risk is an important risk that arises from normal banking activities. Its management is **critical to the stability of banking corporations**.
- It has to be measured under two mutual perspectives: **Earnings Perspective** and **Economic Value (EV) Perspective**.
- Several sub-types of Interest Rate Risk exist: **Gap Risk, Basis Risk, Option Risk**.
- Tools for the measurement of Interest Rate Risk include: **Repricing Gap, Duration Gap**, sensitivities and **stress testing, Value at Risk**; they can all be applied to a **static or a dynamic** balance sheet.

6. Questions and Answers

