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MANAGEMENT OF FINANCIAL INSTITUTIONS

ELECTIVE COURSE

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2023-2024 Edition

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OVERVIEW OF THE BANKING INDUSTRY AND MAIN TRENDS

Banks are financial intermediaries that borrow money from retail customers (households, corporation, funds…) and lend to customers:

- Deposits enter into the BS as liabilities, while Loans made to clients enter as assets
- The bank earns on the spread between the interest rate on loans and deposits
- Together with loans, securities and Reserves lent by the Central Bank enter into the Balance Sheet

Assets	Liabilities
• Loans • Securities • Cash/Reserves (lent by the Central Bank)	• Deposits • Bonds **Equity**

U.S. Commercial Banks Balance Sheet (in $ trillion, as of December 31, 2021)

Assets		Liabilities and Net Worth	
Cash and Reserves	2.4 (10%)	Total Deposits	19.6 (83%)
Securities	7.2 (30%)	Demand/Checkable Deposits	6.4 (27%)
Treasury	1.5 (6.4%)	Savings/Time Deposits	13.2 (56%)
Agency securities (MBS)	3.5 (15%)		
Municipal and Corporate Bonds	1.7 (7.1%)	Bonds and other debt securities	0.3 (1.5%)
Loans	11.1 (49%)	Other Liabilities	1.3 (5.5%)
Real Estate (Mortgages)	5.2 (22%)		
Commercial and Industrial	2.1 (8.8%)		
Consumer	1.8 (7.6%)	Equity	2.3 (10%)
Other Assets	2.5 (11%)		
Total	23.6 (100%)	Total	23.6 (100%)

Mortgage-Backed Securities (**MBS**) are the most common securities held by US banks and derive from the securitization of mortgages:

- Banks can sell their mortgages to **Government Sponsored Enterprises** (**GSE**)
- Then, the GSE will report the acquired mortgages on their asset side and will pay for them issuing MBS, which enter on their liabilities side
- Eventually, the mortgages find a way back to the banks' Balance Sheets as very safe securities, since they pool together many different mortgages from different areas, thus reducing the default risk (law of large numbers)
- Quantitative Easing in 2008 consisted in CBs printing money in order to buy MBS, thus pushing up their prices and relieving banks' Balance Sheets

Euro-area Commercial Banks Balance Sheet (in €trillion, as of December 31, 2021)

Assets		Liabilities and Net Worth	
Securities	5 (13.7%)	Total Deposits	22.9 (62.9%)
General Government	1.6 (4.4%)		
Financial Intermediaries	1 (2.7%)		
Other residents	1.2 (3.3%)	Bonds and other debt securities	4.2 (11.5%)
Equity and other non-MMF funds	1.2 (3.3%)		
		External Liabilities (non-Euro area)	4.3 (11.7%)
Loans (to Euro-area residents)	23.2 (63.7%)		
General Government	1 (2.7%)	Other Liabilities	2.6 (7.1%)
Financial Intermediaries	9.8 (26.9%)		
Other residents	12.4 (34%)		
External Assets (non-Euro area)	5.2 (14.3%)	Equity	2.5 (6.8%)
Other Assets	3 (8.3%)		
Total	36.4 (100%)	Total	36.4 (100%)

The **Euro area** is similar in terms of composition to the US, however we can notice that:

- Deposits in the EU are lower because banks issue many more bonds
- On the asset side, we do not see any MBS
- One peculiarity is that European banks hold a lot of each other's bonds

Banks sources of income

Banks have two different kinds of income:

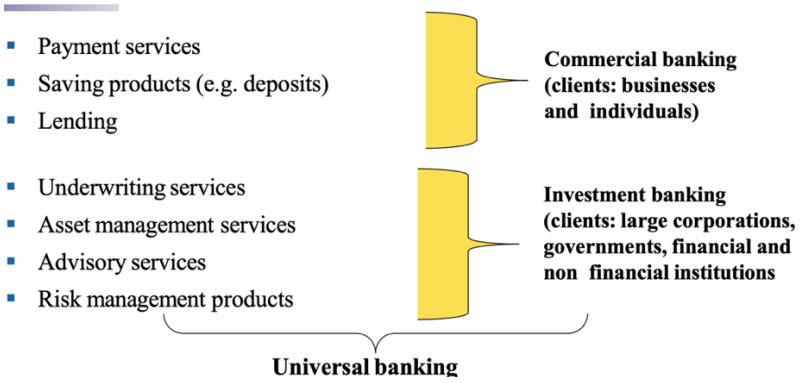
- **Net interest income**, which is the difference between the Interest Revenue (*lending and investment portfolio*) and the Interest Expenses (*funding*)
- **Net Non-interest income**, which is the difference between the fees and commissions (funding, investment portfolio, investment banking, lending) the bank earns, and all of its non-interest expenses (general and administrative expenses, wages)

Whether interest income is more important than non-interest income depends on the kind of services that the bank is providing:

- Commercial Banks (**depository institutions**) will surely have a higher Net interest income as their core business is transforming deposits into loans
- **Investment Banks** will surely earn higher Net non-interest income because they mainly act as **advisors** and **underwriters** of securities, thus earning **fees**

Banks offering both depository and investment banking services are called **universal banks**

- The Glass-Steagall Act (1933) separated commercial banks from investment banks
- However, the Act was repealed in 1999, thus leading to the creation of these universal banks
- The creation of universal bank is more recent in Europe wrt the US



The type of clients for commercial and investment banks are also different:

- **Commercial banks clients** usually are businesses and individuals
- **Investment banking clients** usually are large corporations, governments, as well as financial and non-financial institutions

Traditional Commercial Banks business model

The main business of traditional commercial banks is obtaining deposits and granting loans

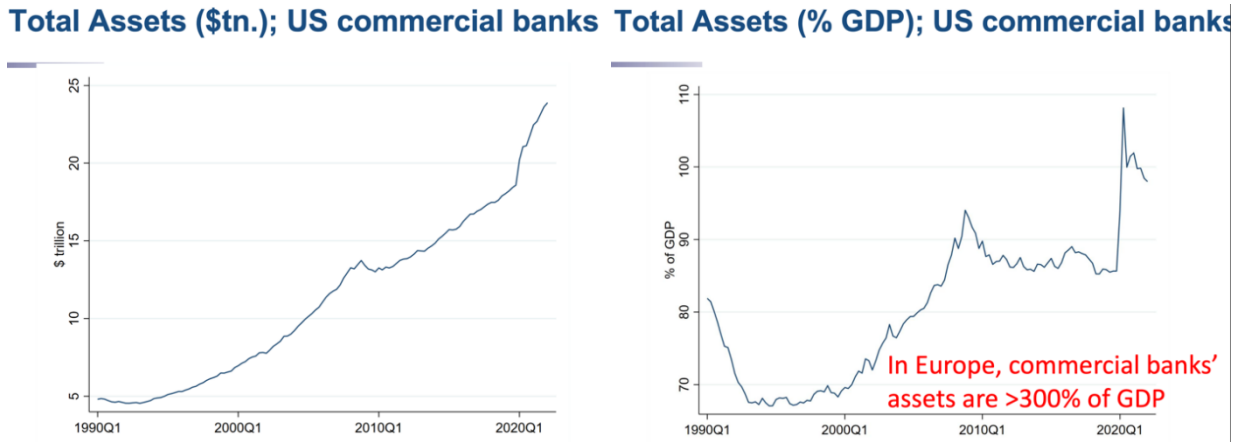
- The main **source of revenue** is the **Net Interest Margin** (**NIM**), which is the spread between the interest received on loans and the interest paid on deposits
- The most important risks that this institutions face are **credit risks**, **liquidity risks** and **interest rate risk**

Universal Banks business model

Universal banks have several main businesses since they offer a wide range of financial products and services

- The main sources of revenues can be either interest or non-interest income, depending on the company's focus
- These banks are exposed to a variety of risks, such as credit and market risk, also depending on the company's main focus

Main Trends



Commercial banks Total Assets (in nominal terms) have been growing over time:

- The growth just reflects the growth of GDP between 1990 and 2020
- By dividing banks' total assets by GDP, we can nonetheless see that total assets have been increasing over time

The **jump** in **Commercial Banks Total Assets** in **2020** is attributable to different factors:

- Expansionary monetary policies and QE by the FED have pumped money into the economy
- Individuals cut on consumption during covid, thus saving a larger part of their extra income
- Banks started to give away more loans because of **government guaranteed loans** (Paycheck Protection Programs in the US)

How banks differ

Bank can differ by:

- **Organizational structure**
- **Main delivery channel**

Regarding the **Organizational structure**, banks can range between:

- *Unit Banks*, which are banks with a single branch and are typical of more rural areas
- *Bank/Financial Holding Companies*, which are financial conglomerates that include banking and non-banking activities

Regarding the **Main delivery channel**, this can range between:

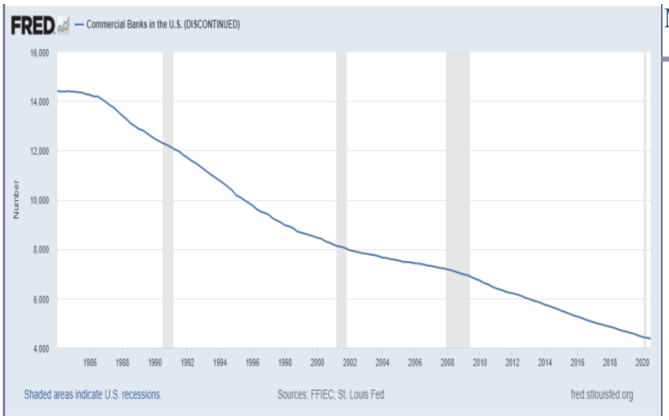
- *Brick-and-mortar branch network*, which characterize banks with a large network of physical locations
- *Internet/Mobile Banking*, which is becoming nowadays more common

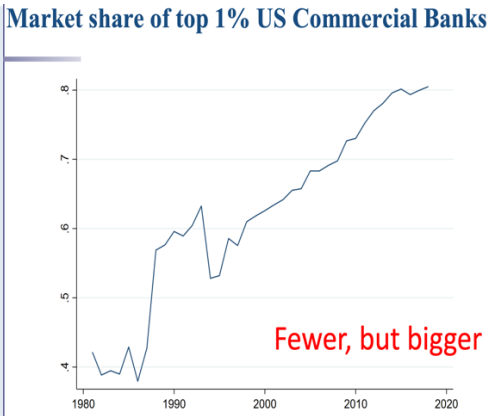
The great differences in **size** across the industry that have appeared in recent years have led to:

- Variety of financial services each institution sells in the market it chooses to serve
- Market differences in the way bank are organized internally (governance, organizational structure)

Despite the strong impulse that Covid gave to digital banking, we do not see a substantial decline of physical branches.

A very important trend has to do with the number of banks in the US:





- In the last 30 years, the number of banks has been steadily declining
- However, we can see that, at the same time, the market share of the top 1% US Commercial Banks has increased significantly

The trend has also shown up in Europe

- **Consolidation process**
  Since 2008, the number of banks in the EU has continuously decreased following mergers in the banking sector.
  In 2018, there were 5,698 banks in the EU, 30% less than in 2008

- **Concentration process**
  Banks with assets above €30bn account for over 80% of EU banks' total assets (3-4 banks per country enough to get 50% of total asset in a country and exceed the country's GDP)

  Since 2014, the largest banks (about 120) are **more strictly supervised** under the supervision of the **ECB** or "**single supervisory mechanism**"

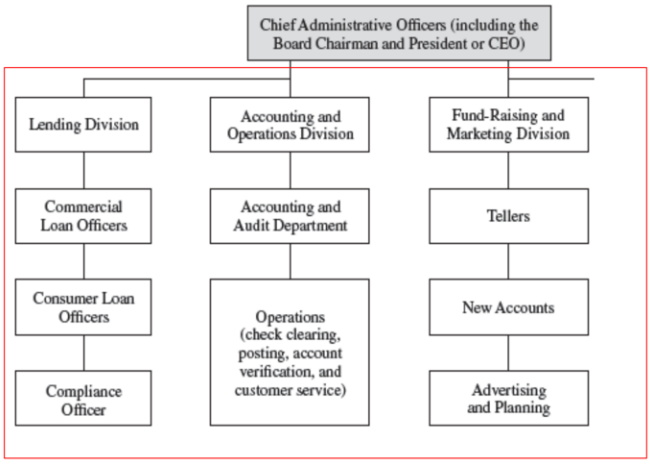
With regard to bank size, we can identify a **multi-tiered system**:

1. **Community Banks** (**US**) **/ Credit Cooperative Banks** (**EU**)
   - These banks operate in a small area and have less than $1bn in Total Assets
   - Their specialization is in **retail banking** activities, such as mortgages, consumer loans, and local deposit base

2. **Regional Banks** (**US**) / **Savings Banks** (**EU**)
   - These banks offer a **more complete array** of **commercial banking services** at both regional and national level

3. **National/Global Banks**
    - These banks offer a **wide array** of products and services (commercial and investment banking) for governments, businesses, and individual clients
    - In the case of National/Global Banks, the sources of funding not only include **deposits**, but also comprehend **wholesale funding**

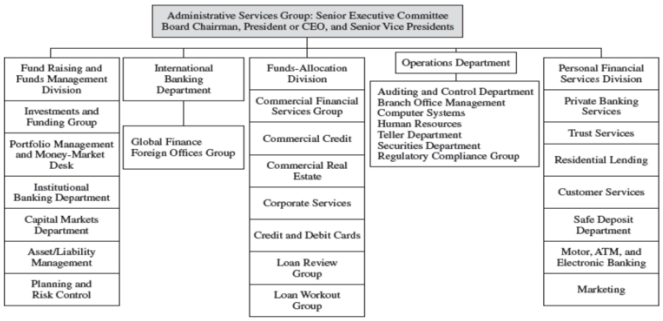
The typical organizational chart of a Community Bank is as such:



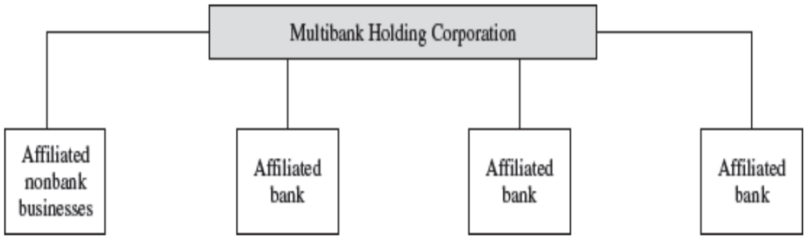
- Small Community banks will usually have three basic departments centered on fund-raising, lending, and marketing, accounting and operations

As the size of the bank grows, its structure will become more and more complex, with many specialized departments and divisions:

EXHIBIT 3–4 Organization Chart for a Money Center or Wholesale Bank Serving Domestic and International Markets



When the bank grows to a multi-bank business, all of the affiliated banks will have their own structure, and they will all respond to the holding company:



Together with the concentration trend, another important trend for banks is that they are becoming less specialized and more *universal*:

- Larger banks have seen the number of subsidiaries steadily increasing, meaning that they are growing bigger by buying up smaller ones

The reasons behind the increase in size and the de-specialization are to be found on:

1. **Exogenous factors**, such as the de-regulation process started in the 1990s until the pre-financial crisis years (this process allowed US banks to expand branch network across states)

2. **Endogenous factors** such as:
   - The search for **cost savings** through **scale economies** and **scope economies**
   - The **risk reduction** through **diversification**
   - The **stabilization** of bank income by widening the sources of revenues

However, the creation of universal banks has some **potential constraints** such as:

- The **high complexity** and excessive **agency problems** because of the need to coordinate costs among different lines of business
- The **high incentive** to engage in **risky** activities (**moral hazard**)

Recent research on the post-war German banks' consolidation imposed by Allies has shown that large banks:

- Did not experience higher profits or efficiency
- Lent to riskier borrowers, who grew more slowly than borrowers of smaller banks
- Gave to their managers **empire-building** incentives because of higher salaries and more media attention

Regarding the **number of branches**, despite the number of banks has been declining, the **number of branches** has increased (plateau reached in 2008).
However, during recent years this number has been declining.

FUNDING, PRODUCTS, AND STRATEGIES

Theory of Deposit Runs

Bank deposits typically are **demandable**, which means that depositors can request the funds back at any time:

- This exposes banks to the risk of runs on their liability side, especially because deposits are **serviced sequentially** (**first-come-first served** basis). Furthermore, bank runs can cause **banking panics**
- In order to manage the **liquidity risk**, banks can hold cash and other assets that can easily be liquidated
- Bank runs can kill banks because one of the main issues of banks' balance sheets is the **maturity mismatch** between assets (long duration) and liabilities (short duration)
- Indeed, around 50%-60% of bank assets are long-term loans, and 60%-80% of bank assets are funded through deposits

Theoretical models of banks consider deposits a defining characteristic of banks due to their demandability:

- The **threat of bank runs** is a **discipline device** because if bank managers know they can lose all deposits, they will surely **limit risk-taking**
- However, deposits are guaranteed by the government through the **deposit insurance**, which is a stable source of funding that allows banks to be patient and hold long-term illiquid assets
- In practice, what really matters is the **type of depositor** (retail vs. institutional investor) and the **amount** (insured vs. uninsured)

The **maturity mismatch** derives from different reasons:

- Short-term deposits rates are lower than long-term loans rates, thus making the activity **profitable** for the bank (NIM>0)
- Since deposits are demandable, **depositors impose discipline** on the bank, thus **limiting** the bank's **risk-taking behavior** (no moral hazard). For this reason, the bank run will not happen in the first place
- Since **deposits** are **insured by the government**, they are safe and stable, thus allowing banks to take **more risks** (i.e., more long-term assets).
  If a bank has more small depositors, covered by the deposit insurance, it will be able to take on more risk.
  On the other hand, if a bank has larger clients not covered by deposit insurance, it will have to limit risk-taking behavior, as these clients may start running.

Funding Structure

The funding structure is fundamental for banks for different reasons:

1. It influences **products and strategies** (which funding sources and why) because:
   - It has an effect on the way business can develop
   - It has an effect on the bank's performance, since it influences profitability and risk

2. It has an **impact on profitability** because it influences:
   - The **cost structure**, because of interest expenses and operating costs
   - The **income**, because of fees and commissions from payment services

3. It has an **impact on risk** because of:

- **Interest rate risk**, because the bank's assets and liabilities have different interest rate sensitivities and, for this reason, changes in the market interest rates directly affect assets and liabilities, thus impacting the Net Interest Margin
- **Liquidity risk**, because banks relying to more unstable funding sources are more exposed to liquidity risk

Because of the importance of the funding, commercial banks fund their balance sheets in layers, **from the most stable to the most volatile funding sources**:

- **Customer deposits** (*retail funding from households and corporates*) are assumed to be **stable** in most circumstances, even though they can be requested with little or no notice
- **Wholesale funding** include Short-Term Liabilities such as Fed Funds (interbank funding), Repos, Large Credit Deposits, and Commercial Papers
- **Equity related instruments** include Common and Preferred Stocks and Retained Earnings, Subordinated debt and hybrids of the two, plus medium and long-term senior debt

Retail deposit funding (**core funding**) is considered a **stable** source of funding, even though it can be requested with little or no notice:

- It benefits from **low interest rate sensitivity**, since depositors tend to be loyal to the bank, especially for small amount deposits
- It benefits from **low sensitivity** to changes in the **bank's credit risk** because of **deposit insurance**
- Deposits can be pooled and managed according to the law of large numbers, however they are relatively **less flexible to raise** on a short-notice

Wholesale funding are considered a **less stable** source than retail funding:

- They commonly have short or very short maturity (for instance, in the case of overnight deposits)
- They account for **large amounts** and are generally **unsecured**, with the exception of Repurchase Agreements (REPOs)
- The funds are issued/purchased at **market interest rate**

➔ For these reasons, the characteristics of **wholesale funding** are:

- Less customer loyalty and **great sensitivity** to **market interest rates**
- High exposure to **liquidity** and **interest rate risk**
- Better flexibility to raise them in good times

➔ During the 2008 financial crisis, **wholesale funding** sources became **scarce**:

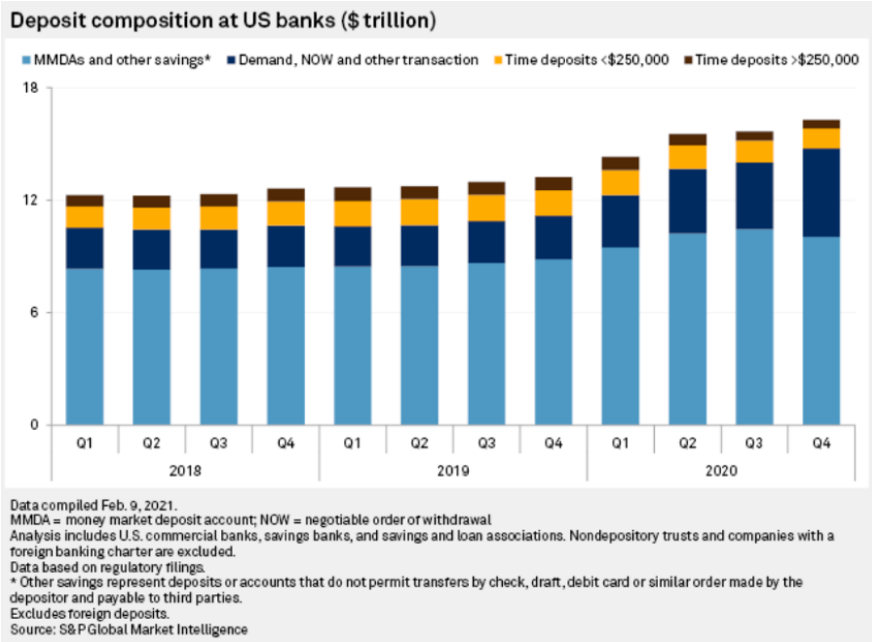
- As of mid-2007, it was possible to completely finance MBS through REPOs
- However, by Q4-2008, only about 55% of each dollar invested in MBS could be financed through REPOs
- Therefore, banks had to either fire-sell these securities, or find **new**, and presumably **expensive**, **sources of credit**

Retail Deposits are assumed to be stable in the post-crisis regulatory framework introduced by **Basel III**:

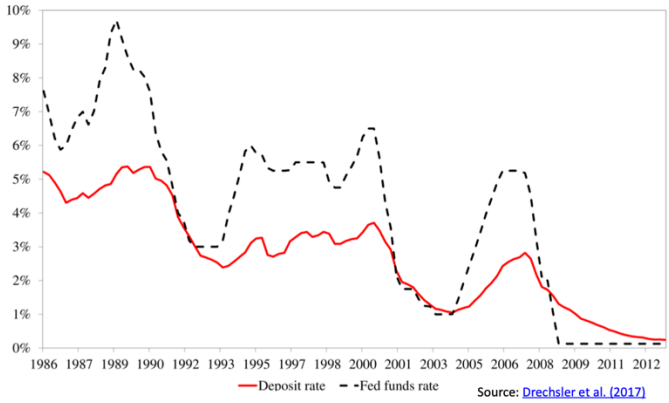
- The **Net Stable Funding Ratio** (**NSFR**) requires banks to have enough *stable funding* for their assets
- The ratio assigns a **higher stability score** (90%-95%) to **retail deposits**, while it assigns a **low stability score** (between 0% and 50%) to **wholesale short-term funding** with less than 1 year until maturity

There are three main types of **retail deposits** in the US:

- **Checking Accounts** are demand deposits that can be withdrawn at any time (NOW)
- **Saving Deposits** are deposits that pay a modest interest rate and have some limitations on withdrawals, even though they are generally flexible (60%-75% of deposits, Money Market Deposit Aaccounts)
- **Time Deposits** are certificates of deposits with different maturities, which pay the market interest rate. These deposits cannot be withdrawn before maturity without paying a penalty, but they can be sold on the secondary market if they are negotiable CDs

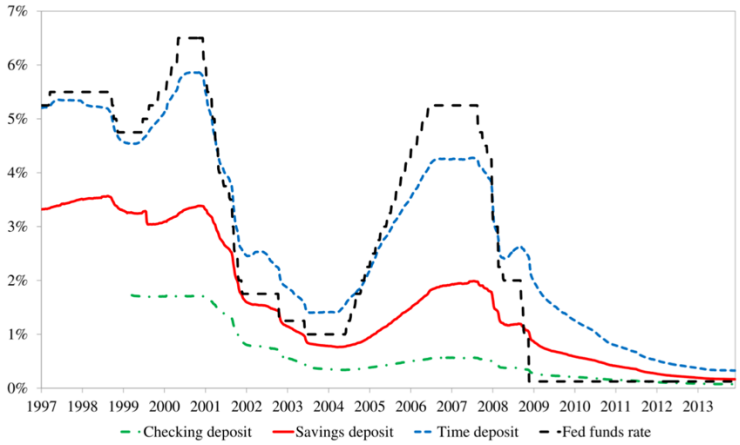


The **interest rates** on these deposits depend on the **monetary policy** (Fed Funds rate in the US):



- In general, there is a **positive co-movement** of the **Deposit rate** and the **Fed Funds rate**
- However, we can notice that, in general, the deposit rates are below the Fed Funds rate, thus the **deposit spread is positive**
- Indeed, increases and decreases are **asymmetric**, since upward increases are sticky, while downward increases are flexible

Regarding the **interest-rate sensitivity** of **deposits**, it varies considerably across deposit types:



- **Time deposits** track the Fed Funds rate almost one-to-one
- On the other hand, **checking** and **savings deposits** are much stickier, thus representing a **stable source of funding**

Pricing Deposits

Deposits are a low source of funding because of **deposit insurance and customer stickiness**:

- Even though they can entail some **operating costs**, they also generate **fees** associated with **payments services**
- **Pricing** is an important component of the **marketing mix**, since different pricing strategies are important to **client segmentation**

Regulation Q was imposed after the Great Recession in order to limit competition by setting a limit on deposit rates:

- When the regulation became binding in the '60s, it eventually led to the creation of **money market mutual funds** which, contrary to banks, were able to pay **market rates**
- The regulation was repealed in 1978 with the introduction of **time deposits**

1. **Setting Fess**

➢ Since Regulation Q limited banking competition based on rates, Banks started to compete on other terms:

- With **deregulation**, banks started to make frequent use of **unbundled service pricing**, since the greater competition raised the average real cost for deposit-service providers
- For this reason, deposits are **priced separately from other services** using the **Cost-Plus pricing formula:**

Unit price charged the customer for each deposit service	=	Operating expense per unit of deposit service	+	Estimated overhead expense allocated to the deposit-service function	+	Planned profit margin from each service unit sold

➢ Example:

(i) ABC savings bank determines that its basic checking account costs the bank $3.00 per month in servicing costs (assume the servicing costs are labor and computer time) and $2.00 per month in overhead expenses. Additionally, the bank also tries to build a $0.60 per month profit margin on these accounts.

Following the cost-plus profit pricing formula, the monthly fee is:
Monthly fee = $3.00 + $2.00 + 0.60 = $5.60 per month

2. Setting interest rates

- In order to set the interest rates, banks should be able to **Price at Marginal Cost**, which is the **cost of new funds** and not the historical average cost, which could expose the bank to interest rate risk:

$$\text{Marginal cost} = \text{Change in total cost} = \text{New interest rate} \times \text{Total funds raised at new rate} - \text{Old interest rate} \times \text{Total funds raised at old rate}$$

$$\text{Marginal cost rate} = \frac{\text{Change in total cost}}{\text{Additional funds raised}} \quad (1$$

Bank should then:

$$MC\ rate = MR\ rate$$

  - The **Marginal Cost** can be thought as the change in total costs over the change in the additional funds raised, and it gives an information about the cost incurred in order to raise an additional unit of funding

- Example:

Example of a Bank Attempting to Raise New Deposit Funds

Expected Amounts of New Deposits That Will Flow In	Average Interest the Bank Will Pay on New Funds	Total Interest Cost of New Funds Raised	Marginal Cost of New Deposit Money	Marginal Cost as a Percentage of New Funds Attracted (marginal cost rate)	Expected Marginal Revenue (return) from Investing the New Funds	Difference between Marginal Revenue and Marginal Cost Rate	Total Profits Earned (after interest cost)
$ 25	7.0%	$ 1.75	$1.75	7.0%	10.0%	+3%	$0.75
50	7.5	3.75	2.00	8.0	10.0	+2%	1.25
75	8.0	6.00	2.25	9.0	10.0	+1%	1.50
100	8.5	8.50	2.50	10.0	10.0	+0	1.50
125	9.0	11.25	2.75	11.0	10.0	−1%	1.25

  - Assume that the bank tries to estimate its supply curve by estimating the additional funds it is able to raise at different interest rates
  - In order to estimate the **Marginal Cost**, the bank needs to perform the following calculation:

$$MC = New\ Interest\ Rate \times Funds\ raised\ at\ new\ rate - Old\ Interest\ Rate \times Funds\ raised\ at\ old\ rate$$

  - After estimating the Marginal Cost, the bank can also compute the Marginal Cost Rate:

$$MC\ rate = \frac{Marginal\ Cost}{\Delta\ Deposits}$$

➔ When the MC<MR, any additional unit of deposits will increase profits. On the other hand, if MC<MR, any additional unit of deposits will lower profits.

3. Segment-Based Deposit Pricing

- Deposit pricing policy is sensitive to at least two factors:
  - The **types of customers** each depository institution tries to serve
  - The **cost** that serving different types of depositors will present to the offering institution, since depositors don't just receive an interest rate but have to pay fees to maintain their deposit account

➔ For these reasons, deposit pricing would require detailed **client segmentation** in order to protect and target **high quality customers**

- **Conditional Pricing** refers to a deposit in which the customer pays **low or no fees** if the **balance remains above some thresholds**, but faces higher fees otherwise

- **Relationship Pricing** refers to a special treatment reserved to clients according to the number of services they use:
  - For instance, customers who purchase additional services may be granted lower deposit fees
  - The **goal** of **relationship pricing** is to promote a greater **customer loyalty**, thus making the customer less sensitive to the prices posted on services offered by competing financial firms (fosters stability of deposits as well)

- *Cost-plus Profit & Conditional Pricing Example:*
  - **Cost-plus profit & Conditional pricing: Example**

Suppose in the example before on cost-plus profit there is a minimum $600 average balance:

Monthly fee (on $600 average balance) =
= $3.00 + $2.00 + 0.60 = $5.60 per month
Operating cost + overhead expenses + profit margin

Further analysis reveals that for each $150 above the $600 minimum balance maintained in its checking accounts, the bank saves about 5% in operating expenses with each customer account.

Q: For a customer who is consistently maintaining an average monthly balance of $1,200, how much should the bank charge to protect its profit margin (and reward the client)?

- **Cost-plus profit & Conditional pricing: Solution**

Monthly fee ($600 average balance) =
= $3.00 + $2.00 + 0.60 = $5.60 per month

(ii) If the bank saves about 5% in operating expenses for each $150 held in balances above the minimum of $600, then a customer who maintains an average monthly balance of $1,200 saves the bank 5%*4=20% in operating expenses (i.e., 20%*3$=0.6$). The appropriate amount that the bank could charge is therefore:

$2.40 + 2.00 + 0.60 = $5.00 per month

FUNDING, PRODUCT, AND STRATEGIES (NON-DEPOSIT LIABILITIES)

Liability Management and the Customer Relationship Doctrine

The **Customer Relationship Doctrine** states that the priority for a lender is to make **loans to all** those **customers** from whom it expects to receive **positive net earnings**:

- Similarly, in a **crisis**, the lender will be **less likely** to **cut credit** to **existing customers**
- Thus, lending decisions often precede funding decisions, since loans make deposits

However, if deposits are not available to cover lending decisions, bank management should seek out the **lowest-cost source** of **borrowed funds** available to meet its customers' needs

Hence, **liability management** refers to banks **buying funds** in order to **satisfy loan requests**:

- This is an **interest sensitive approach**
- The approach is also **flexible**, because the bank can decide exactly how much they need and for how long
- The **control mechanism** to regulate incoming funds is the **price of funds**

In general, **non-deposit** sources of funds have **risen** over time, especially at larger institutions. They have declined after the financial crisis, but are coming **back again**

Alternative **non-deposit sources** of funds are:

- The Federal Funds Market and the Interbank Market
- Repurchase Agreements
- Borrowings from the FED/ECB
- Negotiable Certificates of Deposit
- Long-term Non-deposit Funds Sources (**not** a **money market** instrument)

1. **FED Funds and the Interbank Market**
   FED Funds allow to **borrow** from **other banks** immediately available **reserves** traded between financial institutions and returned within 24h
   - **Overnight Loans** are negotiated electronically (**Fedwire**) and returned the next day. Normally, these loans are **not secured** by a specific collateral
   - **Continuing Contracts** are **automatically renewed** each day, and they are usually traded between smaller respondent institutions and their larger correspondents

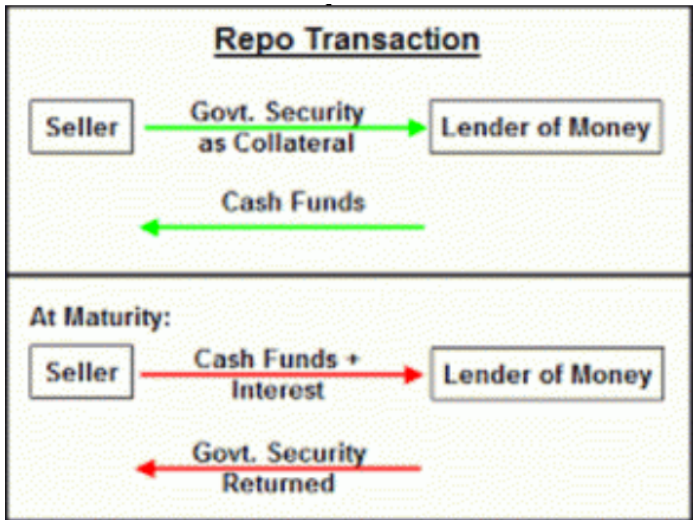
   The **Eurosystem** is the European equivalent of the **FED Funds Market**
   - **TARGET2** is a payment system owned and operated by the Eurosystem, and it processes large-value payments in euro in real time (*Real Time Gross Settlement*)
   - Payment systems are **key plumbing** of financial systems because the economy needs a safe and smooth flow of payments
   - In March 2022, sanctions to Russia disconnected Russian banks from the payment platform SWIFT

   When a transaction occurs, TARGET2 works as such:
   - Bank A and Bank B both have accounts with a central bank
   - Bank A submits the payment instructions to TARGET2
   - Bank A's account is debited, Bank B's account is credited, thus settling the payment
   - TARGET2 transfers the payment information to Bank B

- The **FED Funds market** is very important from a monetary policy standpoint:
  - Indeed, the FED Funds rate is the monetary policy rate of the FED

2. Repurchase Agreements (REPOS)

- Repos are **collateralized transactions** in which the purchaser provides collateral in the form of **marketable securities**, thus reducing the credit risk
  - In the US, REPOS are usually **triparty**, because they use a clearing back for selecting and managing collateral, or **overnight**
  - One major innovation was the invention of **General Collateral Finance**, in which the collateral is not specified ex-ante



$$\text{Interest cost of RP} = \text{Amount borrowed} \times \text{Current RP rate} \times \frac{\text{Number of days in RP borrowing}}{360 \text{ days}}$$

- The **haircut** is the difference in the market value of collateral and the amount borrowed in the REPO:
  - Typically, REPOS, much like mortgages, are **over-collateralized**, which means that borrowers cannot borrow more than the value of the collateral (Loan-to-Value < 1)
  - Haircuts are a function of the **underlying risk** of the security, hence they will depend on the **issuer quality** (**credit rating**), **type of security** (plain-vanilla vs asset-backed), and the **residual maturity** of the collateral
  - **Private market haircuts** on riskier securities, established between two market participants via an exchange or central clearing counterparty, are typically higher than those assigned by central banks

- The **repo rate** depends on the quality of the borrower (credit ratings) and the maturity of the contract, while the haircut only depends on the value of the collateral

3. Borrowing from the Central Bank

- If a FI needs to borrow from the **FED**, the FED will make the loan through its **discount window** by crediting the borrowing institution reserve's account:
  - Each loan made by the Federal Reserve banks must be backed by collateral acceptable by the FED

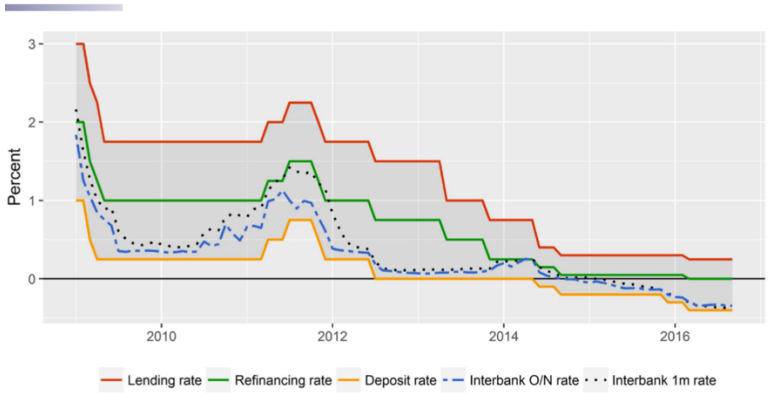
- The **discount window** is **not** normally used to conduct monetary policy, but it is used during crisis times and, for this reason, the **discount window rate** is higher than the **FED Funds rate** in order to discourage banks from using it

➔ There are three main lending programs available from the FED's discount window:
- **Primary Credit** is available to financial institutions in sound financial conditions, at a rate that is slightly higher than the FED Funds rate
- **Secondary Credit** is available at a higher interest rate and haircuts on collateral for institutions not qualifying for primary credit
- **Seasonal Credit** covers longer periods than primary credit and it is addressed to small and medium institutions (Deposits < $500 mln) experiencing seasonal swings in deposits and loans. Usually, these loans are provided at the lowest interest rate

➢ The ECB grants credit lines to FIs according to the maturity of the loans made:
- **Overnight loans** are made at the **Marginal Lending Facility** (**MLF**) rate, which costs banks relatively more than the **MRO rate**
- **One-week loans** are made at the **Main Refinancing Operations** (**MRO**) rate
- **Long-term loans** (1-3 month) are made at the **Long-term Refinancial Operations** (**LTRO**) rate

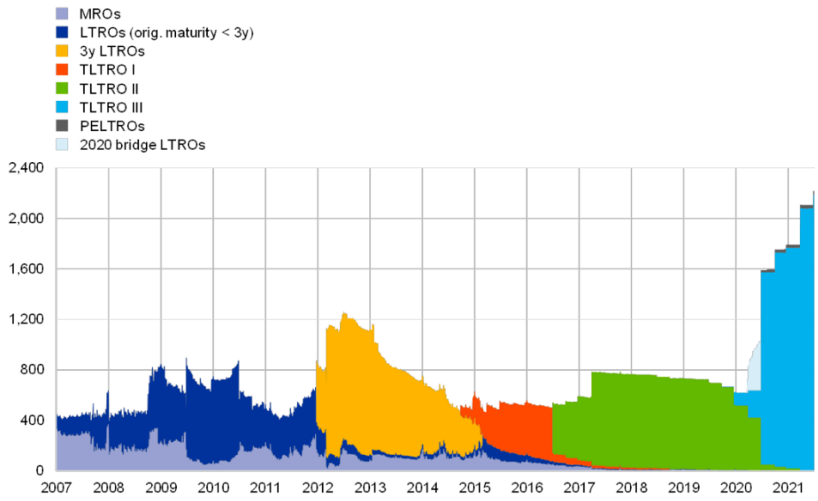
➔ The **Marginal Lending Facility** rate and the **Main Refinancing Operations** rate are two of the three interest rates that the ECB sets as part of its monetary policy (as opposed to the FED):
- The third rate is the **Rate on the Deposit Facility**, which defines the interest FIs receive for depositing money with the ECB overnight
- These three rates together define the **Interest Rate Corridor**

Example: ECB Interest rate corridor



➔ The **deposit rate** is lower than MRO and MLF because otherwise banks could borrow at the MLF/MRO rate and deposit the funds at the Central Bank, thus earning the higher deposit rate

➢ Nowadays, all borrowing from the ECB is composed of funds borrowed at **negative rates** (deposit facility) for **three years**, with the agreement that funds must be used for **new loans** (TLTRO I-II-III, Targeted Longer Term Refinancing Operations)



- **Central Banks** are also **Lenders of Last Resort**, which means they are ready to provide credit to banks in a crisis:
  - According to *Bagehot* (1973), Central Banks in a financial crisis should **lend freely** against **good collateral** at a **penalty rate**
  - It is the Lender of Last Resort who establishes what a good collateral is
  - Typically, the **Collateral Framework** includes government bonds, but this list can change over time, since LOLRs have accepted collaterals of **lower quality** during **financial crises**
  - In the Euro-area, **bank bonds** themselves are eligible, since banks hold a lot of each other's bonds, as well as non-marketable assets like loans

4. Large Negotiable Certificates of Deposit (CD)

- CDs are **interest-bearing receipts** evidencing the deposit of funds in the bank for a specified period of time at a certain interest rate:
  - CDs are considered a **hybrid account** since they legally are **deposits**
  - CDs can be of many different types, such as Domestic CDs, Fixed-rate CDs, Variable-rate CDs …
  - The secondary market for CDs is very large
  - Before the **European sovereign debt crisis**, CDs was an important market for US and European banks, since it was as the REPO market and 10x the unsecured interbank market

- The **interest rates** on **fixed-rate CDs** are quoted on an interest-bearing basis and the rate is computed assuming a 360-day year
  - Fixed-rate CDs represent the majority of all large negotiable CDs issued

$$\begin{matrix}\text{Amount}\\ \text{due}\\ \text{CD customer}\end{matrix} = \text{Principal} + \text{Principal} \times \frac{\text{Days to maturity}}{360\ \text{days}} \times \begin{matrix}\text{Annual rate}\\ \text{of interest}\end{matrix}$$

5. Long-term Non-deposit Sources of Funds

- European banks not only use short-term borrowing, but they also tap **longer-term non-deposit funds** stretching well beyond one year:

- **Covered Bonds** are medium/long-term bonds backed by a special **pool of collateral**, constituted mostly by **high-grade mortgages** or **loans** to the **public sector**, on which investors have a **priority claim**
- By the end of 2019, Covered Bonds reached €2.7 trn, accounting for more than one-third of all debt securities issued by European banks

➔ **Covered Bonds** are an example of **asset encumbrance**, where collateralized assets remain on the balance sheet, as opposed to securitization, and cannot be sold as they belong to another creditors:
- REPOs also create encumbered assets
- Almost 30% of European banks assets are encumbered as of June 2020

Choosing among Alternative Nondeposit Sources

Banks need to consider different factors when choosing Nondeposit Funding Sources:

1. The **relative costs** of raising funds from each source, since differences exists because of different maturities, the presence of collateral…

2. The **risk** of each funding source:
   - **Interest Rate risk**, since interest rates fluctuate, and this risk is enhanced by the longer duration of funding
   - **Rollover risk**, because of the inability of borrowers to issue new debt to pay for old debt. This risk is enhanced for **short-term debt**, where the frequency of rollover is high, when **market rates are high,** and for **weaker banks**, which have lower profitability, higher impaired loans, and higher leverage

3. The **maturity** for which funds are needed, also because of the **maturity mismatch** between banks' assets and liabilities

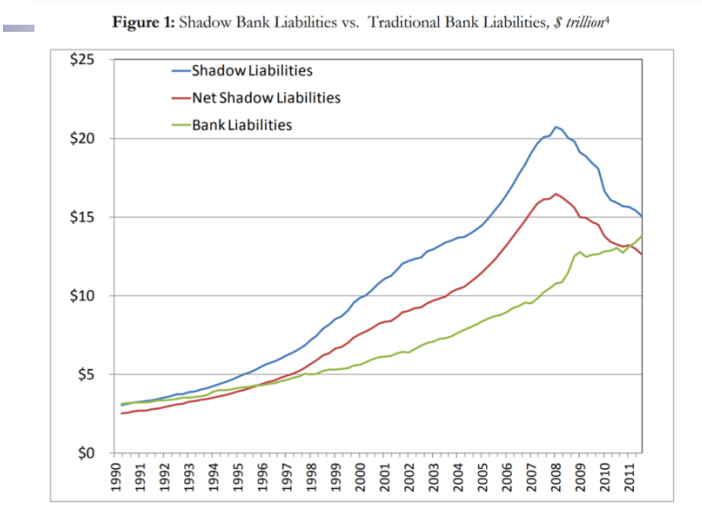
4. The **size** of the **borrowing bank**, because money market securities have large denomination (>$1 mln), and this denomination **may exceed** the **borrowing requirement** for the smallest financial institutions

5. **Regulations limiting** the use of **alternative funds sources**:
   - Indeed, after the 2007-2008 financial crisis, **regulatory liquidity ratios** in Basel III **penalize** the use of **wholesale funding**, which is considered less stable than deposits

Shadow Banks

Buyers of non-deposit liabilities issued by banks are often referred to as **shadow banks**:
- Shadow banks are defined as a system of **credit intermediation** that involves entities and activities **outside** the **regular banking system**

Some examples of shadow banks include:
- Money Market Mutual Funds
- Finance/Mortgage companies
- Asset-backed commercial paper and Special Purpose Vehicles
- Government-Sponsored Enterprises

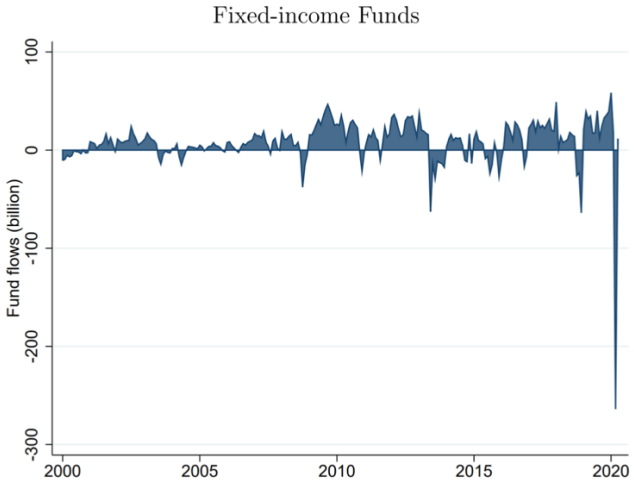


Some **Shadow Banks** (e.g., hedge funds and other finance companies) issue **non-deposit liabilities** in order to fund their assets (especially **REPOs**):

- Mutual Funds issue liabilities in the form of **redeemable shares**, which are similar to bank deposits, but are not insured
- Shadow Banks assets include securities which are **potentially long-term** (this is often the case for fixed-income mutual funds that invest in Treasury Bonds)

Therefore, **Shadow Banks** engage in **maturity/liquidity transformation**, however:

- They are not as regulated as real banks are, for instance because of no capital requirements
- They do **not benefit** from **deposit insurance** and **central bank liquidity**
- For these reasons, **mutual funds** are more exposed to **runs**



BANK CAPITAL

Function of Capital

Equity capital is the **cushion** that protects **liability holders** from unexpected losses affecting the bank's assets:

- Banks, by their own nature, take on many risks
- Their funding is *fragile* due to the special nature of liability holders (depositors)

- The potential effect of bank failures to the financial system stability and the real economy is large
- Moral Hazard drives banks to hold low level of capital (Too-big-to-fail)

For these reasons, there is the need for **regulations** to establish a link between capital held and risk assumed by the bank.

Furthermore, bank capital also has other functions:

- It is a **long-term** source of **funding**
- It promotes **public confidence** for debtholders
- It reduces the **conflict of interest** between shareholders and liability holders (*skin in the game*)

Regulators prefer banks to hold more capital as it reduces the likelihood of bank failures:

- Indeed, riskier banks should hold more capital, while lower-risk banks should be allowed to increase financial leverage

On the other hand, banks may prefer to operate with lower levels of capital than it is socially optimal for a number of reasons:

- Lower capital increases the ROE, keeping everything else constant
- Banks try to operate at minimum capital requirement levels, as they have a book debt-to-asset value of 90%, which is much larger than the 25% for non-financial companies
- Probably, the problem is created by the **government safety net**, which is basically the moral hazard created by **deposit insurance**

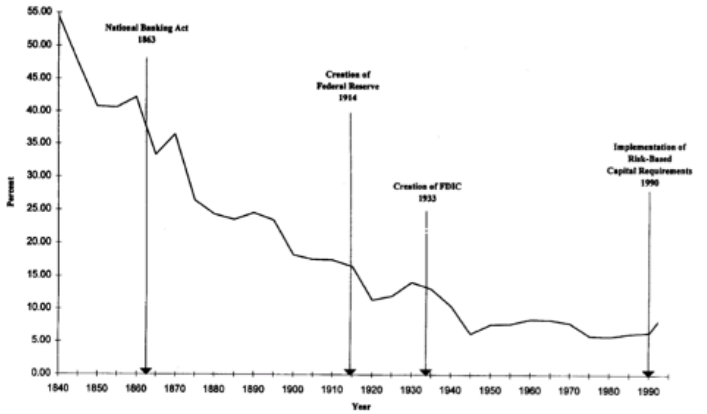
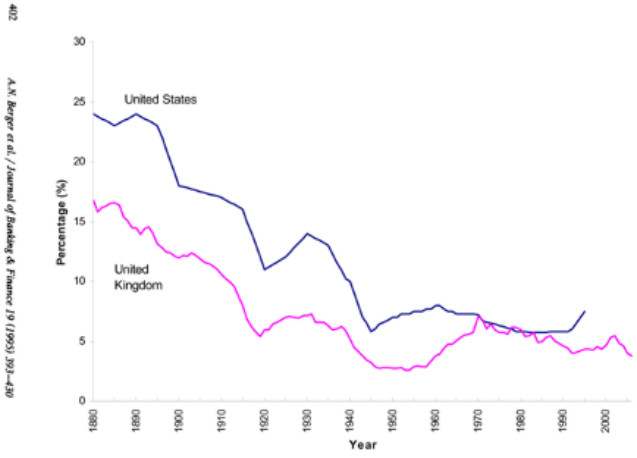


Fig. 1. Equity as a percent of assets, 1840–1993 for U.S. commercial banks. (Ratio of aggregate dollar value of bank book equity to aggregate dollar value of bank book assets.)
Source: Statistical Abstracts through 1970, Report of Condition and Income thereafter.



A.N. Berger et al. / Journal of Banking & Finance 19 (1995) 393–430

On average, we can notice that capital ratios were much higher in the past than they are today:

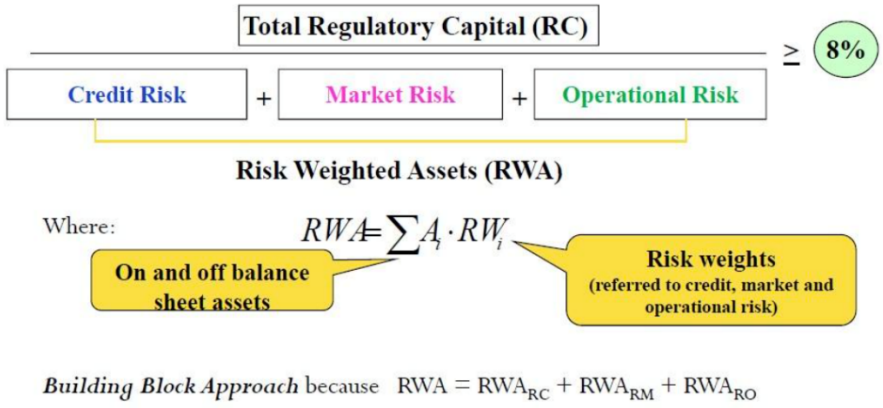
- Indeed, the economic environment was much riskier than today
- Furthermore, the sector was much more fragmented, while today we see consolidation
- On the other hand, as capital requirements have gone down over time, we can also see that the ROE has gone up

Regulatory Capital

The **Basel Agreements** (Basel I, II, and III) are a set of agreements prepared by the Basel Committee on Banking Supervision in order to force banks to meet **minimum capital requirements**:

- The main purpose of the agreements is to ensure that financial institutions have enough capital to **meet obligations** and **absorb unexpected losses** with respect to **three** main categories of risks:
    - **Credit Risk**, which was the initial focus of the Basel Accords
    - **Market Risk**
    - **Operational Risk**, which is becoming increasingly more important

According to the **Basel Agreements**, the broader capital requirement is the *Total Risk-Based Capital Ratio*



Building Block Approach because $RWA = RWA_{RC} + RWA_{RM} + RWA_{RO}$

The **total regulatory capital** can be divided in **Tier 1** and **Tier 2** capital:

1. **Tier 1 Capital** is capable of absorbing losses under going-concern conditions, and is made of two components:
    - **Common Equity Tier 1** (**CET1**)
    - **Additional Tier 1** (**AT1**)

➢ The **CET1** is the highest quality capital, with the best **loss absorption** capacity, and was composed of:
- **Common Equity**, made of common shares, retained earnings, the eligible portion of minority interests, and the Additional paid-in capital
- **Deductions** from CET1 capital, such as goodwill and intangible assets, unrealized gains, and deferred tax assets. Deductions can be very important and on average make up 30% of equity for large EU banks

➔ **Deductions** must be taken out when computing the regulatory capital:
- For instance, DTAs are tax benefits that count as equity capital, but do not have any loss absorption capacity, and must therefore be subtracted from the regulatory capital
- In general, deductions take away **anything** that does **not provide** good loss absorption

➢ The **AT1** includes capital instruments with no fixed maturity and no incentives to redeem

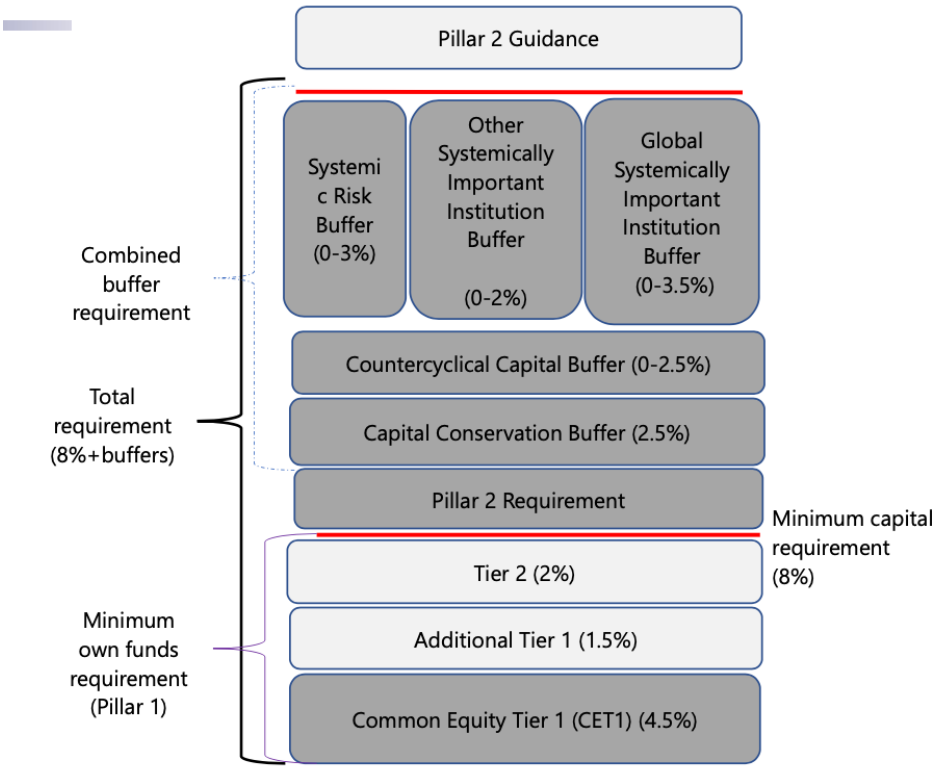
2. **Tier 2 Capital** is also known as **Supplementary Capital**, and must be capable of absorbing losses in the event of a crisis (**gone-concern capital**):
    - T2 has lower loss absorption than CET1
    - It includes hybrid instruments between **debt** and **equity** (such as convertible bonds)

➔ **Tier 2** capital must satisfy some requirements:
- It must be *long term subordinated debt*, with minimum maturity of 5 years

- It must not have any incentive to redeem
- It may be callable after supervisory approval

$$\textbf{\textit{Total Regulatory Capital}} = (\textbf{\textit{CET1}} - \textbf{\textit{Deductions}}) + \textbf{\textit{AT1}} + \textbf{\textit{T2}}$$

➢ The **8%** total regulatory capital is a minimum requirement on banks' own funds:
- However, there are many other **regulatory buffers** to be held on top of the **8%** threshold



Credit Risk

Credit Risk is measured via **credit ratings**:

- **Basel I** introduced for the first time the **Risk Weighted Assets**, which consists in assigning bank assets to different risk groups with preassigned risk-weights (0%, 10%, 20%, 50%, or 100%)
- This regulation created incentives for **risk-shifting**, which allowed banks to choose the **riskier assets within the same bucket**, as these assets provided higher returns but required the same amount of equity financing
- **Basel II** allowed banks to choose between two methods in order to compute the RWAs, only after receiving the approval to use these approaches:

1. The **Standard Methos** is the simplest approach, taken from Basel I, and is based on **external ratings** given by **credit agencies**
    - Bank's asset portfolio is classified in by type of counterparty / type of assets and, within each class, the weight varies by credit rating of the counterparty

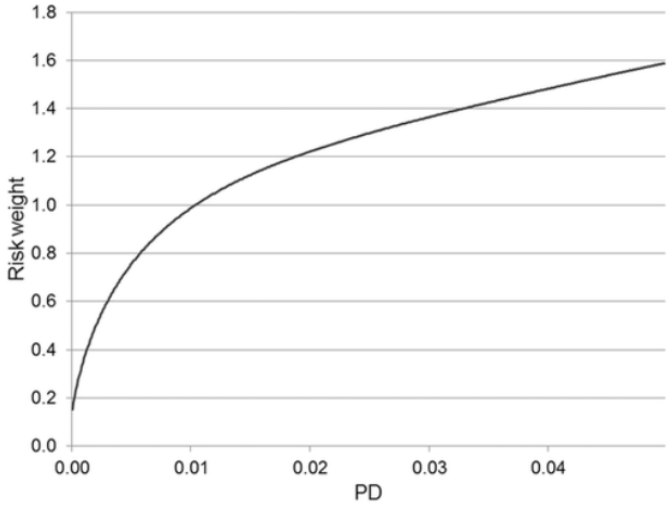
	Rating					
Standard and Poor's	from AAA- to AA-	from A+ to A-	from BBB+ to BBB-	Da BB+ to B-	< B-	No rating
Moody's	from Aaa to Aa3	from A1 to A3	from Baa1 to B3	Da Baa1 to B3	< B3	No rating
	Weight (%)					
Governments and Central Banks	0	20	50	100	150	100
Other Banks:						
Option 1	20	50	100	100	150	100
Option 2	20	50	50	100	150	50
				From BB+ to B-	< BB-	
Loans to Non financial firms	20	50	100	100	150	100
Retail loans	75					
Residential Mortgages	35					
Commercial Mortgages	50					

Main classes

- **Standard Approach: Example**

Amount or credit equivalent	Instrument (rating)	Weight	RWA
25,000	Cash and U.S. Treasury securities	0%	0
5,000	Interbank deposits (Other banks rating A+)	50%	2,500
5,000	Residential loans	35%	1,750
35,000	C&I loans (AAA firms)	20%	7,000
30,000	C&I loans (No rating)	100%	30,000
10,000	Unused loan commitments (B-)	100%	10,000
10,000	Stand-by letter of credit (AAA)	20%	2,000
		RWA_{RC}	53,250
	Minimum Capital requirement (8%)		4,260

2. The **Internal Ratings-Based** approach results from an internal process of measuring the borrower's creditworthiness:
   - This approach allows for a more adequate measurement, since a greater number of risk weights is possible
   - Using the **IRB approach**, banks use internal credit risk parameters to calculate the borrower's probability of default
   - Then, there is a **mapping** of the Probability of Default into Risk Weights (RW)



- The **IRB** requires the existence of a costly and extensive risk management system that had to be certified by the regulator:
    - Some banks have more than 100 different risk models with thousands of parameters in place
    - All of this requires constant validation and recalibration by the bank's risk management team
    - As such, the system was introduced only by the **largest banks**, while smaller banks initially remained under the **standard approach**

- One of the main concerns about the IRB approach is its **high complexity** and the possibility to game the system and reduce the capital burden:
    - Indeed, there is evidence from German banks at the introduction of Basel II that suggests that banks using IRB models **consistently underestimate risk** by exploiting the fact that regulators took time to validate models, thus the same bank could have both IRB and SA models in its pool of loans
    - Interestingly, despite the **lower probability of default**, the interest rates for IRB loans are **higher** because of higher default risk

➔ Therefore, this shows that banks know very well that IRB loans are riskier, but they artificially keep risk weights low to lower the capital charge.
    - This disproportionally benefitted large banks that use IRB

Market Risk

Market risk refers to changes in the **market value** of asset holdings, depending on **unexpected changes** in market conditions (e.g., interest rate risk, exchange risk)

The amount of capital required to cover unexpected losses due to market risk is measured using **VaR Models** (**%**)

- The models are based on the estimation of **expected losses** using statistical models
- The VaR tries to compute the maximum amount a bank might lose over a specific time period and confidence interval
- The **time period** and **confidence interval** are established by supervisors

Operational Risk

Operational Risk refers to the risk of loss resulting from **inadequate human resources**, **failures of processes** and **systems**, or from **external events**:

- This is the second most important risk after credit risk
- It includes internal or external frauds, weather damage, aging or faulty computer system, natural disaster

The Capital to protect against operational risk is determined by:

- **Basic Indicator Approach**, for which the capital requirement is equal to a fixed percentage of gross income
- More advanced approaches based on **internal models**

Basel III

Basel II was reformed in order to achieve different objectives after the financial crisis:

- Strengthening **global capital** and **liquidity rules** with the goal of promoting a more resilient banking sector
- Improving the banking sector's **ability** to **absorb shocks** arising from **financial** and **economic stress**, thus reducing the spillover-risk to the real economy
- Imposing **market discipline** by improving **risk-management** and **governance** as well as strengthening banks' **transparency** and **disclosures** (**Pillar 3**)
- Strengthening the capital requirements of **systemically significant** cross-border bank

Basel III introduced different important measures:

- It **considerably increased** the **quality** of banks' capital
- It **significantly increased** the **required level of capital** as well as it introduced stricter and common guidance on RWAs
- It reduced **systemic risk**, which is the risk that an event will trigger a loss of confidence in a substantial portion of the financial system that is serious enough to have adverse consequence for the real economy
- It increased **Risk Coverage**
- It introduced **Liquidity Requirements**

in percentage of risk-weighted assets	Capital requirements							Additional macroprudential overlay	
	Common equity			Tier 1 capital		Total capital		Counter-cyclical buffer	Additional loss-absorbing capacity for SIFIs*
	Minimum	Conservation buffer	Required	Minimum	Required	Minimum	Required	Range	
Basel II	**2**			4		**8**			
Basel III New definition and calibration	**4.5**	2.5	**7.0**	6	8.5	**8**	**10.5**	0–2.5	Capital surcharge for SIFIs?

* Modalities to be defined.

LENDING

Loans represent banks' dominant assets because they are **highly profitable**, both *directly* and *indirectly*:

- Indeed, **interest** and **fees** represent the net interest income and operating income for banks
- Loans are **indirectly** profitable because give the bank the possibility to cross-sell other fee-generating services (e.g., "*loans make deposits*")

Loans are extremely important from an economic perspective because they support the **growth** of new businesses and jobs within the lender's market area

- Indeed, banks act as **financial intermediators** and as **information providers**

Banks' Specialness is the ability of reducing asymmetric between ultimate suppliers and users of funds, thus distributing funds more efficiently than financial markets:

- They reduce *adverse selection* (ex-ante) because low quality clients are more likely to pay higher-rates, while good borrowers will self-select out
- They reduce *moral hazard* (ex-post) because, once the loan is made, the borrower has incentives to divert funds

In general, listed firms have a **positive abnormal return** on their stock price when they take a bank loan:

- On the other hand, when they announce a bond issuance, the **abnormal return** is **negative**
- Indeed, the market prices the **bank loan** as good news because of the ability of banks to lend to creditworthy borrowers

Banks also act as **information providers**, as they lend money to different individuals, thus obtaining information about their creditworthiness

- **SMEs** are usually **opaque borrowers** since they have low reporting requirements, however they usually borrow against collateral
- **Large Corporations** also borrow from banks because credit lines are a flexible product compared to bonds
- **Europe** is much more of bank-based system that the US, indeed US publicly listed companies have 60% of total debt deriving from the bond market

When designing the **Loan Agreement**, the bank must set up:

- The **Purpose** of the loan and the **Terms**, which include **amount**, **maturity** and **repayment** schedule, **collateral**, and **loan covenants** (**Loan Facility**)
- The **conditions** that bring about a **default**, such as late payments, or breaking loan covenants

The **true need and use** of loan proceeds determine the **loan amount** and **loan facility** (maturity, payment schedule, collateral)

Loans can be made for many different purposes:

- **Working Capital Loans** are loans made to meet short-term needs such as the purchase of inventories goods, materials, wages, interests on previous debts, dividends, taxes…
    - **Self-liquidating loans** are a sub-type of loans, typically collateralized by the firm's account receivables and with short-term maturity (60-90 days)
- **Capital Projects** for long-term investments in fixed-assets or R&D
- **Mergers & Acquisitions** through LBOs

Some examples of **Loans** to **businesses** include:

1. **Revolving Credit** and **Credit Lines**, which are loan commitments in which the bank promises funding on demand at predetermined terms:
    - The unused portion is kept for insurance purposes (like a credit card)
    - The interest is charged only on the used part of the loan, but fees are charged also on the unused part (**commitment fee**). The **utilization fee** may be applied if usage exceeds a certain threshold
    - The **maturity** of these credit facilities can vary, but many are below 1-year because they are mostly used for **working capital**

2. **Term Loans** are long-term loans (5-7 years on average) which are typically used for capital projects:
    - All funds are disbursed when the loan is signed
    - The payment structure can take several forms, as it can be either on an **instalment basis** (principal + interest), or they can be **Balloon Loans** (periodic interest payment until maturity + full principal at maturity)

3. **Syndicated Loans** are large corporate loans made by a group of lenders (the **syndicate**):
    - The loan is shared in tranches among banks in order to **reduce risk**
    - One or more banks can act as **lead arrangers** in charge of monitoring the borrower performance and collecting interest payments
    - They can be composed of both a term loan and a revolving credit line
    - Lenders' shares can be sold on the **secondary market**, but this is more likely to happen for participants' shares than for the lead arrangers who retain their shares
    - Participants are often **non-banks** such as **hedge funds**, who can actively trade shares

Some examples of **loans** to **households** include:

1. **Real Estate Loans** are loans made in order to purchase property and land:
    - These can also be commercial real estate for firms, but include mostly residential real estate for households
    - These loans are heavily **securitized**, especially in the US, where mortgages are packaged and used as collateral to issue MBS

2. **Consumer Loans** are individual loans made in order to finance the purchase of durable goods or education, medical care…
    - These loans usually are made for small amounts and are not secured
    - These loans can be short to medium term, ranging from one to four years
    - Furthermore, these loans are also highly standardized, since banks tend to specialize in consumer lending, and carry out credit analysis through **credit scoring system**

Managing Credit Risk

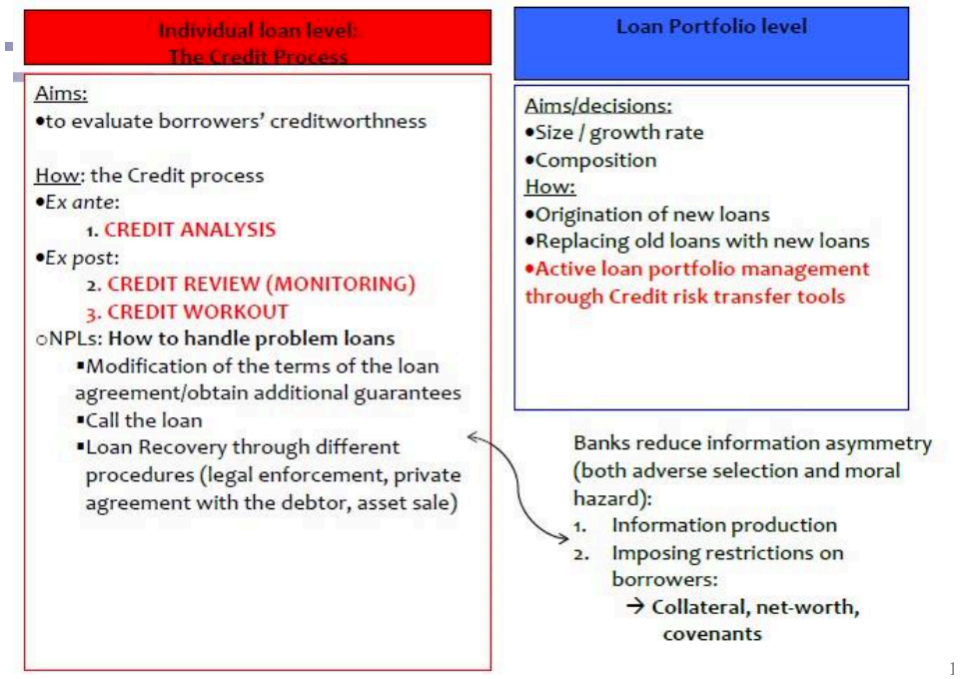
Lending is a profitable activity, but can be costly and risky because banks incur in **credit risk**:

- This is the risk that borrowers are either unable or unwilling to fulfill the terms promised under the loan agreement
- **Credit risk** can lead to **solvency problems** because when debts are not paid, net income and equity decrease from non-payment
- Furthermore, **liquidity risk** arises from the delayed payments

Banks manage **credit risk** both at an **individual** and **portfolio** level:

- At the **Individual Level** the aim is to evaluate the **borrower's ability** and **willingness** to repay the loan (*creditworthiness*) through the **credit process**, which includes credit analysis, credit review, and credit workouts

- At the **Portfolio Level** the aim is to **manage** the loan **portfolio volume** and **quality** through the origination of new loans, replacement of loans to maturity, and credit risk transfer tools (securitization and loan sales)



The **credit analysis** consists in a **screening phase** and has as main objective **assessing** the borrower's **creditworthiness** (ability to pay) in order to avoid two types of *loan errors*:

- Making a loan to a customer who will default
- Denying a loan to a customer who will repay the debt

Both **quantitative** and **qualitative** information (**hard** and **soft** information) are used:

- Banks not only need to assess the borrower's creditworthiness, but must also estimate the **collateral** as most loans are secured

Quantitative Information refer to the borrower's financial statements as well as his credit history:

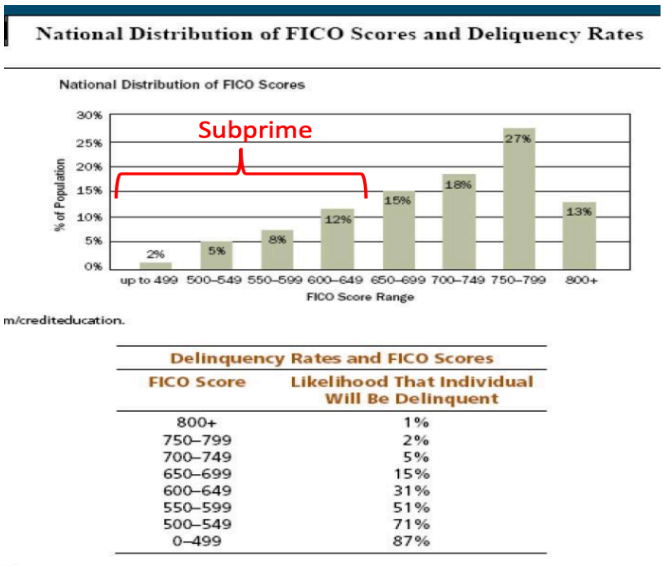
- The Financial Statements provide information about profitability, leverage, liquidity ratios, cash-flows analysis, and future projections
- The Credit History refers to information contained in centralized systems tracking a borrower's payment history, such us credit bureaus (US) and credit-registers (Europe)

Qualitative Information include:

- Quality of **Management, Corporate Governance** and **Ownership** structure
- Personal knowledge of the entrepreneur by the loan officer, which however is a subjective judgement

One example of Credit Scoring is the **FICO System**:

- The system provides a score to borrowers ranging from 300 (high credit risk) to 800 (low credit risk)
- Higher FICO scores increase the likelihood of obtaining credit and paying lower interest rates if accepted
- The score is based on **five** different types of information:
    1. Borrower's payment history (35%)
    2. Amount of money owed (30%)
    3. Length of the prospective borrower's credit history (15%)
    4. Nature of new credit being requested (10%)
    5. Types of credit that the borrower has already used (10%)



Delinquency Rates and FICO Scores	
FICO Score	Likelihood That Individual Will Be Delinquent
800+	1%
750–799	2%
700–749	5%
650–699	15%
600–649	31%
550–599	51%
500–549	71%
0–499	87%

Risk classification is important for different reasons:

- **Loan pricing**, since efficient pricing helps to reduce adverse selection
- **Loan Loss Provisions**, since these are set aside year-after-year in order to take into account potential loan losses. This is an expense item in the P/L account, and allows banks to recognize the estimated loss even before the actual loss realizes
- **Regulatory Risk Weights**, since these are used to set the minimum capital requirements

The evaluation of the borrower *per se* is not enough in context of high information asymmetry, therefore **collaterals** and **covenants** are also needed to estimate credit risk:

- The **collateral** allows to reduce both **adverse selection** and **moral hazard**, because low-quality borrowers will self-select into unsecured debt with high rates, and **collateral** makes default costly, especially if the loan is **over-collateralized**
- **Covenants** help to reduce moral hazard

Some examples of **Collateral** can be:

- **Real guarantees/assets** which can be of several possible types, both physical and financial (receivables, inventory, RE properties…)
- **Personal guarantees** which can be owner pledges of personal assets, both real and financial. However, this is a threat to the limited liability of a company, which is usually done by small business owners

Collateral assets have some main features that we can identify:

- **Value**, because the market value of the collateral exceeds the outstanding loan principal
- **Liquidity**, because collaterals must be ready for market sale
- **Legal Structure**, because the bank must have a clear and legal claim on the collateral, as well as seniority wrt other creditors

In general, the borrowers' **cash flow** is the **preferred** source of loan repayment, because **liquidating** the **collateral** is **costly** and **lengthy**, and for this reason the **collateral** is considered a **secondary source**:

- There are significant transactions costs associated with foreclosure
- Bankruptcy laws allow borrowers to retain possession of the collateral only after default
- Reduced marketability of the collateral
- The collateral value can deteriorate over time

Loan Covenants are arrangements aimed to protect against changes in the borrower's operating environment that may damage the bank. Covenants are of two types:

- **Positive** (**Affirmative**) **Covenants** indicate specific provisions to which the borrower must adhere to and take actions to fulfill the requirements
- **Negative Covenants** indicate financial limitations and prohibited events

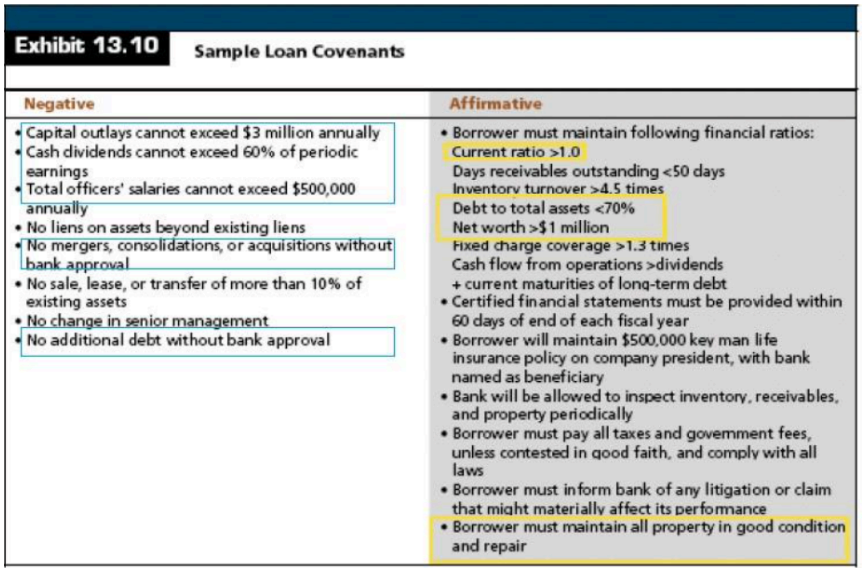


Exhibit 13.10 Sample Loan Covenants

Negative	Affirmative
• Capital outlays cannot exceed $3 million annually • Cash dividends cannot exceed 60% of periodic earnings • Total officers' salaries cannot exceed $500,000 annually • No liens on assets beyond existing liens • No mergers, consolidations, or acquisitions without bank approval • No sale, lease, or transfer of more than 10% of existing assets • No change in senior management • No additional debt without bank approval	• Borrower must maintain following financial ratios: Current ratio >1.0 Days receivables outstanding <50 days Inventory turnover >4.5 times Debt to total assets <70% Net worth >$1 million Fixed charge coverage >1.3 times Cash flow from operations >dividends + current maturities of long-term debt • Certified financial statements must be provided within 60 days of end of each fiscal year • Borrower will maintain $500,000 key man life insurance policy on company president, with bank named as beneficiary • Bank will be allowed to inspect inventory, receivables, and property periodically • Borrower must pay all taxes and government fees, unless contested in good faith, and comply with all laws • Borrower must inform bank of any litigation or claim that might materially affect its performance • Borrower must maintain all property in good condition and repair

Monitoring is fundamental to keep under control the **performance** of **existing loans** and reduce **moral hazard**:

- Examples:

1. How are loan proceeds used?
2. Have the borrowers' condition changed
3. Loan repayment schedule: are payments delayed?
4. Covenants: have been violated?
5. Quality and condition of collateral: Is this kept in good condition? Has the market price decreased?
6. Evaluation of borrower's financial conditions: Any major event at the borrower or industry level?
7. In case of problems, loan downgrading (according to the risk classification scheme) and higher provisions

Non-Performing Loans (**NPLs**) are usually defined as loans where payments are more than 90 days past-due, or that are unlikely to be repaid in full

These loans can be divided in **three subcategories**, from worst to best:

- **Bad Loans** are exposures to debtors that are insolvent or in substantially similar circumstances
- **Unlikely-to-Pay** (**UTPs**) loans are those loans in which banks consider the debtors unlikely to meet their contractual obligations in full unless action such as the enforcement of guarantees is taken
- **Past-due Exposures** are those where interest payments are more than 90 days late

The process of **recovering funds** from a problem loan situation can happen according to **two different strategies**, with the aim of maximizing the full recovery value:

1. **Restructuring the Loan** means modifying the terms of the loan agreement to increase the probability of full repayment. Modifications might include:
    - Deferring interest and principal payments
    - Lengthening maturities
    - Liquidating unnecessary assets
    - Providing new funds

2. **Procedures** for **loan recovery** can either be **Judicial** or **Extra-judicial**:
    - **Judicial enforcement** can be a lengthy process, especially in some jurisdictions
    - **Extra-judicial proceedings** consist in a negotiation between the debtor and creditor.

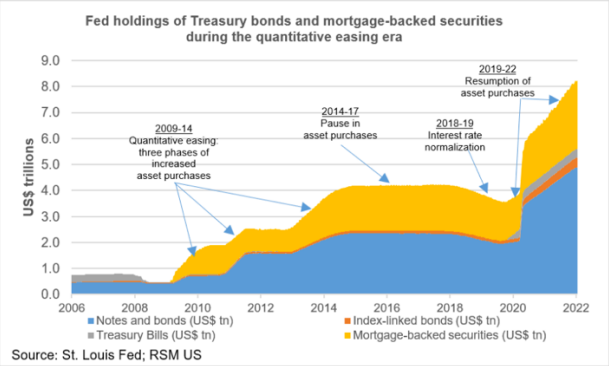
Furthermore, a bank may want to engage in **market solutions** by either selling or securitizing the stock of NPLs

TRANSMISSION OF MONETARY POLICY THORUGH BANKING SYSTEM

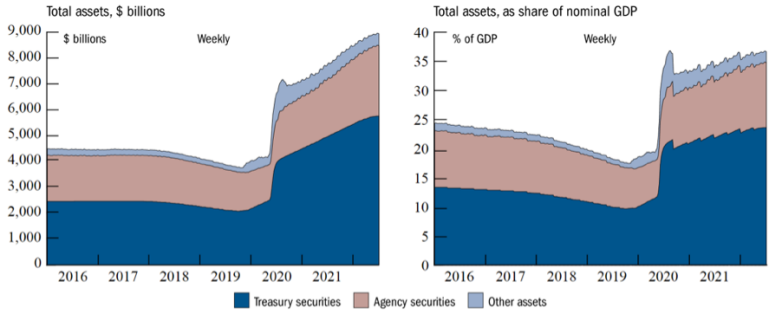
Central Banks Balance Sheet

Central Banks have in their balance sheets t**wo** main **Asset Classes**:

- **Securities** included mostly short-term government bonds before 2008. However, afterwards, long-term government bonds and other asset-backed securities started to become a large share of the BS (because of QE)
- **Loans to Financial Institutions** and other **Liquidity Facilities** are provisions of credit made to **help** financial institutions and **calm markets** during crisis times

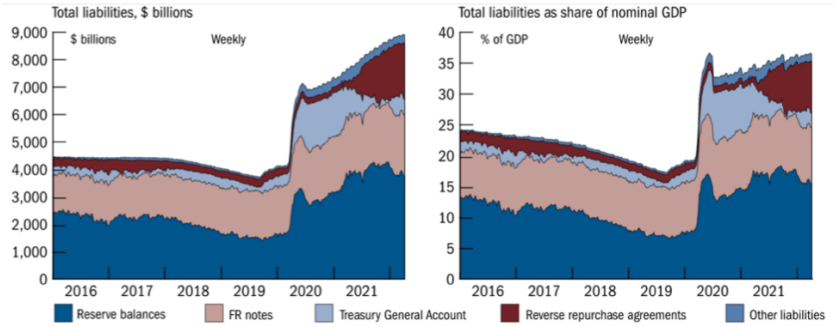


After Covid-19, there was a large expansion in Central Banks' Balance Sheets:



Central Banks have in their Balance Sheets **two** main **Liabilities**:

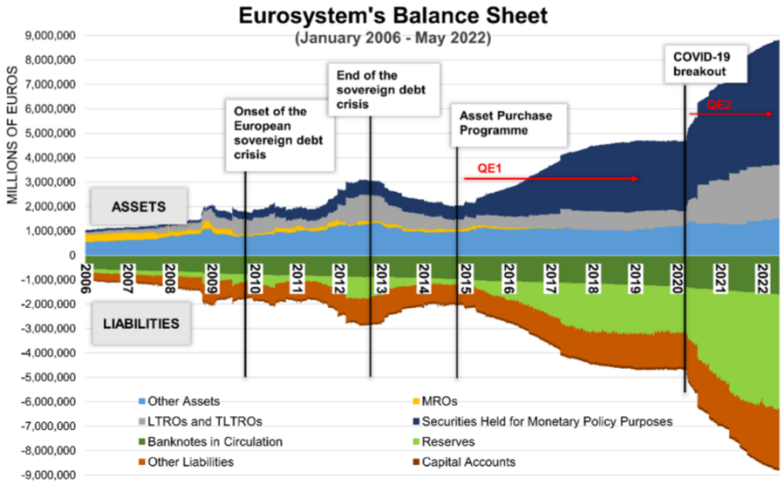
- **Currency in Circulation** refer to banknotes and coins in circulation, which grow at a constant rate with the economy
- **Reserves and Deposits from Banks** refer to the accounts that banks hold with the Central Bank, and these include:
    - **Required Reserves** (% of transaction-checking deposits) and **Excess Reserves**
    - **Other Liabilities** include reverse repos and other short-term funds



We can notice different trends in the ECB Balance Sheet:

1. From the **asset-side** perspective:
   - With the onset of the European sovereign debt crisis, Longer-Term Refinancing Operations (LTROs) started to be a substantial part of the ECB's assets, as the ECB was lending money to Banks with the aim to make loans
   - When the European Sovereign Debt Crisis ended, the BS contracted because the LTRO program almost stopped
   - Then, from 2015, the ECB started an Asset Purchase Program (QE1 and QE2) in order to inject liquidity in the economy and relieve banks' Balance Sheets

2. From the **liability-side** perspective:
   - Starting from the European Sovereign debt Crisis, Reserves and Other Liabilities have continued to increase in size
   - As of today, Reserves account for the largest part of liabilities on the ECB BS



FED Open Market Operations in Normal Times

Open market operations refer to either:

- The purchase or sale of securities by the FED from a set of banks (**primary dealers**)
- Loans made to financial institutions

The objective of **Open Market Operations** is to influence the amount of **money supply** (**bank reserves**)

- Bank reserves can be exchanged by banks in the **FED Funds market** (a **money market**), which are **safe**, **short-term**, **overnight** instruments

Suppose that the FED wants to purchase $100 mln in securities:

- In order to pay for them, the FED will have to **issue reserves** (**money**) for free
- The FED is the only bank that can do so

Therefore, when the **FED** purchases securities from the Open Market, it **expands its balance sheet**:

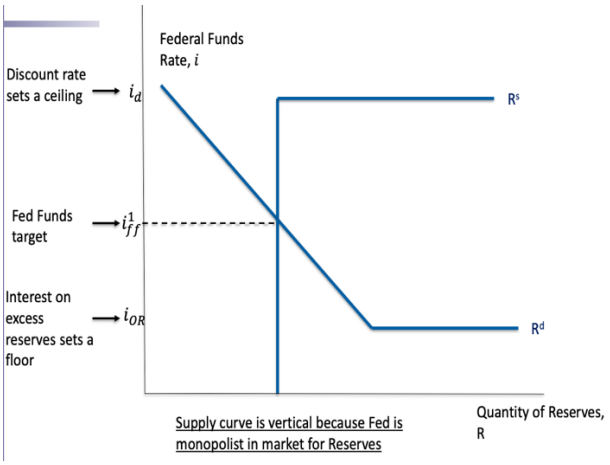
- On the other hand, the **Banking System** Balance Sheet does **not change size**
- This is because **Securities** are **credited** while **Reserves** are **debited**, and these can be **used** to **make new loans**

The Fed

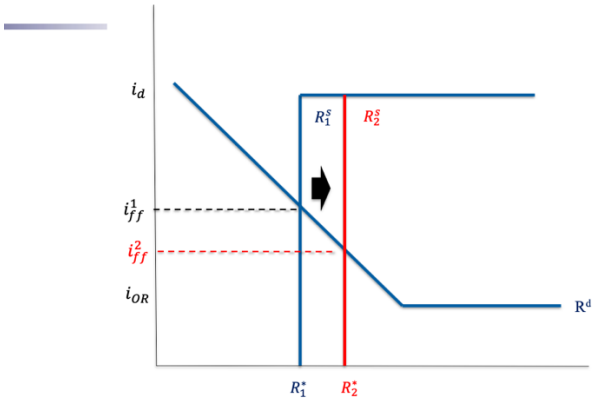
Assets	Liabilities
Securities +$100 m	Reserves +$100 m

Banking System

Assets	Liabilities
Securities –$100 m Reserves +$100 m	



Response to Open Market Purchase



Transmission of Monetary Policy

Monetary Policy impacts bank credit by giving money to banks who then lend it out to firms and households:

- By doing this, both the **short-term policy rates** and the **loan interest rates decrease**
- The same applies to a **contractionary monetary policy**, indeed by decreasing the quantity of reserves, lending contracts and the economy cools down

When CBs carry out **unconventional monetary policy** the type of security bought changes (MBS, long-term Treasury), but the principle remains the same

This is the **Bank Lending Channel** of monetary policy affirms that the effects of monetary policy show up on **bank credit supply**:

- Monetary policy shocks will also affect the **credit demand** by affecting the aggregate demand as well
- Therefore, it is not easy to distinguish what is due to supply or demand in the data

Even though the existence of a **Bank Lending Channel** is undisputed by now, traditional macroeconomic models only had a **monetarist view**, by only caring about **money** and **bonds**:

- By thinking about an IS-LM model, *i* influences investment and aggregate demand
- Indeed, in standard macro-models used by central banks before 2007-2008 there was no role for banking and finance in general

However, the 2007-2008 financial crisis showed that intermediation matters for the real economy, because banks are special as they are able to solve **asymmetric information problems** (by lending to firms that do not have access to the bond market)

- Hence, new models do **not assume** that **bonds** and **loans** are substitutes

There are **three** main theories as to why the bank lending channel exists:

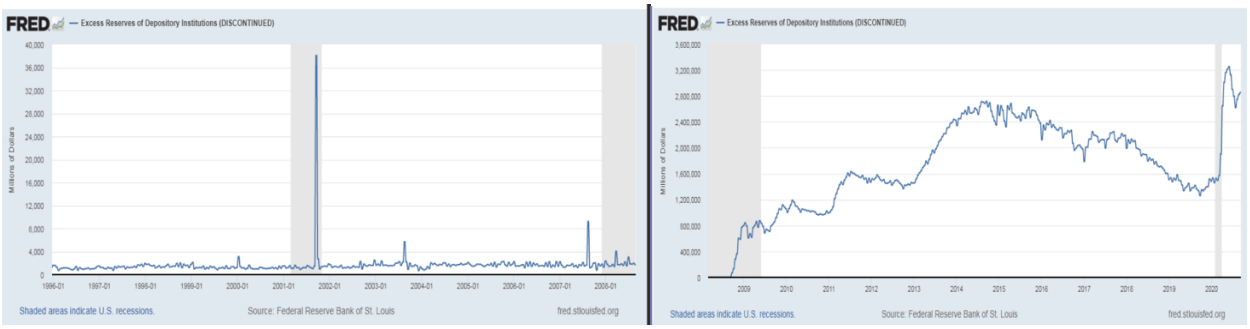
1. **Banks Reserves Channel**

➢ The traditional way in which was though to affect bank credit works on **Required Reserves**:

- When reserves are **drained**, banks have to reduce **reservable deposits** (checking accounts)
- Doing so constraints banks' ability to provide credit
- Even though banks can still borrow from other **funds** (CDs), these are typically **more expensive**, and their rates will increase too with **Fed Funds**

➔ If banks are **not able** to **perfectly switch** to **other funding**, they will **decrease** the **loan supply**

- This channel has not been active after 2008 because banks dispose of **ample excess reserves**, thus making required reserves not binding anymore



2. **Bank Profits / Capital Channel**

➢ Banks earn money by the different in interest rates from assets and liabilities:

- This **spread** is generally positive because of the **maturity mismatch** between the two:

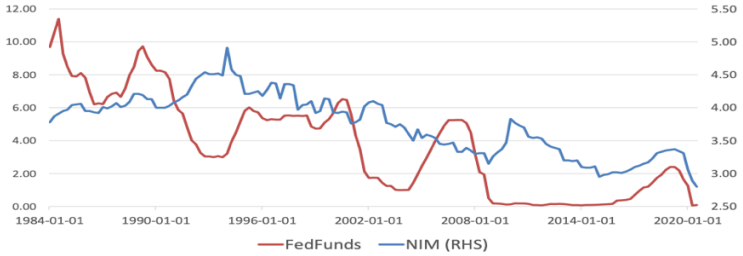
$$NIM = \frac{Interest\ Income - Interest\ Expenses}{Assets}$$

➢ Since monetary policy will affect both interest income and interest expenses, the **mix** of **fixed-rate** and **variable rate** assets will determine what happens to the **Net Interest Income**:

- For instance, if the bank has only 30-years fixed-rate mortgages financed with variable-rate CDs, an increase in interest rates will reduce profits
- If **profits decrease**, banks' willingness to provide new loans will decrease
- Indeed, the **capital** will decrease too, affecting banks' supply of credit

➢ In the data, it is not clear if the correlation between FED Funds and the NIM is positive or negative:

- Overall, the correlation is slightly positive, but the data shows also clear increases in the NIM when interest rates fall



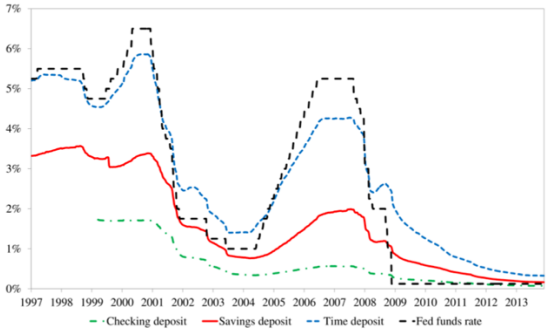
➢ In general, it seems that NIMs are quite **stable** compared to the FED Funds rate, which is much more volatile
  - **Stability** comes from the fact that both assets and liabilities are rate sensitive, matching **interest rate sensitivity** with **maturity mismatch**

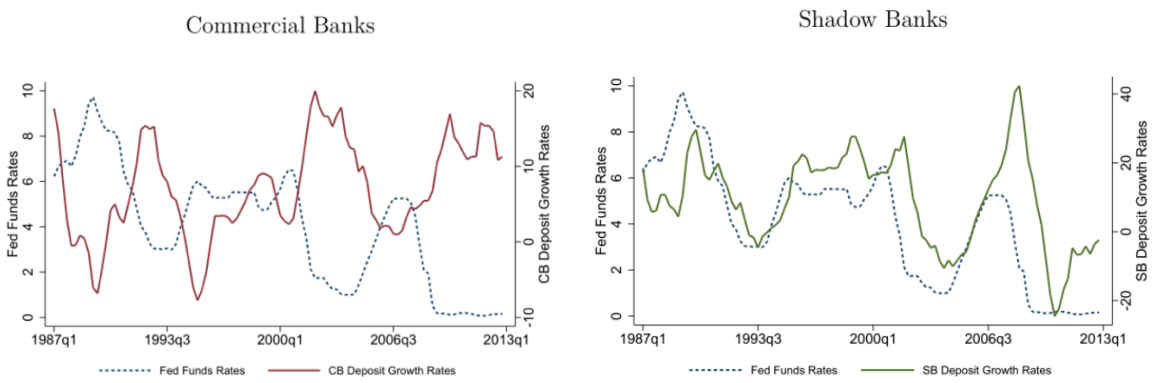
➢ A very strong finding is that **bank capital** affects the transmission channel of monetary policy:
  - Indeed, banks with **low capital expand credit supply** more than other banks and especially to **high-risk firms** when **monetary policy** is **expansionary**

➔ The reasons behind it are that:
  - Low capital banks want to **preserve/increase profit margins** by lending to high-risk firms when interest rates drop
  - Low capital banks may also be **less able to borrow** when rates rise because they are riskier banks
  - Low capital banks are also closer to the **minimum capital requirement** which, contrary to the reserve requirement, is **binding**

3. Market Power

➢ Empirical evidence shows that **savings** and **time-deposits rate** follow the **Fed Funds rate** more closely than deposits:
  - Therefore, this theory suggests that depositors will move money into CDs and other money market instruments when rates rise
  - Hence, when **rates rise**, commercial banks **lose deposits** as money flows from commercial banks to **shadow banks** (Money Market Mutual Funds)





- When rates rise, banks lose deposits and **deposit spread** (the difference between deposits and Fed Funds) **widens**
    - Since deposits are a major source of funding, credit will contract

➔ Banks do **not** increase deposit rates 1-to-1 with the Fed Funds rate because they enjoy **market power** that allows them to pay rates that are **insensitive to the market**:

- Indeed, banks' branch network gives banks market power over retail deposits, which are **sticky**
- Overall, this makes bank lose deposits and hence forego potential new lending opportunities but, at the same time, increase the profit margin per dollar

- **Recent research** suggests that banks are **strategic** in where they reduce credit and deposits:
    - Indeed, they do so especially in areas where there are **fewer other banks**, and thus, where the market is more concentrated
    - We can also think about a market power in the **loans market**

Sum-Up

There is strong evidence that monetary policy affects banks' credit supply mainly through **capital** and **deposit funding** (market power).

- However, there also are other effects of monetary policy on the economy

By lowering short-term rates, monetary policy influences also the **cost of borrowing** for **non-financial firms** that borrow on **bond** or **stock market**

- Indeed, because of **asymmetric information**, smaller, younger, and less-liquid firms will suffer stronger effects
- Short-term rates also affect **variable mortgage rates** directly

Furthermore, the effects on **expectations** are fundamental. For instance, the FED is now raising rates to slow aggregate demand but also to lower **inflation expectations**

Unconventional Monetary Policy

Traditional bank lending channel of monetary policy analyzes changes in **short-term rates** as shocks to monetary policy:

- However, after 2008 **monetary policy** has become **unconventional** through channels such as QE and other asset purchases

However, Unconventional Monetary Policy does not stimulate lending in the same way as through the lending channel:

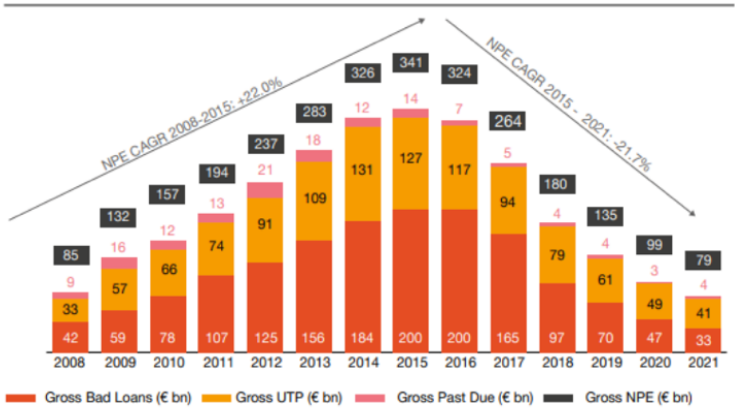
- Indeed, the type of asset bought matters, as QE1 and QE3 increased purchases of MBS, while QE2 focused on Treasuries
- Banks with **higher MBS holdings** increased lending more than others, but mostly of **mortgages** rather than corporate loans
- Therefore, these **unconventional monetary policies** may **crowd-out** lending to corporates

BANKS' ASSET QUALITY

Financial Crisis and **Fragmented Regulation** across European countries on **Non-Performing Exposures** have demonstrated how quickly and forcefully problems in the financial sector can spread:

- The graph shows how NPEs have evolved in Italy, one of the countries most impacted by the problem
- We can see that the peak in NPEs was in 2015, and this was because of the **lagging effect**, since NPEs started to show up from 10 to 24 months after the sovereign crisis
- The decrease from 2015 onwards may come from the fact that, after 2015, many banks started to sell their NPEs, thus freeing their balance sheets

Chart 1: Gross NPE trend



Source: PwC analysis on Banca d'Italia "Banche e istituzioni finanziarie: condizioni e rischiosità del credito per settori e territori", December 2021

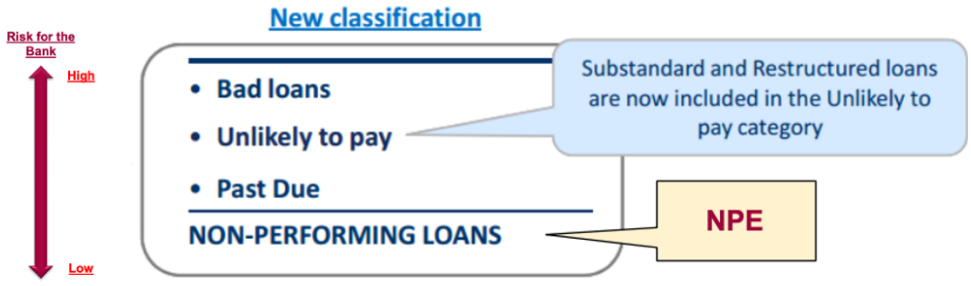
In 2013-2014, the ECB has assumed a supervisory role in order to monitor the financial stability of European Banks, and to create **common definitions** of NPEs in Europe:

- After establishing the necessary definitions, the ECB has run the **Comprehensive Assessment on Banks' Exposures**, based on an **Asset Quality Review** and a **Stress Test Scenario**
- The first **Stress Test** has been carried out in **2016**, in which 51 EU banks were involved in the exercise, and no immediate capital actions were required to banks based on the results of the exercise

The **EU-wide stress test** for 2020 was postponed to 2021 because of Covid-19

- However**, EU-wide stress tests** are now run regularly

These are performed by stressing some macroeconomics variables in order to see what happens to banks balance sheets



Starting from **2015**, following the completion of the **Comprehensive Assessment**, the **new classification** for Banks' Asset Quality has been created:

- **Bad Loans** are exposures to insolvent investors (even when the insolvency has not been declared by a court), or in essentially similar situations, regardless of any expected loss calculation made by the bank
- **Unlikely to Pay** are exposures in which the bank believes that the debtor is unlikely to pay its credit obligation in full (**principal** and **interest**), without embarking in actions such as the **realization of collateral**
- **Past Due** are exposures in which, at the reference date, there are more than 90 days past-due and exceed a given materiality threshold

Banks Asset Quality: Classification and Measures

The **Asset Quality Box** is usually found in investors' presentation and contains the Gross NPE, the Loan loss reserve on NPE, and the Net NPE:

Asset Quality Box	**Y1**
Gross NPE	Total NPEs the bank has
Loan loss reserve on NPE	Cumulated **Loan Loss Provisions** (expense on the P&L that becomes a **contra-asset** account)
Net NPE	Difference between the Gross NPEs and the Loan loss reserve

- The **Loan Loss Reserve** is never reported on the B/S because banks usually publish the **Net Loans to Customers**, which equals to the Total amount of Loans to customers minus the Loan Loss reserve

In order to understand better **Asset Quality**, we can calculate some ratios:

1. **Cash Coverage Ratio**:

$$Cash\ Coverage\ Ratio = \frac{Loan\ Loss\ Reserves\ on\ NPEs}{Gross\ NPEs}$$

   - *Ceteris paribus*, investors prefer a higher Cash Coverage Ratio because it allows the bank to incur smaller losses in case NPEs are written-off

2. **Cost of Risk ratio** (**bps**):

$$Cost\ of\ Risk\ Ratio\ (bps) = \frac{Loan\ Loss\ Provisions}{Gross\ Loans\ to\ Customers} * 10000$$

   - The ratio allows to understand what the yearly expense in the P&L account is, due to provisions for Loan Losses
   - The range for European banks is between 20 bps and 70-80 bps

3. **Gross NPE Ratio**:

$$Gross\ NPE\ Ratio = \frac{Gross\ NPEs}{Total\ Loans}$$

   - The Gross NPE Ratio does not take into account the Loan Loss Ratio
   - This is a powerful ratio because it allows to understand, from an investor perspective, what proportion of total loans is a NPE, disregarding provisions

4. **Net NPE Ratio**:

$$Net\ NPE\ Ratio = \frac{Gross\ NPEs - Loan\ Loss\ Reserves}{Total\ Loans}$$

5. **Texas Ratio**:

$$Texas\ Ratio = \frac{Gross\ NPEs}{Loan\ Loss\ Reserves + Capital}$$

- The formula allows to understand what the bank's **loss absorption capacity** is, assuming that all the Gross NPEs will be written off
- Banks try to keep the Texas Ratio **below one**, as they will still be a **viable institution** even if all of the Gross NPEs were written off

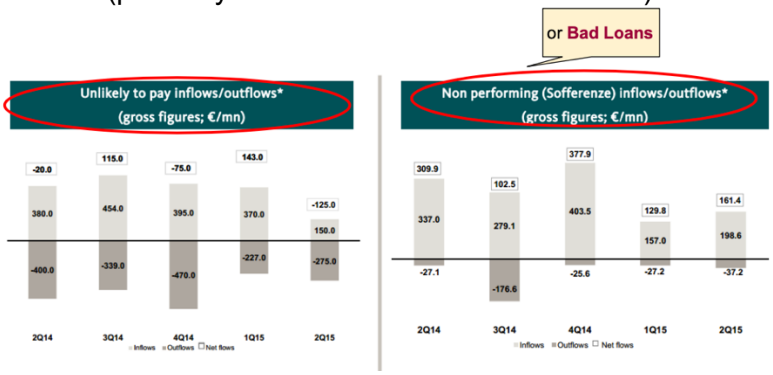
BPER Banca Example

Listed Banks report their earnings on a **Quarterly Basis**:

- The first part of these presentations is dedicated to **Asset Quality**

The tables below compare *inflows* and *outflows* of both **UTPs** and **Bad Loans**

- We can notice, for instance, that in 2Q14 UTPs have decreased, but Bad Loans have significantly increased (probably UTPs have become Bad Loans)



The **migration rates** tell us how Loans are reclassified:

- **Default Rate** is the percentage of total loans shifting from *in bonis* to NPEs
- **Danger Rate** is the percentage of total loans shifting from UTPs to Bad Loans
- **Cure Rate** is the percentage of total loans shifting from UTPs to *in bonis*

If we study the **cash coverage trend**, we can see that the ratio is higher for Bad Loans and lower for Past Due:

- This is because banks make larger provisions for loans that will more likely default
- *In Bonis* Loans also require a Cash Coverage because of a small probability that these will default (**prudent approach**)

Cash coverage trend (%)

	Jun 15	Dec 14	Jun 14
Non performing	56.9%	56.6%	56.5%
including write-off	*63.8%*	*63.9%*	*64.8%*
Unlikely to pay	20.1%	18.3%	18.5%
Past due	8.1%	8.1%	6.7%
Non performing	**41.8%**	**40.7%**	**39.4%**
including write-off	*47.8%*	*47.0%*	*46.5%*
In bonis	0.6%	0.6%	0.5%
Total loans	**10.1%**	**9.6%**	**9.0%**

or Bad Loans

or NPE

The Asset Quality Box is usually reported on quarterly presentations:

or NPE

Gross exposure (€/mn)	Jun 15		Dec 14		Jun 14		Chg 30/6 - 31/12 (A-B)		Chg 30/6 - 30/6 (A-C)	
	A	%	B	%	C	%	Abs.	Chg (%)	Abs.	Chg (%)
Doubtful loans	11,227	23.2%	10,998	22.6%	10,835	21.7%	229	2.1%	392	3.6%
Non-performing loans	6,727	13.9%	6,487	13.3%	6,079	12.2%	240	3.7%	648	10.7%
Unlikely to pay loans	4,150	8.6%	4,302	8.9%	4,397	8.8%	-152	-3.5%	-248	-5.6%
Past due loans	351	0.7%	209	0.4%	358	0.7%	142	67.7%	-8	-2.1%
Gross performing loans	37,096	76.8%	37,604	77.4%	39,055	78.3%	-507	-1.3%	-1,958	-5.0%
Total gross exposure	48,324	100.0%	48,602	100.0%	49,890	100.0%	-278	-0.6%	-1,566	-3.1%

or Bad Loans

Adjustments to loans (€/mn)	Jun 15		Dec 14		Jun 14		Chg 30/6 - 31/12 (A-B)		Chg 30/6 - 30/6 (A-C)	
	A	coverage (%)	B	coverage (%)	C	coverage (%)	Abs.	Chg (%)	Abs.	Chg (%)
Adjustments to doubtful loans	4,690	41.8%	4,472	40.7%	4,271	39.4%	218	4.9%	419	9.8%
Non-performing loans	3,826	56.9%	3,668	56.5%	3,433	56.5%	158	4.3%	393	11.5%
Unlikely to pay loans	835	20.1%	786	18.3%	814	18.5%	49	6.2%	21	2.6%
Past due loans	28	8.1%	17	8.1%	24	6.7%	11	67.4%	4	18.1%
Adjustments to performing loans	208	0.6%	211	0.6%	203	0.5%	-3	-1.3%	5	2.6%
Total adjustments	4,897	10.1%	4,682	9.6%	4,473	9.0%	215	4.6%	424	9.5%

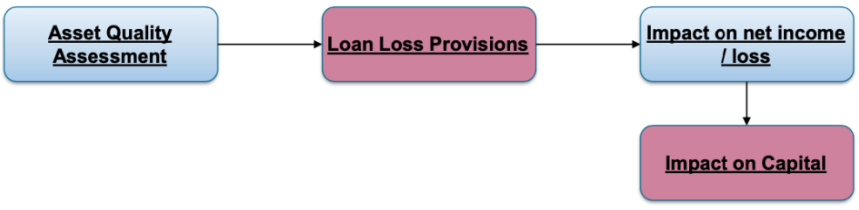
Net exposure (€/mn)	Jun 15		Dec 14		Jun 14		Chg 30/6 - 31/12 (A-B)		Chg 30/6 - 30/6 (A-C)	
	A	%	B	%	C	%	Abs.	Chg (%)	Abs.	Chg (%)
Doubtful loans	6,538	15.1%	6,527	14.9%	6,564	14.5%	11	0.2%	-26	-0.4%
Non-performing loans	2,901	6.7%	2,819	6.4%	2,647	5.8%	82	2.9%	254	9.6%
Unlikely to pay loans	3,314	7.6%	3,515	8.0%	3,583	7.9%	-201	-5.7%	-269	-7.5%
Past due loans	322	0.7%	192	0.4%	334	0.7%	130	67.7%	-12	-3.5%
Net performing loans	36,889	84.9%	37,393	85.1%	38,852	85.5%	-504	-1.3%	-1,964	-5.1%
Total net exposure	43,426	100.0%	43,920	100.0%	45,417	100.0%	-493	-1.1%	-1,990	-4.4%

- NPEs are broken down according to their category
- Then, Loan Loss Provisions are calculated for each category
- Finally, we can compute the Net exposures by subtracting the Gross Exposure and the Loan Loss Provisions

Asset Quality, Profitability, and Capital

These three elements are strictly connected with one another:

- Indeed, **poor asset quality** can generate large **Loan Loss Provisions**, which are negative items on the P&L
- If the Asset Quality is very poor, it can generate losses that have a direct **Impact on Capital**
- Furthermore, Asset Quality can have an indirect impact on capital because banks may have low profitability and, at the same time, RWAs may be increasing. This would lead to a constant CET1 for higher RWAs, which reduce the capital ratios



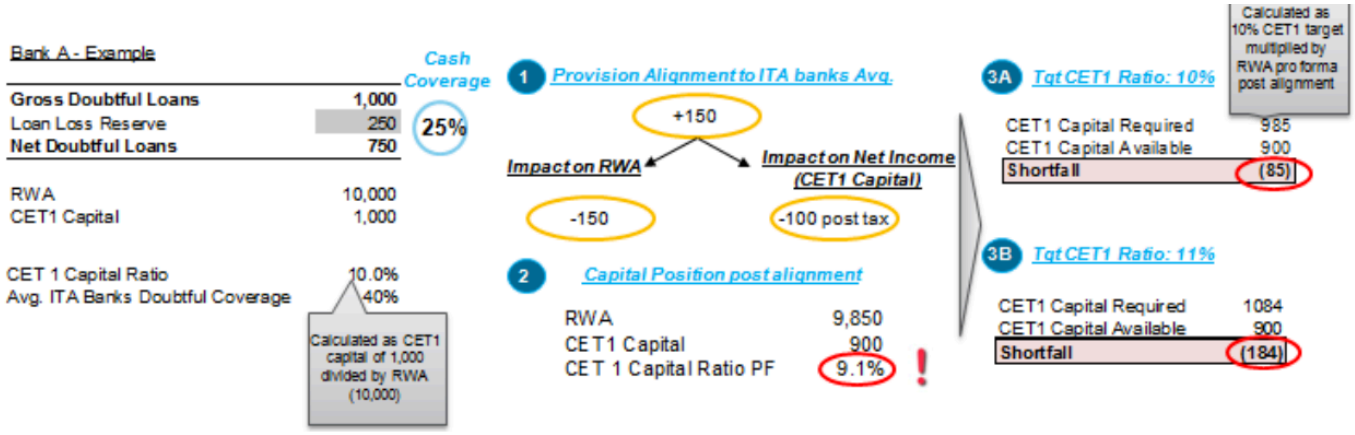
Example

Banks' exposures are *risk-weighted* by assessing the riskiness of each item to obtain **Risk-Weighted Assets**

- Risk Weights are defined by Regulators

- For the purpose of our example, assume that doubtful loans are risk-weighted 100%
- Regulators are focused on capital ratios that express the level of soundness and stability of a bank

➔ The most important capital ratio is the CET1 Ratio, and is calculated as the **ratio** between CET1 Capital and RWAs:
  - Regulators have provided CET1 targets to banks in the region of 10% and 11%



Current Banking Sector Challenges

1. ***Low Interest Rate Environment***

➢ The Low Interest Rate Environment (LIRE) has **penalized** banks **core profitability** and forced them to compete more on **commission income**
  - Indeed, interest income contribution to banks' revenues has been constantly decreasing over the last years
  - For traditional commercial banks, the **NII** represents at least **50-60%** of **Total Revenues**, and therefore a **decrease** in this line item would have a **significant impact** on the **overall profitability** of a bank
  - Furthermore, this situation may cause also concerns about the **cost** and **access** to **funds**, as well as concerns about **asset quality**

➔ In order to sustain profitability, in the recent years, banks advised their clients to move part of their investments towards **asset management**, **insurance**, and other **fee-based products**
  - This has led to a **strong improvement** in **commission income**, with banks targeting on their business plans aggressive Y-o-Y growth (even 10% *per annum*)
  - However, since the market has moved towards **fee-based products**, competition has increased significantly and, therefore, **long-term** sustainability and credibility of banks' projections might be at risk

2. ***Heavy Cost Structures***

➢ Banks face very high **fixed costs** because of their widespread branch presence on the territory, especially in Southern Europe
  - For this reason, banks are trying to further invest on new technologies, also because of more sophisticated clients requiring a massive investment on IT
  - At the same time, banks are trying to reduce the number of branches and employees and substitute them with new digital platforms

➔ There are some concerns about this shift of banks towards a more technological environment:

- Firstly, banks would be entering in a market where there are already **fintech incumbents**, who can be seen both as a threat and an opportunity
- Secondly, many are concerned about the **Too Big to Change** problem
- In general, banks are trying to exploit the **partnership approach** to drive this change (e.g., payments partnerships across multiple jurisdictions, Starling Bank and Funding Circle in the UK)

3. ***Asset Quality***

➢ Asset Quality was one of the main problems affecting EU banks in the past few years:
- **Provisions for Loan Losses** have wiped out banks' core profitability
- Furthermore, the **coverage levels** of NPLs have reached roughly 45%

➔ Solving the asset quality issue could restore confidence in the banking industry and lead to a **re-rating** of the entire sector

➢ Regarding **Non-Performing Exposures**, **Covid-19** has led to the creation of new Non-Performing Exposures, as well as to the delay in the collections of existing NPE:
- This has led to **related measures** from the **Government** and a **lag effect**

4. ***Capital***

➢ Capital Ratios improved in the last years following a series of extraordinary actions undertaken by EU banks:
- These actions included **Right Issues** and **Asset Disposals**
- However, much stricter requirements are and will be applied to banks in the future
- In addition, **asset quality** and **capital** are **interconnected**

5. ***Regulatory Uncertainty and Cost of Regulation***

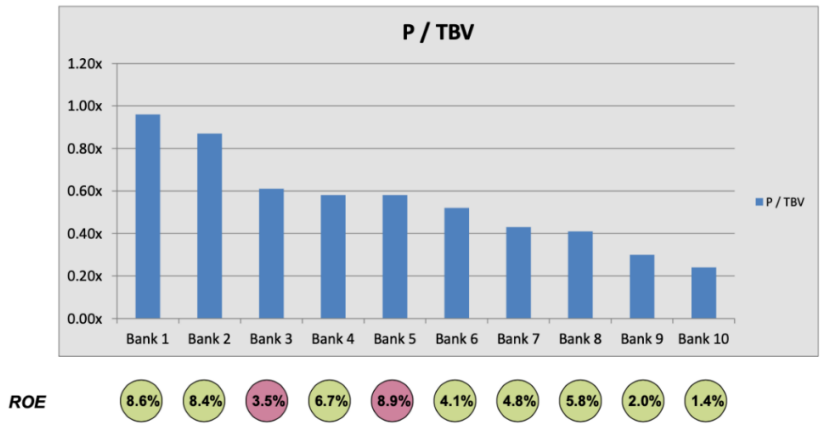
➢ The **rapidly evolving** regulatory environment has led to increasing **regulatory costs**:
- **National** and **Cross-Border M&A** could be a way to **solve** some of the **identified issues**. However, regulatory certainty is key in such transactions (e.g., ISP-UBI transaction, announced in Italy during Covid-19)
- Larger banks have easier life in keeping up with regulation, while costs of regulation can be troublesome for smaller banks

Current Trading Levels and Key Relationships

Banks low profitability and asset quality currently has an impact on their market capitalization:
- Indeed, banks are trading right now at P/BV multiples below 1
- **This means** that the market value of banks equity is lower than the book value

In general, the **Banking sector Stock Re-Rating** cannot happen without first solving the **Asset Quality** and **Profitability issues**

$$\frac{P}{TBV} = \frac{Mkt\ Cap}{Shareholders' Equity - Intangibles}$$



From the graph above we can see that P/TBV and ROE are positively correlated

- It is market practice to perform a **regression analysis** between **ROE** and **P/TBV** in order to understand if some banks are under or over-valued

➢ Bank 1 is trading almost at book value, meaning that investors are assuming that the cost of equity is slightly higher from the ROE, but does not deviate a lot from it

1. ***ROE-TBV Relationship – Methodology A***

$$\frac{Price}{TBV} = \frac{Price}{EPS} * \frac{EPS}{TBV\ per\ Share} = \frac{P}{E} * ROE$$

- $TBV\ per\ Share = \frac{Tangible\ Book\ Value}{\#\ of\ Shares}$
- $EPS = \frac{Net\ Income}{\#\ of\ Shares}$

➢ We can see that there is a **Positive Correlation** between the ROE and the P/TBV:
  - This relationship is studied by **hedge funds** and **portfolio managers** in the stock selection

2. ***ROE-TBV Relationship – Methodology B***

➢ The price of a stock can be expressed using the stable growth DDM:

$$P_0 = \frac{DPS_1}{k_e - g}$$

- The DPS can also be expressed as $\boldsymbol{DPS_1 = EPS_1 * Payout}$, thus we get:

$$P_0 = \frac{EPS_1 * Payout}{k_e - g}$$

➢ The ROE can be defined as:

$$ROE = \frac{EPS_1}{BV\ per\ share_0}$$

- Thus, if we express the EPS as $\boldsymbol{EPS_1 = ROE * BV\ per\ share_0}$, we get:

$$P_0 = \frac{ROE * BV\ per\ share_0 * Payout}{k_e - g}$$

➔ If we divide both sides of the above equation by the Book Value per share, we obtain:

$$\frac{P_0}{BV\ per\ share_0} = \frac{ROE * Payout}{k_e - g}$$

➔ If we define ROE using earnings at *t=0*, the above formula can be stated as follows:

$$\frac{P_0}{BV\ per\ share_0} = \frac{ROE * (1+g) * Payout}{k_e - g}$$

➢ From the above formula, we can see that the PBV is an **increasing function** of **ROE**, the **stable growth rate**, and the **payout ratio**
- On the other hand, it is a **decreasing function** of the **risk** of a firm

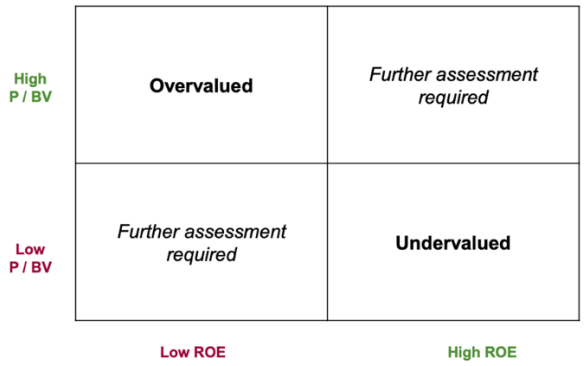
➢ If we define the growth rate as the product of ROE and one-minus the payout ratio [i.e., $\boldsymbol{g = ROE * (1 - Payout)}$] the formula can be simplified as such:

$$\frac{\boldsymbol{P_0}}{\boldsymbol{BV\ per\ share_0}} = \frac{\boldsymbol{ROE - g}}{\boldsymbol{k_e - g}}$$

➔ The bottom-line consideration here is that if a company manages to **outperform** its **cost of equity** (i.e., ROE>*Ke*), it should **trade above BV**
- It is therefore not surprising that stocks of banks with poor ROE, which are below *Ke*, are trading at P/BV multiples below 1

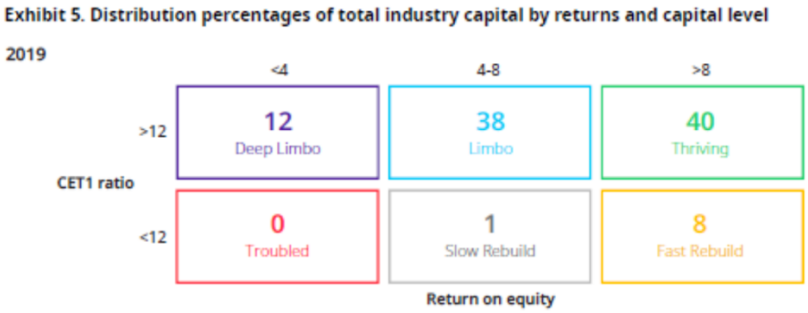
Valuation Matrix

This graphic representation is an alternative to a **regression analysis,** and it is used to determine whether a bank is over- or undervalued
- Keep in mind that the ROE calculated must consider a sustainable Net Income
- Therefore, it must exclude one-off expenses/income that is not assumed to be sustainable in the long-run



Oliver Wyman has classified the health of banks based on their CET1 Ratio and ROE:

- Banks with low CET1 and low ROE are considered to be in trouble because they are not profitable enough in order to increase CET1 to their target



Economic Impact from Selling NPLs

Removing NPEs from banks' balance sheets has several benefits, including:

- A **reduction** in **RWAs**
- Potential improvements of **Capital Ratios**, depending on the **sale price**
- Improvements on **asset quality indicators** and **market perception**
- It leaves room for **capital re-deployment** on **more profitable** business

Furthermore, selling NPLs can remove the risk of further **credit deterioration** and **increase of coverage**, since banks have to account for potentially **less Loan Loss Provisions**, consequently having **higher profits** and **ROE**

Example: Selling NPLs at Carrying Value

Starting data on bank's capital

CET1 capital	1,000
RWA	10,000
CET 1 capital ratio	10%

- Key data on identified portfolio of non performing loans to be sold

Gross non performing loans	1,000
Loan loss reserves	700
Net non performing loans	300
Risk weigthed assets	300

- Risk weighted assets assuming a risk weight of the portfolio sold of 100% (300*100%)
- Sale Price: 300
- Impact on CET1 capital = 300 – 300 = 0
- Impact on RWA = -300
- Resulting capital position post sale

	Pre	Sale	Post
CET1 capital	1,000	0	1,000
RWA	10,000	-300	9,700
CET 1 capital ratio	10.0%		**10.3%**

However, Banks may not be selling their NPEs portfolios at **Carrying Value**:

$$Carrying\ Value = \boldsymbol{Gross\ NPEs} * (\mathbf{1} - \boldsymbol{Cash\ Coverage}) = \boldsymbol{Net\ NPEs}$$

- If the **Sale Price** is lower than the **Carrying Value**, the bank will have to account for a **Loss** in the **P&L**

However, the **Loss** in the **P&L** does **not** necessarily **imply** that the firm will have a **Negative Impact** on the **Capital Ratio**

- However, if the sale price of the exposures is too low, the Capital Ratio will deteriorate

Example: Selling NPLs below Carrying Value

Starting data on bank's capital

CET1 capital	1,000
RWA	10,000
CET 1 capital ratio	10%

- Key data on identified portfolio of non performing loans to be sold

Gross non performing loans	1,000
Loan loss reserves	700
Net non performing loans	300
Risk weigthed assets	300

- Risk weighted assets assuming a risk weight of the portfolio sold of 100% (300*100%)
- Sale Price: **280**
- Impact on CET1 capital = **280** – 300 = **-20** *(no tax impact assumed)*
- Impact on RWA = -300

- Resulting capital position post sale

	Pre	Sale	Post
CET1 capital	1,000	-20	980
RWA	10,000	-300	9,700
CET 1 capital ratio	10.0%		**10.1%**

- **P&L Loss: -20**
- **Capital impact positive of ~10bps**

INVESTMENT FUNCTION IN FINANCIAL-SERVICES MANAGEMENT

Buying and **Selling Bonds** is not the primary activity of most banks, however it is important to mention that banks do not allocate their funds only to loans for different reasons:

- Liquidity
- Risk
- Diversification, including geographical diversification for smaller institutions
- Tax Efficiency
- Stabilize income

In general, between 20% and 33% of all assets of a bank are allocated to **investments in securities** that are **under management** of **investment officers**:

- Investments include **government** and **corporate bonds**, **ABS**, …

Banks can invest in mainly **two groups** of **financial assets**:

- **Money Market Instruments**, characterized by maturity within a year, low risk, and high liquidity
- **Capital Market Instruments**, characterized by maturity beyond a year, high expected return and risk, and liquidity inversely proportional to the market volatility (the higher the volatility, the lower the liquidity)

Popular Money Market Instruments

1. **Treasury Bills** (**T-Bills**) are short-term government bonds that have a short-term maturity since inception:
    - T-Bills are characterized by a high degree of **safety** and **liquidity**, and could be used for **collateral borrowing**
    - T-Bills are either issued at **discount or par**, and the **yield** consists on **price appreciation** as the bill approaches maturity

2. **Short-Term Treasury Notes and Bonds** (BTP in Italy) usually have original maturities of more than a year, but since they come within one year of maturity, they are considered **money market instruments**:
    - **Notes** have original maturities between 1 and 10 years, while **Bonds** have original maturities of more than 10 years
    - These instruments are **more sensitive** to **interest rate** movements and **less marketable** than T-Bills, with higher risk and higher returns
    - Usually, these are **coupon instruments**
    - These securities can be used for **collateral borrowing**

3. **Federal Agency Securities** (Cassa Depositi e Prestiti in Italy) are marketable notes and bonds sold by agencies owned by or sponsored by the federal government (such as Fannie Mae or Freddie Mac in the US):
    - Even though these securities are **sponsored** by the government, they do **not** have **explicit government guarantee**, although investors believe the government would rescue an agency in trouble
    - Because investors believe the government would always rescue an agency in trouble, **Agency Yields** are in line, or slightly above, with those on Treasury securities, and are characterized by high liquidity
    - Federal Agency Securities can be used for **collateral borrowing**

4. **Certificates of Deposit**
5. **Eurocurrency Deposit**
6. **Banker's Acceptances**
7. **Commercial Paper**
8. **Short-Term Municipal Obligations**

Popular Capital Markets Investment Instruments

1. **Treasury Notes and Bonds** are government instruments with maturity of over one year (see Short-Term Treasury Notes and Bonds above)

2. **Corporate Notes and Bonds** are marketable debt instruments issued by firms:
    - *Corporate Notes* have maturity within 5 years
    - *Corporate Bonds* have maturity of more than 5 years
    - These securities have **higher pre-tax yields** with respect to government securities because of higher risk
    - However, these securities can **sustain banks' income**, especially during **low interest rates periods**
    - Keep in mind that the income generated by these securities is **taxable**

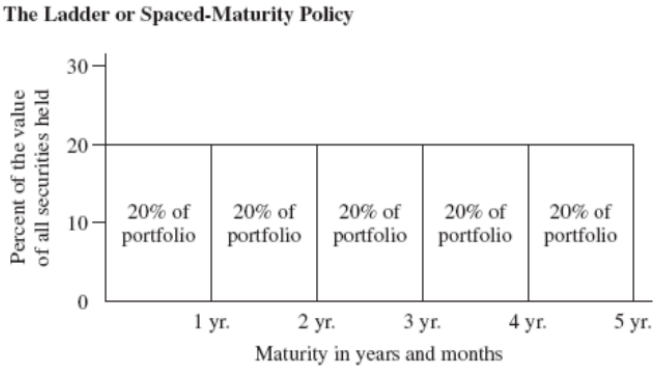
Investment Maturity Strategies

Once the investment officer chooses the **type of securities**, he believes the financial institution should hold, he needs to decide **how to distribute** those security holdings **over time**:

We can have **five** different **maturity distribution strategies**:
- The *Ladder* or *Spaced-Maturity Policy*
- The *Front-End Load Maturity Policy*
- The *Back-End Load Maturity Policy*
- The *Barbell Strategy*
- The *Rate Expectation Approach*

1. ***Ladder* or *Spaced-Maturity Policy***

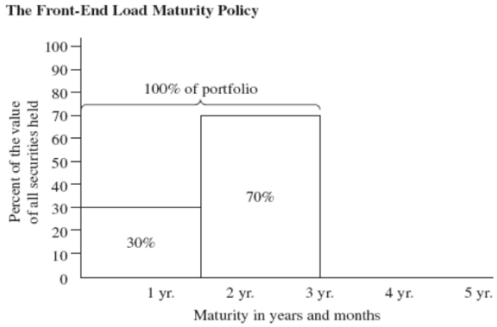
➢ The strategy is to **divide** the **investment portfolio equally** among **all maturities** which are **acceptable** to the investing institutions:
    - The main advantages are a **reduction** in **investment income fluctuations**, and it requires **little management expertise**
    - Furthermore, the investment strategy is flexible and allows to take advantage of other investment opportunities, since some securities are always rolling over into cash



2. ***Front-End Load Maturity Policy***

➢ The strategy is to invest **only** in **short-term** securities:

- This is a *liquidity strategy*, in order to be able to easily liquidate all securities
- Furthermore, the strategy **limits** the FI exposure to **rate fluctuations**, which could create capital losses

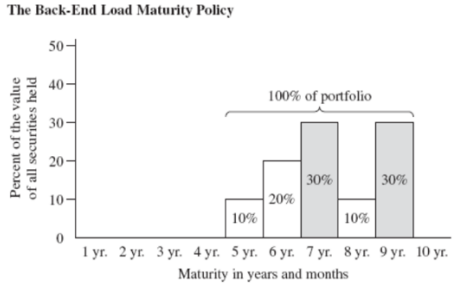


3. ***Back-End Load Maturity Policy***

➢ The strategy consists in investing **only** in **long-term securities**:

- The investment strategy **maximizes** the **income potential** from security investments, especially if **interest rates** are expected to **fall**
- This strategy creates an investment portfolio that also is a **source of income**

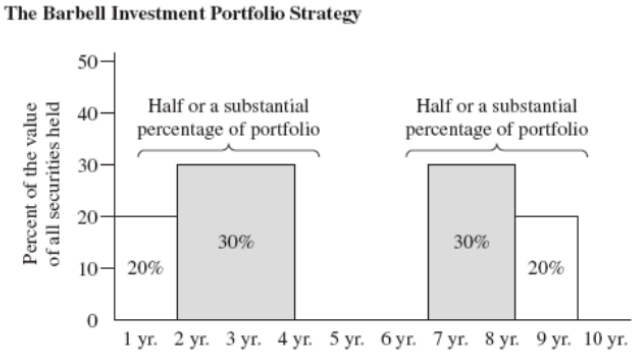
➔ However, it is fundamental for the FI to have **other sources of funding** to satisfy short-term liquidity needs



4. ***Barbell Strategy***

➢ The strategy consists in dividing security holdings into **short-term** and **long-term** securities, with no holdings of intermediate securities:

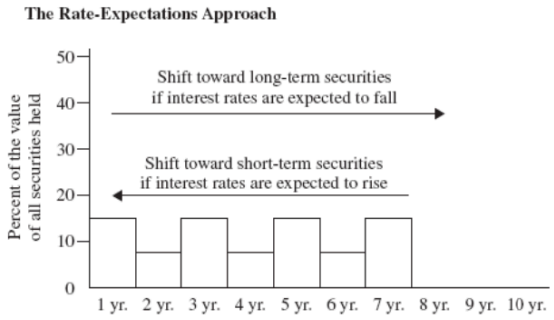
- This is one of the mostly used strategies in practice because of its flexibility
- The main advantage is that the FI can meet **liquidity needs** with **short-term securities**, while retaining **income potential** thanks to the **long-term securities**



5. ***Rate Expectation Approach***

- The strategy consists in **changing** the **mix** of **investment maturities** as the **interest rate expectations change**:
  - This approach allows to **maximize** the potential returns
  - However, this is a **high-risk strategy** that heavily relies on forecasts
  - Furthermore, the banks must incur **high transaction costs** to switch the investment portfolio

➔ For these reasons, the strategy is applied only to a **limited portion** of the banks' portfolio



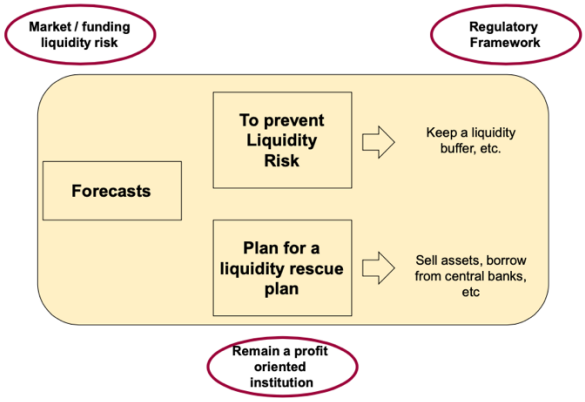
LIQUIDITY AND RESERVES MANAGEMENT: STRATEGIES AND POLICIES

A financial firm is considered to be **liquid** if it has **ready access** to **immediately spendable funds** at a **reasonable cost**, at precisely the **time** in which those **funds** are **needed**

- Liquidity is fundamental for banks because of the **maturity mismatch**, which is also the **core** of the **banking activity**

A financial institution's **Treasury Function** has to make **forecasts** in order to **Prevent Liquidity Risk** and **Plan** for a **Liquidity Rescue Plan**:

- In order to prevent **Liquidity Risk**, banks usually keep a **liquidity buffer**
- A **Liquidity Rescue Plan** is a set of guidelines fundamental to keep the FI as a **profit-oriented institution** in the case of a liquidity drain
- Regulators are also interested in the **Rescue Plan**, which comprehend measures such as asset sale and central bank borrowing



After 2008, Basel III introduced **two liquidity ratios**, that require banks to have a minimum amount of liquidity.

The **Treasury Function** is fundamental because the core business of a bank is *borrowing short and lending long*, therefore the **Treasures** ensures that the bank has **enough liquidity.**
The **Treasurer** must know the firm's **Net Liquidity Position** and the factors affecting it:

1. **Supplies of Liquidity Flowing into the Financial Firm** (**+ Liquidity**)
    - **Positive changes of liabilities**, such as incoming deposits and bond issuances
    - **Negative changes of financial assets** such as customer loan repayments or sale of securities
    - **Sale of real assets** such as real estate
    - **Borrowings from the money market or Paid capital increase** (increase in equity by shareholders)
    - **Revenues** from the sale of **nondeposit services**, such as commissions and dividends

2. **Demands on the Financial Firms for Liquidity** (**– Liquidity**)
    - **Negative changes in liabilities** such as deposits withdrawal and bonds repayment
    - **Positive changes in financial assets**, such as new loans granted and the acquisition of securities
    - **Acquisition of Real Assets** such as Real Estate
    - **Financial Costs** as dividends repayments to stockholders and interest expenses
    - **Non-financial Costs** and **Operating Expenses** such as salaries and rent
    - **Taxes**

These various sources of **liquidity demand and supply** come together to determine each financial firm's **Net Liquidity Position** at any moment in time:

- If the **Net Liquidity Position** is below zero, we have a **Liquidity Deficit**, while a positive **Net Liquidity Position** is called a **Liquidity Surplus**

$$\text{A financial firm's net liquidity position } (L_t) = \underbrace{\text{Incoming deposits (inflows)} + \text{Revenues from the sale of nondeposit services} + \text{Customer loan repayments} + \text{Sales of assets} + \text{Borrowings from the money market}}_{\textit{Supplies of Liquidity Flowing into the Financial Firm}} - \underbrace{\text{Deposit withdrawals (outflows)} - \text{Volume of acceptable loan requests} - \text{Repayments of borrowings} - \text{Other operating expenses} - \text{Dividend payments to stockholders}}_{\textit{Demands on the Financial Firm for Liquidity}} \quad (11\text{–}1)$$

Liquidity Management Strategies

1. ***Asset Liquidity Management*** (***Asset Conversion***)

➢ This strategy consists in **storing liquidity** in **assets**, predominantly in **cash** and **marketable securities**:

- When liquidity is needed, selected assets are converted into cash until all demands for cash are met

➔ Liquid assets need to be:

- **Readily marketable**, meaning that the cash conversion happens quickly and with no delay
- **Stable in Price**, meaning that the market must be **deep**
- **Reversible**, meaning that the **risk of loss** is **limited**

➢ However, keep in mind that this approach is **not costless** because of different reasons:

- Transaction costs
- High liquidity implies low returns
- Cost of foregone income once assets are sold

2. ***Borrowed Liquidity*** (***Liability***) ***Management***

➢ This is a good and easy to implement strategy that consists in **borrowing immediately spendable funds** to **cover** all **anticipated demands** for **liquidity**:

- The strategy allows a FI to **borrow only when it needs**
- Furthermore, the FI does **not need to change asset composition**, and can **continue** to **hold assets** it is **satisfied with**
- Lastly, it is a **flexible strategy** as banks can **borrow more** if they need

➔ However, this is also one of the **riskiest strategies** because **interest rates** are **volatile** and **credit availability** can **change**

- Indeed, FI may need to purchase liquidity when it is **most difficult** to do so, both in terms of availability and cost (e.g., Lehman Brothers)

3. ***Balanced Liquidity Management***

➢ This strategy is a mix between the two strategies above, since **part** of the **liquidity needs** are satisfied by **holding liquid assets**, while part is satisfied through **borrowings**:

- When the bank faces **unexpected liquidity needs**, these can be addressed by **short-term borrowing**
- On the other hand, **expected** or **longer-term liquidity needs** are forecasted and specifically addressed (for instance, if there is a bond expiring in two years, the treasurer will ensure that the cash will be available to cover it)

Estimating Liquidity Needs

Estimating Liquidity Needs is fundamental in order to address specific short- and long-term liquidity needs:

- This can be done using two different methodologies

1. ***Sources and Uses of Funds Approach***

Step 1

➢ **Loans** and **deposits** must be **forecasted** for a given **time period**:

- In order to do so, **different methodologies** could be adopted by the banks' internal research department
- The common practice is to **break down** the **forecasts** into **three components**:
  - **Trend**
  - **Seasonality**
  - **Cyclicality**

Deposit Forecast for	Trend Estimate for Deposits	Seasonal Element *	Cyclical Element **	Estimated Total Deposits
January, Week 1	$1,210	−4	−6	$1,200
January, Week 2	1,212	−54	−58	1,100
January, Week 3	1,214	−121	−93	1,000
January, Week 4	1,216	−165	−101	950
February, Week 1	1,218	+70	−38	1,250
February, Week 2	1,220	+32	−52	1,200
Loan Forecast for	**Trend Estimate for Loans**	**Seasonal Element ***	**Cyclical Element ****	**Estimated Total Loans**
January, Week 1	$799	+6	−5	$ 800
January, Week 2	800	+59	−9	850
January, Week 3	801	+174	−25	950
January, Week 4	802	+166	+32	1,000
February, Week 1	803	+27	−80	750
February, Week 2	804	+98	−2	900

Step 2

➢ The **estimated changes** in **loans** and **deposits** must be calculated in order to raise cheap funds when a **Liquidity Deficit** is expected, and **invest** in **profitable opportunities** when a **Liquidity Surplus** is expected

Time Period	Estimated Total Deposits	Estimated Total Loans	Estimated Deposit Change	Estimated Loan Change	Estimated Liquidity Deficit (−) or Surplus (+)
January, Week 1	$1,200	$ 800	$____	$____	$____
January, Week 2	1,100	850	−100	+50	−150
January, Week 3	1,000	950	−100	+100	−200
January, Week 4	950	1,000	−50	+50	−100
February, Week 1	1,250	750	+300	−250	+550
February, Week 2	1,200	900	−50	+150	−200

2. ***Structure of Funds Approach***

Step 1

➢ The methodology starts with a classification of the **banks' liabilities** based on **liquidity criteria**:

- For instance, the liabilities of banks can be divided into three categories based on liquidity, and more liquid liabilities (*hot money*) should have higher liquidity coverage

	«Hot Money»	Vulnerable funds	Stable funds
Volatility	High	Medium	Low
% of withdrawal over the time period under analysis	Up to 100%	Up to 30%	Limited, close to 0%

Step 2

- Once we understand what the liquidity of the liabilities of the FI is, we can set up the **Liquidity Reserve against them**:

$$\boldsymbol{Liability\ Liquidity\ Reserve} = 0.95 * (Hot\ money\ deposits\ and\ non\ deposit\ fund - legal\ reserves) + 0.30 * (Vulnerable\ deposits\ and\ non\ deposit\ fund - legal\ reserves) + 0.15 * (Stable\ deposits\ and\ non\ deposit\ funds - legal\ reserves)$$

➔ However, the **Total Liquidity Requirement** must also incorporate the fact that some good customers may ask for a loan:

- Therefore, the **Total Liquidity Requirement** not only includes the **Total Liquidity Reserve**, but also include the necessary liquidity for new loans:

$$\boldsymbol{Total\ Liquidity\ Reserve} = 0.95 * (Hot\ money\ deposits\ and\ non\ deposit\ fund - legal\ reserves) + 0.30 * (Vulnerable\ deposits\ and\ non\ deposit\ fund - legal\ reserves) + 0.15 * (Stable\ deposits\ and\ non\ deposit\ funds - legal\ reserves) + 1 * (Potential\ loans\ outstanding - Actual\ loans\ oustanding)$$

- In general, estimating liquidity needs is not easy and, for this reason, **scenario analysis** is **frequently adopted** (also for **stress tests**):
  - The expected liquidity requirement is indeed calculated through **probability weighting**

$$\text{Expected liquidity requirement} = \text{Probability of Outcome A} \times \left(\begin{array}{c}\text{Estimated liquidity surplus or deficit in Outcome A}\end{array}\right) + \text{Probability of Outcome B} \times \left(\begin{array}{c}\text{Estimated liquidity surplus or deficit in Outcome B}\end{array}\right) + \cdots + \cdots \quad (11\text{–}7)$$

3. *Liquidity Indicator Approach*

- This method estimates liquidity needs based upon experience and industry averages. The indicators usually adopted are:
  - **Cash Position Indicator**

$$Cash\ Position\ Indicator = \frac{Cash}{Total\ Assets}$$

  - **Liquid Securities Indicator**

$$Liquid\ Securities\ Indicator = \frac{Cash\ and\ Cash\ like\ securities}{Total\ Assets}$$

➔ However, using industry averages may be misleading because factors like size, geographical presence, business model… must be considered to assess the soundness of the liquidity position. Furthermore, an appropriate peer set must also be identified

- This methodology is **never used** as a **main methodology**, but it is utilized only to **check** the **main one**

ANALYSIS OF BANKS' FINANCIAL STATEMENTS

The key stakeholders of a bank include:

- **Regulators**, as they review FSs
- Investors (debt and equity)
- Auditors
- Equity Research Analysts
- Investment Banks and Advisors
- Competitors
- **Clients**, as they want to understand the soundness of the bank

Return on Equity

When **analyzing** financial statements, the **ROE** is one of the most synthetic measures to assess performance and returns for banks' stakeholders:

- The **ROE** is a function of **several factors** and basing our assessment of a bank on ROE may be **misleading**

Indeed, **ROE** should be seen as an **immediate benchmark communication tool** between banks and markets:

- However, it should not be used to assess the quality, soundness, and performance of a bank

The main **limits** of **ROE** are:

- **Banks' riskiness**, which is **not part** of the equation
- It might include **extraordinary** and **non-recurring** items (both positive and negative)
- It depends on banks' assessment of **credit quality**, since **lower loan loss provisions** drive higher ROE, but lower loans loss provisions do **not mean** better asset quality
- It has a **limited time horizon** and therefore it does not indicate **sustainable profitability**

Analyzing Financial Statements

When analyzing financial statements, we must decide whether to use **Consolidated** or **Parent Company Accounts**:

- The choice depends on the objectives of the analysis

In general, to gather a comprehensive understanding of the financial performance and situation of a banking group, **consolidated accounts** need to be used as a base for the analysis

Banks Balance Sheets will give information about different aspects of a bank, such as:

- Funding
- Lending
- Finance and Investment Function
- Financial Services such as Payments and Advisory
- Stakes

Key Principles for Preparing Financial Statements

The **International Accounting Standards Board** (**IASB**) is an independent body in charge of developing and updating international accounting principles (IAS and IFRS):

- **Regulation** (**EC**) **1606/2002** regards the implementation of these standards at the European level
- *Art. 5* of the Regulation states that member states could decide a **different application perimeter** of the accounting principles with respect to the ones outlined by *Art. 4*

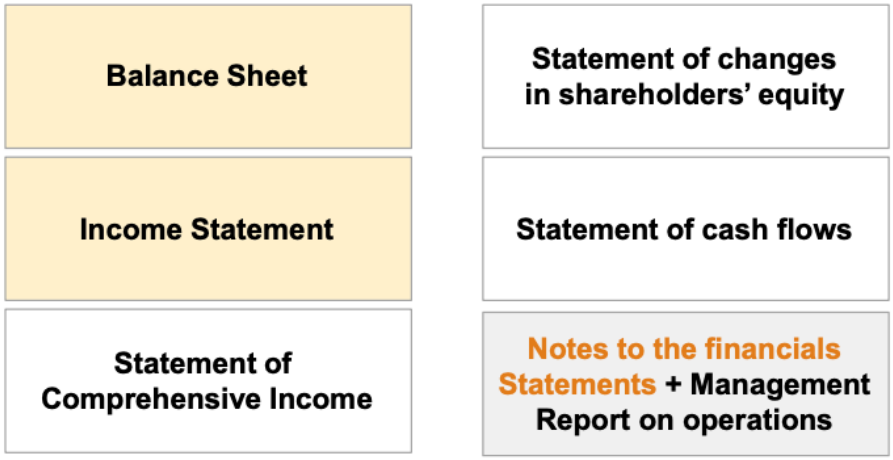
In **Italy**, the **Law Decree 38/2005** establishes that **IAS/IFRS** must be adopted by:

- Publicly traded companies
- Companies issuing financial instruments sold to the public
- **Banks** and **Financial Intermediaries**
- **Insurance Companies**, with the exception of insurance companies that have no publicly listed instruments in the regulated European markets and that do not prepare consolidated accounts
- **Smaller companies** are **exempted** from preparing financial statements according to IAS/IFRS (for instance, firms authorized to prepare an abbreviated from of their financial statements are exempted)

Bank of Italy Circular 262/2005 sets all the necessary instructions for the preparation of financial statements:

- It includes all the **compulsory financial statements forms**, as well as contents of the notes to the financial statements
- Furthermore, the circular also includes the Items' codes

Here below we can find a **standard index** of an annual report of banks:



- **Notes** are extremely important because they include further disclosures about qualitative information of B/S and P&L accounts
- **Management Report on operations** should be the starting point of the analysis, in order to understand the business model of a bank. Furthermore, it also includes information about the period between End of the Year and time of publication

When approaching the **analysis** of a bank, we should follow **four main steps**:

- Understand the banks' **business model**, which is going to be different if the bank is a commercial bank, investment bank, universal bank…
- Analyze the **main items** (loan book, commission income …) and the **historical trends** of the bank, based on their **business model**
- Perform a **KPIs analysis**, in order to understand **profitability**, **capital**, **asset quality**…
- Perform a **benchmarking analysis** with respect to the peers

Once all of the above statements have been completed, the stakeholder should have a **clear understanding** of the bank's financial situation and performance

Balance Sheet

Assets	Liabilities + Equity
Uses of Funds	**Sources of Funds**

The B/S provides us with a **snapshot** of the banks' situation at a point in time:

- In particular, it provides information about sources and uses of funds
- On the other hand, the P&L will provide information about how the **bank used its funds**

The main **limitation** of the B/S is that it does not include all of the banks' items and exposure:

- Indeed, there are elements that are not included, namely the **Off-Balance Sheet Items**
- Depending on the **banks' business model**, **off-balance sheet** items might be more or less relevant and could include Assets Under Management, Credit Guarantees…

In order to approach the **analysis** of the **B/S**, we should **divide each line** by **Total Assets**:

- This allows us to have a **preliminary understanding** of the banks' **business model**
- In addition, the amount of **total assets** can give us an **idea** of the **bank's size**, which however is not a measure of banks' important in the Financial System

Assets

	millions of euro	2018	% of TA	2017	% of TA	% change
10	Cash and cash equivalents	10.350	*1,3%*	9.353	*1,2%*	*10,7%*
20	Financial assets measured at fair value through profit or loss	42.115	*5,3%*	39.582	*5,0%*	*6,4%*
30	Financial assets measured at fair value through other comprehensive income	60.469	*7,7%*	64.968	*8,2%*	*-6,9%*
35	Financial assets pertaining to insurance companies, measured at fair value pursuant to IAS 39	149.546	*19,0%*	152.582	*19,1%*	*-2,0%*
40	Financial assets measured at amortised cost	476.503	*60,5%*	483.959	*60,7%*	*-1,5%*
	a) loans and advances with banks	*69.307*	*8,8%*	*72.057*	*9,0%*	*-3,8%*
	b) loans and advances with customers	*407.196*	*51,7%*	*411.902*	*51,7%*	*-1,1%*
45	Financial assets pertaining to insurance companies measured at amortised cost pursuant to IAS 39	952	*0,1%*	423	*0,1%*	*125,1%*
50	Hedging Derivatives	2.993	*0,4%*	4.213	*0,5%*	*-29,0%*
60	Fair value change of financial assets in hedged portfolios (+/-)	124	*0,0%*	-204	*0,0%*	*-160,8%*
70	Investments in associated and companies subject to joint control	943	*0,1%*	678	*0,1%*	*39,1%*
80	Technical insurance reserves reassured with third parties	20	*0,0%*	16	*0,0%*	*25,0%*
90	Property and equipment	7.372	*0,9%*	6.678	*0,8%*	*10,4%*
100	Intangible Assets	9.077	*1,2%*	7.741	*1,0%*	*17,3%*
	o/w goodwill	4.163	*0,5%*	4.056	*0,5%*	*2,6%*
110	Tax assets	17.253	*2,2%*	16.887	*2,1%*	*2,2%*
	o/w current	3.320	*0,4%*	3.688	*0,5%*	*-10,0%*
	o/w deferred	*13.933*	*1,8%*	*13.199*	*1,7%*	*5,6%*
120	Non-current assets held for sale and discountinued operations	1.297	*0,2%*	627	*0,1%*	*106,9%*
130	Other assets	8.707	*1,1%*	9.358	*1,2%*	*-7,0%*
	Total Assets	**787.721**	***100%***	**796.861**	***100%***	***-1,1%***

On the asset side, we can see that the most important assets are **loans and advances with customers**

we can notice that the bank also holds a large portion of its assets in **financial assets pertaining** to **insurance companies**

We can deduce that this must be a **large** and **diversified banking group**, active mainly as **commercial bank**, but also providing **insurance services**

Liabilities and Sh. Equity

	millions of euro	2018	% of TL+E	2017	% of TA	% change
10	Financial liabilities measured at amortised cost	513.775	*65,2%*	516.360	*64,8%*	*-0,5%*
	a) due to banks	*107.815*	*13,7%*	*99.989*	*12,5%*	*7,8%*
	b) due to customers	*323.900*	*41,1%*	*323.386*	*40,6%*	*0,2%*
	c) securities issued	*82.060*	*10,4%*	*92.985*	*11,7%*	*-11,7%*
15	Financial liabilities pertaining to insurance companies measured at amortised cost pursuant to IAS 39	810	*0,1%*	1.312	*0,2%*	*-38,3%*
20	Financial liabilities held for trading	41.895	*5,3%*	41.218	*5,2%*	*1,6%*
30	Financial liabilities designated at fair value	4	*0,0%*	3	*0,0%*	*33,3%*
35	Financial liabilities pertaining to insurance companies measured at fair value pursuant to IAS 39	67.800	*8,6%*	68.233	*8,6%*	*-0,6%*
40	Hedging Derivatives	7.221	*0,9%*	7.489	*0,9%*	*-3,6%*
50	Fair value change of financial liabilities in hedged portfolios	398	*0,1%*	478	*0,1%*	*-16,7%*
60	Tax liabilities	2.433	*0,3%*	2.509	*0,3%*	*-3,0%*
	o/w current	*163*	*0,0%*	364	*0,0%*	*-55,2%*
	o/w deferred	*2.270*	*0,3%*	*2.145*	*0,3%*	*5,8%*
70	Liabilities associated with non-current assets HFS and disc. operations	258	*0,0%*	*264*	*0,0%*	*-2,3%*
80	Other liabilities	11.645	*1,5%*	12.247	*1,5%*	*-4,9%*
90	Employee termination indemnities	1.190	*0,2%*	1.410	*0,2%*	*-15,6%*
100	Allowances for risks and charges	5.064	*0,6%*	5.808	*0,7%*	*-12,8%*
110	Technical reserves	80.797	*10,3%*	82.926	*10,4%*	*-2,6%*
120	Valuation reserves	-913	*-0,1%*	-1.206	*-0,2%*	*-24,3%*
125	Valuation reserves pertaining to insurance companies	9	*0,0%*	417	*0,1%*	*-97,8%*
150	Redeemable shares	0	*0,0%*	0	*0,0%*	*n.m.*
160	Equity instruments	4.103	*0,5%*	4.103	*0,5%*	*0,0%*
170	Reserves	13.006	*1,7%*	10.921	*1,4%*	*19,1%*
180	Share premium reserve	24.768	*3,1%*	26.006	*3,3%*	*-4,8%*
190	Share capital	9.085	*1,2%*	8.732	*1,1%*	*4,0%*
200	Treasury shares	-84	*0,0%*	-84	*0,0%*	*0,0%*
210	Minority interests	407	*0,1%*	399	*0,1%*	*2,0%*
220	Net income (loss)	4.050	*0,5%*	7.316	*0,9%*	*-44,6%*
	Total Liabilities and Sh. Equity	**787.721**	***100%***	**796.861**	***100%***	***-1,1%***

On the Liability/Equity side, the largest amount of liabilities is **towards customers** (**deposits**) and other **Banks** (**interbank loans**)

The bank also has **outstanding marketable securities**, thus showing once again that it is a large institution

There are **financial liabilities** pertaining to **insurance companies** outstanding

The sum of the grey lines is the **Shareholders' Equity.**

Balance Sheet Reclassification Methodology

The B/S can be reclassified in **several ways** to take into account the **different objectives** and **perspectives** of the stakeholders analyzing the document

One of the **most common methodologies** to reclassify B/S is into **Interest Earning Assets** and **Interest-Bearing Liabilities**

- Assets that generate income are thus separated from those not generating income
- Symmetrically, liabilities not bearing a financial cost are separated from those that have a cost for the bank

	millions of euro	2018	% of TA	2017	% of TA	% change
10	Cash and cash equivalents	10.350	*1,3%*	9.353	*1,2%*	*10,7%*
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70	Investments in associated and companies subject to joint control	943	*0,1%*	678	*0,1%*	*39,1%*
80	Technical insurance reserves reassured with third parties	20	*0,0%*	16	*0,0%*	*25,0%*
	Interest Earning Assets (IEA)	**744.015**		**755.570**		

	millions of euro	2018	% of TA	2017	% of TA	% change
90	Property and equipment	7.372	*0,9%*	6.678	*0,8%*	*10,4%*
100	Intangible Assets	9.077	*1,2%*	7.741	*1,0%*	*17,3%*
	o/w goodwill	4.163	*0,5%*	4.056	*0,5%*	*2,6%*
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	o/w current	3.320	*0,4%*	3.688	*0,5%*	*-10,0%*
	o/w deferred	*13.933*	*1,8%*	*13.199*	*1,7%*	*5,6%*
120	Non-current assets held for sale and discountinued operations	1.297	*0,2%*	627	*0,1%*	*106,9%*
130	Other assets	8.707	*1,1%*	9.358	*1,2%*	*-7,0%*
	Non Interest Earning Assets	**43.706**		**41.291**		

A further potential **refinement** would be including **remunerated cash** in **IEA** and **non-remunerated cash** into **Non-Interest Earning Assets**

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	millions of euro	2018	% of TL+E	2017	% of TA	% change
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	a) due to banks	*107.815*	*13,7%*	*99.989*	*12,5%*	*7,8%*
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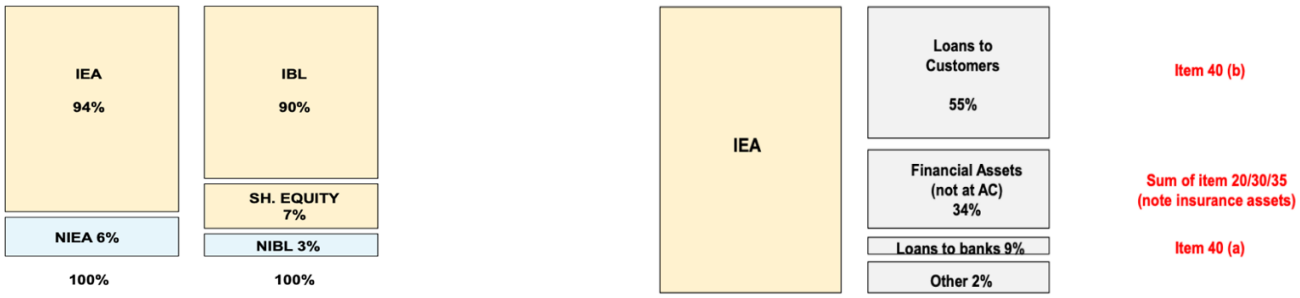
40	Hedging Derivatives	7.221	*0,9%*	7.489	*0,9%*	*-3,6%*
50	Fair value change of financial liabilities in hedged portfolios	398	*0,1%*	478	*0,1%*	*-16,7%*
110	Technical reserves	80.797	*10,3%*	82.926	*10,4%*	*-2,6%*
	Interest Bearing Liabilities (IBL)	**712.700**		**718.019**		

60	Tax liabilities	2.433	*0,3%*	2.509	*0,3%*	*-3,0%*
	o/w current	*163*	*0,0%*	364	*0,0%*	*-55,2%*
	o/w deferred	*2.270*	*0,3%*	*2.145*	*0,3%*	*5,8%*
70	Liabilities associated with non-current assets HFS and disc. operations	258	*0,0%*	*264*	*0,0%*	*-2,3%*
80	Other liabilities	11.645	*1,5%*	12.247	*1,5%*	*-4,9%*
90	Employee termination indemnities	1.190	*0,2%*	1.410	*0,2%*	*-15,6%*
100	Allowances for risks and charges	5.064	*0,6%*	5.808	*0,7%*	*-12,8%*
	Non Interest Bearing Liabilities	**20.590**		**22.238**		

The **first check** is to analyze how **IEA** are financed, since the **spread** between **IEA** and **IBL** is a key component for banks' **income generation capacity**

- In our example, **Interest Earning Assets** are financed through **Interest Bearing Liabilities** and **Equity**
- Furthermore, most of the **IEA** of the bank are composed by **loans to customers**, **financial assets** (such as **insurance assets**) and **equity investments**
- Very likely, the bank in the example is active in the traditional banking sector and, when assessing the bank, **credit function** and **finance** will be the key area of scrutiny



It is **important** to always keep in mind that **loans to customers** are presented in the B/S on a ***net basis***, meaning that the **Loan Loss Reserve** is **netted out** both on **performing exposures** and on **non-performing exposures**

The **notes** to the **consolidated financial statements** can be analyzed in order to obtain further details about the **loan book** of the bank, such as:

- **Loan Geographical Breakdown**, which could be useful to see in which geographical areas the bank is active, and if there are concerns about the economic situation of the regions in which the bank is active
- **Loan Breakdown by Client**, thus dividing the clientele in retail, SMEs, large corporates…
- **Loan Breakdown by Product**, such as mortgages, consumer credit…
- **Loan by Sector**, such as manufacturing, travel industry…

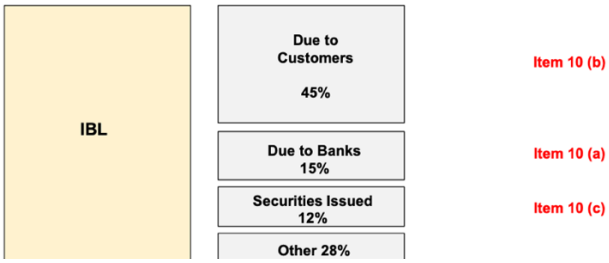
Customer Loans reported in the B/S do **not** take into account any other **Off-Balance Sheet exposure** that the bank might have:

- Therefore, once the **banks' business model** has been **identified**, it might be **relevant** to also **analyze** the **Off-Balance Sheet activities**

Interest-Bearing Liabilities: Key Components

Banks usually finance their activities through **three** different **funding channels**:

- From **Retail Customers** (**Due to customers / Customer Deposits**)
- From other **Banks** (**Due to banks / Interbank Funding**)
- From the **Wholesale Market** (**Securities Issued**)



Customer Deposits are one of the most **important indicators** of **bank's funding strategy**, and they generally include **current accounts** and **time deposits**:

- Usually, these are a **stable source** of **funding**
- However, the **cost of funding** may vary depending on the type of deposit

The evolution of customer deposits line item is an important indicator to assess bank's reputation and reliance on the retail market

- During the **2007-2009** financial crisis, certain financial institutions have lost more than 25%-30% of the customer deposits in a short period of time
- When the market believes that a bank is in trouble, or when panic spreads, we might see **bank runs**

Interbank Funding is an indicator of how much the bank relies on funding provided by other banks:

- Keep in mind that this is a **less stable source of funding** compared to customer deposits, and it usually is **short-term**
- During the **Financial Crisis**, the **interbank funding** was **close to zero**, given the lack of confidence among financial institutions

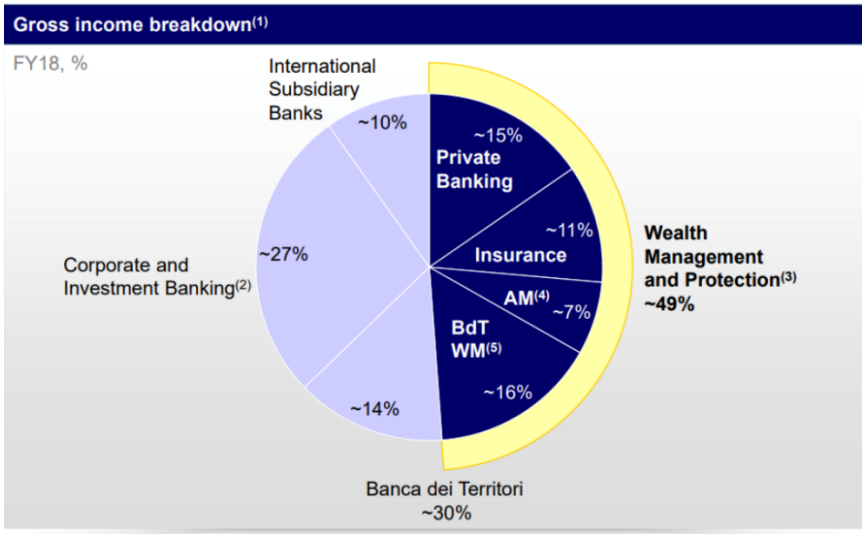
Securities Issued are debt securities issued by the bank on the market and subscribed by investors:

- Securities Issued usually have a **higher cost of funding** compared to the other two sources of funding
- Usually, these are **medium term** sources of funding

Profit and Loss Account

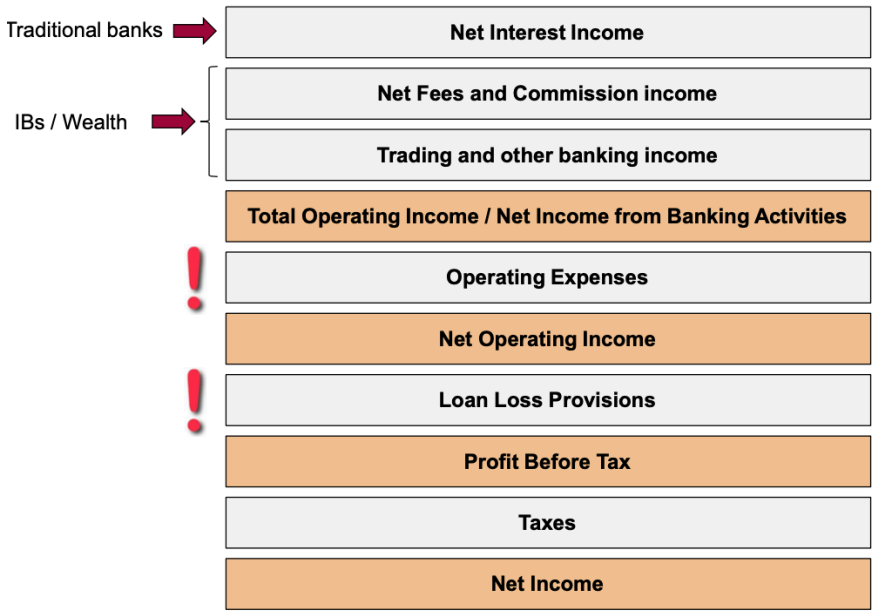
The **P&L** measures the bank's ability to **optimize sources** and **uses** of funds

- Furthermore, by analyzing the composition of the Gross Income, we are also able to **understand more** about the banks' **business model**



The **P&L** can also be **reclassified** using a **vertical structure**, starting from Revenues until Net Profits:

- Regarding the **business model**, traditional banks will probably earn the largest portion of their income as **Net Interest Income**
- On the other hand, **Investment Banks** and **Private Banks** will probably have a Total Operating Income mainly driven by Fees and Commissions Income, as well as Trading Profits


Traditional banks
IBs / Wealth
Net Interest Income
Net Fees and Commission income
Trading and other banking income
Total Operating Income / Net Income from Banking Activities
Operating Expenses
Net Operating Income
Loan Loss Provisions
Profit Before Tax
Taxes
Net Income

ANALYSIS OF BANKS' FINANCIAL STATEMENTS (RATIOS)

Business Model and Profitability Ratios

Income Weights ratios:

$$\text{Net Interest Income Weight} = \frac{\text{Net Interest Income}}{\text{Total Operating Income}}$$

$$\text{Net Fees and Commissions Weight} = \frac{\text{Net Fees \& Commissions Income}}{\text{Total Operating Income}}$$

$$\text{Net Trading and Other Op. Income Weight} = \frac{\text{Net Trad.and Oth.Op.Inc.}}{\text{Total Operating Income}}$$

The **Loan to Deposit** ratio (**LD ratio**) tells us how many loans have been issued, given the bank's total funding

$$\text{Loan to Deposit Ratio (LD Ratio)} = \frac{\text{Customer Loans}}{\text{Direct Funding}}$$

Where $\text{Direct Funding} = \text{Customer Deposits} + \text{Securities Issued}$

The **Interest Spread** (**Net Interest Margin**) tells us what it the difference between the positive yield on assets and the negative yield on liabilities:

$$\text{Interest Spread} = \text{Positive Yield on Assets} - \text{Negative Yield on Liabilities}$$

Where:

$$\text{Positive Yield on Assets } (A) = \frac{\text{Interest Income}}{\text{Interest Earning Assets}_{avg.}}$$

$$\text{Negative Yield on Liabilities } (B) = \frac{\text{Interest Expenses}}{\text{Interest Bearing Liabilities}_{avg.}}$$

The **Net Yield on Assets** tells us the percentage of Net Operating Income with respect to Total Assets:

$$\text{Net Yield on Assets} = \frac{\text{Net Operating Income}}{\text{Total Assets}_{avg.}}$$

Where

$\text{Net Operating Income} = \text{Total Operating Income} - \text{Operating Expenses}$

The **Cost Income Ratio** tells us the proportion of Operating expenses, either inclusive or exclusive of D&As, with respect to the Total Operating Income:

$$Cost\ Income\ (ex\ D\&A) = \frac{Operating\ Expenses}{Total\ Operating\ Income}$$

Where

$$Operating\ Expenses = Personnell\ Expenses + Adminstrative\ Expenses$$

The **Extraordinary Contribution Ratio** tells us the impact of non-operating activities with respect to the Net Operating Income:

$$Extraordinary\ Contribution\ (incl.LLP) = \frac{PBT}{Net\ Operating\ Income}$$

Where

$$Net\ Operating\ Income = Total\ Operating\ Income - Operating\ Expenses$$

The **Tax Impact** tells us the impact of taxes on the total bank's income:

$$Tax\ Impact = \frac{Net\ Income}{Profit\ Before\ Tax}$$

The **Tangible Shareholders' Equity** is not a KPI, but it is useful to calculate other ratios, and is given by the difference between shareholders' equity and intangibles

$$Tangible\ Shareholders'Equity = Shareholders'Equity - Intangibles$$

The **Pre-Provisions Profit** is not a KPI, but tells us the Income of a bank before it accounts for the **Loan Loss Provision**:

- Applying the specific bank or country tax rate would result in a Pre-Provision Profit, post tax

$$Pre\ Provisions\ Profit\ (pre\ tax) =$$

$$Total\ Op.Income - Operating\ Expenses + Other\ Net\ Op.Income\ (Exp.)$$

The **ROE** is generally calculated as the Net Income over the Total Equity, however it can take different forms that tell us more information about the bank:

$$ROE = \frac{Net\ Income}{Shareholders'Equity}$$

$$ROE\ (ex\ LLP) = \frac{Pre\ Provisions\ Profit\ post\ tax}{Shareholders'Equity}$$

$$ROAE = \frac{Net\ Income}{Shareholders'Equity_{avg.}}$$

$$ROTE = \frac{Net\ Income}{Tangible\ Shareholders'Equity}$$

$$ROATE = \frac{Net\ Income}{Tangible\ Shareholders'\ Equity_{avg.}}$$

The **ROA** is generally calculated as Net Income over Total Assets but, similarly to the ROE, it can take different forms according to the Total Assets we are considering:

$$ROA = \frac{Net\ Income}{Total\ Assets}$$

$$ROAA = \frac{Net\ Income}{Total\ Assets_{avg.}}$$

$$RORWA = \frac{Net\ Income}{Risk\ Weighted\ Assets\ (\text{RWA})}$$

In particular, the **Return on Risk Weighted Assets** is particularly important on certain credit processes, where the bank would like to ensure that the return generated by the exposure will be above bank's target capital

Capital and Leverage Ratios

Regulatory Capital Ratios:

$$CET1\ Ratio = \frac{CET1\ Capital}{RWA}$$

$$Tier\ 1\ Ratio = \frac{Tier\ 1\ Capital}{RWA}$$

$$Total\ Regulatory\ Capital\ Ratio = \frac{Tier\ 1 + Tier\ 2\ Capital}{RWA}$$

Capital Composition Ratios:

$$Capital\ Composition\ (Tier\ 1) = \frac{Tier\ 1\ Capital}{Total\ Regulatory\ Capital}$$

Where $Total\ Regulatory\ Capital = T1 + T2$

$$Capital\ Composition\ (CET\ 1) = \frac{CET1\ Capital}{Tier\ 1\ Capital}$$

The **RWA Density** ratio tells us how much a bank's RWAs compare to the Total Assets:

$$RWA\ Density = \frac{RWA}{Total\ Assets}$$

Leverage can be computed in different ways:

$$Leverage_{alt.1} = \frac{Tangible\ Sh.\ Equity}{Total\ Assets}$$

$$Leverage_{alt.2} = \frac{Total\ Assets}{Shareholders'\ Equity}$$

$$Leverage_{alt.3} = \frac{Tangible\ Assets}{Tangible\ Shareholders'\ Equity}$$

$$Leverage_{alt.4} = \frac{Tangible\ Shareholders'\ Equity}{Risk\ Weighted\ Assets}$$

- In particular, the fourth methodology was introduced by Basel III in order to take into consideration the **risk-adjusted exposures**

Asset Quality Ratios

The **Cash Coverage Ratio** tells us what part of the Gross Non-Performing Exposure has already been expensed through the Loan Loss Reserve:

- The ratio can be calculated for each class of NPEs, as well as for the total NPEs
- The ratio can also be calculated for *in-bonis* exposures, even though it is less meaningful

$$Cash\ Coverage\ Ratio\ (ex\ write\ off) = \frac{Loan\ Loss\ Reserve}{Gross\ Non\ Performing\ Exposures}$$

$$Cash\ Cov.\ Ratio\ (incl.write\ off) = \frac{Loan\ Loss\ Reserve\ (incl.write\ off)}{Gross\ Non\ Performing\ Exposures\ (incl.write\ off)}$$

The **Gross NPE Ratio** tells us the proportion of NPEs, inclusive of the loan loss reserve, with respect to the Gross Loans Portfolio:

- **Gross Loans** are equal to the sum of Net Customer Loans and the Loan Loss Reserve for both NPE and *in-bonis* loans
- Recall that **Gross NPEs** refer to the total amount of NPEs, inclusive of the **Reserve**
- The ratio can be calculated for each class of NPE, as well as for the total NPEs

$$Gross\ NPE\ ratio = \frac{Gross\ NPE}{Gross\ Loans}$$

The **Net NPE Ratio** tells us the proportion of Net NPEs with respect to the Net Loans

- The ratio can be calculated for both each class of NPE, as well as the total NPEs

$$Net\ NPE\ ratio = \frac{Net\ NPE}{Net\ Loans}$$

The **Cost of Risk Ratio** tells us how many expenses, in basis points, the bank incurs because of provisions for bad loans, with respect to the total loan portfolio:

$$Cost\ of\ Risk = \frac{Loan\ Loss\ Provision\ (P\&L)}{Gross\ Loans} * 10{,}000$$

The **Texas ratio** tells if the bank is able to completely cover the write-off of its gross NPE exposures with its Tangible Equity and the Loans Loss Reserve:

- If the ratio is smaller than one, it means that if all the NPEs of the bank were written-off, the bank would still be able to survive

$$Texas\ Ratio = \frac{Gross\ NPE}{(Tangible\ Sh.Equity + |\ loan\ loss\ reserves\ |)}$$

MANAGEMENT OF FINANCIAL INSTITUTIONS
2022-2023

Second Partial
Francesco Pezzuto

INTEREST RATE RISK

The major objective of a bank's management is to **increase** the **returns** for its **owners**, however, this comes at the **cost** of **increased risk**, mainly:

- **Interest rate risk**, deriving from the maturity mismatch of assets and liabilities and their duration
- **Market risk**, deriving from the changes in the banks' trading books

For each risk, we want to **quantify** and understand how to **mitigate** them:

- **Measuring** both risks require **valuation** of a bank's **portfolio** at **market value**

Duration-Gap Model

The **Duration-Gap Model** is a market value-based model for managing the exposure of the bank to interest rate risk:

- The main idea is viewing a bank's assets and liabilities as **fixed income instruments**

This is important for the bank's **equity holders** because, due to the **accounting identity**, we can write the **value of equity** as the **difference** between the **value of assets** and **liabilities**:

$$E = A - L$$

- **Equity holders** are holding a **portfolio** of **fixed income securities**, such as **long consumer loans** and **short time deposits**
- Therefore, the **change in equity** after a **change** in the **interest rates** is given by the **difference** between the **changes in assets and liabilities**

$$\Delta \boldsymbol{E} = \Delta \boldsymbol{A} - \Delta \boldsymbol{L}$$

Fixed-Income Instruments

Straight Bond

A **straight** (**plain vanilla** or **bullet**) bond is a security corresponding to a borrowing agreement where the borrower sells a bond to the lender for an amount of cash:

- The issuer then makes specific payments (**coupon payments**) to the holder at **specific dates** (**coupon payment schedule**)
- The issuer **extinguishes** the **debt** by paying the holder the **bond par value** when the **bond expires**

When the payments are fixed at settlement, the bond is a **fixed income security.**
When the payments depend on some economic variables that may fluctuate over time, the bond is a **variable income security**

Amortization is one possible **complication** in **bonds valuation**:

- We call these bonds **amortizing** / **sinkable** bonds
- Indeed, when the principal is not repaid in full at maturity, we see that bonds **gradually repay** the principal over time according to a **pre-specified amortization schedule**

Provided the **coupon** is **fixed**, these continue to be **fixed-income securities**, although **cash flows** reflect **coupon payments** on a **decreasing face value**, as well as **principal repayments**

Example

YPF 8.75% USD-den bond with face value $1,000, maturity April 4, 2024 and seminannual coupon payments with original issuance April 4, 2014 of $1 bln. Amortization schedule: April 4, 2022 30%, April 4, 2023 30%, April 4, 2024 40%.

	straight		amortizing				
	$c/2(\%)$	CF_t	F_t	$F_{t-1/2}$	coupon	reimb	CF_t
(...)							
Oct 4, 21	4.375	43.75	1,000	1,000	43.75	-	43.75
Apr 4, 22	4.375	43.75	700	1,000	43.75	300	343.75
Oct 4, 22	4.375	43.75	700	700	30.625	-	30.625
Apr 4, 23	4.375	43.75	400	700	30.625	300	330.625
Oct 4, 23	4.375	43.75	400	400	17.5	-	17.5
Apr 4, 24	4.375	1,043.75	400	400	17.5	400	417.5

Often used amortizing schemes prescribe either **equal instalments** (**French Type**) or **principal repayments** (**Italian Type**)

Typically, loans are amortized since the principal is repaid over time, however some types of bonds in banks' balance sheets are not:

- **Bullet Loans** are *zero-coupon bonds* that require the principal amount repayment at maturity
- **Interest-only Loans** are *fixed-coupon bonds* that require principal amount repayment at maturity plus interest payments during the life of the loan

Remarks

1. The **loan interest rate** is used as **discount factor** at **loan origination**, and makes the **market value** of the loan **equal** to the **principal**
2. **Changes** in the **interest rate after origination** would **not affect** the **instalments**, which are determined in the **loan contract**, but rather the **loan market value** via the **discount factor**:
    - As it happens for bonds, an increase in the interest rate means a reduction in the loan value

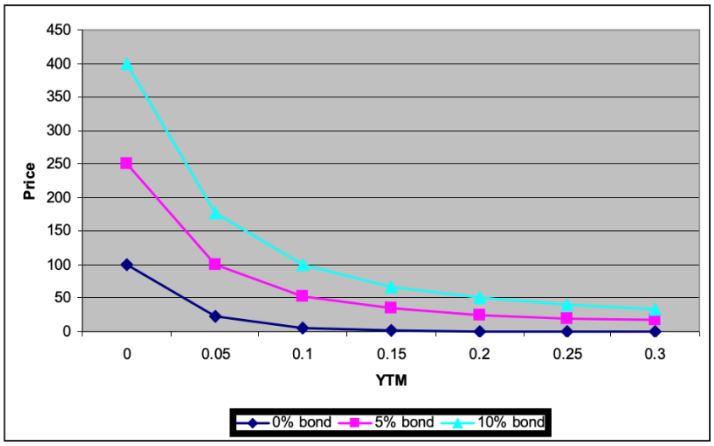
Measuring Interest Rate Risk

The relationship between a bond's **price** and **interest rate** is **negative** and **convex**:

- The **convexity** derives from the fact that we **compound** the **interest rate geometrically**

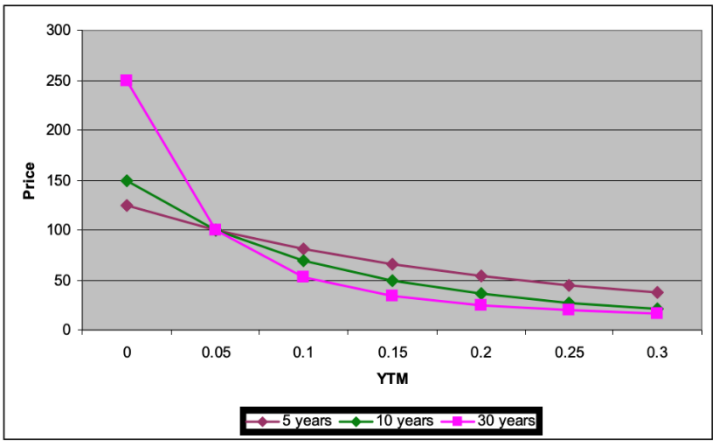
For a fixed maturity loan, the **Price-Interest Rate curve increases** with the **coupon** rate:

- Evidence shows that prices for high coupon bonds are less sensitive to interest rate changes than those of low coupon



For a fixed coupon, the Price-Interest Rate curve becomes steeper with maturity

- The higher the maturity of the bond, the more it's value will be affected by changes in the interest rate (recall geometric compounding)



To summarize

1. There is an **Inverse Relationship** between interest rates and bonds prices

2. The relationship between **bonds prices** and **rates** is **Convex**, indeed an **increase** in the **interest rate** results in a **smaller price decline** than the **price gain** associated with a **decrease** of **equal magnitude** in the **interest rate**

3. Prices for **long maturities** are **more sensitive** to **interest rate changes** than those of **short maturities** because of the geometric compounding of the discount factors

4. Prices for **high coupon bonds** are **less sensitive** to **interest rate changes** than those of **low coupon**

5. Prices for **high interest rate bonds** are **less sensitive** to **interest rate changes** than those of **low interest rate** bonds

➔ In order to understand how bond prices vary when interest rates change, we use **Duration**

Macaulay Duration

The Duration is a **weighted average** of **cash flow payment dates**, where the weights are proportional to the Present Value of each cash flow:

$$Dur = \frac{\sum \frac{CF_t * t}{(1+R)^t}}{Price}$$

- Therefore, we say that the Duration is the **effective maturity** of a bond
- For ZCBs, the duration is simply equal to the maturity of the bond

Properties of duration:

- The Duration **decreases** with the **interest rate**
- The Duration **decreases** with the **coupon**

- Duration usually **increases** with **maturity**, but at a **decreasing rate** (this is **not the case** for **deep discount bonds**, which have a **coupon rate** much **lower** than the **interest rate**)

➔ **Duration** is used to **measure** the **sensitivity** of a **bond's price** to changes in interest rates

The derivative of the price with respect to the interest rate is given by:

$$\frac{dP}{dR} = -\frac{P * D}{1+R} \leftrightarrow \frac{\frac{\Delta P}{P}}{\frac{\Delta R}{1+R}} = -Dur$$

- Therefore, the duration measures the **interest rate elasticity** of the security's price to small interest rate changes

The above formula can be rearranged as:

$$\frac{\Delta P}{P} = -\frac{D}{1+R} * \Delta R$$

Where $\boldsymbol{D/(1+R)}$ is called **modified duration**

➔ Thus, multiplying the Modified Duration by the change in interest rates gives a measure of a bond's percentage price change

➔ Multiplying the Modified Duration by the bond price yields the **dollar duration**, which is the local slope of the Price-Interest Rate curve

$$\frac{\Delta P}{\Delta R} = -MD * P$$

Remarks:

1. For a given change in interest rates, according to the duration formula, bond prices are inversely related to their modified duration:
   - Indeed, long duration securities suffer a larger loss when interest rates increase
   - Symmetrically, long duration securities experience larger gains when interest rates decrease

2. According to the duration formula, gains and losses are *symmetric*, even though we have seen that this is not necessarily true due to the convexity of the Price-Interest Rate relationship

3. With *m* payments per year, the modified duration formula becomes as such:

$$Modified\ Duration = \frac{D}{1+\frac{R}{m}}$$

INTEREST RATE RISK (DURATION GAP MODEL)

Interest rate risk is not managed solely at an individual level, but must also be **managed** at a **portfolio level**:

- Consider a **portfolio** with ***n*** **assets** (or liabilities), each of which is a **fixed-income security** with **Duration** $\boldsymbol{D_i^A}$ (or D_i^L in the case of liabilities)

The **weight** of each **security** in the **portfolio** is given by the **ratio** of the **market value** of the **individual security** over the **market value** of the **whole portfolio**:

$$X_i^A = \frac{V_i^A}{\sum V_i^A}$$

The **Macaulay Duration** of a **portfolio** of assets (or liabilities) it the **market value weighted average** of the **individual durations** of the **assets** (or liabilities):

$$D_A = \sum X_i^A D_i^A = X_1^A D_1^A + \cdots + X_n^A D_n^A$$

➔ Keep in mind that this is an **approximation** of the **portfolio duration**:

- Indeed, in order to **hold true exactly**, one **needs all securities' cash flows** to be **synchronized** (e.g., all semi-annual payments should be in six months)
- However, the equation is **useful** because it allows us to build a **portfolio duration** starting from **individual durations** instead of figuring out the **portfolio cash flow stream** and use it to compute duration

Once calculated the Duration of a portfolio, it will still be possible to calculate the change the portfolio value after a change in the interest rates with the same equations as above:

$$\frac{\Delta A}{A} = -D_A * \frac{\Delta R}{1+R}$$

➔ When **securities differ** in their **YTM** (for instance, when **term structure** of interest rates is **not flat**), the **portfolio duration** measures the **change** in the **portfolio value** when interest rates change so that **all YTMs experience** a **parallel shift**

Duration Gap Model

The change in the market value of equity for a change in interest rates can be calculated as:

$$\Delta E = -[D_A - D_L * k] * A * \frac{\Delta R}{1+R}$$

- Where ***k*** is the **bank leverage**, which gives the proportion of the borrowed funds used to fund the asset portfolio:

$$\boldsymbol{k = \frac{L}{A}}$$

According to the **Duration Gap Model equation**, the effect of **changes** in **interest rates** on **equity holders** has **three components**:

1. The **leverage adjusted Duration Gap** $\left[D_A - D_L * \frac{L}{A}\right]$ in years, which is the **degree** of **maturity mismatch** in the balance sheet:
   - The larger the gap in absolute terms, the more exposed the bank is to interest rate risk
   - When it is positive, equity holders lose when interest rates increase

2. The **bank size** in terms of **dollar value** of **assets**, since the larger the bank's scale, the larger the dollar size exposure to interest rate shocks

3. The **interest rate shock size**, $\Delta R/\ (1 + R)$, since the **bank's exposure** will be **larger**, the **larger** the **shock**

The **Duration Gap Model equation** provides the **bank's manager** with a **benchmark** measure of the **bank's equity performance** for various **interest rate changes**:

- Indeed, it can be used to **identify changes** on the **bank's balance sheet** to **immunize** the **bank** against **interest rate risk**

In the extreme case of **perfect immunization**, the **duration gap** can be **reduced to zero**, so that:

$$\Delta E = -[0] * A * \frac{\Delta R}{1 + R} = 0$$

The **Duration Gap Model equation** also gives an important insight about the importance of *leverage*, since the bank manager should not directly set $\boldsymbol{D_A = D_L}$:

- Indeed, doing so could make the bank even more sensitive to interest rate risk

On the other hand, the bank manager should set $\boldsymbol{D_A = D_L * k}$:

- This allows the bank manager to immunize the bank from interest rate risk
- The manager can achieve this situation by either changing the Duration of Assets or Liabilities
- Furthermore, another possible way is changing the leverage of the bank

Dynamic Rebalancing

So far, we have assumed that interest rates change only once:

- However, **interest rates** can change at **any point** during the **holding period**

Assume that the **bank manager** has achieved a **zero-duration gap** when **interest rates increase**, so that the **effect on equity** is **negligible**:

- However, at the **new rates**, **bond prices** and their **durations** will be **different**
- Therefore, the manager will have to **re-immunize** in order to **protect** the **bank** from a **further change** in **interest rates**

In this sense, immunization is a **dynamic strategy**, since bank managers should **continuously rebalance** the **portfolio**:

- In practice, **continuous rebalancing** can be **costly** because of **transaction costs**
- For this reason, managers **rebalance** at **discrete intervals**, or opt for **cheaper off-balance sheet immunization**

Convexity

The **bond convexity** implies that, as interest rate shocks get larger, the error in the duration model increases:

- Indeed, the duration model **underpredicts** the bond price increase when rates decrease

- Symmetrically, the duration model **overpredicts** the bond price decrease when rate increase

In some sense, the duration model is **pessimistic**

A better approximation can be obtained correcting the duration model with the convexity adjustment $\left[\frac{1}{2} * \boldsymbol{CX} * (\Delta \boldsymbol{R})^2\right]$, which simply is the **second order Taylor expansion**:

$$\frac{\Delta \boldsymbol{P}}{\boldsymbol{P}} = -\boldsymbol{DUR} * \frac{\Delta \boldsymbol{R}}{(\mathbf{1} + \boldsymbol{R})} + \frac{\mathbf{1}}{\mathbf{2}} * \boldsymbol{CX} * (\Delta \boldsymbol{R})^2$$

Where CX is going to be equal to:

$$CX = \frac{1}{P * \left(1 + \frac{R}{m}\right)^2} * \sum PV_t * t * \left(t + \frac{1}{m}\right)$$

Example

Example (T-note, reprise)

Suppose rates decrease from 8% to 5%. From the previous example we know that, at $R = 8\%$, $P = 94.76$ and $MD = 2.67$. The price change would be

$$\Delta P \simeq -\underbrace{2.67 \times 94.76}_{\text{dollar duration}} \times (-0.03) = 7.59,$$

which is, the new (approximated) price will be 102.35$, while the exact price is 102.75$ –a 40bps error.

Example (cont.)

The convexity of the T-note in previous example is

t	CF_t	DF_t	PV_t	$PV_t \times t \times \left(t + \frac{1}{m}\right)$
0.5	3.0	0.9615	2.88	1.44
1.0	3.0	0.9246	2.77	4.16
1.5	3.0	0.889	2.67	8.01
2.0	3.0	0.8548	2.56	12.80
2.5	3.0	0.8219	2.47	18.53
3.0	103.0	0.7903	81.40	854.70
			P=94.76	CX=8.78

The predicted price change using the convexity adjustment would be

$$\begin{aligned} \Delta P &= 7.59 + \frac{1}{2} \times 8.78 \times (-0.03)^2 \times 94.76 \\ &= 7.59 + 0.37 \\ &= 7.96 \end{aligned}$$

which is, the new (approximated) price will be about 102.72$ and the error would get smaller to 3bps.

RISK MANAGEMENT USING DERIVATIVES (FUTURES)

Bank managers can insulate the balance sheet against interest rate risk by reducing the **absolute value** of the **duration gap** (i.e., decrease $|D_A - D_L * k|$)

However, bank managers also have the option to **hedge interest rate risk** using **derivatives** such as:

- Forwards and Futures
- Options
- Swaps

In general, we can see that **swaps** are the most common type of derivative contract used for hedging purposes by banks

- **Futures** and **Options** follow and have a similar market share
- **Credit Derivatives** are the least common type of derivatives used by banks

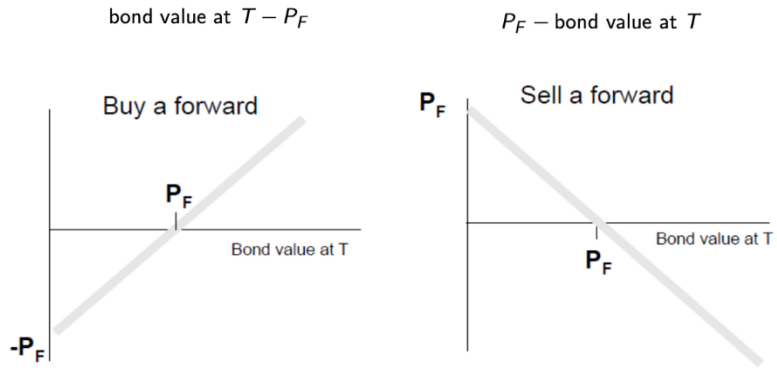
Derivatives are mainly used by US banks to hedge **interest rate risk**, however they are also quite popular in order to hedge **foreign exchange risk**

At the end of Q2 2018, the total US market cap was around 30 trillion, which is around 50% of the total market capitalization:

- At the same time, derivative contracts had a total economic value of $200 trillion, just for the banking sector (N° of Contracts x Price of underlying asset)
- This means that derivatives are extremely important economically

Forward Contract is an agreement between a buyer (**long position**) and a seller (**short position**) at the present time (**settlement date**) to exchange the underlying asset at a specific future time (**maturity** or **delivery date**) for cash (**forward price**)

- *T* is the **maturity** of the **contract**
- If the underlying asset is a **bond**, then the maturity of the bond must be greater than the maturity of the contract



Forwards are **bilateral** (**decentralized** or **OTC**) contracts which are subject to high default risk

- Furthermore, we can define them as a **zero-sum-game** since the loss of one party is equal to the gain of the other

Future Contracts are very similar to forward contracts, with the only difference that they are exchanged through a **centralized exchange**. The main **differences** are:

- **Standardization**, since underlying, maturity, contract size, trading hours, delivery arrangements, are decided by the exchange

- **Marking-to-market** on a daily basis, in order to reflect changes in the value of the contract
- **Little Counterparty Risk** since the exchange acts as a counterparty to both parties
    - This risk is eliminated by means of the **margins system**, whereby cash settlements occur between buyer and seller on a daily basis to reflect changes in the value of the contract

Banks can use **forwards**/**futures** for two main purposes:

- **Micro-hedging**, which means hedging interest rate risk of an **individual bond**
- **Macro-hedging**, which means hedging the entire balance sheet ***duration gap***

Micro-hedging

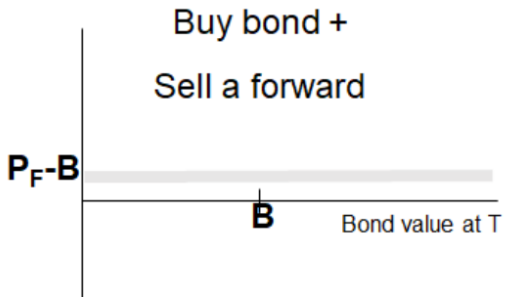
Assume that we hold one bond with **maturity N** at price **B**, and we are worried about an **increase** in **interest rate** at the end of this month (**T**):

- Indeed, recall that, after an increase in interest rate, the bond value will fall

Forward Hedging (short hedge) consists in **selling** the bond **forward** with maturity **T** for a price P_F:

- Therefore, **buying the bond** and **selling the forward** allows to **neutralize** the position and make the **bond insensitive** to **interest rate movements**

$$B_T - B_{t=0} + P_F - B_T = \boldsymbol{P_F - B}$$



Keep in mind that, in this example:

- The forward maturity is **deliberately short** in order to ignore the time value of money between settlement and maturity, which otherwise would change the value of the **spot position** (and **not** the **forward**)
- We rule out pricing issues, but in reality, there exist a mechanism that ensures that riskless profits cannot arise
- We may be worried about what happens to interest rates over a certain period, and not only at a specific date

In order to address the last point, we can consider a **futures contract** because price changes are **marked-to-market** any day between 0 and T

- Therefore, one can attach a change in value to a future position, similar to the change in value to the underlying position

Example (offsetting a futures position)

Today (settlement, date 0) a trader buys a futures contract with price \$40.5 for delivery of the underlying asset in four weeks (maturity, date T). One week prior to maturity the price of the (same) futures contract is \$41.25. The trader takes a short (offsetting) position in the futures contract.

When traders hold a future contract and want to earn the profit on it, they must take and **offsetting short position** in the futures:

- Therefore, at maturity, the trader will take delivery of the old contract and he will pay the strike price (\$40.5) to the counterparty
- Furthermore, the trader will also deliver the underlying asset to the counterparty of the short position for the offsetting contract strike price (\$41.25)
- In the end, he will earn a profit of (\$42.25 – \$40.5)=\$0.75

This exercise shows how **changes** in **futures price** can be **cashed in**

Hedging interest rate risk

Hedging interest rate risk means taking a future position prior that bond and futures prices change:

- In order to do so, we can use a **duration approximation** for the expected change in the bond price following a change in the interest rate

$$\Delta B = -D * B * \frac{\Delta R}{1+R}$$

Regarding the **futures position**, the change in value also depends on how the underlying bond value changes:

- If we let $\boldsymbol{N_F}$ be the **number** of futures **contracts**, a trader can either have a **long** ($N_F > 0$) or **short** ($N_F < 0$) positionThe **value** of the **futures position** therefore is:

$$F = N_F * P_F$$

➔ Hence, the **change** in the **value** of the futures position will depend on the **duration** of the **underlying bond**, D_F:

$$\Delta F = -D_F * N_F * P_F * \frac{\Delta R}{1+R}$$

- Keep in mind that the underlying bond is not necessarily the same bond to be hedged

➔ In order to **immunize** the spot position, we are after a futures position such that:

$$\Delta \boldsymbol{B} + \Delta \boldsymbol{F} = \mathbf{0}$$

$$\rightarrow \left[-D * B * \frac{\Delta R}{1+R}\right] + \left[-D_F * N_F * P_F * \frac{\Delta R}{1+R}\right] = 0$$

➔ If we want to find the **number of futures contracts** needed to immunize the portfolio:

$$N_F = -\frac{(D_A - kD_L) * A}{D_F * P_F}$$

- Therefore, a **positive duration gap** will be hedged using a **short futures hedge**
- Symmetrically, a **negative duration gap** is hedged using a **long futures hedge**

Interest Rates Futures on US Treasuries

- Underlying asset: 2YR, 5YR, 10YR T-note, T-bond
- Size/minimum lot: \$200,000 (2YR), \$100,000 (others) of face value (equivalently, 2,000 and 1,000 units)
- Delivery date: March, June, September, December (3 quarters); last business day of contract month
- Delivery method: physical (maturity range, e.g. maturity 15-25 years for T-bond futures)
- Price quote: USD per \$100 of face value
- Notional amount: Size (units) × Bond price

Macro-hedging

For macro-hedging, bank managers follow the same logic, by setting the change in equity equal to the change in value of the futures contracts:

$$\Delta E + \Delta F = 0$$

➔ Then, it is possible to compute then number of contracts the company needs to enter into by simply setting:

$$N_F = -\frac{(D_A + kD_L) * A}{D_F * P_F}$$

Basis Risk

So far, we have assumed that the **term structure** of **interest rates** is **flat**, however bonds actually differ in their **YTMs** and **IRRs**

- In this case, interest rates on spot and futures position may not be perfectly correlated (**basis risk**)
- Hence, we can change the equation for the change it the futures value as:

$$\Delta_F = -D_F * N_F * P_F * \frac{\Delta R_F}{1 + R_F}$$

➔ Hence, immunization is achieved in the same way as before, by setting N_F such that $\Delta E + \Delta F = 0$ (**macro-hedging**) or that $\Delta B + \Delta F = 0$ (**micro-hedging**)

For **micro-hedging**, the number of futures contracts will be given by:

$$N_F = -\frac{(D_A + kD_L) * A}{D_F * P_F * \boldsymbol{br}}$$

Where **br** is equal to:

$$br = \frac{\Delta R_F}{\Delta R} * \frac{1 + R}{1 + R_F}$$

- **br** is the **basis risk adjustment**, which is derived from past history
- The **basis risk adjustment** is used to investigate the **relation** between **%changes** in **YTM** of the bond underlying the futures contract, and the YTM on spot bonds
- The **adjustment** is calculated by running an **OLS regression**

RISK MANAGEMENT USING DERIVATIVES (OPTIONS)

A **European Call Option** contract entails the right to buy the underlying asset for a certain price (**exercise/strike price**), which is fixed at the present time (**settlement date**) for a certain future time (**maturity/expiration date**)

- The purchase of the right requires an upfront payment at date 0 (**premium**)
- **European options** can be exercised only at maturity
- **American options** can be exercised anytime until expiration

A **European Put Option** contract entails the right to sell the underlying asset for a certain price (**exercise/strike price**), which is fixed at the present time (**settlement date**) for a certain future time (**maturity/expiration date**)

The main differences with **forwards/futures** are:

- Options are a **right** to buy or sell rather than an obligation (futures)
- Options carry a premium that is paid **upfront** by the buyers, while for futures cash is received at maturity

➔ This implies that **profits** are **non-linear** for options

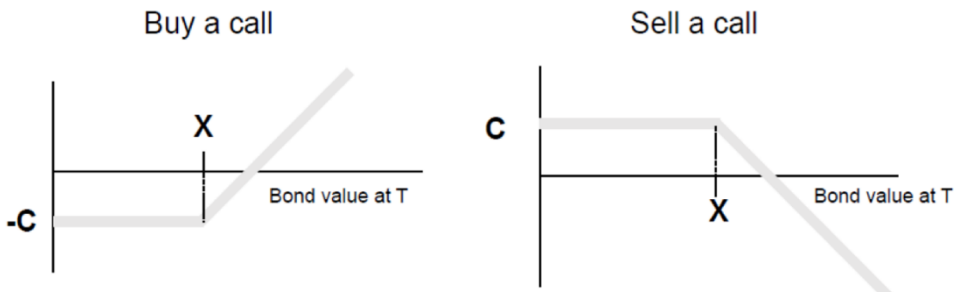
Exchange-traded options, like futures, inherit the features of **standardization** and **marking-to-market**:

- The only different is the absence of a **margin system**, since premiums are paid at settlement
- **Naked option** positions (**sell call/ buy put without having** the **underlying asset**) usually require **collaterals**. However Naked strategies reflect **speculative reasons** rather than hedging needs

Options

The **buyer of a call** will exercise the right if the bond value at **maturity** is higher than the **strike price**:

- In this case, the profit will be the spread between the value at T and the strike price, minus the premium paid at origination
- If the price at maturity is lower than the strike price, the holder will not exercise the option and will incur a loss equal to the premium



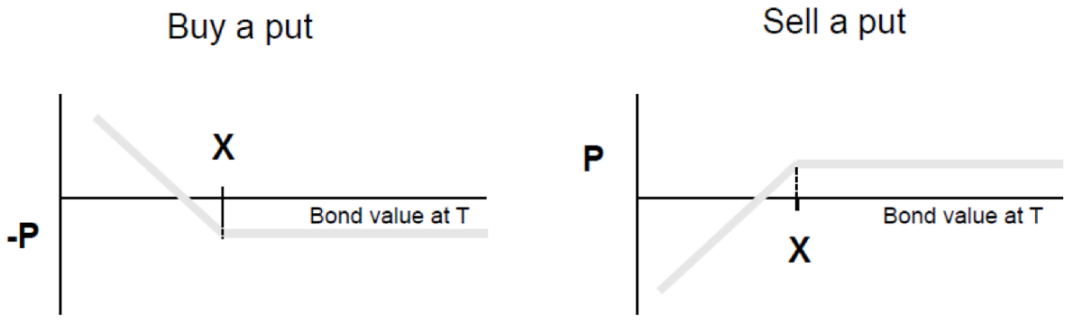
$$Profit = (Bond\ value\ at\ T - Strike) - Premium$$

$$Only\ if\ Bond\ value\ at\ T \geq Strike$$

$$Otherwise: Loss = -Premium$$

The **buyer of a put** will exercise the right if the bond value at **maturity** is lower than the **strike price**:

- In this case, the profit will be the spread between the strike price and the bond value at T
- If the price at maturity is higher than the strike price, the holder will not exercise the option and will incur a loss equal to the premium



$$Profit = (Strike - Bond\ value\ at\ T) - Premium$$

$$Only\ if\ Bond\ value\ at\ T \leq Strike$$

$$Otherwise: Loss = -Premium$$

Options Micro-hedging

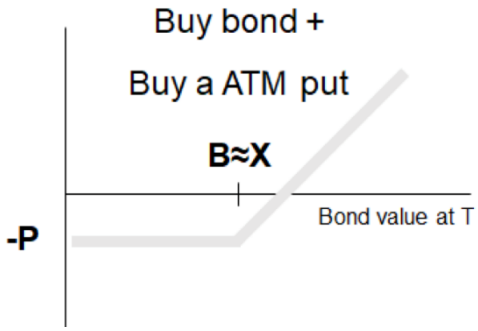
Assume that we hold a **bond**, and we want to immunize ourselves against a **downside interest rate risk**:

- Recall that losses on the bond position are incurred when interest rates increase
- Therefore, we need to open an option position that benefits if interest rates increase (i.e., the underlying value falls)

➔ Therefore, we will need to buy an **at-the-money put option**:

- If **interest rates increase** and the value of the bond falls, we will only incur a loss equal to the **Put Premium**, since the payoff on the put offsets the loss on the bond
- On the other hand, if interest **rates fall** and the value of the bond increases, our profit will be equal to the price of the bond, minus the premium and the Put value

➔ Hence, **losses** are **capped** at the **put premium**, and are not affected by **upward interest rates movements**



In order to hedge against **interest rate risk**, we can use **duration approximation** to approximate the change in the bond's cash position after a change in interest rates:

$$\Delta P = -D * P * N * \frac{\Delta R}{1 + R}$$

On the other hand, calculating the **change in value** of the **option position** is more **complicated** because of **non-linearity**:

- Let **V** be the total value of the **call option** position, such that:

$$\boldsymbol{V = N_C * Call\ Price\ (C)}$$

Let **B** be the value of the **bond underlying** one **call option contract**:

$$\boldsymbol{\Delta V = N_C * \left[\frac{dC}{dB} * \frac{dB}{dR} * \Delta R\right]}$$

➔ $\boldsymbol{dC/dB}$ is the **change** in value of one call option for a $1 change in the bond price:

- This is called the **option delta** ($\boldsymbol{\delta}$) which, for a **call**, is between **0** and **1**
- This reflects that a **call option** is **more valuable** when the bond price increases
- When the underlying bond price is equal to the strike price, the **delta** will be equal to **0.5**

➔ $\boldsymbol{dB/dR}$ is the change in value of the underlying bond when interest rates change by 1 basis point:

$$\boldsymbol{\frac{dB}{dR} = -\frac{D * B}{1 + R}}$$

Therefore, the change in the **call option position** after a variation in interest rates will be given by:

$$\boldsymbol{\Delta V = -N_C *\ \delta * D * B * \frac{\Delta R}{1 + R}}$$

In order to hedge against **interest rate changes**, a bank needs to offset the **change** in **equity** with an equal and opposite change in the **put option contract** value:

$$\boldsymbol{\Delta E + \Delta V = 0}$$

Which becomes:

$$\left[-(D_A - kD_L) * A * \frac{\Delta R}{1 + R}\right] + \left[-N_P *\ \delta * D * B * \frac{\Delta R}{1 + R}\right] = 0$$

➔ Hence, the number of **put options** needed to hedge against interest rate risk is given by:

$$\boldsymbol{N_P = \frac{-(D_A - kD_L) * A}{\delta * D * B}}$$

- In conclusion, if the **Duration Gap** is **Positive**, changes in interest rate are hedged by a **long-put hedge**

- Symmetrically, if the **Duration Gap** is **Negative**, changes in interest rate are hedged by a **long-call hedge**

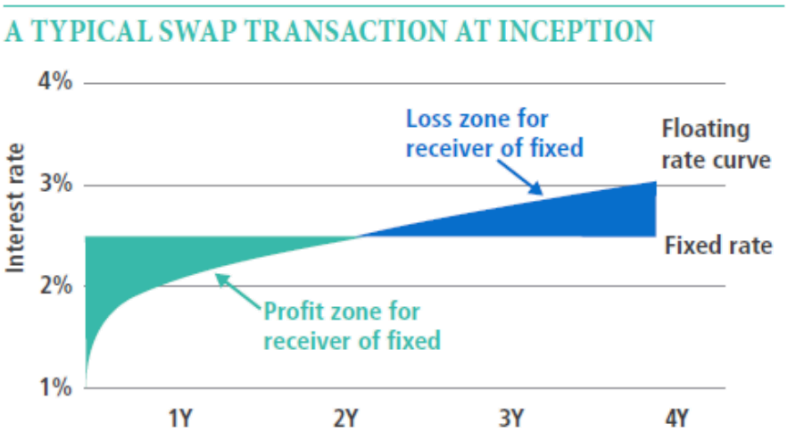
RISK MANAGEMENT USING DERIVATIVES (INTEREST RATE SWAPS)

A **fixed-for-floating Interest Rate Swap** is an agreement between a buyer and a seller at the present time (**inception**) to exchange cash flows at prespecified future times (**settlement dates**) until **maturity**:

- These cash flows are determined as **interest payments** on some **notional value**
- The **swap buyer** (**fixed leg**) makes periodic fixed rate (**swap rate**) payments
- The **swap seller** (**floating leg**) makes periodic **floating rate payments**, usually at a **reference rate** (e.g., LIBOR) plus a fixed rate

Some remarks:

- IRS contracts are **traded OTC** and are therefore exposed to **counterparty risk**
- The **notional** is **not exchanged** and is only used to **compute payments**
- **Rates** are **annual** and periodic cash flows are given by rate/m
- The **reference rate** observed at time ***t*** sets the **floating rate payment** at time ***t+1***



When an investor enters into a swap, the difference between the fixed rate payments and the expected future floating rate payments should be zero (the blue zone equals the green zone)

Consider a **floating rate note** (**FRN**) at every settlement date *t*, the payment at *t+1* will be determined by the **prevailing reference rate**:

- Hence, as in the case of **all fixed income** securities, the **first cash flow** is **fixed**, while the **following** ones are **random**

$$P = \frac{CF_1}{1+R} + \frac{\widetilde{CF}_2}{(1+R)^2} + \ldots + \frac{\widetilde{CF}_N}{(1+R)^N}$$

The **random cash flows** are indexed to some **reference rate** (**R**):

- Hence, an **increase** in **R** will leave the **present value** of the **floating rate note unaffected** because the **cash flows** will **increase with R**
- In this sense, the **FRN** will **reprice annually**

➔ As a consequence, **FRN** has a **very low duration** since **interest rate risk** is associated **only** with the **first cash flow**

- Indeed, the **Macaulay duration** equals the **time until next payment** (usually < 1)

In the context of **Banks' risk management**, hedging with **swaps** consists in finding a **position** that makes the **total variation** in **banks' equity** and in the **swap position** equal to **zero** after a **change** in **interest rates**

- Hence, everything boils down to finding the **duration** of the **swap contract**

The **duration** of the **swap buyer** (duration of net cash flows) is equal to:

$$\boldsymbol{D_{float} - D_{fixed}}$$

- $\boldsymbol{D_{float}}$ is the **duration** of a **floating rate** bond with the **same duration** of the **swap-payment interval** (maturity and floating rate are irrelevant, in this case, for duration determination, since **duration** is equal to the **time** until **next payment**)
- $\boldsymbol{D_{fixed}}$ is the duration of a **fixed rate** bond with the **same maturity**, same **coupon rate** and same **frequency** as in the **Interest Rate Swap**

The **duration** of the **swap seller** is equal to:

$$-(D_{float} - D_{fixed}) = \boldsymbol{D_{fixed} - D_{float}}$$

- Since the typical case is that $\boldsymbol{D_{fixed} - D_{float} > 0}$, the duration for the **seller** is **positive**, while for the **buyer** is **negative**

As long as $\boldsymbol{D_{fixed} - D_{float} > 0}$, then as rate increase, the present value of fixed payment falls more than the present value of floating payments:

- Thus, the **swap buyer gains**, in present value terms, when **interest rates increase**
- On the other hand, the **swap seller gains**, in present value terms, when **interest rates fall**

It follows that, for the **Swap Buyer**, the **change** in the **swap position** will be given by:

$$\Delta S = -\left(D_{float} - D_{fixed}\right) * S * \frac{\Delta R}{1 + R} =$$

$$= \left(\boldsymbol{D_{fixed} - D_{float}}\right) * \boldsymbol{S} * \frac{\boldsymbol{\Delta R}}{\boldsymbol{1 + R}}$$

- The **inverse** will be equal for the **swap seller**

Banks

In the context of a bank, the **Equity** of a bank **loses value** when **interest rates increase**:

- Hence, the bank wants to be a **swap buyer**

$$\Delta E + \Delta S = \left[-(D_A - kD_L) * A * \frac{\Delta R}{1 + R}\right] + \left[\left(D_{fixed} - D_{float}\right) * S * \frac{\Delta R}{1 + R}\right] = 0$$

By setting the above **equation** to **zero**, we can find the **number of swaps** the bank needs to **buy** in order to **hedge** against **interest rate risk**:

$$S = \frac{(D_A - kD_L) * A}{D_{fixed} - D_{float}}$$

Example

Example (cont.)

A ten-year IRS with annual payments, swap rate 8.25%, floating rate equal to LIBOR, and \$100,000 notional. The (price and) duration of a 10YR bond with 8.25% coupon at $R = 10\%$ is (see lecture 1)

t	CF_t	DF_t	PV_t	$t \times PV_t$
1	8.25	0.9091	7.5	7.50
2	8.25	0.8264	6.82	13.64
3	8.25	0.7513	6.20	18.60
...	...	...	...	...
9	8.25	0.4241	3.50	31.49
10	108.25	0.3855	41.74	417.35
			P=89.25	D=7.00

while the duration of a FRN that reprices annually is one year. Thus

$$D_{\text{fixed}} = 7 \quad \text{and} \quad D_{\text{float}} = 1.$$

Bank ABC manager has to enter as buyer into this IRS for a notional value of

$$S = \frac{\left(5 - \frac{9}{10}3\right) \times 100,000,000}{7-1} = 38,333,333\$.$$

or equivalently, since each contract has \$100,000 notional, she has to buy 383.33 contracts.

MARKET RISK

The **Banking Book** refers to instruments that are expected to be **held to maturity**

- On the other hand, the **Trading Book** includes instruments that a bank holds for **short-term resale**, profiting from **short-term pricing moves**, locking in **arbitrage profits**, and hedging risks that arise from instruments meeting these criteria

	Assets	Liabilities
Banking book	Cash	Retail CD (3YR)
	I-O Consumer loans (3YR)	Corporate time deposits (1YR)
	Industrial loans (5YR)	Coupon bonds (5YR)
	Fixed rate mortgages (20YR)	(Equity)
Trading book	Bonds (long)	Bonds (short)
	FX (long)	FX (short)
	Equities (long)	Equities (short)
	Commodities (long)	Commodities (short)
	Derivatives (long)	Derivatives (short)

Example - Long-Term Capital Management

LTCM was a **hedge fund** management company focusing on **convergence trading**:

- **On-the-run** bonds (**OTR**) are the most recently auctioned Treasuries, with different original maturities (3M, 6M, 1Y, 2Y, 5Y, 7Y, 10Y, 30Y)
- With respect to **Off-the-Run bonds** (**old bond**), **On-the-run bonds** (**new bond**) have a higher price/lower yield because of liquidity preference

LTCM engaged in **fixed income arbitrage** by **buying Off-the-run** 29.5Y (which are cheaper 30Y bonds issued 6 months ago), and **selling new On-the-run** 30Y:

$$P_{30Y} - P_{29.5Y} > 0$$

- Over time, the **valuation** of the **two bonds** will **converge** since the **premium** of the **30Y bond** will **fade** when a **new 30Y bond** is **auctioned**
- Hence, the **strategy** consisted in **waiting** the **29.5Y** bond to **increase** in **price**, until it was **greater** than or **equal** to the **30Y bond**

However, in August 1988, Russia defaulted on its domestic local currency bonds:

- This led to a general flight to quality, thus **increasing** prices of **most liquid securities**, and **decreasing prices** of **less liquid** ones
- This means that the On-the-run 30Y price increased, while the Off-the-run 29.5Y price fell

This led to the default of LTCM, as the premium on the 30Y bonds did not fade, instead it increased because of the liquidity of the security

Market Risk

Market Risk is the risk of portfolio or trading book associated with **extreme changes** in market conditions:

- In order to **measure market risk**, the classic **measure** of **risk** from **portfolio theory** is **not sufficient**

Instead, we need a measure of **downside** (**tail**) **risk**, using two different approaches:

1. **Value at Risk** (**VaR**), which can be carried out using:
   - **Parametric** approach
   - Historical approach
   - Monte Carlo simulation approach

2. **Expected shortfall**

VaR Approach

The **VaR Approach** consists in creating a **confidence interval** of the **maximum** possible **loss** during the **holding period** of an asset:

- Therefore, the VaR depends on the **confidence interval** (alfa) and the **holding period** (**N**)

$$VaR(\alpha, N)$$

- Popular choices are $\boldsymbol{\alpha = 95\%}$ and **N=1 day**, or $\alpha = 99\%$ and N=10 days

By convention, VaR is identified as a **positive number**, even though it refers to a loss

- Keeping the **holding period fixed**, the **higher** the confidence level $\boldsymbol{\alpha}$, the **higher** the **VaR values**
- In general, **determining VaR** requires **knowledge** of the **distribution** of **future portfolio values** over the chosen **holding period**

VaR can be used for different purposes:

- **Micro/Internal uses**, since banks want to limit the risk-taking of their traders
- **Macro/External uses**, since regulators want to limit the risk taken by the banking system

In order to build a **VaR Model**, we need to follow different steps:

1. Mark-to-market the **current portfolio** and finding its **current value** ($\boldsymbol{W_0}$), and then fixing the **confidence level** and the **holding period** (α, N)

2. Let $\widetilde{\boldsymbol{W}}(\boldsymbol{N})$ be a **random variable** that represents the **portfolio value**:

   - $\widetilde{\boldsymbol{\Pi}}(\boldsymbol{N}) = \widetilde{\boldsymbol{W}}(\boldsymbol{N}) - \boldsymbol{W_0}$ is going to be the **profit and loss** during the holding period, with $\Pi > 0$ being a **profit**, while $\Pi < 0$ a **loss**
   - Then, we should **figure** out $\boldsymbol{f(\pi_N)}$, the distribution of the future **P&L**

3. We should find $\boldsymbol{\Pi^*}$ as the **lowest possible P&L** at a given **confidence interval**

$$\alpha = \Pr\left[\widetilde{\Pi}(N) \leq \Pi^*\right] = \int_{\Pi^*}^{+\infty} f(\pi_N)\, d\pi$$

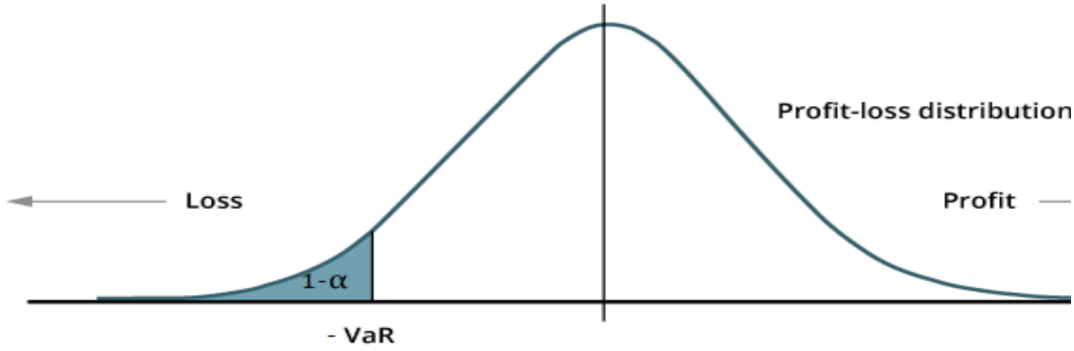
➔ This means that $\boldsymbol{\Pi^*(\alpha, N)}$ is the $\boldsymbol{(1-\alpha)th}$ **percentile** of the distribution $\widetilde{\Pi}(N)$

- We set the probability of the P&L to be above $\boldsymbol{\Pi^*}$ using $\boldsymbol{\alpha}$
- We want to be $\boldsymbol{\alpha\%}$ **sure** that the value will be above $\boldsymbol{\Pi^*}$

4. Since $\boldsymbol{\Pi^*(\alpha, N)}$ is typically **negative** for **large** $\boldsymbol{\alpha}$ (a loss), the **VaR** will be given by:

$$\boldsymbol{VaR = -\Pi^*(\alpha, N)}$$

➔ The **VaR** is the $\boldsymbol{(1-\alpha)th}$ of my **P&L** distribution



Parametric Approach

The **Parametric** (**model-building**) **Approach** assumes that:

- **Normally Distributed** portfolio returns, with **mean** $\boldsymbol{\mu}$ and **standard deviation** $\boldsymbol{\sigma}$
- Portfolio returns are **iid** over time

➔ The first assumption is useful to **aggregate individual asset returns** into **portfolio returns**, because of the **additivity property** of normal random variables:

Indeed, assume that $X \sim N(\mu_X, \sigma_X^2)$ and $Y \sim N(\mu_Y, \sigma_Y^2)$, then X+Y will be distributed as:

$$X + Y \sim N(\mu_X + \mu_Y, \sigma_X^2 + \sigma_Y^2 + 2\sigma_{XY})$$

- Furthermore, the first assumption is useful to **easily compute** the $\boldsymbol{(1-\alpha)th}$ **percentile**

➔ The second assumption is useful to compute VaR changing the holding period N

The key idea behind the **parametric approach** is to work with **centiles** of the **distribution** of future portfolio returns instead of the distribution of future portfolio values (or P&L):

- Letting $\tilde{R}$ be the **portfolio net return** over the holding period N, we have that:

$$\tilde{W} = W_0(1 + \tilde{R}) \rightarrow \boldsymbol{\tilde{\Pi} = \tilde{W} - W_0 = W_0 \tilde{R}}$$

- **Riskmetrics** further assume that **expected daily returns** are equal to **zero** which, even if may not be true, it is a reasonable assumption for many securities at the **daily level**

➔ When $\boldsymbol{\mu = 0}$, the **Normal Distribution** is symmetric around **0**, and we can therefore have that the **threshold return** $\boldsymbol{R^* = R^*(\alpha, N)}$ satisfies the following distributional **properties** (keep in mind that $\boldsymbol{R^* < 0}$):

$$5th\ percentile = -1.65 * \sigma = -(95th\ percentile)$$

$$1st\ percentile = -2.33 * \sigma = -(99th\ percentile)$$

- When $\boldsymbol{\mu \neq 0}$ it will be sufficient to subtract the product of the centile of the Normal distribution and the standard deviation from the mean

$$\begin{aligned} 0.05\text{-th centile} &= \mu - 1.65\sigma \\ 0.01\text{-th centile} &= \mu - 2.33\sigma \end{aligned}$$

➢ Steps to use the **Riskmetrics approach**:

1. **Mark-to-market** the current position $\boldsymbol{W_0}$ and fix the **confidence level** and the **holding period** $(\boldsymbol{\alpha, N})$
2. Measure the daily volatility $\boldsymbol{\sigma}$ of the **portfolio returns** (**risk factor**)
3. Set the **confidence level** $\boldsymbol{\alpha}$ and obtain the $\boldsymbol{(1-\alpha)th}$ **centile** of the return distribution $\boldsymbol{R^*}$ so that:

$$\boldsymbol{VaR(\alpha, N) = -W_0 * \sigma * (1-\alpha)th\ centile_{SN}}$$

Where $\boldsymbol{\sigma * (1-\alpha)th\ centile_{SN}}$ is just equal to the **threshold return** $\boldsymbol{R^*}$

- Since the Standard Normal is symmetric around 0, the latter equation is just going to be equivalent to:

$$W_0 * \sigma * \alpha_{th}\ centile_{SN}$$

Examples

Example

Bank ABC has \$10 mln in Microsoft shares. Let Microsoft have $\mu = 0.08\%\ (\sim 0)$ and $\sigma = 2\%$. The threshold daily portfolio return R^* with $\alpha = 0.95$ is

$$0.02 \times (-1.65) = -3.3\%.$$

Therefore by (3) VaR is

$$-10,000,000 \times (-0.033) = 330,000\$.$$

- The meaning of R^* is that Microsoft loses *more* than 3.3% only in 1 day every 20 days.

Example

Bank ABC (US headquartered) has a 800,000€ trading position in spot euros. The current exchange rate is €0.8/$1 (equivalently $1.25/€1). Over the past year, the average (resp. standard deviation) of changes in EUR/USD daily exchange rate is 2bps(~ 0) (resp. 50bps). The $ value of the position is

$$800,000 \times 1.25 = 1\$ \text{ mln.}$$

The threshold daily portfolio return R^* (with $\alpha = 0.95$) is

$$R^* = 50 \times (-1.65) = -82.5 \text{ bps},$$

and by (3)

$$\text{VaR} = -1,000,000 \times (-0.00825) = 8,250\$.$$

- The meaning of R^* is that EUR depreciates relative to USD by more than 82.5 bps *only* 5 days in every 100 days.
- Incorporating mean returns. By eq. (4) we have that with $\mu = 2$bps

$$\text{VaR} = -1,000,000 \times (0.0002 - 0.00825) = 8,050\$.$$

- Changing the confidence level. Setting $\alpha = 0.99$ gives

$$\text{VaR}(0.99, 1) = 1,000,000 \times \underbrace{50 \times 2.33}_{116.5 \text{ bps}} = 11,650\$$$

- Changing the holding period. This is where the second assumption (i.i.d. returns) bites.
- Assuming that daily changes in EUR/USD are i.i.d. (*and* daily volatility is constant)

$$\text{VaR}(\alpha, N) = \text{VaR}(\alpha, 1) \times \sqrt{N}.$$

- For instance, using $N = 5$ days with $\alpha = 95\%$

$$\text{VaR}(0.95, 5) = 8,250 \times \sqrt{5} = 18,448\$.$$

Fixed Income Securities

When securities have **finite maturities**, we cannot measure **volatility** by only using a set of daily prices:

- The **Delta-normal method** is based on **security sensitivity** to the **risk factor**, instead of using the security itself as the risk factor
- The advantage of the **Duration Approximation approach** is that only **one price** is needed, rather than the whole volatility history of the stock
- This approach is also useful to deal with large portfolios

For bonds, the main risk is **interest rate risk**, and we know that the change in price is given by:

$$\frac{\Delta P}{P} = -DUR * \frac{\Delta R}{1+R}$$

- Therefore, instead of measuring volatility with real data, we can **Proxy** the **Price Volatility** by multiplying the **modified duration** and the **change** in **interest rates**

However, we may want to measure only the **downside volatility**:

- Since we know there is an **inverse relationship** between **prices** and **interest rates**, **downside risk** will be a **large increase** in the **interest rate** R (**large** ΔR^*)

➔ As we will see, the **confidence level** and **holding period** will **fix** this increase ΔR^*, thus we can see that:

$$VaR(\alpha, N) = W_0 * MD * \Delta R^*$$

In order to specify the **adverse movement** in **interest rates** (ΔR^*), we need to find the **daily** interest rate change such that there is α **probability** that interest rates will **increase** by **more** than ΔR^* over **one day**, thus causing a **large bond price decrease**

- Let μ be the **average daily change** in **interest rates** and σ the **standard deviation** of **daily changes** for which we do have (historical) data
- Then, we can calculate the α **confidence interval** for the **daily changes** in interest rates, and take the **upper bound** as our ΔR^*

Keep in mind that it is also **possible** to use the **actual volatility** by computing the **bond price** at the **new rate** (initial rate + ΔR^*):

- We can see that the **VaR** using the **Duration formula** is **larger** than the one computed with the **actual price change**

➔ The reason is that the **duration approximation** is **conservative/pessimistic**

Example

Example

Bank ABC has a \$1,500,000 of face value of zero-coupon bonds (unit face value \$100) with maturity 5 years in its trading book. Current interest rates are equal to 7% (equivalently, YTM on these bonds is 7%). Compute VaR(0.99, 1).

- From lecture 1, the current price of each bond is

$$\frac{100}{1.07^5} = 71.3,$$

and the market value of Bank ABC trading position is

$$W_0 = 15,000 \times 71.3 = 1,069,500\$.$$

- Again, from lecture 1, we also know that the (Macaulay) duration of these bonds is 5 yrs. Therefore

$$MD = \frac{D}{1+R} = \frac{5}{1.07} = 4.673.$$

suppose during the last year

$$\mu = -1\text{bp} \quad \text{and} \quad \sigma = 10\text{bps}.$$

- Thus, 98% of the data are between

$$-1 - 10 \times 2.33 = -24.3\text{bps},$$

and

$$-1 + 10 \times 2.33 = 22.3\text{bps}.$$

- The latter defines the adverse movement, ΔR^*, that causes a drop in value of the bond position.
- Therefore

$$\begin{aligned} \text{VaR}(0.99, 1) &= W_0 \times \overbrace{MD \times \Delta R^*}^{\text{downside volatility}} \\ &= 1,069,500 \times 4.673 \times 0.00223 \\ &= 11,145\$ \end{aligned}$$

Remarks:

- Changing the confidence level. Setting $\alpha = 0.95$ tells us that $\mu \pm 1.65\sigma$ contains 90% of the data. Thus the adverse change in interest rates is now

$$-1 + 10 \times 1.65 = 15.5\text{bps},$$

and

$$\text{VaR}(0.95, 1) = 1,069,500 \times 4.673 \times 0.00155 = 7,747\$.$$

- Changing the holding period. Assuming that interest rate changes are i.i.d. (and daily volatility is constant), over 10 days

$$\text{VaR}(0.99, 10) = 11,145 \times \sqrt{10} = 35,244\$.$$

- One could alternatively use the *actual* volatility by computing the new bond price at $R = 7.223\%$ $(= 7\% + 22.3\text{bps})$

$$\left|\frac{\Delta P}{P}\right| = \frac{|70.56 - 71.3|}{71.3} = 0.010379,$$

and obtain

$$\text{VaR}(0.99, 1) = 1,069,500 \times 0.010379 = 11,100\$.$$

- We see that the VaR with the duration formula is larger than the VaR with the actual price change. But this should *not* come as a surprise by now –duration approximation is conservative/pessimistic.

MARKET RISK (2)

VaR Aggregation

Bank managers may be interested in the **VaR** of their **whole portfolio**, and not just of **single trading positions**

In order to aggregate **VaRs**, we need to keep in mind that the **parametric approach** hinges on **normally distributed returns**

- Assume that the **initial portfolio value** is given by the **sum** of two individual positions

$$W_0 = W_1 + W_2$$

- Since **future values** of **individual positions** are **normally distributed**, then the **future portfolio value** will be **normally distributed** as well

$$\widetilde{\boldsymbol{W}} = W_1\left(1 + \widetilde{R_1}\right) + W_2\left(1 + \widetilde{R_2}\right) = \boldsymbol{W_0} + \boldsymbol{W_1}\widetilde{\boldsymbol{R_1}} + \boldsymbol{W_2}\widetilde{\boldsymbol{R_2}}$$

➔ $\widetilde{\boldsymbol{W}}$ will be **Normally Distributed** provided that $\widetilde{\boldsymbol{R_1}}$ and $\widetilde{\boldsymbol{R_2}}$ are **Normally distributed**

Hence, the future portfolio value can be rewritten as:

$$\widetilde{\boldsymbol{W}} = W_0 + W_0 * \widetilde{R_p} = \boldsymbol{W_0} * \left(\mathbf{1} + \widetilde{\boldsymbol{R_p}}\right)$$

- Where $\widetilde{\boldsymbol{R_p}}$ is the expected portfolio net return, calculated as a **weighted average** of the **expected return** of individual assets, weighted by the **portfolio weights**

Hence, what applies for **individual assets** will also apply to **portfolios**, with the P&L being equal to:

$$\widetilde{\boldsymbol{\Pi}} = \widetilde{\boldsymbol{W}} - \boldsymbol{W_0} = \boldsymbol{W_0} * \widetilde{\boldsymbol{R_p}}$$

Assume that the average return of the portfolio is **zero** (**Riskmetrics assumption**)

1. The **VaR formula** will apply also to **portfolios**:

$$VaR_p(\alpha, 1) = -W_0 * \boldsymbol{\sigma_p} * (1 - \alpha)th\ centile_{SN}$$

2. The **portfolio volatility** $\boldsymbol{\sigma_p}$ is computed by taking into account the linear correlation between the variables:

$$\sigma_p = \sqrt{X_1^2\sigma_1^2 + X_2^2\sigma_2^2 + 2\boldsymbol{\rho_{1,2}}\sigma_1\sigma_2X_1X_2} =$$

$$= \frac{1}{W_0}\sqrt{W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2\boldsymbol{\rho_{1,2}}\sigma_1\sigma_2W_1W_2}$$

➔ Hence, the $\boldsymbol{VaR_p(\alpha, 1)}$ can be rewritten as:

$$\boldsymbol{VaR_p(\alpha, 1)} = -\sqrt{W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2\boldsymbol{\rho_{1,2}}\sigma_1\sigma_2W_1W_2} * (1 - \alpha)_{th}\ centile_{SN} =$$

$$= \sqrt{[VaR_1]^2 + [VaR_2]^2 + 2\rho_{1,2} * VaR_1 * VaR_2}$$

➔ Hence, we can see that, **unless** the portfolios are **perfectly positively correlated**, then the VaR of a portfolio is **less** than the **sum** of **individual VaRs**:
- This is due to **diversification**

Delta-normal method

As the **portfolio grows** in **size**, **complexity** increases because more **individual volatilities** and **correlations** must be **estimated**
- For FX there is not much one can do, since **each currency** is a source of **risk**
- For **other asset classes**, thinking in terms of **risk factors** helps in **simplifying** the **variance-covariance matrix** structure (**delta-normal method**)

Equities

In light of the CAPM, the stock's total risk is given by:

$$\sigma_i^2 = \beta_i^2 \sigma_m^2 + \sigma_{\varepsilon_i}^2$$

Where $\beta_i^2 \sigma_m^2$ captures the **systematic risk**, while $\sigma_{\varepsilon_i}^2$ captures the **individual risk**

Similar to durations, **betas** are **additive** in a portfolio with N stocks, where X_i captures each individual stock:

$$\beta_p = \sum X_i \beta_i$$

- For a **diversified portfolio *p*** (large N), **idiosyncratic risk** is reduced to zero and only systematic risk matters
- Thus, according to the CAPM, the **equity portfolio volatility** is equal to:

$$portfolio\ volatility \approx \beta_p \sigma_m$$

➔ It follows that, with $\mu_p = 0$, **VaR** model can be rewritten as:

$$VaR\ (\alpha, 1) = W_0 * \beta_p * \sigma_m * \alpha_{th}\ centile_{SN}$$

- In this way, we are able to reduce complexity and to compute only (N+1) parameters, namely the **market volatility** and the **individual betas**
- Indeed, using volatilities and standard deviations we would need to estimate $N + N * (N-1)/2$ parameters
- $\beta_p * \sigma_m$ is just the **portfolio sensitivity** to the **market** multiplied by the **market volatility**

Example

Example

Bank ABC holds a 1$ mln trading position in stocks. This portfolio has a beta of 1.25. Over the past year, the standard deviation of daily returns on the S&P ("the market") is 150bps. Then

$$\text{VaR}\,(0.99, 1) = 1,000,000 \times 1.25 \times 2.33 \times 0.015 = 43,688\$.$$

Bonds

If we want to calculate the **VaR model** for a **bond portfolio**, we need to take into account that:

- Under the assumption of a **flat term structure**, the **risk factor** for all bonds is the **interest rate R**
- **Durations** are **additive** in a portfolio of bonds, hence we need to calculate a **Modified Duration** ($\boldsymbol{MD_p}$) of the **portfolio** from the **individual durations**

➔ Hence, for a **fixed-income portfolio** we ca readily use:

$$VaR_p(\alpha, 1) = W_0 * MD_p * \sigma_R * \alpha_{th}\ percentile_{SN}$$

Summing-up, the **delta-normal method** in equities and bonds prescribes to compute VaR in the following way:

$$\boldsymbol{VaR_p(\alpha, 1) = W_0 * sensitivity * factor\ vol * \alpha_{th}\ percentile_{SN}}$$

Equities	$\boldsymbol{sensitivity * factor\ vol = \beta_p * \sigma_m}$
Bonds	$\boldsymbol{sensitivity * factor\ vol = MD_p * \sigma_R}$

➔ In general, keep in mind that:

- When **aggregating** across **asset classes**, one has to estimate the **correlations** between **risk factors** on top of their volatilities, as well to compute the portfolio VaR
- The **delta-gamma method** is a **furher refinement** that allows to correct for **non-linear effects** in the portfolio, such as the **convexity** of bonds or **non-linear derivatives** such as options

Expected Shortfall

The **VaR** is a single number which, under the **parametric approach**, hinges upon **normally distributed asset returns**:

- However, in many instances return distributions exhibit **negative skewness** and **fat tails** (so called *Black Swan Events* under Basel III)
- In these instances, **managers** are more interested in knowing the **potential size** of the **loss** that **exceeds** the **VaR**

➔ **Expected Shortfall** (**Expected Tail Loss**) is a measure of **market risk** that estimates the **expected value** of loss beyond a given confidence level

- Given α, the **expected shortfall** is the **area** to the **left** of Π^*
- Formally, after fixing the **confidence level** α and the **holding period N**, the **expected shortfall** is given by:

$$ES(\alpha, N) = \frac{1}{1-\alpha}\int_{\alpha}^{1} VaR(u, N)\, du$$

Example

Example

Consider two positions with the following probability distribution of profits and losses ($ mln)

Pos A		Pos B	
Prob	P/L	Prob	P/L
49.5%	100	49.5%	100
49.5%	90	49.5%	95
1%	-100	0.25%	-100
		0.75%	-430

- For both positions:
  - Setting $\alpha = 99\%$, identical $(1-\alpha)$-th centile

$$0.01\text{-th centile} = -100.$$

  - We conclude that

$$\text{VaR}_A\,(0.99, 1) = \text{VaR}_B\,(0.99, 1) = 100\$ \text{ mln}.$$

- And yet:
  - For position A

$$\text{ES}_A\,(0.99, 1) = \text{VaR}_A\,(0.99, 1) = 100\$ \text{ mln}.$$

  - For position B

$$\text{ES}_B\,(0.99, 1) = \frac{0.0025}{0.01} \times 100 + \frac{0.0075}{0.01} \times 430 = 347.5\$ \text{ mln}.$$

RISK AND INSURANCE

Risk Definition

Insurance can be defined as a **device** to deal with **uncertain events** (**perils**) that could produce **negative effects** (**damages**) on **risk units** that are **exposed** to their occurrence:

- Therefore, it is a device that **eliminates** or **reduces** the effects of **pure risks**, which are risks that can only produce a **negative effect**
- On the other hand, insurance does not deal with **speculative risk**, which are risks that can either generate a loss or a gain

➔ Important concepts in the context of insurance:

- **Risk units** are the person/object/activity/situation to which an exposure exists
- **Perils** are the uncertain events that could impact the risk unit and create some kind of negative effects
- **Risk Exposures** are the circumstances that create a connection between the risk unit and the perils and determine the exposure to the peril
- **Damages** are the type of negative effect that the combination of peril and exposure could generate to the risk unit

It is possible to categorize different types of insurance with respect to:

- **Risk units**, such as *person* or *property insurance*
- **Perils** or **Damages**, such as *fire*, *theft*, *accident insurance*
- **Exposure**, such as *elderly* or *owner insurance*

A very important distinction between types of insurance is between **life** and **non-life insurance**:

- **Life insurance** deals with events connected to the duration of human life, for instance related to life or death at a certain point in time
- **Non-life insurance** deals with all other adverse events

In the case of **life insurance**, the potential loss refers to the financial needs that are normally triggered by life events:

- In the case of **death**, the damage may be the loss of a source of income
- In the case of **survival**, the damage may be the **financial needs** due to **retirement** or envisaged at a certain age. Therefore, this insurance type aims at **avoiding** the **adverse impact** for individuals connected to a **lack** of **financial resources** at a **certain age**

The most popular categories of pure risk include:

- **Property risk**, which refers to the conditions that could result in property damage, destruction, or disappearance
- **Personal risk**, which refers to the lost income or increase costs due to perils that affect the life of individuals
- **Liability risk**, which refers to conditions that creates the possibility that a firm's financial resources may be diminished as a result of a liability loss

Depending on the **category**, we have **different types** of **insurance coverage**, with **different technical** and **financial implications**, and different **management methods**:

- In the context of **insurance business**, the various **types** of insurance coverage are usually identified as **lines of business**

Insurance Process

Individuals can deal with **pure risks** in different ways:

1. **Retaining the risk**, which means doing nothing and hoping that the event will not occur
    - However, this is not a rational attitude

2. **Avoiding the risk**, which means avoiding the situation that entails the exposure
    - This approach reduces losses, even though it constrains the normal development of social life and economic activity

3. **Reducing the possibility of occurrence**, which means putting in place preventive measures in place that reduce the probability or intensity of a potential loss
    - This could reduce actual losses, even though it is not sufficient to eliminate them

4. **Accumulate resources** to cover any loss stemming from risky situations, even though this is not an efficient wat to deal with risks

5. **Transferring the risk** to other individuals or groups of individuals:
    - This means **agreeing** with **other parties** that, against a certain **payment**, **other parties** will **suffer** the **effects** of any **materialization** of the risk
    - The **insurance process** is a specific way to transfer pure risks to other parties

The **insurance process** is based on **collecting advance contributions** from a **group** of **units** exposed to the **same risk** in order to be able to **compensate** for the **losses** of any units in the group who are **hit** by the **unfortunate event**:

- **Collecting contributions** in **advance** entails the need to **estimate** the **probable losses** stemming from the unfortunate event
- The **risk units** belonging to the group **share** the **losses** on some **equitable basis**, since the **contributions** are coming from a **group** of **risk units** exposed to the **same possibility** to be **hit** by the **unfortunate event**
- The **losses** of any risk unit in the group are **expected** to be **covered** by the sum of all the **advance contributions** collected

Therefore, insurance is an economic device whereby individuals substitute a low, certain cost for a large uncertain financial loss

The **insurance process** has **two** fundamental **features**:

- **Transfer of risk** from an **individual** to a **group** of individuals
- **Sharing losses**, on some **equitable basis**, by **all members** of the **group**

Basic actuarial concepts

The **Law of Large Numbers** states that the **observed frequency** of an event (***a posteriori probability***) more closely approach the ***a priory probability*** as the number of trials increase:

- The *a priori probability* is based on the **underlying conditions** that cause an event and can be interpreted as the **best estimate** of the **probability** that the **event** will **occur** in the **future**

By the Law of Large Numbers, it is possible to obtain a notion of a **future uncertain event** by **observing similar events** occurred in the **past**, and determining the *a posteriori probability* of the event:

- After observing the proportion of the time that the various outcomes have occurred over a long period of time under the same risk condition, it is possible to calculate the **probability distribution**
- The Probability Distribution assigns a probability to any single outcome of the event, which is the mean of the probability distribution
- The same approach can be used if we want to predict the best estimate of the intensity of the loss caused by an uncertain event

In general, the **larger** the **sample** on which the **empirical estimate** of the **frequency** of the event is based, the **more closely** the **estimate approximates** the *a priori probability* of the event, and therefore the **more reliable** the **best estimate** of the **future occurrence**

- However, it is not possible to obtain as large a sample as we would like
- Hence, we must estimate the mean of the probability distribution based on the largest sample we can get from statistical studies, and then allowing for a margin of error
- The larger the dispersion of the individual values from the mean, and the lower the sample, the less certain we can be that our estimates approximates a reliable (*a priori*) probability

In general, we can conclude that:

- In order to **estimate** *a priori probability* **accurately** through the **empirical observation** of past events, it is necessary to have a **sufficiently large sample**
- The **estimate** of the a priori probability must be applied to a **sufficiently large number** of **risk units** to permit the a priori probability to work itself out in the concrete application of the process

Functioning of the insurance process

Individuals can handle risk in different ways:

1. **Do-nothing strategy**, which means doing nothing and hoping that nothing will happen or, at most, using preventive measures to reduce the probability of occurrence
    - The main advantage is that it does not require any risk evaluation process
    - On the other hand, losses are never funded, and risk remains potentially softened only by preventive actions

2. **Retention and Self-insurance strategy**, which consists in making provisions to fund predicted losses
    - The main advantage is that losses might be entirely funded if savings are sufficient
    - On the other hand, losses may be difficult to predict
    - Furthermore, setting aside money entails an opportunity cost

➔ This solution is **neither efficient nor effective**:

- It is **not efficient** because it implies **setting aside money** that could be used for **more satisfying needs** or **profitable investments**
- It is **not effective** because it is **very difficult** to **reach** an amount of **savings** that covers **all possible losses**, in particular when the latters vary in size

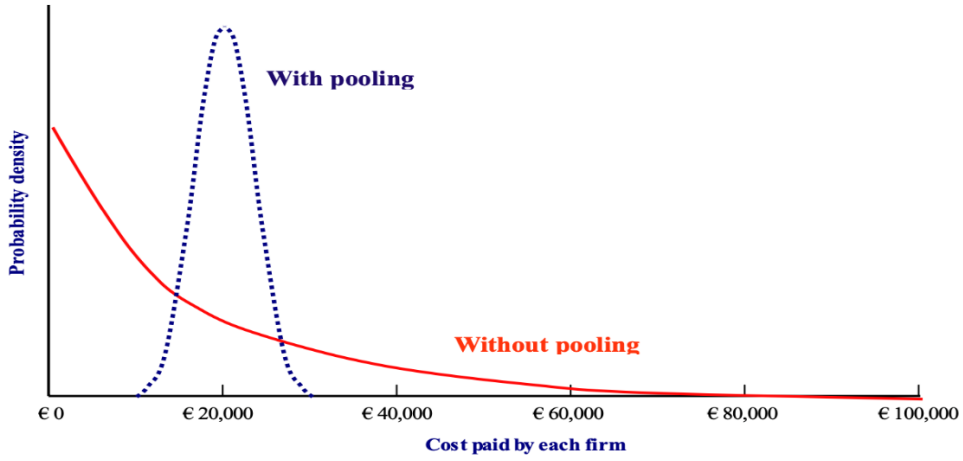
For this reason, the best method is to pool together similar risks borne by different individuals:

- Assume that the **accident losses** are **uncorrelated** between each other
- Then, the **pooling arrangement** of similar and uncorrelated risks does **not change** the **expected costs** for the **individuals**, but it **reduces** the **standard deviation** of **costs**

➔ Therefore, the **pooling arrangement** reduces the **risk of gaps** between the expected costs and the possible outcomes of the event:
- In this sense, it **reduces** the **uncertainty** of the **outcomes** within the **pool**, taken as a **whole**

In general, we can conclude that, as the number of **participants** in the **pooling** arrangement **increases**:
- The **probability** of **extreme outcomes decreases**
- The **probability** that the **average losses** will be **close** to the **expected loss increases**
- The **curve** of the **probability distribution** of each firm's **cost** becomes **more bell-shaped** (and therefore, less skewed)

➔ In summary, the **pooling** of **uncorrelated risk** units makes the **amount** of accident losses that each firm must pay **more predictable** because **pooling reduces** the **standard deviation** of the **loss probability distribution** for **all** the **participants**
- This means that **pooling** also **reduces** the **standard deviation** of the **possible payment** required by each participant to **cover** the **actual losses** of the pool
- When the **number** of **participants** become larger, the **standard deviation** of each participant's **cost** eventually becomes **zero**
- Furthermore, the **shape** of the **probability distribution** becomes more and more **bell-shaped** until it eventually **equals** the **normal distribution**

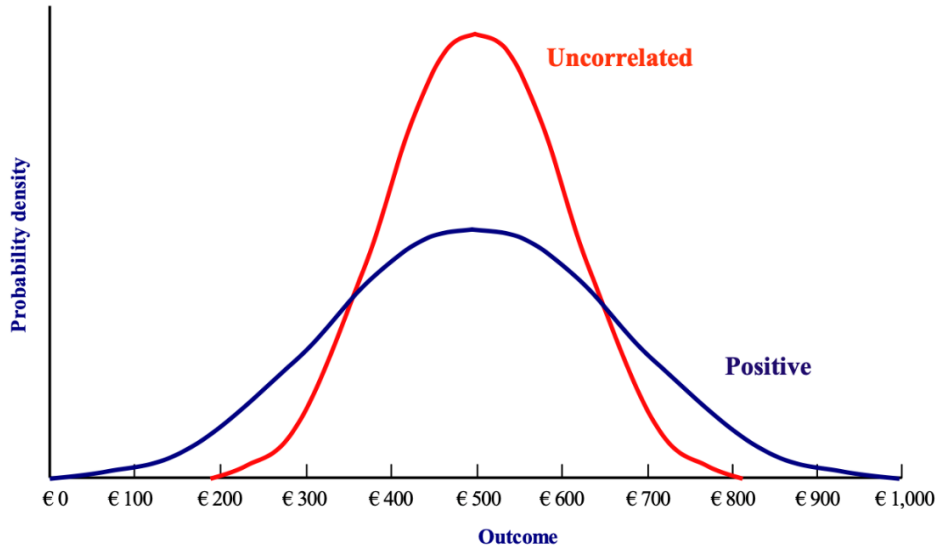


Even if we outlined it, the condition of the **identical distribution** and **full independence** of risk units is **not essential** in the process:

1. The **standard deviation** of average loss tends to **decline** when more **participants** with **different loss distributions** are added to a pooling arrangement:
   - If a participant with a **very high standard deviation** of losses, or **very different distribution**, is added to the pool, then the **decrease** in the **standard deviation** of the probability is **compressed** and could eventually **disappear**
   - Furthermore, participants with different expected losses may be unwilling to share losses equally in a pooling arrangement

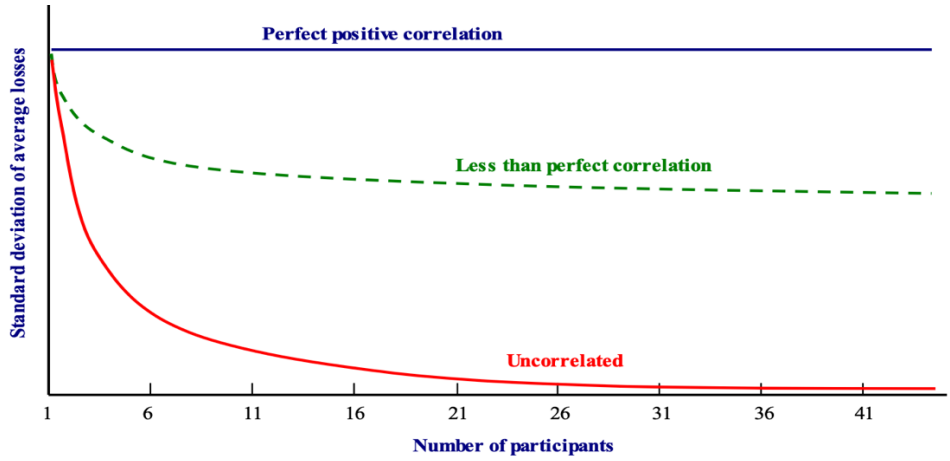
2. The **pooling arrangements reduce risk** for each participant even if **losses** are **not fully independent**, **provided** that they are **not perfectly correlated**:
   - However, the magnitude of the reduction of the standard deviation of the pool is lower when losses are positively correlated wrt when they are independent

➔ Indeed, we can see that positive correlation increases standard deviation:



When losses are perfectly positively correlated, the pooling arrangement does not reduce risk:

- On the other hand, if losses are correlated, the pooling arrangement is able to reduce risk as the pool increases in size
- In general, the largest risk reduction is obtained when risks are uncorrelated



Since we have seen that individual solutions are neither efficient nor effective, individuals should use **mutual solutions**:

- These solutions require decisions by multiple parties, based on the pooling and sharing of the risks between the participants

1. **Unfunded Mutual Insurance plan** consists in individuals sharing ***ex post* total losses** incurred by the **pool** of firms on some **equitable basis**:
    - The main **advantage** is that the **probability** that the **payment** by each participant will **equal** the participant's **maximum loss** is **low**
    - However, the **issue** is that the **probability** of a **payment** by each participant is **high**, and some **participants** may **refuse** to **pay** their **contribution**

2. **Funded Mutual Insurance plan** requires all participant to **agree** to make an **advance payment** for predicted future losses on some **equitable basis** (**insurance process**):
    - The main **advantage** is that each participant **exchanges** an **uncertain loss** with a **certain cost** (**advance payment**)
    - On the other hand, the **payment** is **certain** for **all participants** and the main **issue** is that **total losses** might be **difficult** to **predict** in advance

➔ A **pooling risk management strategy** transforms a **pure risk** borne by individuals into a **speculative risk** for the **pool as a whole**:
- Indeed, the **actual risk** for the **pool** is to have **uncertain profits** or **losses**
- The **transfer of risk** from **individuals** to a **group** of individuals is one of the **pillars** of the **insurance process**
- In general, the higher the advance payment, the lower the speculative risk for the pool, which is the probability that the overall risk provision will not be able to fund the overall loss
- Furthermore, when a larger number of firms takes part in the pooling agreement, the speculative risk also becomes lower (Law of Large Numbers)

Summary

We can identify three main pillars of the insurance process:

1. As the **number of participants** in the pooling arrangement **increases**, the **distribution** of the **possible outcomes** of the pool's **actual** total **losses** gets **closer** to their **expected value**

2. As each participant's **risk provision** becomes **larger** than the **expected loss**, the **probability** that the **overall provision** will be able to **fund** the **pool's actual total losses increases**, assuming a sufficiently large number of participants

3. As the **number** of **participants** in the pooling arrangement **increases**, the **probability** that the **overall provision** will be able to **fund** the pool's **actual total losses increases**, provided that each participant's risk provision is large enough

The two main features of the process are:
- **Pooling** of **similar risks**, since individuals decide to share the potential losses they are exposed to
- **Transfer** of **risks**, since individuals transfer their pure risks to the pool, thus transforming them into a fraction of a collective speculative risk borne by the pool as a whole

Insurable risks should have the following ideal features:

1. The **number** of **risk units** must be **sufficiently large** in order to make the **law of large** number work out

2. Risk units should be exposed to **homogeneous risks** both in terms of probability to be hit (**qualitative homogeneity**) and amount of loss (**quantitative homogeneity**)
    - This means that the loss probability distribution of individual risks should be as similar as possible to avoid some participants being disadvantaged wrt others
    - Indeed, **Commercial Insurance** is based on the principle of **fairness** among insured parties, while **Social Insurance** is based on **solidarity** among insured parties

3. Risk units should be **independent** between each other in terms of possible losses

The insurance process implies the so-called **inverted production cycle**, since the overall future loss is estimated in order to determine an advance payment:

- Indeed, the organizer of the process receives revenues before suffering costs

➔ Some **practical consequences** of the **inverted cycle** are that:

- The **potential loss** stemming from the risk unit should be **definite or measurable** in order to **estimate**, based on past experience, the **possible loss** based on the **probability distribution** of the relevant event and connected losses
- The loss should be **fortuitous** or **accidental**
- The less the pool of risk is characterized by the above ideal features, the less the insurance process works out well and can eventually mitigate the risk of uncertain losses

Insurance Firm

The **insurance firm** is an entity which professionally implements the **pooling risk management solution** based on a **funded mutual insurance plan**.
Indeed, the **insurance firm**:

1. **Collects risk units** within a **pool** (**portfolio**)
   - The **risk units** should be **numerous**, **equally distributed**, and **independent**

2. **Calculates** the **required advance payment**
   - Collected premiums are expected to cover the losses from the risk units in the portfolio that are hit by the event
   - Calculation of the premiums is based on the calculation of the potential economic consequences of the insured event, taken from statistical analysis of historical data

3. **Invest** the **monetary resources** deriving from the premium collection, pending the payment of the claims

4. **Pays claims** and **benefits** of **policyholders** as they fall due, based on contractual clauses

In order to effectively apply the insurance process, the insurance firm must always make sure that:

- It is able to collect a **large number of units** exposed to the same risk within a portfolio
- It ensures sufficient **qualitative** and **quantitative homogeneity** of the risk units in the portfolio
- It ensures sufficient **independence** of the risk units in the portfolio
- It ensures **stability** of the **risk conditions**, which means ensuring sufficient similarity between the risk conditions characterizing the statistical estimate of the advance payment and the actual risk conditions to which the portfolio is exposed
- It meets the **investment's returns expectations** when investing the premiums collected

➔ The less these conditions are met, the more the smooth functioning of the insurance process is at risk

However, optimizing the above conditions is **not easy**:

- Firstly, the **portfolio size objective** is **negatively** correlated to the objective of **homogeneity** and **independence** of the selected risk units

- Secondly, **competition pressure** or **aggressive marketing policies** can **prevent accurate selection** and **pricing** of the portfolio risk units
- Lastly, **insurers** often accept a **lower insurance performance** of the portfolio in exchange for a **faster** and **wider acquisition** of **financial resources** to **invest**, since the investment performance is expected to compensate for the insurance underperformance

➔ Therefore, as a consequence of the above, we can summarize the **key risks** of the **insurance firm**:

- The possibility that the **actual loss experience** of the portfolio is **more costly** than the **estimate** made when the **advance payment** was **determined**, and therefore that the **pool of premiums** is **not sufficient** to **cover** the **pool of losses**
- The possibility that the **return** on the **investment activity** is **negative** or **not sufficient** to achieve the **expected targets**, or **lower** than any **estimate** made in the **calculation** of the **advance payment**

THE BUSINESS MODEL OF INSURERS

Underwriting

The **underwriting** activity is the **activity** of the insurer aimed at **selecting** the **risk units**, **pooling** them in a **portfolio**, and **calculating** the **advance payment**:

- Because of the **inverted production cycle**, the calculation of the **premium** is a **critical** element in the insurance **business model**
- Indeed, the **sum** of the **premiums** received by the policyholders gathered into a certain portfolio should be **sufficient** to **cover** the **overall cost** of losses of the risk units within that portfolio

The main **consequences** of the **inverted production cycle** are:

- Crucial importance of **correct pricing** for the functioning of the insurance device
- Insurance companies hold **resources** that they can **temporarily invest** during the time between **premium collection** and **payment** to policyholders
- The **insurance** activity is **heavily regulated** by public authorities with the objective of **minimizing** the **risk of failure**, since the **transfer of risk** is a **critical** function for the collectivity and **insurance companies** might **not** be **able** to meet their **obligations** to **policyholders**

It is important to point out that the **typical risk** for the **insurer** is **not** related to the **occurrence** or **non-occurrence** of the unfavorable event **hitting** an individual **risk unit**:

- Rather, it is **related** to the possibility of **gaps** between the **total actual losses** in the relevant portfolio of risk units and the **estimated losses** that are at the basis of the **premium calculation** (**underwriting risk**)

➔ The **gaps** can be **classified** based on their **nature**:

- **Normal gaps** are positive or negative gaps which are normal in the ordinary development of the insurance process
- **Systematic gaps** are gaps that recurrently occur in the same direction
- **Exceptional gaps** are gaps with low frequency and large size

The **actions** that insurers can take action in order to **reduce** the **occurrence** and **intensity** of **negative gaps** depend on the nature of the gap:

- **Normal gaps** can be dealt with by improving the selection of the risk units and/or adding a risk loading when calculating the premium
- **Systematic gaps** can be dealt with by reviewing the assumptions used in computing the premium
- **Exceptional gaps** can be dealt with by setting aside reserves in order to compensate exceptional losses with profits realized in normal years

The **frequency** and **intensity** of **gaps** between the **estimated** and **actual losses** in a portfolio mainly depends on the **degree** of **fulfillment** of some **criteria**:

- **Number**, since the risk units in a portfolio should be as many as possible (Law of Large Numbers)
- **Homogeneity**, since the level of riskiness of the risk units should be as consistent as possible, both qualitative and quantitative
- **Independence**, since the risk units in the portfolio should be independent from one another

- **Stability of conditions**, since the risk conditions that had determined the outcomes of the observation of past events and the consequent estimate should continue to be valid during the actual coverage period

The insurer should include in the portfolio **risk units** with the **purpose** of **optimizing** these **criteria** in order to make the portfolio **less risky** in terms of **underwriting** risks

- However, factors such as **competition**, actual **diversity** of **risk units**, and **incomplete** knowledge of **riskiness** of the risk units mean that the **ideal risk units cannot** actually be **selected**

➔ After including the risk units on a best effort basis, insurers can implement actions to further reduce the riskiness of the resulting portfolio, such as:

- **Contractual conditions** and **limitations**
- **Specific pricing methods**
- **Reinsurance**, which consists in transferring part of the risk to other companies

The Insurance Contract

The **insurance contract (insurance policy**) can be defined as a **contract** in which **one party** pays a **fixed price** (**premium**) to an insurer for the **right** to receive a **compensation** following the **occurrence** of a **specified adverse event**:

- Therefore, it is the legal document that governs relationship between the insurer and the policyholder

➔ In particular, **insurance** contracts can be **distinguished** from other **risk transfer arrangements** by the **legal aspects** of the contracts themselves, the **kinds of obligations** they create, and the **type of risk addressed**

The principle of **Insurable Interest** requires the **purchaser** of an **insurance** to be at **risk** of **sustaining** some **economic loss** as a **precondition** for receiving **compensation** under the **insurance** of that **risk**:

- **Insurable interest** is required for a contract to be considered an **insurance contract**, as opposed to, for instance, speculative derivative instruments in which the purchaser assumes a risk by entering into the contract

Contractual Obligations

Contractual Obligations such as **premium** and **benefit** are typical elements of insurance contracts:

- The payment of the premium is the price to be paid to get the random benefit, which will be paid according to the policy conditions
- Indeed, insurance contracts are known as **aleatory contracts** because, while the premium is certain, the insurer payment associated with it depends on the occurrence of an uncertain future event

➔ The benefit can consist of:

- **Reimbursement** of expenses paid by the insured party because of medical expenses or third-party liability (*non-life insurance*)
- **Indemnity** covering, totally or partially, the actual loss suffered because of an accident (*non-life insurance*)
- **Forfeiture Amount**, which is the amount stated in advance in the insurance contract (*life insurance*)

The **two** essential **features** that make the insurer's **obligation random** are the **trigger** and the **amount** of the benefit that the insurer commits to pay to the **policyholder**:

- The **amount** is the amount of money that the insured party get if the insurance contracts pays off
- The **trigger** determines if and when this amount should be paid

➔ In order for a **contract** to be **random**, and therefore be recognized as insurance, the **trigger/benefit amount** of the insurance contract must be **based** on an **uncertain event**

The **insurance contract** clearly specifies the nature of risk, hazard, or peril that can trigger the contingent payment promised by the insurance company to the policyholder:

- **Policyholders** can file a **claim** to receive **compensation** only if at least one **trigger** of the **contract** is **pulled**

Principle of Indemnity

The **Principle of Indemnity** is a very **important legal feature** of many **insurance contracts** and applies any time the contract defines the **benefits** as an **indemnity** to **cover a loss**:

- It states that the **insurer** agrees to pay **no more** than the **actual amount** of the **loss** borne by the **insured person**, meaning that the insured person should not profit from a loss under an insurance contract
- However, a **contract of indemnity** does **not** imply that **all covered losses** are always **paid in full**
- Indeed, the **amount paid** may be **less** than the **actual loss** due to **deductibles**, **limits** on the **amount paid**, and **other** contractual **provisions**

The **Principle of Indemnity** has two fundamental purposes:

- It **prevents** the insured party from **profiting** from a **loss**
- It reduces **moral hazard**

➔ On the other hand, the **insured party** should be able to rely on the **correct determination** of the **indemnity** by the **insurer**:

  - Indeed, **fair treatment** of the **policyholder** by the insurer is **required** by **regulations** and is **enforced** by the **supervisory authorities** (market conduct supervision)

Benefit of the Contract

With regard to the **benefit envisaged** in the **contract**, insurance contracts can be **classified** at least into **two classes**:

- **Indemnity contracts** are contracts in which the **amount** that the insurer pays after the occurrence of the event is **equal** to, or **proportionate** to, the **value** of the **actual loss** caused by the event
- **Valued contracts** are contracts in which the **amount** the insurer pays after the occurrence of the event is **established** at the time of **inception** of the **contract**, **without** any **regard** to the **actual loss** caused by the event

➔ Normally, the **choice** between an **indemnity** and a **valued contract** can be explained largely by the **costs** and **challenges** of **assessing** the **value** of the **loss**, and the **risk** of **moral hazard**

Valued Contracts are mainly used to **insure damage** with **highly subjective values** that are **hard** to **quantify**:

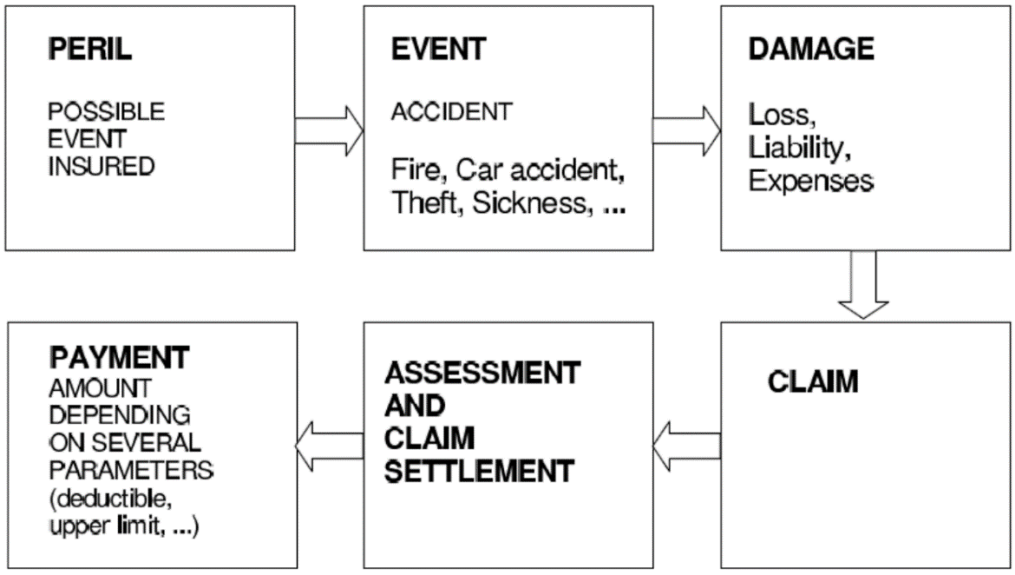
- By pre-agreeing on a fixed payment, the need to measure the value of the loss is avoided, but the risk of moral hazard is not eliminated
- An example may be a standard life insurance contract, which pays a fixed amount following the triggering event of the death of the insured party

Indemnity Contracts envisage a contingent payment that is proportional to the economic loss incurred by the insured party

- A **full indemnity contract** is one that restores insurance purchasers to exactly the same position they were before the adverse triggering event
- These contracts are preferred to insure damages for which the **size** of the **loss** can be **reasonably determined** after a **damage** has **occurred**
- Furthermore, they **reduce moral hazard** as the **amount paid** by the insurer is **related** to the **size** of the **loss** and **cannot exceed it**

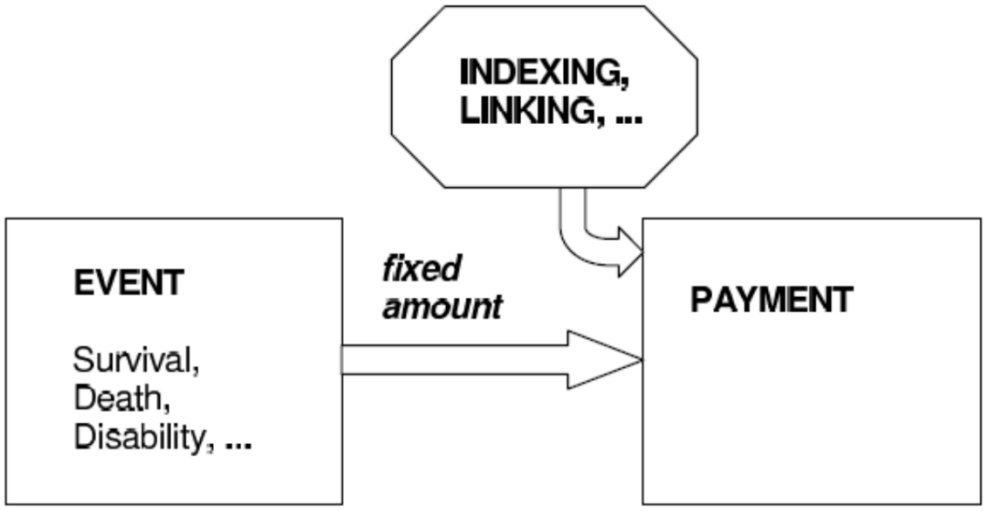
The Sequence of the Relationship under an Insurance Contract

The insurance contract specifies all the different moments in the relationship between insurer and policyholder:



- When some peril is perceived, the individual who suffers the potential damage can handle it by taking out an insurance contract
- If the event occurs, the insured party will apply for the benefits (a **claim arises**)
- The insurer has to assess the damage and **settle** the claim by defining the amount of the benefit
- Finally, the benefit is paid according to the policy conditions

Regarding **life insurance**, the typical sequences of the contracts are as follows:



- The **insured event** can either be the death or the survival of the insured party at some fixed time
- In traditional life insurance policies, the benefit comprised a fixed amount, stated in the policy
- In modern policies, the initial amount is stated in the policy, however this can vary throughout the duration of the policy because of its link to some reference value

Asymmetric Information and Insurance Contract Design

Since the **purchaser** of **insurance** must be at **risk** of **suffering** direct **economic damage before** engaging in an **insurance transaction**, the **insurance process** poses at least **two main problems** to an insurer:

- **Adverse Selection**, which occurs when the **insurer** does **not** have **enough information** to make a **proper assessment** of the **true risk profile** of the insurance purchaser, and ends up collecting in the portfolio too many bad risks wrt the premium it charges
- **Moral Hazard**, since **insurers cannot** perfectly **observe** the **risk management** activities of insurance purchases. Furthermore, if risk management is costly, insurance may reduce an individual's its risks proactively

The measures that an insurer can put in place to reduce the effects of adverse selection and moral hazard insist mainly on the design of insurance contracts:

- The **risk classification process** helps reducing adverse selection problems
- **Contractual provisioning** (especially in *non-life*) in insurance policies helps mitigate moral hazard problems

1. **Risk Rating Methodologies**

➢ In order to make the **premium reflect** the **actual loss probability** and **intensity** associated with the **risk unit**, the **insurer** must **classify** each **risk unit** he collects in the portfolio:

- Classification involves grouping together risk units with similar characteristics and charging them a premium rate
- **Risk classes** and **premium charged** to each risk class are based on **analyses** performed by actuaries who **examine historical data** and **estimate expected claim costs**

➢ In general, classification and rating of risks are based on the following approaches:

a. **Individual rating**, which is based on the **assessment** of **any single risk unit**, and are usually based on the **actual loss experience** of the **specific risk unit** for the **risk underwritten** in the **policy**
   - The approach requires that the **historical loss experience** data for the risk unit is **stable** and **representative** of **future losses**
   - This approach is used when **insurers** have **very good information** about the **true risk profile** of a **specific risk unit**, or when an insurer has an **extremely large portfolio** of **homogeneous risk units** and knows well their **risk profile**

b. **Class rating** is based on the **assessment** of **groups of risk units** which are considered **homogeneous**, rather than individual risk units, and it typically involves **three components**:
   - **Definition** of **classes** for a given type of **risk unit**
   - **Classification** of **policyholders** into the **proper class rating**
   - **Determination** of the **proper rate** for **each class**

➔ In **classes definition**, classes must be **large enough** to facilitate **adequate risk pooling** and **diversification** within the class so that the **average policy risk** within a given class can be **covered** by the **premium identified** for the class:
   - Ideally, classes should be defined so that the **risk** is **homogeneous** within the given class
   - This **methodology** allows to **avoid** the **specific rating** of **individual risk units** and only **requires** the **allocation** of each **risk unit** into the **most appropriate class rating**

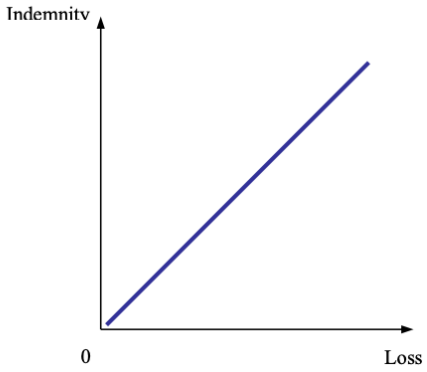
c. **Merit** or **Experience rating** is a hybrid between an individual and a class rating system, since they begin with a group classification and a class rating:
   - As the actual loss experience of the specific risk unit is revealed, the rate is then adjusted to address the actual risk profile of the individual insurance purchaser
   - In this way, **merit ratings** allow for a **better alignment** of the **premium** to the **actual risk profile**, but they also **dynamically discourage moral hazard** and **mitigate adverse selection**

➔ An example may be the ***bonus-malus*** rating system, which is specifically designed to reduce moral hazard:
   - A *no-claims bonus scheme* sets the initial rate at a deep discount with the expectation of no claims but, if there are any claims during the life of the policy, the future discount is forfeited
   - An *up/down scheme* places the policyholder in an initial category based on a class rating approach, and each claim-free period allows him to migrate to a higher-class rating with lower premium

2. Contractual Provisioning

➢ In some cases, the amount of coverage of an insurance policy can be limited by contractual provisioning:
   - The main purpose of contractual clauses that limit coverage is to reduce moral hazard

➢ **Claim profile** for a **full non-life insurance coverage**:



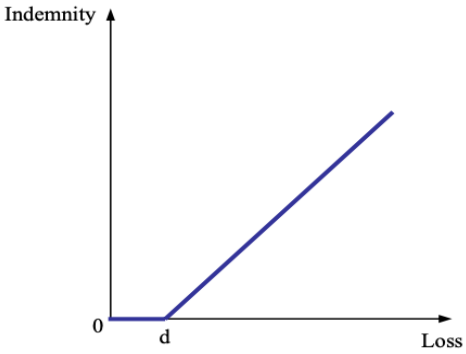
➔ However, in most insurance contracts the claim profile above is limited by the following contractual provisions:

- Deductibles
  - Fixed
    - Straight (or per-loss)
    - Aggregate
  - Percenta
- Franchises
- Policy limits
- Other-insurance provisions
- Exclusions

a. Deductibles

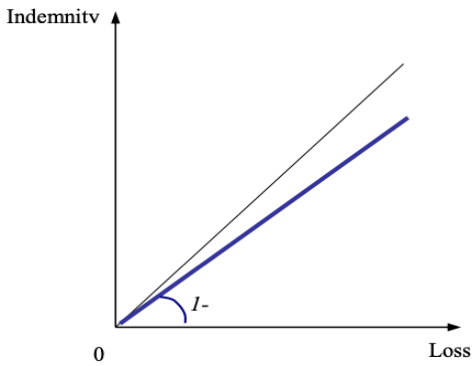
➢ A **Fixed Deductible** is a provision by which a **specified amount** (***d***) is **subtracted** from the **total loss payment** that would otherwise be payable:

- **Straight Fixed Deductibles** apply only to single losses
- **Aggregate Fixed Deductibles** apply to all **losses** occurring during a **specified period** of time



➢ A **Percentage Deductible** is a provision requiring the **insured** to pay a **specified proportion** of the **loss** (***a***)

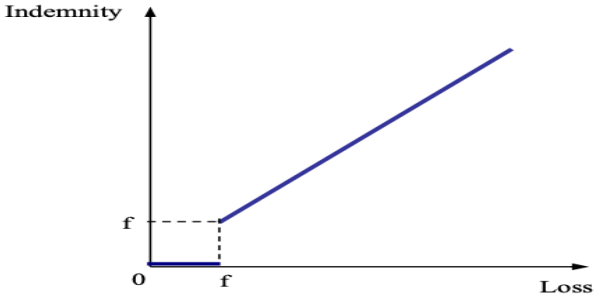
- Percentage Deductibles usually have a **minimum** and a **maximum**



- **Deductibles** can also differ depending on the cause of the claim, as different deductibles may be applied to loss or damage arising from different causes

b. Franchises

- The **Franchise** is a **threshold** (***f***) that needs to be **exceeded** in order for the **insurer** to be **liable** for the **entirety** of the **claim**

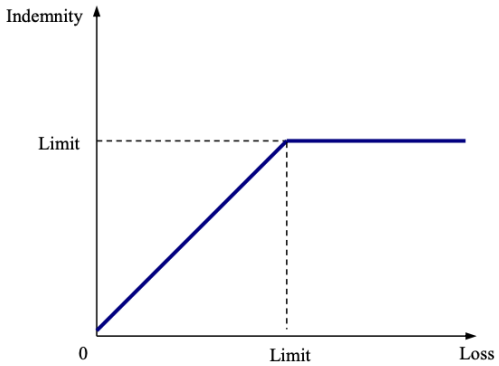


➔ Franchises have several **important purposes**:

- They **eliminate small claims** that are **expensive** to **handle** and process. Since a **franchise** eliminates **small claims**, the **insurer's loss-adjustment expenses** are also **reduced**
- They **reduce premiums** paid by insurers and **moral hazard** at the same time
- They make it **possible** for the **insured party** to find the **best risk financing mix**

c. Policy limits

- Insurance policies usually limit the amount of coverage by placing an upper limit, known as policy limit, on the amount that the insurer will pay for any loss:



- Policy limits are **always** used in **liability insurance** since indemnities are, by definition, **uncapped**

- In this type of **coverages** the **amount** of the **maximum loss** is very **difficult** to **estimate** in advance, as it **depends** on a **damage** on properties/persons that are **not known** in **advance**
- Setting a **cap** allows a more **precise rating** and **limits** the amount of **premium** that the policyholder should pay

➔ In general, the **demand** for liability insurance depends on a **person's wealth**:
- Indeed, if **people** have a **limited amount** of **wealth** that they want to **protect** from **liability suits**, they do **not** have **incentives** to **purchase insurance** for the **entire amount** of **damage** they can cause

d. Exclusions

➢ **Insurance policies** often contain **exclusions** that **exclude coverage** for specific types of **losses** arising from **exceptional clauses**:
- The first reason for employing contractual **exclusions** is that the **cost** of **insuring** some **types of losses** is **very high** due to the **likely correlation** in **losses** associated with **catastrophic events**
- The **second** reason for employing contractual **exclusions** is to **eliminate coverage** that is **not needed** by the **typical buyer**

Peculiarities of Life Insurance Contracts

Life Insurance contracts present particular features that differentiate them from other insurance contracts and require specific considerations:
- Indeed, even regulators apply a special treatment to these contracts

A simplified classification of life insurance contracts can be done by looking at:
- Type of **underlying event** or **risk**
- Type of **premium**
- Type of **return**

1. Classification by Type of Underlying Event

➢ The aleatory event underlying life insurance is related to the duration of human life, such as death and survival

Early Death

➢ There are **two** basic **types** of **early death contracts** that protect the beneficiary in the case of the **death** of the **policyholder** and the consequent loss of income:

- **Term Insurance** is a policy with a **definite timeframe** through which the **insurer** will pay out a **fixed amount** upon the **death** of the **policyholder** to the beneficiaries indicated in the contract
  - Hence, in this case the **payment** is **uncertain** since the **event** could **not happen** in the specified **time frame**

- **Whole life insurance** is a policy in which the **insurer** will pay a **fixed amount** upon the **death** of the **policyholder**, to the beneficiaries indicated in the contract
  - The **duration** of this contract is exactly the **life** of the **policyholder**
  - Contrary to Term Insurance, the **occurrence** of the **insured event** is now **certain**, while the **time** is **aleatory**

Survival and need for resources at retirement

- When the **underlying event** is the **survival**, the **contract protects** the **policyholder** from the **risk** of living too long and not having the **necessary resources** to survive
    - If the **policyholder** is **alive** at the **specified date**, the **insurer** will either provide a **lump sum** or a **regular income**

- There are **two types** of survival insurance contracts:

    - **Pure Endowment Insurance** is a contract through which the **insured party pays** a **premium** upon the issue of the policy and will **get** the **insured amount** at the **stated maturity if alive** at that time
        - The **policy duration** is on average **very long** (10-20 years)
        - Since this is a **savings-type contract**, it is **often combined** with a **term insurance contract** for the **risk** of **death before maturity** (**mixed contracts**)

➔ **Combining Pure Endowment Insurance** with **Term Insurance** benefits policyholders in **two ways**, since they receive a **certain payment** with an **uncertain timing**:
    - In the case of **death** during the tenure, the **beneficiary** gets the **sum insured**
    - If the individual **survives** the policy tenure, he **gets** the **benefit** as defined in the contract
- **Annuities** are contracts through which the insurer pay out either fixed or with-profit annuities from a certain date, usually the retirement age
    - This kind of policies provide a certain income from a certain date onwards
    - Depending on the jurisdiction, the annuity can be sold to the policyholder together with another contract or separately

2. Classification by type of premium

- Depending on how the premium is paid, products can be split into **three categories**:
    - **Single Premium** consist in a one-off payment at the beginning of the contract
    - **Recurring Premium** consist in premium payments whenever the policyholder wishes
    - **Annual or Regular Premiums** are paid at regular intervals by the policyholder

3. Classification by type of benefit

- **Financial returns** on the policies **may** or **may not** be **guaranteed**:
    - Therefore, **policyholders** can **participate** in the **profits** or **losses** of the **insurer** or **not**
    - This **possibility**, which is **typical** of **long-term contracts** such as **life** insurance, lead to **different types** of contracts
    - The **two types** of contracts are **Traditional** and **Linked contracts**

a. Traditional Contracts

- **Fixed contracts** are **traditional** contracts in which the **amount** of **benefit** to be paid at **maturity** of the contract, or in case of the **occurrence** of the **event**, is **stated** in the **contract** and the **total return** of the policy is **guaranteed**
    - On the other hand, the **policyholder** does **not participate** in any **excess profit** earned by the **insurer** on the **invested premia**
    - Since **investment risks** are borne only by the **insurer**, the **guaranteed return** is very **conservative**
    - These contracts are nowadays very **rare**

- **With-profit contracts** are **traditional** contracts in which **policyholders** are guaranteed a **minimum return** but also **participate** in the **investment profits** of the **insurer**:

- The **additional profit** is given in the form of **bonuses**
- Usually, **profits** are **distributed** on a **discretionary basis** by the insurers, with the **aim** of keeping the **return** to **policyholder constant** over time, or based on **pre-defined contractual provisions**

➔ The **main risk** for the insurer is **associated** with the **level of interest rate** that is guaranteed to the **policyholder** and to the **amount of profits** that is **contractually distributed** to the **policyholder**

b. Linked Contracts

➢ In these types of contracts, the **monetary value** of the **benefit** is **variable**, and **no guaranteed return** is set in the contract:
- Hence, **policyholders** bear the **investment risk** and fully **participate** in the **profits** and **losses** of the **insurer**

➢ **Index-linked contracts** are contracts in which the value of the benefit is **linked** to an underlying **financial index**

➢ **Unit-linked contracts** are contracts in which the value of the **benefit** is **linked** to the value of the **underlying mutual fund** or **internal fund** managed by the **insurer**:
- The monetary value of the **benefit** depends on the **monetary value** of the **units** of the **fund** at the time of the **payment** of the **benefit**

➔ These contracts do **not pose** any **risk** to the **insurer**, as they can be **financially hedged** by **buying** a **mutual fund** that is **contractually linked** to the **benefit** of the contract

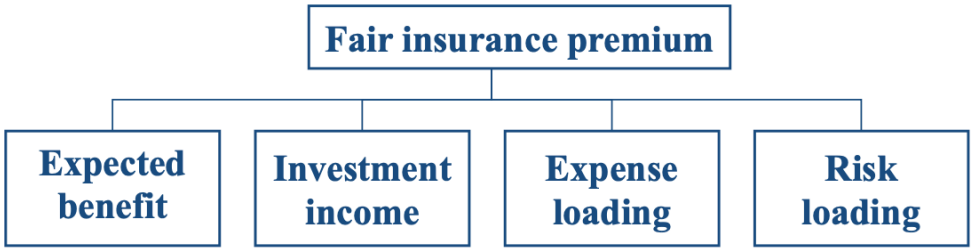
The Surrender

The **Surrender** is the **option** of the **policyholder** to **terminate** the **contract before** its **natural term** and **cash out** the **benefit** as provided in the contract for early encashment:
- This is **typical** to **all contracts** where the **uncertainty** of the **benefit** is **associated** with the **timing** of the **payment** (and not to **if** the **benefit** will be **paid** or **not**)
- This contractual **option** could create **liquidity problems** and entails **increased difficulty** for the **insurer** to find the **right assets** to **invest** in, both in terms of **duration** and **liquidity**

For this reason, the **exercise** of this **option** is normally **associated** with **penalties** for the **policyholder**:
- The **lower** the **penalties**, the **more** the **liability** of the **insurer** is **liquid** and resembles and ordinary investment contract, where the protection purpose does not exist

The Insurance Premium

Ideally, the **Fair Insurance Premium** is the premium that is just sufficient to cover all the expected benefit costs and all the expenses incurred by the insurer, and that provide the insurer a fair return on their invested capital:
- The Fair Premium is therefore the premium that would be charged in a perfectly competitive and transparent insurance market
- The major determinants of the Fair Premium are:



1. ***Expected Benefit Cost***

➢ The **Expected Benefit Cost** is the largest component of the insurance premium for most types of insurance, and it is the component that is supposed to cover the cost of future claims:

- The **determination** of the **Expected Benefit Cost** is based on **statistical determination** of the **probability distribution** of **frequency** of the **loss** (for **life contracts**), and **intensity** (for **non-life indemnity contracts**)

➔ The **Expected Benefit Cost** is the product off the means of the above two probability distributions:

$$E(Benefit\ Cost) = E(Frequency) * E(Intensity)$$

- Keep in mind that the **statistical data**, **risk considerations** and **expert judgement** relevant for **determining** the **probability distribution** of the **frequency** of an **event** are **not the same** as those **relevant** for **estimating** the **intensity** of the **loss**
- The **determination** of an **accurate probability distribution** is one of the **key aspects** of **insurance activity**

➢ Given a group of ***n items*** exposed to the same risk in one single period, and ***r claims*** for a total ***monetary amount D***, the statistical premium would be:

$$P = \frac{r}{n} * \frac{D}{r} = \frac{claims}{items} * \frac{monetary\ amount}{claims}$$

2. ***Investment Income***

➢ When **determining** the **premium**, the insurer may also consider its **ability** to **earn investment income** during the period of time between the payment of the premium and the payment of the benefit:

- In these cases, the **insurer** may ask the **policyholder** to pay a **premium lower** than the **expected benefit cost**
- In this sense, the **insurer** is transferring a **pre-determined interest rate return** to the **policyholder** (i.e., **guaranteed financial performance** of the policy)
- Indeed, the **policyholder** is implicitly **guaranteed** to get an **investment return** that is equal to the **interest rate** used to **discount** the **expected benefit cost**, and this **deduction** is expected to be **paid** by the **actual return** of the **investment**

➔ A **premium** that includes such a **negative component** is called the **Discounted Expected Benefit Cost**, and it **depends** on:

- The **advance interest rate** allocated to **policyholders**
- The **length** of the **contract premium** to which the premium is related
- The **higher** the **interest rate** used to **discount** the expected benefit and the **more uncertain** the **payoff period**, the **higher** will be the **risk** for the **insurer**

- **Discounting** the **expected benefit cost** is a **usual** and explicit practice in **life insurance** lines, but also in **long-tail non-life business** lines
    - This is because **long pay-off tail** and **relative ease** in predicting **amount** and **timing** of **cash outflows**
    - This practice implies a **significant investment component** in **life insurance**, which varies depending on the **type** of **benefit** and on the **design** of the contract
    - The **investment component** could end up becoming the **most important economic aim** of the **insurance transaction**

➔ Accordingly, the **investment risk** could become the **most significant risk** for **life insurers**, which is **more concerning** the more the **investment returns** earnable in the market are **low** and **uncertain**
    - These considerations are particularly important for **Traditional life insurance**

- **Traditional With profit contracts** can transfer the return on invested premia during the life of the policy, in addition to the interest rate transferred to policyholders by discounting the premium
    - The allocation of investment returns is less risky in a with profit contract because interest rate transferred to policyholders is not fixed at inception and is typically not guaranteed

- It is worth noticing that the **persistent LIRE** has **emphasized** the **relevance** of **investment risk** of **life insurers**:
    - Indeed, many **insurers** shifted their **commercial offers** from traditional life insurance products towards **linked products**

3. Administrative Costs

- **Administrative costs** usually refer to the **compensation** for all expenses that **insurers incur** to distribute and manage **insurance contracts**
    - Hence, insurance premiums should include and **expense loading** to cover all **administrative costs**

➔ The **main categories** of administrative costs are:
    - **General Expenses**, which are expenses incurred for pricing/underwriting, marketing, and issuing policies not written by agents
    - **Distributing Expenses**, which are commissions to agents and brokers
    - **Loss Adjustment Expenses**, which are costs related to processing and settling claims

***4.* Risk (or Profit) Loading**

- **Risk Loading** is an **additional component** of the **premium** included as a **source** of **expected profit**, as well as a **protection** against **negative gaps**:
    - Indeed, assuming **no Risk Loadings**, the **expected profit** for the insurer would be **zero** and **probability** of **negative gaps** between premium charged and claims and expenses would be **too high**

➔ Under these conditions, **no insurer** would be willing to **perform** such **activity**

- The **Profit** (**Risk**) **Loading** is **directly proportionate** to the **riskiness** of the **portfolio**, and **inversely proportionate** to the **risk appetite** of the **company**:

- The **purpose** of the Loading is to **cover gaps** between the **actual claim experience** and the **best estimate** of the **cost for claims**, but also to **provide** an **additional source** of **expected profit** for the insurer

➔ In **statistical terms**, the amount of **Risk Loading** is **proportionate** to the **dispersion** of the **loss probability distribution** around its **best estimate**

➢ **Factors** affecting the amount of **Risk Loading**:

(–) the magnitude of the pool (*i.e.*, the number of risks or policyholders);

(+) the correlation in benefit payments across policyholders

(+) the lack of homogeneity of riskiness of exposed units

(+/-) any other factor that influences the functioning of the insurance process, and also, obviously:

(–) the pressure from competitors

(+) the return required by capital providers

➢ The main **sources of profit/loss** for the **insurer** derive from **differences** between the **estimate** of the **premium** and the **actual cost experience**, and they could be **classified** according to the **components** of the **fair premium** described before:

- **Expected Benefit (claim) cost** is the difference between estimate and actual claim experience
- **Discounting of Expected Benefit (claim) cost** is the difference between the interest rate used in pricing and the actual return earned from investments
- **Expense Loading** is the difference between estimate and actual amount of expenses
- **Profit Loadings** are the unexpected gaps between estimated and actual losses and expenses experiences

REDUCING RISKS AND PROTECTIGN POLICYHOLDERS

Reducing Risks

Insurers are mainly exposed to two types of risks:

- **Underwriting risk**
- **Investment risk**

Underwriting Risk

The main **sources** of **Underwriting Risk** for **Non-life insurance** are:

- **Estimate** of **frequency and intensity** of **claims**, which are risks related to the adequacy of the expected benefit costs
- **Estimate** of the **dispersion** of the **claim probability distribution**, which is the risk related to the adequacy of risk loadings
- **Estimate** of the **expenses**, which is the risk related to the adequacy of expense loadings
- **Consideration** of any **financial aspects** in the **premium**, which is the risk related to the adequacy of implicit discount rates

The main sources of **Underwriting Risk** for **Life-Insurance** are:

- **Estimate** of **Mortality Assumptions**, which is the risk related to the adequacy of life expected benefit cost
- **Estimate** of **Financial Assumption**, which is the risk related to the adequacy of discount rates or other financial guarantees (closely related to investment risk)
- **Estimate** of **Expenses**, which is the risk related to the adequacy of expense loading

Usually, **insurers** face a **trade-off dilemma** when trying to achieve the **target level** of **solvency**:

$$Solvency\ Index = \frac{Applied\ risk\ loading + Available\ Own\ Funds}{\begin{matrix} Riskiness\ of\ the\ portfolio \\ (StDev\ of\ claims\ prob.distribution) \end{matrix}}$$

➔ **Insurers** can leverage on **different factors** to achieve their **target level** of **solvency**, such as the **level** of **premiums**, the level of **own funds**, and the **riskiness** of the **portfolio**

- **Adjusting** the **premia** may be difficult because of **market competition**
- **Increasing capital** can be limited by the **ability** of **raising capital** in the **market**
- **Solvency** could therefore **improve** by reducing **underwriting risk**

Insurers can **mitigate underwriting risks** during the **underwriting phase** in **different ways**, such as:

- Imposing **legal limitations** on the contract
- **Portfolio selection**, by creating portfolios that optimize insurability criteria
- **Contractual limitations** like the elimination of small claims, the reduction in the value of potential claims, or by sharing responsibility of any damage with policyholders
- **Premium determination** based on **experience ratings**

➔ Once the **risk units** are **selected** and **priced**, and the policies are issued, **insurers** can **reduce underwriting risk** through **reinsurance**

Reinsurance

Reinsurance is a device whereby an insurance company transfers to another party a share of the risks associated to its portfolio in exchange of a premium:

- Reinsurance allows insurance companies to avoid unsustainable risks or claims in the operation of insurance mechanisms, as well as risks or claims incompatible with the risk appetite of the company

➔ In a reinsurance contract:
  - The **direct writer** is the insurer seeking reinsurance
  - The **reinsurer** is the company assuming part of the risk
  - The **net retention** is the portion of risk that the direct writer retains
  - **Ceding** refers to the act of transferring a part of the risk to the reinsurer, while the **Cession** is the portion of risk passed on to the reinsurer
  - The **reinsurance premium** is the premium paid by the ceding company

There are mainly two types of reinsurance treaties:

1. In **Facultative Treaties** the **risks** are **considered individually** by **both parties** and each risk is **submitted** by the **direct writer** to the **reinsurer** for **acceptance** or **rejection**:
   - However, the **direct writer** is **not bound** to **submit** the **risks** in the first place

2. In **Automatic Treaties** the **reinsurer** agrees to **accept** a **portion** of the **gross line** of the **direct writing company** or a **portion** of **certain risks** that meet the **reinsurance underwriting rules** of the **reinsurer**
   - The **direct writer** is **obliged** to cede a **portion** of the **risk** to which the **automatic treaty applies**

➔ Keep in mind that the **reinsurance contract** is **legally separate** from the **insurance contract** it **relates to** and does **not create** any **relationship** between **policyholder** and **reinsurer**

Reinsurance allows **insurers** to **decrease** the **riskiness** of their portfolio by **optimizing** their **solvency index**, without changing **risk appetite**, **premia** and **capital**:
- Hence, reinsurance is **instrument** sustain the **development** of the **business without** necessarily **increasing** its capital

We can find **three** main **purposes** of **reinsurance**:

1. **Increasing Insurance Capacity**, because reinsurance allows insurers to underwrite risk units that, otherwise, would not be economically affordable:
   - For instance, reinsurance allows to underwrite risk units that would not be consistent with available own funds, ability to apply risk loadings, or risk appetite

2. **Qualitative Harmonization of Portfolio**, since reinsurance allows to transfer a portion of risk in excess of a certain amount to reinsurers to obtain a more harmonized portfolio
   - This allows a better functioning of the insurance process through more reliable estimates of losses on insured risks

3. **Segmentation and International Spreading of risks**, since reinsurance allows to repeatedly segment and transfer risk units
   - This leads to risk sharing between many companies at an international level
   - Hence, better diversification is reached by geographical fragmentation and increase in the level of independence of risks

We can find **two** main types of **reinsurance**:

- **Proportional reinsurance** requires the reinsurer to share the cost with the insurer in relation to every loss that occurs to a reinsured risk
- **Non-Proportional Reinsurance** requires the reinsurer to pay only after a loss reaches a certain size

➔ However, notice that parties have the freedom to design a reinsurance contract as they wish, by either combining the above types or creating completely new types

Proportional Reinsurance can be of **two** types

1. **Quota Share Treaties** bind the **direct writer** and the **reinsurance company** to share the **amount** of **each risk** on some **predetermined percentage basis**
    - This type of **reinsurance** helps **increase** the **insurance capacity** of the **insurer** and also **improve** the **segmentation** and **diversification** of **risks**
    - However, it does **not** affect the level of **quantitative harmonization** of the **direct writer's portfolio**, as the **diversity** between **risks** remains **proportionally** the **same**

2. **Surplus Treaties** allow the **reinsurer** to **accept** a **share of each risk** in **excess** of a **specified amount** (**net retention**)
    - The **percentage** of **risk ceded** is **not** the **same** for **all risk units**
    - Any **loss** under the **policies included** in the **treaty** is **shared** on the basis of the **proportion** of **each risk** that is **transferred**
    - **Surplus Treaties** produce the **same effects** as **Quota Share Treaties**, but also contribute to reduce quantitative differences of the retained risks, thus **improving** the **quantitative harmonization** of the **direct writer's portfolio**

Non-Proportional Reinsurance can also be of **two** types:

1. **Excess Loss Treaties** are reinsurance contracts in which the **reinsurer** is **obliged** to **pay** only when a **loss exceeds** a **certain amount**:
    - This type of reinsurance treaty can be **written** to **cover** a **specific risk** or to **reduce catastrophe risk**
    - These contracts also provide a **maximum limit** of **liability** for the **reinsurer**
    - **Losses** are **not** shared **proportionally** between **reinsurer** and **direct writer**
    - The **reinsurance premium** is subject to **independent assessment** and **negotiation** between the two parties and, therefore, it is **not impacted** by the **pricing policy** of the **direct insurer**

➔ These contracts **cover** the **direct insurer** from **unexpectedly high intensity** of **claims** or **catastrophic events** and, therefore, it is **more protective** (and more **costly**) than a **proportional reinsurance treaty**

2. **Stop Loss Treaties** are reinsurance contracts where the **amount** of **loss above which** the **reinsurer** will be **responsible** is determined in **reference** to the **result** of a **certain portfolio** of **risks** or **line of business**:
    - These **treaties** are **more protective** as they **relate** to **whole portfolios** and not to single claims

➔ **Stop Loss Treaties** can be considered an **insurance** against the **poor performance** of the **insurance process** related to a **portfolio**

Investment Risk

One of the main risks for insurers stems from investment activities

- **Market Risk** includes Interest rate risk, Equity risk, Real estate risk, and Exchange risk
- **Counterparty Risk** is the risk of deterioration of financial instruments issued by third parties, or the risk of default of reinsurers or other debtors
- **Liquidity Risk** is the risk that the insurer does not have enough liquid assets, or is unable to realize investments and other assets in order to settle obligations when they fall due

The management and reduction of investment risks in insurance is based on the same approach and techniques used in other financial institutions

Keep in mind that in **insurance** the **Integrated Consideration of Assets and Liabilities** (**ALM**) is crucial due to the insurers business model:

- Indeed, in the insurance business model financial features of liabilities normally drive asset allocation
- Therefore, through the appropriate matching of amounts, timing, and uncertainty of cash inflows and outflows insurers can mitigate many assets risks

In fact, a good matching allows to have changes in the value of assets and liabilities driven by changes in market factors that tend to offset each other, thus maintaining the value of own funds constant over time

- The main issue in insurance is that cash flows stemming from insurance liabilities are not certain in amount and timing, thus making the matching objective very difficult to achieve
- Indeed, the more the liabilities are uncertain in amount and timing, the more difficult it is to reduce investment risk

Interest Rate Risk is particularly **important**, especially in **Life Insurance**, because:

- The Market Value of most assets in the Balance Sheet is sensitive to changes in interest rates
- The Market Value of insurance liabilities is also affected by changes in interest rates
- Life Insurance contracts could incorporate long term financial guarantees

When considering assets and liabilities of an insurer, the risk immunization is fully reached when market changes in interest rates produce the same offsetting impacts on both assets and liabilities

- However, in insurance this is just an expectation as liabilities are not certain
- Therefore, the level of alignment of assets and liabilities determines the type of investment risk exposure of the insurer

Insurers are particularly exposed to **decreases** in **market interest rates** because of **longer duration** of insurance liabilities compared to the assets

- Since the change in value of a fixed income security is proportional to its duration, and insurance liabilities have longer duration than insurance assets, a decrease in interest rates, in principle, produces a larger change in value on the insurer's liabilities than on its assets, with a resulting fall in equity

The persistent LIRE puts pressure on the sustainability of the minimum interest rate guarantees embedded in many life-insurance contracts:

- This has led insurers to focus on policies where the investment risk is borne by policyholders

Protecting Policyholders

Policyholders can be defined as **conditional creditors** because the amount they are entitled to is uncertain:

- Conversely, the pool of policyholders can be considered the actual creditor of the insurer, who is expected to fulfill its contractual obligations

As a result, the collectivity of policyholders face a sort of credit risk in the period spanning from the payment of the premium to the end of the insurance coverage

- For this reason, insurers have been subject to **prudential regulation** enforced by independent Supervisory Authorities in order to protect policyholders
- The **prudential regulation** for insurers represents the set of standards and rules that any insurer should abide by as a pre-condition to carry out its activity

Regulators have acted mainly on **three areas** in order to **minimize insolvency** and, for this reason, they represent **key objectives** of the **prudential regulation** of **insurers**:

1. **Liabilities** of the insurance company towards the policyholders must be **measured accurately** and **prudently** at **any time** of their **relationship**

2. **Liabilities** towards the **policyholders** are covered by a corresponding amount of **safe**, **profitable**, and **liquid assets** that can be used to **fulfill** the liabilities as they come due

3. **Insurers** have **sufficient amount** of **capital** to face **unexpected circumstances** and to **remain solvent** even when assets are **not sufficient** to **cover liabilities**

Technical Provisions

Technical Provisions represent the **expected value today** of the insurer's **future obligation** towards **policyholders** for the **existing contracts**:

- These **provisions** are usually calculated when **drafting** the **financial statements** of the **insurance company** since, at that time, it is necessary to **recognize** and **measure** the value of the **existing obligations** towards **policyholders** in the **BS**
- Since the **amount** and **timing** of insurance **obligations** are **random**, the insurer should make the **same** set of **estimates** as in the case of **premium calculation**

Depending on the **assumptions** embedded in these **estimates**, the **current value** of **liabilities** could need an **adjustment** compared to the **correspondent value** embedded in the **amount** of the **premium**:

- In this way, the **insurer** will end up **recognizing profits/losses** in its **Income Statement**, even **before** the **end** of the **contractual period**

Consider the case in which the **insurer** makes the **exact same assumption** he made when calculating the **premium**:

- In this case, the **premium** is still considered an **appropriate estimate** of **future obligations**
- However, the amount of **technical provisions** will **differ** from the **premium** only because of the **time elapsed** and the **benefits** already **paid**

On the other hand, if the **insurer updates** the **assumptions made** at the **inception**, he will be able to **recognize** a **positive** or **negative adjustment** in the **financial statement**:

- For instance, if the **new assumptions** require an **increase** in the **frequency** of the event, the **insurer** should implicitly **recognize** a **loss**

- Similarly, if **interest rates** used to discount the **expected benefit cost** is **higher** than the one used at **inception**, the insurer should also implicitly **recognize** a **loss**

For this reason, **supervisors** and **regulators** must make sure that **assumptions** and **methodologies** used to calculate technical provisions are **updated**, **correct** and **prudent**:

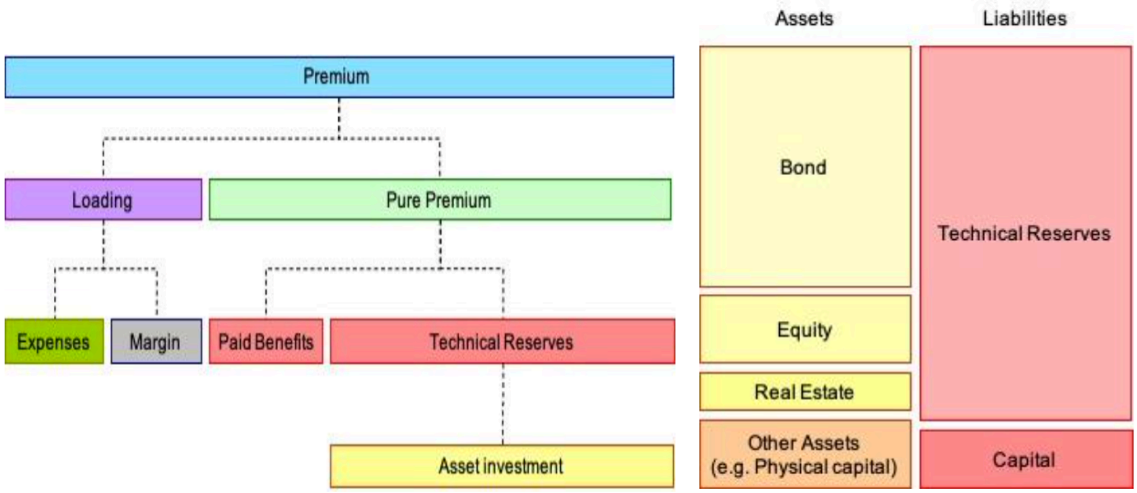
- Indeed, due to the **size** of **technical reserves**, **mistakes** in their estimation could **affect** the **whole BS**

Under **EU Prudential Rules** in force **before 2016** (**Solvency I**), **insurers** were legally **prevented** in recognizing **positive adjustments** when **updating** the **assumptions** for the **calculation** of **technical reserves**

- On the other hand, they were **obliged** to **recognize** any **negative adjustment**

Solvency II has **updated** this rule and **allows insurers** to **recognize** both **positive** and **negative adjustments** if the current **market** conditions **justify** the **new assumptions**

Allocation of Premium in Insurance Companies:

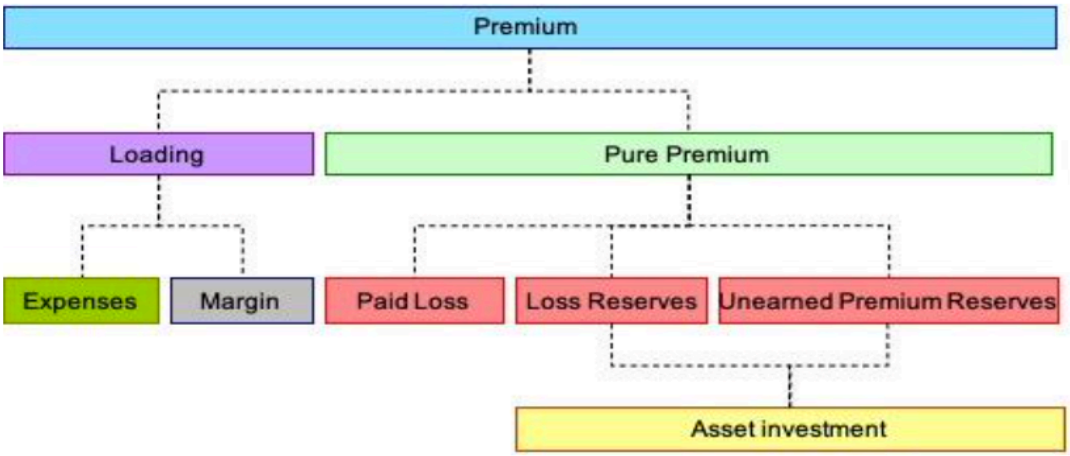


- **Technical Provisions** represent a **liability** for the **insurer** because they constitute the **amount** that the insurance firm must **set aside** to pay **future benefits**
- Usually, **technical provisions** are the **largest liability** for an insurer

Main types of Non-Life Technical Provisions

The main types of **Non-Life technical provisions** are:

- **Loss Reserves**
- **Unearned Premium Reserve**



1. ***Loss Provisions***

➢ **Loss Reserve** is the estimate of the cost of all known and unknown claims which, at the date of technical provisions calculation, are already incurred, but are still to be paid

➔ These Reserves can be classified into three components, which reflect three different stages of the claim payment process:

- **Claims reported and settled but still unpaid**
- **Claims reported but not yet settled**
- **Claims incurred but not yet reported**

➢ **Claims reported and settled but still unpaid** are reserves that result from the **time-lag** of the **actual payment process**

- These represent a **certain amount** that does **not need** to be **estimated**
- These are the **most liquid liabilities** for the **insurer**

➢ **Claims reported but not yet settled** are claims **known** by the **insurer**, but whose **amount** is still **subject** to **estimation** and **settlement**

- Usually, these are the **largest claims** for an **insurer**
- Since the **measurement** of these claims is **complex**, **statistical methods** based on the average cost of **past claims** are often used
- These claims are the **most significant portion** of **loss reserves**

➢ **Claims incurred but not yet reported** represent the **future cost** of **claims** that, at the **date** of technical provisions **calculation**, have **occurred** but are **not known** by the **insurer**:

- These can arise because of **delays** in **reporting claims** to the insurer, or because the **policyholder** may **not know** that the **insured event** has **occurred**
- This **estimate** is challenging and is usually done based on **past experience**

2. ***Unearned Premium Provision***

➢ The **Unearned Premium Reserve** represents the **expected cost** for **future claims** that are **still** to **occur** at any point in time during the **coverage period** of the **policy**:

- This provision is represented by the **portion** of **premium** that has been **paid** in **advance** for the **portion** of **insurance coverage** that has **not** been **provided** yet
- Hence, this provision is the **portion** that should be **set aside** to **cover** the **cost of claims** that could be **incurred** in the **residual timeframe** of the **policy**

- ➢ Under **Solvency I**, this **portion** was calculated as a ***pro-rata*** of the **premium collected**, in **proportion** of the **remaining lifetime** of the **insurance contract**:
  - If **assumptions** had **changed** and the expected benefit cost increased, insurers had to make the **adjustment** and **cover** the **deficit** by setting aside **additional amount**

- ➔ **Solvency II** allowed insurer to make **both negative** and **positive adjustments** in the **expected benefit cost**, meaning that the ***pro-rata*** **calculation** made at the **inception** of the policy could be **revised**

Main types of Life Technical Provisions

Similarly to non-life, when a **life insurance** company issues a **policy**, it determines the **premiums** so that it is able to **cover** the **expected benefit payments** related to the policy:

We have seen that, at the **time** of **policy issuance**, the **PV** of **expected premia** should theoretically equal the **PV** of **future benefit payments**, thus making the **expected loss** of the **insurer** equal to **zero**
- However, this equivalence does not generally remain valid during the lifetime of the contract

Hence, we can define the variable L_t, which is the **difference** at time $t < T$ between the **Present Value of Future Benefit Payments** and the **Present Value of Future Premia Payments**
- This difference is also known as the **Net Premium Reserve** (or **Mathematical Reserve**)

Mathematical Reserves are the **difference** between the **PV** of **future obligations** of the **insurer towards** the **policyholder**, and the **PV** of **future obligations** of the **policyholder towards** the **insurer**
- These are calculated using **demographic assumptions** (**survival** and **death probabilities**) and **financial assumptions** (**interest rates**), taking into account the design of the insurance policy and the nature of corresponding liabilities

Insurance Policies should be designed in order to have a **positive** or **non-negative Net Premium Reserve**:
- If the Net Premium Reserve was negative, the insured would be a debtor to the insurance company and would not have incentive to continue the insurance
- **Mathematical Reserves** are set-aside by the insurer in order to cover the differences in these expected value

Mathematical Reserves represent the **main liability** of **life insurers**:
- This is due to the **long-term nature** of these contracts

Assets Backing Technical Provisions

The **second main objective** of **prudential regulation** is to ensure that the **liabilities** towards policyholders are **backed** by **safe**, **profitable**, and **liquid assets**:
- Indeed, in the **time** between **collection** of premiums and **payment** of benefits, **premiums** are **invested** in assets
- **Investments** represent both a **source** of **additional profit** and **risk** for insurers

Hence, **insurers** must **ensure** the **safety**, **profitability**, and **liquidity** of the investments in order to **fulfill** their **obligations** as they fall due:
- These **objectives** can be **optimized** only in the context of a **diversified portfolio**

Prudential Regulations usually set **asset allocation rules** that set **conditions** on **admissible** assets and **limits** by **type** of assets to **ensure diversification** and **safety**

- The **purpose** of these limitations is to **reduce** the **risk** of **losses** on assets

However, it is important to notice that the **appropriateness** of any **asset allocation policy** must be **assessed** in **conjunction** with the **financial characteristics** of the **insurance liabilities** (**technical reserves**)

One of the **primary objectives** of **insurance companies** in **managing** their **assets** is to **ensure matching** of **cash flows** from **investments** and **liabilities**:

- Since **insurers** cannot modify their policies to change the cash outflow profile, they usually **allocate assets** consistently with the **expected cash out-flows** of liabilities

Hence, we can say that **financial characteristics** of **insurance liabilities drive asset allocation**

With the **Prudent Man Approach**, **prudential regulations** have **shifted** from strict quantitative restrictions on admissible investments, to **measures** based on **principles** of **good asset management**

- The **new requirements** are **more qualitative** and rely on the **managers competence** to select the **best investments** that **match** the **characteristics** of technical reserves

However, this **approach** must be **supported** by severe **requirements** on **corporate governance** and **integrity** of management

Capital Requirements

The **third objective** of **prudential regulation** insists on the presence of **sufficient capital** in order to **protect policyholders** from the insurers' **insolvency**:

- Indeed, **capital** acts as a **prudential buffer** to ensure that **unexpected losses** and **obligations** could be **covered** as they fall due
- The **main purpose** of a solvency requirement is to **absorb** any **remaining risk** that may occur even if concrete risk reducing measures have been taken

All jurisdictions set a **solvency requirement**, but **differences** across jurisdictions rely on **how** this **requirement** has been **determined**:

- In the **EU before 2016**, the **Solvency Margin** depended exclusively on the **size** of the **insurance company** and did **not reflect** its **actual risk profile**

However, the **Solvency II regime** in the EU has introduced **capital requirements** that are **more sensitive** to the **actual risk profile** of the company

THE SOLVENCY II REGIME

Solvency II: Reasons And Drivers Of The New Regime

Prudential Regime refers to the set of principles, rules and guidelines that are applied to insurance companies with the aim of reducing the risk of their insolvency

- In the **EU**, the prudential regime is enforced by **National Supervisory Authorities** in each Member State, coordinated by an **EU Authority** (European Insurance and Occupational Pension Authority - EIOPA)
- **EIOPA**'s main purpose is enhancing the convergence of good supervisory practices across EU
- The **Market conduct regime** is a set of principles, rules, and guidelines to ensure that the conduct of the insurers' business is fair and transparent

Solvency II is the current EU prudential regulation regime starting from 2016:

- The regime replaced **Solvency I**, which was in place for more than 30 years

The Solvency I regime was a simple, rule-based **regulatory framework** that prescribed **basic requirements**

- All EU Member States were required to only comply with prescribed **minimum requirements**
- However, Member States could supplement that regime with different and further requirements at the national level

The **Solvency I** regime presented **four** main disadvantages:

- Lack of Risk Sensitivity
- Failure to adequately differentiate between the riskiness of different product lines
- A partial balance sheet approach
- Inconsistent level of policyholder protection within the EU

1. **Lack of risk sensitivity** derives from the fact that capital requirements were determined using a factor-based approach that did not capture the risk profile of the insurer
    - Indeed, **Capital requirements** were mainly dependent on the **size of the company** and did not consider the specific **risk profile** of the insurer
    - Moreover, prudent managers were penalized as they would have seen their capital requirements increasing with the number of reserves

➔ In general, Solvency I was a rules-based regime that could conflict with good risk management

2. **Failure** to adequately **differentiate** between the **riskiness** of **different product lines**, since insurers should have more capital when writing riskier business
    - However, this was not necessarily the case under Solvency I because of the way the capital requirements were calculated
    - For **Non-Life insurers**, the capital requirements were based upon the volume of premiums or historical claims

➔ This did not sufficiently differentiate between business lines that experience differing loss volatility

3. **Partial balance sheet approach**, because Solvency I capital requirement ignored the risks that could materialize on the asset side of the balance sheet

- For instance, Solvency I capital requirement did **not consider currency risk** if insurer invested in assets denominated in a different currencies wrt its liabilities

4. **Inconsistent level** of **policyholder protection** within the **EU** because, under Solvency I, regulatory regimes differed significantly throughout Europe
    - This led the way to **Regulatory Arbitrage**, since companies could take advantage of differing regulations in order to lower their regulatory requirements
    - This resulted in inconsistent levels of protection for policyholders and unfair competition between companies

➔ Solvency II sought to radically reform Solvency I and overcome its limits by creating an enhanced and more consistent level of protection throughout Europe
    - Indeed, Solvency II introduced a single set of requirements to be applied consistently across Europe

The Solvency II key elements can be summarized as follows:

1. A **market-consistent** (**realistic**) **approach** for valuing all **assets** and **liabilities** and their **interconnectedness** (*total balance sheet approach*) with **no additional prudential buffers implicit** in their valuation
    - More concretely, the **valuation** prescribed under **Solvency II** aims at determining the **transfer value** of **each element** of the balance sheet
    - The **difference** between **assets** and **liabilities** can be considered as the **amount** the insurer could **realize** by **transferring** all **assets** and **liabilities** to a third party at the time of the valuation
    - In addition, **market consistent valuation** provides insurers with **useful information** for **effective risk management**

2. **Forward-looking** and **risk-sensitive capital requirements** aimed at **improving** the insurer's **resilience** to **financial shocks**
    - The capital requirement should equal the potential loss that the balance sheet of the insurer could suffer at the occurrence of an adverse event
    - Therefore, the requirement will depend on the risk exposure of the specific insurer's balance sheet
    - The higher the risk exposure, the higher the capital requirement

3. **Special focus** on **governance** and the enhanced role of **Enterprise Risk Management**
    - The aim was to **improve** the insurer's **ability** to **identify**, **measure** and, **mitigate risks**, and to incentivize the development of internal models to assess risks

4. **Enhanced supervisory approach** to give supervisors **effective tools** to intervene **before** the **full materialization** of the **risk** and with **increasing intensity** in proportion to the **level** of insolvency risk
    - Hence, a **laddering** of **early supervisory interventions** was **introduced**

5. Increased **market transparency** and disclosure to strengthen **market discipline**

6. **Harmonised EU regulatory regime** to implement **consistent supervisory practices** in **EU**, with the **aim** of making **regulation** and **actual supervision** in different **jurisdictions** as **convergent** as possible
    - Indeed, Solvency II is a **maximum harmonizing regime** in which the **discretion** left to **national jurisdictions** in the implementation is **limited**
    - Furthermore, the **EIOPA** works to **foster common supervisory practices**

Outline of the Solvency II regime

Solvency II regime is intended to **cover** all aspects of the **insurance business** that could have an **influence** on the **solvency** of the **insurer**

Solvency II provisions can be divided into **three pillars**

- **Pillar 1:** Focuses on financial requirements and the available capital to cover the requirements
- **Pillar 2:** Establishes requirements for governance and risk management as well as for the way the supervisory review process should be carried out
- **Pillar 3:** Focuses on supervisory reporting and public disclosure to trigger market discipline

Pillar I - financial requirements based on an economic approach

Solvency II follows a **risk-based economic approach** to set financial requirements

- The capital needed to cover **capital requirements** is **determined** based on the **Market Consistent Valuation** of all assets and liabilities of the company
- The **value** of both **assets** and **liabilities** should **reflect** the **current value** at which they could be **traded**, **irrespective** of how they are **valued** for general financial information purposes

There are two levels of capital requirements:

1. **Solvency Capital Requirement (SCR)**, which are calculated in terms of the **potential loss** under an **adverse scenario assumption** calibrated to a **confidence interval** of **99.5% VAR** over a **1-year** time horizon
    - This represents the **quantity** of **capital** that is supposed to be **sufficient** to cover **future unexpected losses** over the following year, up to the **statistical level** of a *1 in 200-year event*

2. **Minimum Capital Requirement (MCR)**, which reflects a **level** of **capital below** which **ultimate supervisory action** should be **triggered**
    - This is calculated on a **simple factor basis** (i.e. based on **percentages** of **certain balance sheet items**), but **within** the **corridor** of **25%** and **45%** of the **SCR**

By **comparing** the **available capital** of an insurer with its **capital requirements** (**Solvency Ratio**), supervisors and other stakeholders can get an indication of the **financial strength** (**Solvency Level**) of the **insurer**

- **Supervisors** calibrate their **actions** based on the **Solvency Ratio** and on all other **indications** coming from other aspects of their **supervision**

This approach allows a **sequence** (**ladder**) of **supervisory interventions**, with **increasing intensity** the more the **solvency ratio decreases**

- Eventually, when the **available capital** breaches the **MCR**, **ultimate supervisory intervention** is **triggered**

- Indeed, the closer the available capital gets to the SCR and eventually breaches it, the more supervisors take actions with increasing intensity to prevent further erosion of the solvency position and eventually to recover it

➢ With **Solvency II regime** supervisors are able to get an **early indication** of the **solvency position** of the **company**
  - This is **useful** in order to **apply in time** the **supervisory measures** and **simplify** the **recovery**, thus **protecting** more effectively **policyholders' interests**
  - When the **MCR** is also **breached**, supervisors should take **final actions**

➔ When the **MCR** is **breached**, companies should in principle still be **able** to **transfer** all their **assets** and **liabilities** at their **market price** to a **solvent company**, before **policyholders' rights** are **undermined**

Pillar II - Central Role of Risk Governance

In addition to financial requirements, **good governance** and **strong risk management** are **essential** aspects of a **prudential regime**

Solvency II sets **explicit requirements** on the quality of the governance of the company and the way it manages its risks:

1. **Fit and proper requirements** of the people managing the company
   - Indeed, the source of company crises are usually attributable to bad management attitude and decisions
   - The reputation, professionalism and experience of the managers is a precondition for maintaining its solvency

2. **Appropriate internal control system**, which should be proportionate to the size, nature and complexity of the risks borne by the company
   - This includes requirements about responsibilities and tasks of key functions such as risk management, actuarial, compliance, and audit functions

3. **Severe risk governance standards** covering **all risks** (not just those captured by the Pillar 1 requirements) in order to:
   - Ensure that **risk assessment** and **management** play a **central role** in the system of governance, with **direct responsibility of the management board**
   - **Insurers** send to **supervisors** a **specific report** (**ORSA**) regarding **how** risks are **measured** and **controlled** by supervisors, in order to **assess** the **capital needs**

   ➔ The **ORSA** (**Own Risk and Solvency Assessment**) is one of the **main** and most **innovative tools** in the **Solvency II** framework which has two purposes:
   - A **risk assessment process** to support **internal business decisions**, which should always be based on their risk implications
   - A **report to supervisors,** which not only **explains how** the company **measures** and **assesses** its **risk profile**, but also **represents** a **platform** for the company to develop its **interactions** with **supervisors**

Assumptions and **Methodologies** to assess the **risks** in the **ORSA** are **not** necessarily the **same** as those underpinning the **calculation** of the **Solvency Capital Requirement** (**SCR**)

- However, any **divergence** with **SCR** calculation should be **highlighted**
- Therefore, the **ORSA** also helps **supervisors** to check whether the **risk profile** of the company is **appropriately captured** by the **SCR calculation** and, therefore, to consider the **request** of any **adjustments** to the **capital requirements**

In order to verify **how well** the **insurers** comply with the **requirements**, **Supervisors** need **appropriate powers** and **resources**

- Indeed, based on their **review process**, **supervisors** have the **power** to **require** the company to **inject capital** in **addition** to the **amount** resulting from **SCR calculation** (**capital add-on**)

➔ There are **two** main **reasons** for a **capital add-on**

1. **Deficiencies** in **governance** and **internal control** which **increase** the **risk** of **losses**
   - Therefore, the **capital add-on** should be **temporary**, as **shortcomings** in the **governance** and **control** system should be **quickly addressed** and **eliminated**

2. **Deviation** of the **actual risk profile** of the **specific company** from the assumptions underpinning the ordinary calculation of the capital requirement (SCR)
   - Indeed, the **SCR** uses certain **assumptions** and **simplifications** that do **not always fit** the **actual risks** borne by the company

➔ The actual **convergence** of the **day-to-day approach** and **methods** used by **EU national supervisors** in applying the above powers is **critical** to achieve **actual harmonization**

Pillar III - Broad and Risk Based Disclosure

Solvency II also introduces **new public disclosure requirements** with the aim of **fostering market discipline** and reward companies that manage their risks better

According to the **Third Pillar**, insurers **not only** should show **financial position** and **results**, but also:

- They should explain how the insurers' risk profile and risk appetite fit in with their overall business strategy
- They should explain to external stakeholders how insurers assess and manage risk

One of the objectives of **Solvency II** is that **Supervisors** should have **sufficient information** to **fully understand** a firm's **risk profile**

- Hence, besides public disclosure, **Solvency II requires** to regularly **report**, based on **harmonized reporting formats**, a set of **information** to **supervisors**

Insights on Financial Requirements

Market Consistent Valuation of Assets and Liabilities

The first step to calculate financial requirements and assess the solvency position of the company is the determination of the **Solvency II balance sheet**

- The Solvency II BS recognizes and values assets and liabilities according to the **market consistent valuation**, which is the Solvency II valuation criteria

Under Solvency II this step has a twofold purpose:

1. Determining the **available capital** of the company, which is the amount of own funds available to cover the capital requirements

2. Determining the value of assets and liabilities which should be used as a starting point to calculate the **capital requirements** (**SCR** and **MCR**) according to the **Total Balance Sheet Approach**

The **Total Balance Sheet Approach** ensures that the **risks associated** to **all assets** and **liabilities** are **considered** and, at the same time, **allows** to take into **account** any **compensating effect** of the **risk exposures** stemming from assets and liabilities

- For instance, the risk compensating effects of derivatives that are used to hedge the risk exposure of certain assets or liabilities

Hence, in the **Solvency II balance sheet** all **assets** and **liabilities** should be recognized and measured at the value at which they could be **transferred** in an **arm's length transaction** between **two** willing **parties** in **normal market circumstances** (**transfer value**)

Hence, we must use **different valuation methods** according to the **depth** and **liquidity** of the **markets** of **relevant assets** and **liabilities**

- In general, **assets** and **liabilities** are **valued** at their **market value** if they are **traded** in **deep** and **liquid** markets
- Otherwise, the **transfer value** of assets or liabilities should be **derived** by using **reliable models** and using **updated market information** (**mark to model**)

Solvency II provides the **criteria** to **model insurance liabilities**:

- **Insurers** are requested to **forecast** expected **liability future cash flows** and then discount them using **risk-free interest rates**
- This allows to determine the **best estimate** of **insurance liabilities**
- Then, a **risk margin** is **added** to the **best estimate** in order to produce a **market consistent value**

Considering the **large amount** of **insurance liabilities** on insurers' balance sheets, a **wrong calculation** or the use of **unsound assumptions** could **reduce** both:

- The **reliability** of the determination of the **insurer's technical provisions**
- The **reliability** of its **available capital**

Valuation of Technical Provisions

Similarly to **Solvency I**, the **calculation** of the **technical provision** in **Solvency II** is **crucial** for a sound assessment of the **solvency position** of the company and, therefore, for the protection of **policyholders**

The **main objectives** of **Solvency II** with regard to **technical provisions** are as follows:

1. **Harmonising** the **calculation across EU jurisdictions** by using a **single set** of **criteria** and certain **key assumptions** to **model technical provisions**
    - However, it is **unavoidable** that in a such **complex modelling** a number of **assumptions** remain within the **discretion** of the **company**
    - To **make** these **assumption sound** and **convergent** across companies and Member States, it is necessary that **EIOPA** and **National Supervisory Authority** apply **detailed harmonized guidelines** and **supervisory practices**

2. **Aligning** the **valuation** to the **IFRS**, however this objective has been pursued only in general terms because at the time of Solvency II the International Accounting Standard on insurance contract (**IFRS 17**) did not exist
    - Now that **IFRS 17** is **defined** we can say that the **two standards** have a number of **conceptual similarities**, even though **differences exists**
    - In general, we may say that those **differences** are **justified** by the **different purpose** of the **two standards**

3. **Eliminate implicit, opaque, prudential margins** in the **valuation** of **assets** and **liabilities** by introducing a **transparent approach** based, in principle, on **realistic** and **market consistent assumptions**
    - Some **key elements** of the **model** (e.g., discounting interest rate curve to be used) **depart** to a certain extent from **pure market data**
    - However, this **departure** aims at **softening** the **excessive volatility** that **pure market data** would have **entailed** in the valuation, thus also **reflecting** the **long-term horizon** of **insurance** business (**Long Term Guarantee measures**)

The **conceptual steps** to calculate the **insurance liabilities** under **Solvency II** are the following:

- **Determining** the **amount** and **timing** of **all expected cash flows stemming** from the **insurance contracts** in force, including those that depend on the insurer's discretion or policyholder behaviors

This determination should be made based on **contract boundaries**, which determine how **long** in the **future** the **estimates** of the **expected cash flows** should **last**

Discounting these cash flows using a **pre-determined risk-free** interest rate **term structure** in order to determine the **best estimate** of **insurance liabilities** (interpreted as the **probability weighted expected present value** of the **insurance liabilities**)

- Adding a **risk margin** to the **best estimate** in order to account for the **uncertainty implicit** in the best estimate

Main Criteria to calculate insurance liabilities under Solvency II

The **Best Estimate** is the **present value** of **probability - weighted average** of **future cash flows** related to **existing contracts**, and it is calculated by projecting all the expected cash flows within the **contract boundary**. Projected Cash Flows include:

- All future premiums to receive
- All expenses incurred in servicing
- All payments to policyholder and beneficiaries, including expected future discretionary benefits
- Inflation and expected future environmental developments
- All financial guarantees and contractual options

Solvency II prohibits any **allowance** for **prudential buffers implicit** in the **reserve's valuation**

- This is because **no surrender value floor** (the fact that reserves cannot be lower than the sum of the surrender value for each policy) is **envisaged**
- In line with the **transparent**, **economic approach** of the system, the **valuation** should be based on **realistic assumptions** and cannot be **excessively** and **implicitly conservative**

In the case of **life with profit contracts**, the projection of **guaranteed benefits** has to be separated from **discretionary benefits**

- Indeed, the **discretionary** part of insurance liabilities could **legitimately** be **used** to **reduce** the **capital requirement** (**SCR**)
- This is because, in **stressed conditions**, the **insurer** can **reduce** the **profits** that it would otherwise allocate to **policyholders**

The **best estimate** is determined by applying a **pre-determined discount interest rate curve** to expected cash out-flows

- The **interest rate curve** is set by referring to the **risk-free** interest rate expressed by the market at the time of the valuation
- EIOPA regularly sets and publish one **risk-free** interest rate curve for each currency, to be applied by all companies in the EU

Conceptually, the **discount rate** is the rate of the **least risky financial instrument** that the insurer can reasonably **invest in** at the **time** of the **valuation**

- This **principle protects** the **policyholders**, by not **exposing** them to the **risk** of determining liabilities on the basis of too **optimistic expected return** of **investments**

When setting the **interest rate curve**, the main **decisions** to take are:

1. **Choosing** the **basic interest rate curve** to assume as a reference for the risk-free rate
   - Currently, the reference rate is the interest rate curve expressed by the swap rate in the relevant market

2. How to **extrapolate** the **interest rate term structure** for durations where **no deep** and **liquid** market values **exist**
   - This is based on **forward rates converging** smoothly from the **Last Liquid Point** (the **forward** rate with the **longest maturity** for which the observed **financial instrument** expresses **reliable market data**) to the **Ultimate Forward Rate** (a **rate** that can be considered **stable** over time)
   - The **wider** the **extrapolated** part of the **curve** is, the **less** the curve will be **sensitive** to the **values expressed** by the **market**, thus **reducing volatility** over time.

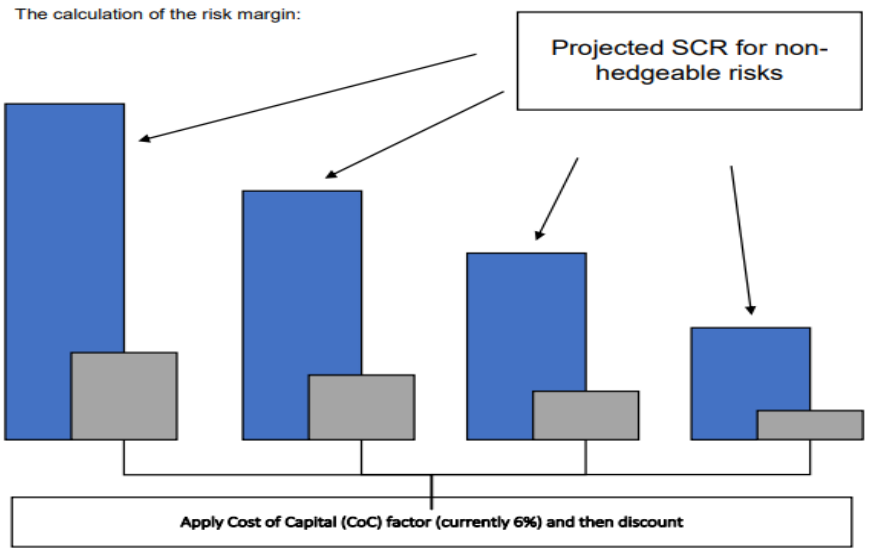
3. Whether to **add adjustments**, such as the **matching adjustment** and the **volatility adjustment**, to the **basic curve**
   - This could be done to take into **account** and **compensate** for **abnormal widening** of **credit spreads** on **bonds**
   - This could be **necessary** at a time of **generalized financial crisis** or when the **movements** of **credit spreads** of bonds are **artificially volatile**
   - Basically, **adjusting** the curve is a **countercyclical measure** introduced to take into account the **long-term nature** of many **insurance products**

➔ The **chosen level** of the **discount rate curve** is crucial to determine the **available capital** of the company and its **solvency rate**

- The **change** in the **discount curve** can have a **huge impact** on the amount of **technical provisions** and, therefore, on the **available capital** of the insurer

In **Solvency II**, the **risk margin** is calculated by determining the **cost** of **providing** an **amount** of **eligible own funds** (cost of capital) that is **equal** to the **Solvency Capital Requirement** (**SCR**) necessary to **support** the **run-off** of the **insurance obligations**

- In practice, the **risk margin** is calculated by **projecting** the **capital requirements** (**SCR**) that will be **generated** by the **presence** of the **best estimate** of **technical provisions** in the **following years**, until they will be **completely paid out**
- These **projected SCR** will allow the **determination** of the **cost** of the **corresponding capital** to hold in the **future years**
- These **costs** will be then **discounted** using the **risk-free interest rate curve** that we discussed above



Risk Based Solvency Capital Requirement (SCR)

The **available capital** is determined by calculating the **market consistent value** of all **assets** and **liabilities** of the company

- At the same time, the **market consistent value** of **assets** and **liabilities** is the basis on which the **methodology** to calculate the **Solvency Capital Requirement** (**SCR**) is applied

The **comparison** between the **available capital** of the insurer and its **capital requirement** (**SCR**) determines the **Solvency ratio**

- This is the **main indicator** of the **solvency position** of an **insurer** under **Solvency II**
- Any **change** of **market value** of **assets** and **liabilities** could significantly **affect** the calculation of the **Solvency Ratio** either by **changing** the value of **available capital** (**most significant effect**), or by **changing** the determination of the SCR.

SCR Standard Calculation

The **calculation** of the **SCR** includes the **measurement** of **all quantifiable risks**, to which all **assets** and **liabilities** of the company are exposed to, based on **EU average market data**

- Each **quantifiable risk** is defined and **considered individually**, based on a **modular approach**, and the list of all **quantifiable risks** is **provided** by the **regulation**

- **Prescribed Factor Based** or **Scenario Based Calculations** are used to define the capital charge for each risk, using the **total balance sheet approach** and recognizing the **risk reduction mechanisms** in **force**

➔ **Factors or Scenarios** are **prescribed** in the **regulation** and are calibrated using a **confidence level** of **99.5% VaR** over **one year**

- **Results** of the capital charge for each risk are then **aggregated** using a prescribed **correlation matrix**, in order to allow for diversification between risks that are not fully correlated

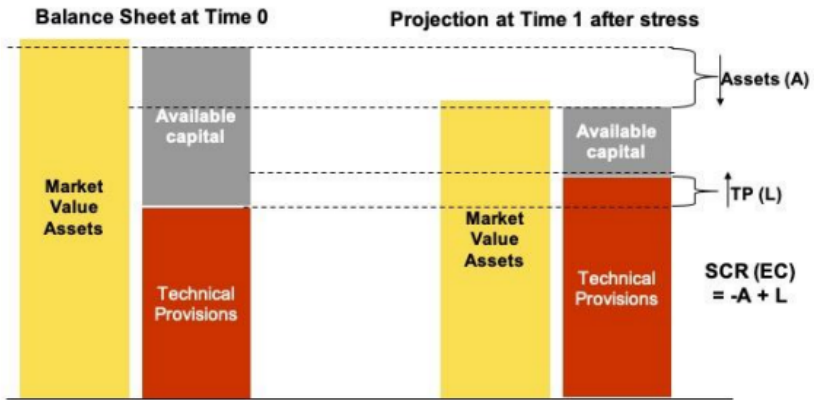
For **each risk** considered by the **regulation**, **predetermined formulas** are applied to **all assets** and **liabilities** included in the **Solvency II Balance Sheet**, whose **value** is **sensitive** to the **relevant risk**. These formulas could be based on the application of:

- Predetermined Factors (factor based)
- Relevant Market Factors (scenario based)

The **purpose** is to identify the **potential loss** that the **available capital** could be subject to in the case of a statistically defined **adverse scenario**

However, the **capital requirement** calculated for each **risk** is then **reduced**, where relevant, to take into account the fact that, in a **stressed situation**, **some liabilities** could be **reduced in value** or **eliminated**. For instance, this is the case for:

- **Technical provisions for 'with profit' life contracts** in relation to part related to discretionary future allocation of profit to policyholder
- **Deferred tax liabilities**



The supervisory role is made difficult by the fact that the SCR calculation is very complex and introduces subjectivity into the computation

Example - Interest Rate Risk Module

The module aims at measuring the **impact** on the **balance sheet**, using the **total balance sheet approach**, of **potential changes** in the **term structure** of **risk-free** interest rates

- Companies should simulate the impact of **up/down** prescribed changes of the risk-free curve, varying by term to maturity
- All assets and liabilities should be considered and their change in value recorded

- On insurance liabilities, the effects should be considered through changes in discount rates, value of options and guarantees, management actions, etc.

➔ The SCR related to interest rate is the larger (net) result of the two scenarios.

After the calculation of the capital charge for each risk, prescribed correlation matrixes are used to aggregate the capital charges and define the final SCR

- This allows for the recognition of diversification effects between risks

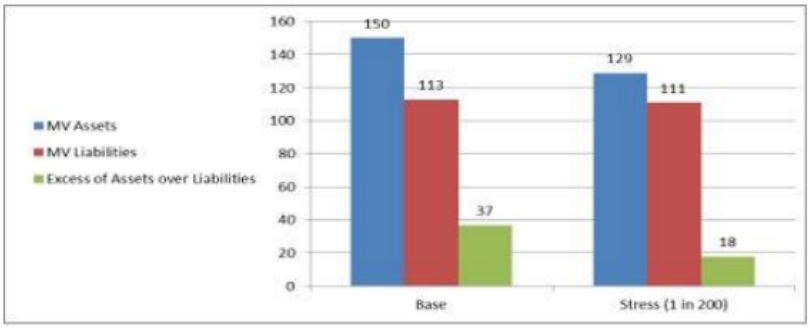
The recognition of **diversification effects** is fundamental to provide incentives for insurers to enhance the diversification of their risk profile

- Solvency II regime includes these correlations matrices as an incentive to diversify risks, even though correlations tend to change over time, especially during crises

Maturity	Increase	Maturity	Decrease
Up to 2 years	70%	Up to 1 year	75%
3 years	64%	2 years	65%
4 years	59%	3 years	56%
5 years	55%	4 years	50%
6 years	52%	5 years	46%
7 years	49%	6 years	42%
8 years	47%	7 years	39%
9 years	44%	8 years	36%
10 years	42%	9 years	33%
.....		.....	
18 years	29%	15 years	27%
19 years	27%	From 16 y to 18	28%
From 20 y to 29	26%	From 19 y to 21	29%
From 30 y on	25%	From 22 y on	30%

	Market	Default	Life	Health	Non-life
Market	1	-	-	-	-
Default	0.25	1	-	-	-
Life	0.25	0.25	1	-	-
Health	0.25	0.25	0.25	1	-
Non-life	0.25	0.5	0	0.25	1

In order to calculate the **Solvency Ratio**, we will have to divide the available capital of our company by the Solvency Capital Requirement calculated:



	Base	Stress (1 in 200)
MV Assets	150	129
MV Liabilities	113	111
Excess of Assets over Liabilities	37	18

SCR	19

Balancing Sensitivity and Simplicity in the SCR calculation

The main purpose of Pillar I of **Solvency II** is to define a capital requirement coherent with the company's risk profile

- Indeed, **Solvency II** provides the **option** to **adjust** or **replace**, after supervisory approval, the **results** of the **formula** with a more **company-specific calculation**

Recall that the **SCR standard formula**, **calibrated** in accordance with **statistics** based on **Europe-wide data**, considers the **average** of **relevant European data**

- However, this calculation may not be in line with the specific risk profile of the company

If the **difference** between the **assumptions underlying** the **standard SCR calculation** and the **risk profile** of the company would **suggests** an **increase** of **required capital**, **supervisors** could require a **capital add-on**

More generally, in order to make the calculation of SCR fully based on a **company's risk profile**, the company could ask the supervisor to approve an **internal model**

- This is done when the **risk profile** significantly **deviates** from the **assumptions** underlying the **standard formula**
- The **internal model** can be used to **calibrate factors** and **stress** of the formula on the basis of the **company-specific situation**

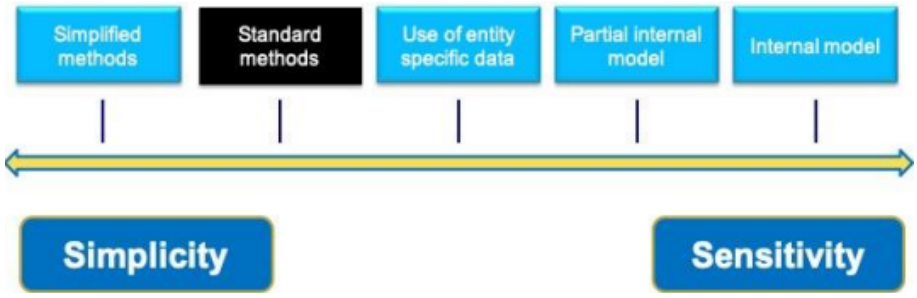
The **European Authority** (**EIOPA**) role is critical to ensure **consistency** in the approaches of **national supervisors**

The use of **Entity Specific Data** is an **intermediate option** between standard formula and internal model

- In this case, the **standard formula** continues to be **used**, but with the **replacement** of some **standard factors** with **entity specific factors**

However, even if **companies** can decide between **Entity Specific Parameters** or **Internal Models**, they may also need to **apply simpler calculations** for **non-significant risks**

- The **table** below summarizes the **options** that **insurance companies** have to **balance simplicity** and **risk sensitivity**



MCR Calculation

Solvency II also envisages a **Minimum Capital Requirement** (**MCR**), which is a requirement lower than the SCR

- **MCR** and **SCR** allow for the calibration of the intensity of supervisory actions (**supervisory ladder** of **intervention**), depending on their comparison with the available capital
- The **MCR** level should be **consistent** with the **SCR** in order to allow for a **reasonable distance** from the **SCR** and, therefore, for a **ladder** of **supervisory interventions**

The **MCR** is considered a **safety net** against the model risks associated to the complexity of Internal Models

- Indeed, MCR is based on an objective calculation approach that is easily auditable

The **MCR calculation** is based on **percentages** applied to a **combination** of **premiums**, **technical provisions**, and the **insured amounts** at risk

- The **MCR** is subject to a **maximum cap** (**45%**) and a **minimum floor** (**25%**) determined as **percentages** of the **SCR**
- This ensures **enough distance** from the **SCR**

The **SCR** and **MCR** should be **covered** by **eligible** elements of **own funds**

- **Solvency II** provides **requirements** to ensure a **sufficient quality** of the capital
- **Eligible elements** of own funds include **shareholders' equity**, certain **liabilities** like **subordinated debt**, and elements such as **ancillary own funds**

The elements of **eligible own funds**, including subordinated debts, are **allocated** into **three classes** of **decreasing quality** (**tiers**), where the quality is measured by considering

- Subordination to other liabilities
- Loss absorbency capability
- Sufficient duration
- Freedom from incentive to redeem
- Absence of mandatory servicing costs
- Absence of encumbrances

A set of **quantitative limits** is prescribed for **each tier** in order to **ensure** an overall **minimum level** of **quality**

Regulation Of Investment Activities

Solvency II updated Solvency I by **eliminating** any **pre-determined limit** or **constraint** on **investments**

- However, the company should follow the **prudent man principle** and invest in the **best interest** of the **policyholder**, considering **transparently** all **investment risks**

This **qualitative principle** is more effective than predetermined constraints or conditions because it can be tailored to the specific concrete circumstances

- The main constraint is that it makes the supervisory review more difficult

In general, under **Solvency II** all **risks undertaken** (including **investment risks**) are reflected in capital requirements

- Hence, **companies** are **free** to take **more investment risks**, provided that they **own** the **necessary capital** to **cover** the corresponding **capital requirements**

A Summary of the Main Impacts of Solvency II in the EU Environment

Main **impacts** for **Supervisors:**

1. Increased **complexity** of the framework requires an **increased quality** and **quantity** of technological and human **resources** in the **supervisory authorities**

2. **Supervisors** should have the **ability** to appropriately use **increased discretion** and take a **stand** against **reactions** of **companies** and other **stakeholders**

3. An enhanced **risk supervisory culture** should be **embedded** at **all levels** of the supervisory **organization**

4. Need for **converge** in **day-to-day supervisory** practices in the **EU**, since **expert judgement** and **discretion** opens the possibility of **unlevel playing fields** in the **EU**

5. Need for **international cooperation** between **supervisors**, even if this is made **difficult** by **differences** in the **legal systems** of each **jurisdiction**

Main impacts for **Insurers:**

1. The introduction of **Solvency II** can affect the **overall business strategy** and **operations** of **insurance** companies

2. The **regulation** should be **understood**, **interpreted** and, **embedded** in the business, taking into account **supervisory expectations**

3. **Solvency II** has an extensive **impact** on **governance**, **risk management**, and **business operations**

4. **Solvency II** could change the competitive landscape, thus requiring a reassessment of business strategy

5. In terms of **quantitative impact**, the average **capitalization** of the **EU** insurance **market** has **not** been put **under stress** by the introduction of **Solvency II**, however the impact could vary at individual level

One Major Challenge: Volatility and Pro-Cyclicality

The **volatility** of the **Solvency II** ratio and the consequent risk **pro-cyclical interventions** represent the most **controversial aspects** of the new regime

- Indeed, the new regime poses the risk that supervisory interventions are triggered only by a temporary change in market factors or a market crisis
- This could make the crisis even worse

The **original Solvency II directive** already included some **countercyclical** elements

- However, the **most recent Solvency II** legislation includes a **package** of measures (**Long Term Guarantee** measure) that focuses on the **long-term nature** of many **insurance products**
- The **package** allows to **reduce** the **effects** on the **balance sheets** of short-term market **volatility**, thus **limiting pro-cyclical** supervisory **interventions**

The **aim** of these measures is to **make balance sheets less volatile**

- This is done by **compensating abnormal changes** in the **value** of some **assets** and **liabilities** with **specific changes** in the **discount rate** used for **technical provisions**
- Alternatively, this is done by making the **discount interest rate curve less dependent** on **market values**

The following **measures** have the **purpose** to **depart** from **pure market consistent valuation** of assets and liabilities in order to **soften** the **volatility** that would otherwise be **reflected** in the **Solvency II balance sheet:**

1. **Volatility Adjustment** is a **premium** added to the **risk-free** rate curve in order to **reduce** the **technical provision** in the case of **abnormal widening** of the **credit spread** on bonds
   - The **own funds** will be **less dependent** on **abnormal volatility** of the **credit spread** of bonds

2. **Matching Adjustment** is a margin added to the risk-free rate curve in order to reflect the credit spread of the specific assets in which certain liabilities are invested
   - Also in this case, **own funds** will be **less dependent** on **abnormal volatility** of the **credit spread** of bonds

3. **Extrapolation** refers to the method used to determine the curve for maturities where no reliable market data exists
   - By using **constant**, **predetermined** data, the resulting **curve** ends up being **less dependent** on **market volatility** at **long maturities**

A List of Other Critical Aspects of the New Framework

Complex quantitative requirements and **demanding qualitative requirements** are likely to penalize small companies and drive consolidation in the market

Internal Models could be **misleading** if **not well calibrated**, **understood** and **managed**

Allowance for **risk diversification** could be a driver for **market consolidation**, forcing the exit from the market of many small companies

- Furthermore, **diversification benefits** are difficult to **measure** statistically

Severity of **capital requirements** for certain businesses

- Indeed, the **capital absorbed** by certain **business lines** may **increase** because of the **risk-based approach** and the **calibration** of **capital charges** for **certain risks**

Assurance of a **level playing field** in the context of a **principle-based regime**

- Although **Solvency II** is **designed** to increase **harmonization** across **Europe**, actual harmonization **requires convergent day-to-day supervisory practices**