MANAGEMENT OF FINANCIAL INSTITUTIONS

BIEF

Management of Financial Institutions

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BANKING INDUSTRY

1) Intro

Banks have their main source of income in the **Net Interest Income**, which is the interest revenue (from loans and investments) minus the interest expense, related to funding. Moreover, we have the **Net Non-interest Income**, whose expenses are related to wages and rents, while the revenues are the ones related to the fees on the services provided by the bank.
The main risks of the banking industry are: credit risk, liquidity risk, interest rate risk, market risks, operational risk; the existence of this consistent amount of risks supposes the need for an effective risk management.
Since the Glass-Steagall Act (1933), Universal Banking was separated into two different kinds of institutions. First, we have **Commercial Banking**, whose operations concern payment services, saving products and lending for businesses and individuals. The other kind institution is **Investment Banks**, providing underwriting, asset management, and advisory services and risk management products. Still, today all relevant investment banks are also commercial banks (Universal Banking), due to deregulation and some endogenous factors: cost saving, risk reduction through diversification, and stabilization of bank income by increasing the sources of revenues.

Traditional commercial banking:

- **Main business**
  - *Deposits and loans*
- **Main source of revenues: Net interest margin (NIM)**
  - *The difference between interest revenues from lending minus the interest cost on deposits and other liabilities is a main driver of bank profitability.*
- **Main sources of risk:**
  - *Credit risk (but also liquidity and interest rate risk)*

Universal banking:

- **Main business**
  - *Several: The bank offers a broad range of financial products and services*
- **Main sources of revenues**
  - *Either non interest or interest income depending on the banks' main focus*
- **Main sources of risk**
  - *Several, e.g. credit and market risk, depending on the bank's main focus*

Still, the complex structure of Universal Banks may cause agency problems, due to the complex cost coordination among different lines of business, and their colossal size gives them incentives to engage in riskier activities (moral hazard). Based on recent research, larger banks didn't have higher profits or efficiency and lent to riskier borrowers, but their managers received higher salaries and received more media attention, giving them empire-building incentives.
Banks differ among themselves based on their organizational structure, delivery channels, and size. This last factor influences the variety of services that each institutions offers and their internal organization. From small to large we have: Community Banks / Credite Cooperative Banks, which have a small area of operation and are specialized in retail banking; Regional Banks / Saving Banks, which offer a wider range of services at regional or national level; and National / Global Banks, offering many products and services to governments, businesses, and individuals.
Lately, the number of banks in EU and US has been decreasing, while their size has had an opposite trend, and European banks with assets over $30bn account for over 80% of EU banks' total assets, with 3-4 banks per country that own more than 50% of that country's total assets, exceeding its GDP. This is known as a **concentration process**, which is positive if it only allows the most productive firms to survive, and negative if it creates entrance barriers.

2) FUNDING: Deposits

The funding structure of a bank is important because of its impact on profitability (cost structure, income) and on risk (interest rate risk, liquidity risk).
Deposits are the banks' main source of funding, being relatively stable despite its demandability, which exposes the banks to the risk of runs, that can sometimes be hedged through a deposit insurance (generates operating costs). This can be interpreted as a discipline device, as knowing that they can lose all deposits, managers will limit risk-taking. In addition, they have a low interest rate sensitivity (sleepy depositors) and have a short duration, therefore banks will manage liquidity risk by holding cash and other liquid assets. Still, the majority of bank assets are loans, causing a **maturity mismatch** in their balance sheets.
Wholesale funding is a less stable but more flexible source of funding. They commonly have a short maturity and are done in large amount but have a greater sensitivity to changes in market interest rates, as they are purchased or issued at that same rate. Before the Global Financial Crisis, all mortgage-back securities were funded through wholesale funds, but the introduction of the Net Stable Funding Ratio (NSFR) required banks to have enough stable funding for their assets, causing this to change.
The three **main types of retail deposits** are checking accounts (can be withdrawn at any time), saving deposits (some limitation on withdrawal, paying modest interest rate) and time deposits (only withdrawable at a given maturity).
Deposit rates are typically below the Fed Funds rate (deposit spread > 0) and they are sticky relative to upward movements of that rate and flexible to downward movements. Still, interest-rate sensitivity varies across the type of deposit, with time deposits tracking FedFunds rate almost one-to-one, while checking and savings accounts are much stickier.
Pricing deposits: consider the interest rate elasticity.

$$Net\ Interest\ Income\ (NIM) = (interest\ income - int.expense)/assets$$

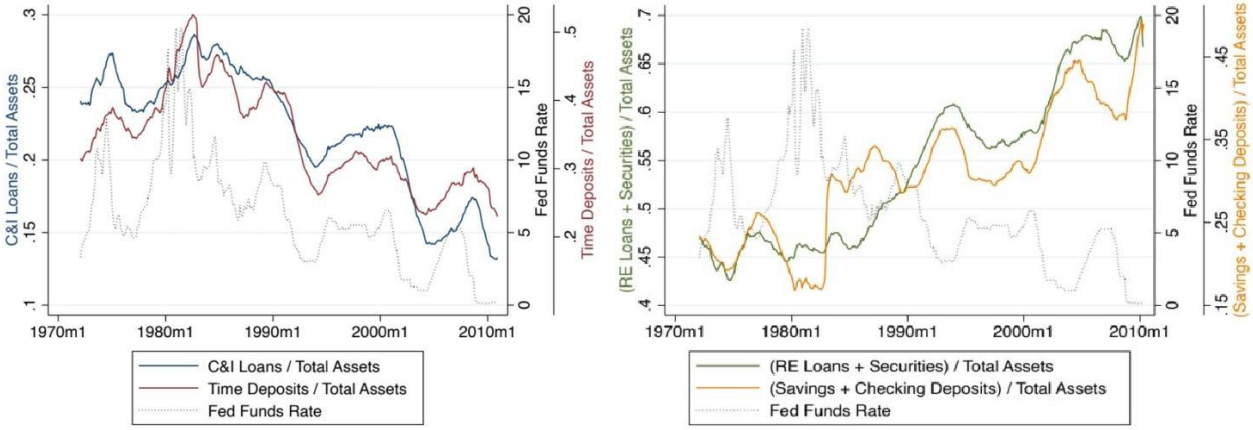
$$Interest\ income = w_{FedFunds} \times r_{FedFunds} + w_{mortgage} \times r_{mortgage}(fixed)$$
$$Interest\ expense = deposit\ rate$$

$$ROA = NIM - Operating\ Costs/Assets$$

If after the Fed raises the interest rates there is no change in NIM and ROA, the bank is hedged with respect to interest rate risk, but this only works if deposits are sticky and stay with the bank.

$$Implied\ loss = \Delta l.term\ rates \times Avg\ Duration \times long\ term\ assets$$

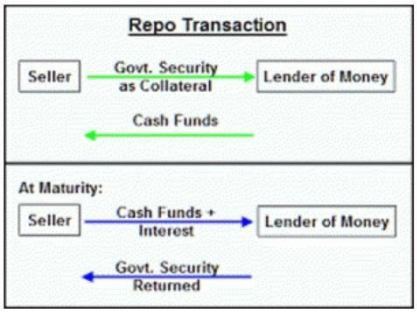
Banks hedge interest rate risk by matching interest rate sensitivity of assets and liabilities. That is why time deposits finance assets that pay market rates (C&I loans), while savings and checking deposits finance assets that pay fixed rates (RE loans and securities).



Even if hedged, banks may still incur in runs, just as it happened for SVB, which had 95% of its deposits uninsured (source of risk).
Regional banks pay significantly higher deposit rates than large banks.

3) FUNDING: Non-Deposit Liabilities

Banks have the priority to make loans to all those costumers from which they expect to receive positive net earnings and even in times of crisis it is less likely to cut credit to existing customers in order to maintain the relationship. Therefore, if there are no deposits available to cover those loans, bank management should seek the lowest-cost source of funds to meet the client's needs.
A first way of funding is using the **Interbank market**, in which banks borrow from other banks, usually returning the amount within 24 hours. This market is useful to move deposits and reserves among banks, granting a safe and smooth flow of payments necessary for the economy.
A second instrument are **Repurchase Agreements** (Repos), which are transactions collateralized by marketable securities, reducing the credit risk. They are an example of asset encumbrance, in which the collateral remains on the balance sheet. They can be private or with a central bank, and in the US they are usually triparty (a third bank selects and manages the collateral) and overnight.



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

The difference between the market value of the collateral and the amount borrowed in the repo is called the haircut, which is always positive or equal to 0. That is because repos are overcollateralized, meaning that banks cannot borrow more than the value of the collateral. Haircuts depend on the underlying risk of a security, and they are typically bigger in private markets than the ones assigned by central banks.
Another way of funding apart from deposits is **borrowing from the Central Bank**. In the case of the Fed, it is possible through its discount window by crediting the borrowing institution's reserve account, always backed by acceptable collateral. On the other hand, it is possible to borrow from

the ECB through the interest rate corridor. It is defined by three main lending programs with a relative interest rate, based on the maturity of the loan. Overnight borrowings are made at the marginal lending facility (MLF) rate, for one week at the main refinancing operations (MRO) rate, or 1-3 months at the long-term refinancial operation (LTRO) rate. The MLF is costlier than the MRO and they are two of the three interest rates that the ECB sets as part of its monetary policy, together with the rate on the deposit facility, which defines the interest that banks receive for depositing money with the ECB overnight. Furthermore, Central Banks are Lenders of Last Resort, meaning that they are ready to credit banks in times of crisis, during which they can also accept collateral not included in the collateral framework (list of eligible securities), but instead other of lower quality. Recently, banks have been borrowing 3-year funds at a negative rate from the ECB, with the agreement that those would have to be used for new loans (TLTRO) and now that the banks have started to return the TLTRO funds, the ECB is reducing its balance sheet, as part of the monetary policy tightening cycle.

Finally, we have **Long-term Non-deposit Funds**, like covered bonds (medium/long-term bonds backed by a special pool of collateral with priority claim). Those bonds are an example of asset encumbrance, as the collateralized assets remain on the balance sheet.

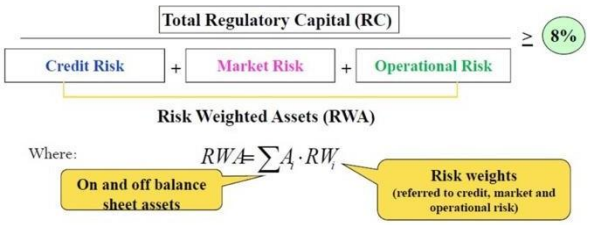
When **choosing** among non-deposit funding sources (all of the above), you must consider the relative costs of raising funds from each source, the relative interest rate risk and rollover risk (inability to issue new debt to pay for old debt, higher in case of short-term debt, high market rates and with weak banks). In addition, it is necessary to consider the maturity for which the funds are needed, the size of the borrowing bank, and the effective regulations.

People or entities outside the regular banking system that invest in non-deposit liabilities issued by banks (repos, covered bonds) are often referred to as **shadow banks** (MMMF, Finance/mortgage companies, ABCP, SPV, GSE). Also shadow banks may issue non-deposit liabilities to fund their assets (mutual funds -> redeemable shares) while holding securities as assets. However, shadow banks are less regulated and do not provide deposit insurance, exposing even them the risk of runs.

4) CAPITAL

Capital is the cushion that protects liability holders from unexpected losses due to the high level of risk taken by banks, affecting its assets. The more the capital the less likelihood of a bank failure, therefore regulators prefer a high level of capital, while banks try to operate at the minimum level of capital required in order to increase their ROE. In addition, they might have incentives to take on risks due to the government safety net and the "too-big-to-fail" supposition.

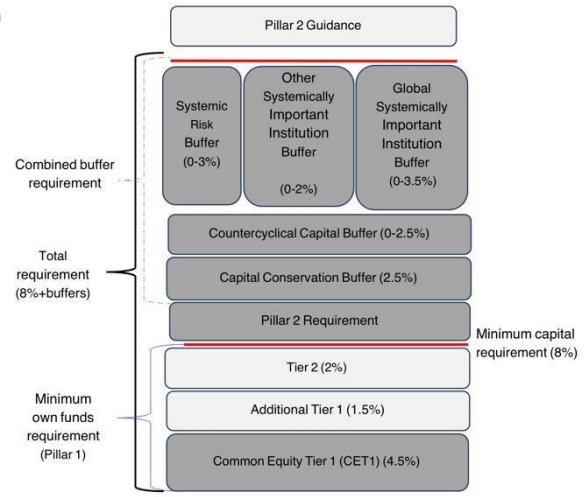
For this reason, the **Basel Agreements** were introduced. Those are a set of three agreements to regulate minimum level of capital with the aim of dealing with credit, market and operational risks, so to protect the depositors.



The total regulatory capital is made of 2 tiers. Tier 1 Capital is all capital able to absorb losses under going-concern conditions. It is made of Common Equity Tier 1 (CET1) and Additional Tier 1. Tier 2 is the supplementary capital, the one that should absorb losses in the event of a crisis (gone-concern capital), made of some non-redeemable debt instruments.

Common Equity Tier 1 is the highest quality capital, with the best loss absorption capacity, including common equity and deduction from CET1 capital. Additional Tier 1, on the other hand, are capital instruments with no fixed maturities (perpetuities).

On top of the minimum 8% total regulatory capital requirements, there are many other capital buffers to be held on top.



Credit risk is measured via credit ratings, and Basel I introduced RWA for the first time, classifying bank assets into different risk groups with preassigned risk weights, inducing risk shifting, as riskier assets within the same group of a less risky one provided higher returns while requiring the same amount of capital. Since Basel II, banks can choose between two methods to assess credit risk of their assets, each needing approval of a supervisor:

- Standard method (SA): using rating given by credit agencies.

(Basel III update)	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

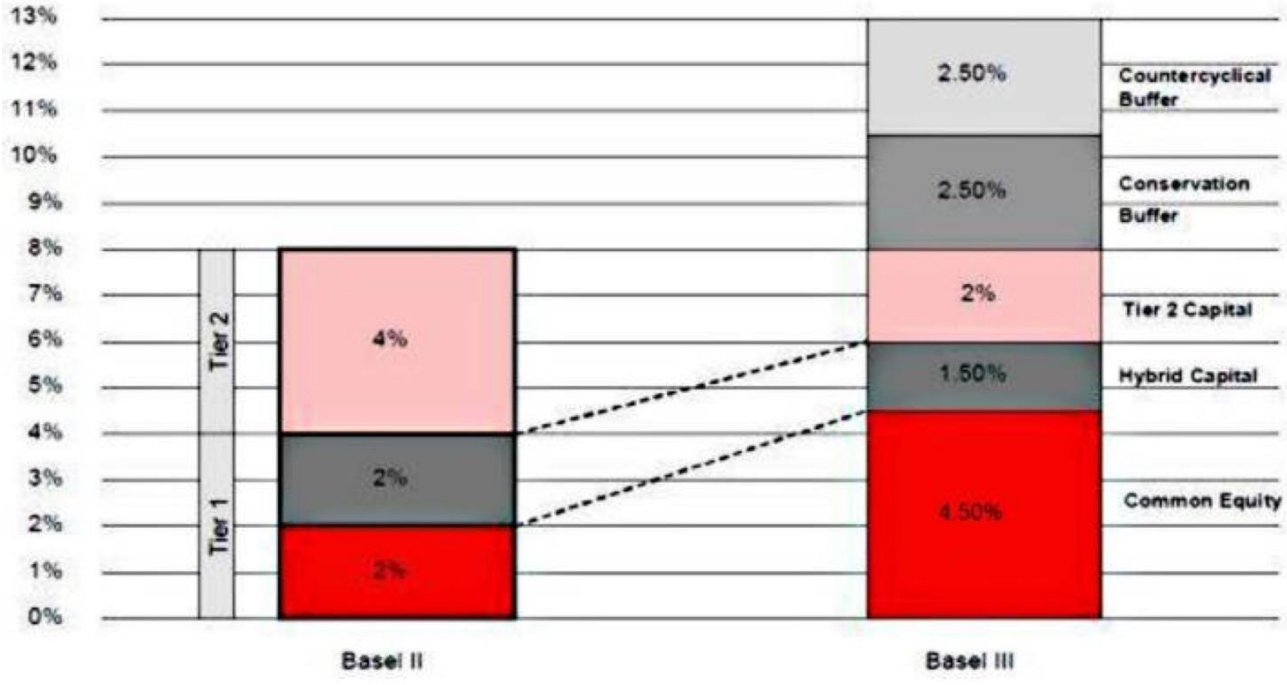
- Internal Ratings-Based (IRB) approach: internal process of measuring the borrower's creditworthiness, allowing for a more adequate measurement, needing the existence of a costly and extensive risk management system that must be certified by a regulator. Therefore, only the largest banks started using this system and it allowed them to reduce the capital burden, as they consistently underestimate the relative risk, artificially keeping the risk weights lower.

Another type of risk banks are exposed to is **market risk**, relative to changes in the market value of asset holdings depending on unexpected changes in market conditions. The amount of capital required to cover it is measured with VaR models, involving the estimation of maximum expected losses over a specific time per a confidence interval, both established by supervisors.

Finally, we have **operational risk**, related to inadequate human resources, failure of processes or external events (fraud, weather damages, …). The capital needed to protect yourself from operational risk is usually a fixed percentage of gross income or determined by some advanced approach.

With the introduction of **Basel III**, the aim was to strengthen global capital and liquidity rules and improve risk management and market discipline (transparency and disclosures), improving the banking sector's ability to absorb shocks and consequently reducing the risk of a spillover in the real economy.

The main measures were to increase the required level of capital and its quality, reduce systemic risk, increase risk coverage, and introduce liquidity requirements.



5) LENDING

Loans are banks' dominant assets, as they are highly profitable (interests and fees) and help cross-selling other fee-generating services. They also have a very important economic function, as they support the growth of new businesses and jobs, as well as giving the bank the role of information provider.

Indeed, banks are able to reduce information asymmetry between suppliers and users of funds, reducing consequently adverse selection and moral hazard, and provide information on small-medium enterprises (SMEs), which have low reporting requirements.

The true need and use of the loan determine the loan amount and loan facility, which include the purpose of the loan and its term, as part of the loan agreement.

There are three different **categories of loans based on the purpose**. First, we have working capital loans, which are made to fulfill short-term needs such as purchase of inventories, payment of wages or of interest on previous debt. A sub-category of these loans are self-liquidating loans, which are collateralized through the firm's account receivables. Then, we also have capital project loans, made to finance long-term investments in fixed assets, and loans made to finance mergers and acquisitions, called "leveraged buyouts" when financed with debt.

Examples of **loans to businesses** vary based on the aim or provider of that loan. Credit lines are commitments in which the bank promises funding *on demand* at predetermined terms, including a maximum amount, that can be not reached generating interest only on the used portion, but generates fees if usage exceeds some threshold. Term loans are long-term loans typically used for capital projects, that can be installment basis or balloon loans (principal is repaid all at once at maturity). Finally, a syndicated loan is a large corporate loan made by a group of lenders (syndicate), of which one bank (lead arranger) has to monitor the borrower performance. The members of the syndicate are often non-banks and can actively trade their shares on the secondary market.

Regarding loans to households, we have real estate loans to purchase property and land, which can also be commercial and are heavily securitized, and consumer loans to finance the purchase of

durable goods, education, and medical care, usually made in small amount and in which the credit analysis is carried out through credit scoring systems.
Loans incur, indeed, **credit risk**, potentially causing decreases in net income and equity and the arise of liquidity risk. It is managed on the individual level by evaluating the borrower's creditworthiness (ability and willingness) and on portfolio level by originating new loans, replacing the loans at maturity, or through CRT tools.
Credit analysis is important to avoid making a loan to a customer who will default and denying one to a customer who would repay. It is based on both quantitative and qualitative information but is not enough to grant a loan without collateral. In the US, the used credit scoring system is the **FICO System**, which assigns to borrowers a score between 300 and 850, which the higher the more likely of obtaining credit. This system is based on the borrower's payment history, the amount of money owed, the length of its credit history, the nature of the requested credit, and the types of credit already used.
It is important to classify the risk of the loans, in order to give it the right price (reduce adverse selection), set Loan Loss Provisioning, and calculate the regulatory risk weights. Still, as it is impossible to remove information asymmetry, it is important to include a collateral and loan covenants. **Collateral** can be made of assets or personal guarantees, but it is important that it has a value exceeding the outstanding principal, is liquid, and it has legal claim with seniority. Even though it has a value exceeding the principal, it is still a secondary source of repayment, as it is usually costly and lengthy to liquidate, and its value can deteriorate over time. **Loan covenants** are arrangements made to protect the bank against changes in the borrower's operating environment and can be positive (provision the borrower must adhere to) or negative (financial limitations and prohibited actions).
Another instrument to manage credit risks are **monitoring**, involving examining how the loan proceeds are used, the borrowers' conditions, the respect of the terms and covenants, and more. Part of monitoring is defining the Non-Performing Loans (NPLs), whose payments are usually more than 90 days past-due or unlikely to be repaid in full, distinguished into bad loans, UTP (unlikely-to-pay), and past-due exposures.
Finally, we have **loan workouts**, processes of recovering funds from a problem loan situation. It can be carried on through loan restructuring (deferring payments, lengthening maturities, providing new funds) or through other procedures for loan recovery like judicial enforcement or negotiation.

6) MONETARY POLICY TRANSMISSION

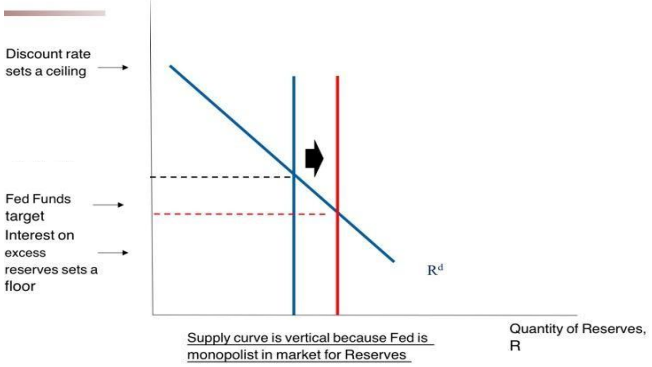
The balance sheet of a central bank is mainly made on the asset side by securities and loans to financial institutions or other liquidity facilities to help them in crisis times, and on the liability side by currency in circulation and reserves/deposits from banks (divided into required and excess reserves). Central banks normally modify their balance sheets through **Open Market Operations**, including providing loans and purchasing/selling securities from a set of banks. When the CB buys securities it pays for them by issuing bank reserves, which constitute an asset for banks.

The Fed

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

Banking System

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



Therefore, monetary policy impacts the amount of loans that banks can provide, and with a decline of the short-term rates also the loan interest rate will go down, therefore increasing the circulation of money in the economy. These effects on bank credit supply is what is known as the **bank lending channel** of monetary policy, which was not contemplated by traditional macroeconomic models (only considered the effects on money and bonds), but since the 2007-08 crisis it is inevitable to consider the role of financial intermediation as solver of asymmetric information, meaning that bonds and loans are two different debt instruments and cannot be considered substitutes.
There are three main theories on why this channel exists. First of them is the **bank reserve channel** according to which with a lower reserve supply banks have to reduce reservable deposits (checking accounts), as the required reserves are equal to 10% of the checking deposits, and if they're not able to perfectly switch to another source of funding they will have to decrease the loan supply, because of the costlier nature of the alternative source. Then, for the **bank profits/capital channel** a contractionary monetary policy ($r \uparrow$) will negatively affect the bank's net interest income causing it to reduce the supply of new loans because of the mix of fixed and floating rates of the assets (fixed rate loans financed with variable rate CDs). In addition, also bank capital will play a role, as banks with low capital will be in such situation less able to borrow (rates will be even higher for them) and therefore less willing to provide loans. In the opposite scenario, an expansionary monetary policy will make low capital banks want to expand credit supply because of the higher profits and the fact of being closer to minimum capital requirements ($ROE \uparrow$). Finally, **market power** plays a role as with rising rates banks lose deposits and the deposit spread (FedFunds rate – deposit rate) widens and therefore the supply of credit will decrease despite a higher profit margin per $, as they cannot raise the deposit rate 1-to-1 along the Fed Funds as the banks' branch network give them market power and the ability to keep the deposit rates sticky. Still, they strategically select where to reduce credit (and deposits) where there are fewer other banks.
In case of an **unconventional** (expansionary) **monetary policy**, in which the CB operates through MBS and Treasuries, banks with many MBS will increase lending, but specially towards households that ask for mortgages, leaving out corporate loans.

FINANCIAL STATEMENTS

1) ASSET QUALITY

Since 2015, Non-performing exposures are distinguished with a decreasing level of risk into bad loans, unlikely to pay, and past due. Considering the amounts of NPEs and their relative risk a **Loan Loss Provisions** account is created and recorded on the income statement as an expense, impacting net income and, thus, capital, which has to reach some threshold and the difference between this threshold (CET1 10% or CET1 11%) and its actual level is known as the **shortfall**.
Currently, the banking sector faces many challenges. First, it dwells a favorable interest rate environment (but can change) but in which there is a high competition on commission income. Indeed, net interest income represents for commercial bank at least around 50-60% of total revenues, meaning that changes in the interest rate would overly affect its profitability and, therefore, banks have lately advised their clients to move part of their investments towards asset management, insurance or other fee-based products, leading to a strong improvement in commission income. Still, it is not possible to predict how long this will be able to go on as the whole market shifted towards this direction and competitions keeps increasing.
In addition, this sector has a heavy cost structure with high fixed costs, due to the widespread web of branches and massive necessary investments on IT.
Then, one of the most relevant issues in the past few years has been asset quality itself. LLP have cut profits and lately coverage of NPE has been at its historical highs. Therefore, it would be

necessary to improve the general asset quality so to restore confidence and re-rate the entire sector.
Finally, ROEs are now lower because of the higher recent capital ratios generated by some extraordinary actions undertaken by EU banks (also due to lower asset quality) and profits are lower because of the cost of regulation, as the banking sector has a rapidly evolving regulatory environment.
Nowadays, banks trade based on asset quality, ROE, or P/TBV.

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

Simply, ROE and P/TBV have a positive relationship, meaning that the higher net income compared to the value of equity, the higher the market price of a security will be compared to its book value.

Return on Equity (ROE) is defined as:

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

Therefore, EPS can be expressed as

$$EPS_1 = ROE * BV\ per\ share_0$$

Hence, substituting back EPS in the Price equation

$$P_0 = \frac{EPS_1 * Payout}{Ke - g} = \frac{ROE * BV\ per\ share_0 * Payout}{Ke - g}$$

So, dividing both element for $BV\ per\ share_0$

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

Defining ROE using year 0 earnings, the formula can be restated as follow

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

If a company outperforms its cost of equity (ROE > Ke) then it would trade above book value.
In general, it is always positive to get rid of non-performing exposures, as their sale release RWAs, improve market perception, improve CET1 capital ratio, remove credit risk and gives you room for capital re-deployment. But if the sale price of the NPE is not carrying value (= gross NPE x (1- cash coverage)) the bank incurs P&L losses, that if big enough may even cause the sale to have a negative impact on capital.

2) THE INVESTMENT FUNCTION

Investing through the purchase and sale of bonds and other securities is not the primary function of most banks, but they allocate from 1/5 to 1/3 of their resources to that because of risk, liquidity, diversification, tax efficiency, and more.
They usually invest in **money market instruments**, which are short-term, low-risk, highly liquid, and all usable as collateral or **capital market instruments**, with over 1-year maturity, higher returns (and risk), and also marketable but with higher volatility.
Among the most popular money market investment instruments, we have **Treasury Bills** (ita, BOT), short-term government bonds, highly liquid, and safe used, and **Short-term Treasury Notes and Bonds** (ita, BTP), first of whom originally go from 1 to 10 years and the other beyond 10 years. As they have a longer maturity they're more sensitive to interest rates than T-Bills, but also have

higher returns as they provide coupons, when their maturity is due in less than a year they become money market instruments, while before that they belong to the capital market. Finally, we have **Federal Agency Securities**, marketable notes and bonds sold by agencies owed by owned or sponsored by the federal government (Fannie Mae, Freddie Mac, or ita *Cassa Depositi e Prestiti*). They not always have explicit government guarantees, even though investors believe that agencies in trouble would be rescued.
Among the capital market instruments, we have the above-mentioned T-Notes and T-Bonds and **Corporate Notes and Bonds**. Those are debt instruments issued by corporations, distinguished for their maturity, as ones have it under 5 years and the other above. Those instruments have higher pre-tax yields than govies, sustaining banks' interest income during low interest rates periods.
Once the institutions choose in which instrument to invest, it is necessary to choose how to distribute the holdings over time, and it can be done following different maturity distribution strategies.

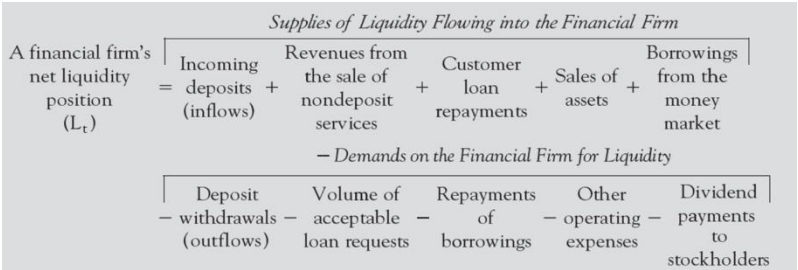
- For the **Ladder** or **Spaced-Maturity Policy**, it is necessary to divide the portfolio equally among all acceptable maturities (to be defined), which reduces investment income fluctuation and requires little management expertise, giving the chance to take advantage also of other investment opportunities.
- The **Front-End Load Maturity Policy** requires the institution to form its portfolio of all short-term instruments, strengthening its liquidity position and avoiding large capital losses in case of an interest rate rise.
- The **Back-End Load Maturity Policy** involves only investing in long-term securities, maximizing the income potential especially in case of a fall in market rates. With this strategy the investment portfolio is seen as a source of income, but it requires to have other source of funding available to satisfy the short-term liquidity needs.
- The **Barbell Strategy** wants the portfolio to be divided among short-term and long-term securities, so to being able to meet liquidity needs and achieve earnings goals. It is important not to hold intermediate maturity securities.
- Finally, the **Rate Expectation Approach** involves changing the mix of investment maturities as the interest-rate outlook changes, maximizing the potential for profits and losses. When interest rates are expected to rise you shift the investment towards short-term securities, while you do it towards long-term ones when they are expected to decrease. This complex strategy totally relies on the institution's forecasts and also involves high transaction costs to switch the investment portfolio.

3) LIQUIDITY MANAGEMENT

A firm is considered to be liquid if it has ready access to immediately spendable funds at a reasonable cost at precisely the time those funds are needed. Financial institutions care about liquidity because of maturity mismatch, which causes them to need money to pay for their liabilities at a time not corresponding to when they cash from their assets.
Silicon Valley Bank built a powerful niche over the years and in particular during the recent tech boom, reaching its peak at a $44bn market capitalization. Its clients were tech start-ups, which were able to attract billions from venture capitalists during the speculative coronavirus tech boom. Hence, those startups parked billions in SVB's current accounts and the low interest rate environment contributed with the abundance of cash in tech start-ups and given the rapid increase in deposits SVB was unable to give loans at the same speed, rather investing in long-dated securities. Therefore, when rumors about its unsoundness started, the bank wasn't able to contrast with liquid instruments all the deposits that were being withdrawn.

A necessary instrument to prevent risk, remain profit oriented, and comply with the regulatory framework, is the **Treasury**. The treasurer needs to know the firm's net liquidity position and which factors affect it. Positive changes of liabilities, reduction of assets, borrowings, and revenues are all supplier of liquidity. On the other hand, negative changes of liabilities, reduction of assets, financial costs, and other expenses are all factors demanding for liquidity.

L<0 -> deficit
L>0 -> surplus



In order to manage liquidity, there are 3 different strategies. First, we have **Asset Liquidity Management** (or Asset Conversion). This strategy involves storing liquidity in assets as cash and marketable securities, then when liquidity is needed assets are converted into cash until all demands for cash are met. Those assets need to be ready marketable, have a stable price in a deep market, and be reversible. They bring, though, transaction costs and low returns. Another is **Borrowed Liquidity Management**, in which you borrow immediately spendable funds (e.g. credit line) to cover liquidity demands. Among its advantages, we have that you can use it only when needed, doesn't require to change your asset composition, and is flexible, but it is one of the riskiest because of the volatility of interest rates and credit availability. Problem is that they tend to have to do it when it is most difficult to obtain them. Finally, there is the **Balanced Liquidity Management**, which is a mix of the two previous strategy, working through the holding of liquid assets to deal with expected liquidity needs, and borrowing for the unexpected ones.
In order to estimate those liquidity needs there are various methods. The first methodology uses a **Sources and Uses of Funds Approach**, starting with a forecast of loans and deposits for a given time period, breaking it down into trend, seasonality, and cyclicality. Later, it is necessary to estimate the change in loans and deposits. Finally, based on the estimated weekly liquidity surplus or deficits you decide when it is necessary to raise funds and how. A second methodology is the **Structure of Funds Approach**, which starts with a classification of banks' liabilities based on liquidity criteria into "*Hot Money", "Vulnerable funds"*, and *"Stable funds"* (decreasing volatility).

$$\begin{aligned}\text{Total liquidity requirement} = \text{Deposit and nondeposit liability liquidity requirement and loan liquidity requirement} &= 0.95 \times (\text{Hot money funds} - \text{Required legal reserves held behind hot money deposits}) \\ &+ 0.30 \times (\text{Vulnerable deposits and nondeposit funds} - \text{Required legal reserves}) \\ &+ 0.15 \times (\text{Stable deposits and nondeposit funds} - \text{Required legal reserves}) \\ &+ 1.00 \times (\text{Potential loans outstanding} - \text{Actual loans outstanding})\end{aligned} \quad (11\text{–}6)$$

This is often done through a scenario analysis, in which you assign a certain probability to any possible outcome and then you calculate the weighted expected liquidity requirement.
One last method is the **Liquidity Indicator Approach**, which is done based on experience and industry averages. Some used liquidity indicators are the cash position indicator (cash/total assets), liquid securities indicator (cash and cash equivalents/total assets). Still, comparing to industry averages might be misleading if we don't consider geographical, structural, and other factors.

4) PERFORMANCE MEASUREMENT

Among the people interested in analyzing banks' financial statements, we have regulators, investors, auditors, analysts, corporate finance advisors, investment banks, and competitors.
One of the most synthetic measures to assess bank performance is the **ROE** (NI/SE), which is an indicator that should be considered more as an intermediate benchmark rather than a meaningful assessment tool of the performance. Indeed, it does not consider the bank's riskiness, might include extraordinary items, depends on the bank's assessment of credit quality, and considers a limited time horizon.
Therefore, it is important to conduct a deep analysis of the financial statements, even though some items and exposures might be "off-balance sheet", and of its footnotes, where it is possible to find the loan geographical breakdown, breakdown by clients, breakdown by product, and the loans by sector. Still, the loans don't take into account off-balance sheet exposures, therefore it might be relevant to analyze also them.
Within the balance sheet, though, it is possible to analyze the **bank's funding**. Generally, deposits are the main source of funding and to them is associated a different cost based on their type. This is a stable source of funding, but during the 2007-09 financial crisis some banks lost more than 30% of their deposits in a very short time due to bank runs. Another important indicator is the interbank funding, a much less stable and only short-term source of funding, which was almost dead during the financial crisis because of the total lack of confidence among financial institutions.
Finally, we can analyze the debt securities issued by the bank on the market, which are useful to fund on the medium term but are usually much costlier.
Within the **income statement**, it is possible to analyze the bank's ability to optimize their sources and uses of funds.
Finally, an important analysis is carried through the use of a series of financial ratios.

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

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

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

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

Where $Direct\ Funding = Customer\ Deposits + Securities\ Issued$

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

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

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

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

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

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

Where
$Operating\ Expenses = Personnell\ Expenses + Adminstrative\ Expenses + D\&A$

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

$$Pre\ Provisions\ Profit\ (pre\ tax) = Total\ Op.Income - Operating\ Expenses + Other\ Net\ Op.Income\ (Exp.)$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$ROE = \frac{Net\ Income}{PBT} * \frac{PBT}{Net\ Op.Income} * \frac{Net\ Op.Income}{Tot.Assets} * \frac{Tot.Assets}{Sh.Equity}$$

$$ROE = Tax\ Impact * Extr.Items\ Contribution * Net\ Yield\ on\ Assets * Leverage\ (2)$$

PART 3 – RISK MANAGEMENT

1) INTEREST RATE RISK

Interest rate risk is the risk that comes with the maturity mismatch between a bank's assets and its liabilities. In order to evaluate it, it is necessary to evaluate EVE risk (economic-value-of-equity) and VaR (Value-at-Risk). Considering the bank's assets and liabilities, as they are sensitive to interest rate changes, also will equity ($\Delta E = \Delta A - \Delta L$). Assuming also a flat yield curve and supervisory consideration, alongside ignoring complications for specific terms, we know that a straight bond is a borrowing agreement where the borrower sells a bond to a lender for some amount of cash, entailing a specific payment schedule, including the payment of its face value at maturity date. When the payments are fixed at settlement, such bond is considered a fixed income security, while when they depend on interest rates (which are variable), it is a variable income security.
If we want to determine the price of a bonds, we use the formula:

$$P = \sum_{t=1}^{T} PV_t = \sum_{t=1}^{T} \frac{CF_t}{(1+R)^t}$$

Therefore, changes in the interest rate R would not change the cash flows, but rather the bond price through the discount factor ($R \uparrow => P \downarrow$).
Other kinds of *fixed income securities* are amortizing/sinkable bonds, which gradually repay the principal over time through a pre-specified amortization schedule, bullet loans, which also require a interest payment at maturity alongside the principal (ZCB), and interest-only loans, which require interest payments throughout all the life of the loan (fixed-coupon bonds). Yet, most typically loans are amortizing, and are usually done through a schedule involving equal installments (French-type) or equal principal repayments (Italian-type).
For a **French-type loan** we know that all installments are equal, and we calculate interest payments as the multiplication of residual debt with the relative interest rate. So, it is then easy to calculate the principal repayment amount by subtracting the interest payment from the installment amount.
In case of an **Italian-type loan**, you first calculate the principal repayment by dividing its amount by the number of periods between the receipt of the loan and its end. As for the interest payments, they are calculated the same way as for a French-type loan, so you can finally compute the installment by summing up principal and interest payments.
The relationship between bond prices and interest rate is characterized by being inverse (rate rises, price falls), convex (an increase in R corresponds to a smaller price decline than the increase associated to a decrease of equal magnitude), the maturity of the bond (longer maturity, more interest rate sensitivity), and coupon (low coupons are more sensitive to interest rate changes).
Therefore, an important measure to evaluate interest rate sensitivity is **Duration**.

$$D = \frac{\sum_{t=1}^{T} PV_t \times t}{P} = \frac{\sum_{t=1}^{T} \frac{CF_t \times t}{(1+R)^t}}{P}$$

It is a weighted average of cash flow payment dates, where weights are proportional to the PV of each cash flow, meaning that it measures the effective maturity of a bond. It therefore decreases with coupon, and usually increases with maturity (but a decreasing rate). Therefore, we have that duration is useful to measure the sensitivity of a bond price to interest rate changes, as its derivative with respect to R is:

$$\frac{dP}{dR} = -\frac{P \times D}{1+R}$$

Or equivalently,

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

Which can be rearranged as:

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

Where MD is the modified duration:

$$MD = \frac{D}{1+R}$$

Thus, **multiplying MD by the change in interest rates ΔR gives a measure of a bond's percentage price change**. On the other hand, multiplying it by the bond price P, yields the dollar duration, which is the local slope of the P-R curve.

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

Therefore, for a given change in interest rates, bond prices are inversely related to their duration (larger duration, larger price change), gains and losses are symmetric, and with *m* payments per year, the formula gets replaced by:

$$MD = \frac{D}{1+\frac{R}{m}}$$

Finally, we can calculate the price change of a bond with respect to an interest rate change by multiplying the negative value of the modified duration by the original price and the change in R.

In case of a **portfolio** of fixed-income securities, in which the market value of each security is V_i^A and its weight $X_i^A = V_i^A / \Sigma V_i^A$, the duration of the portfolio is the value weighted average of the individual durations.

From that, we obtain the relative change of assets with respect to changes in the interest rate:

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

This works in case of a flat yield curve, but if securities differ in their YTM/IRR (more realistic case), duration measures the change in portfolio value when interest rates change so that all YTMs experience a parallel shift.

By calculating the relative change in assets and liabilities, it is possible also to calculate the change in shareholders' equity's market value.

$$\Delta E = \Delta A - \Delta L$$

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

where $k = \frac{L}{A}$, = bank leverage

This is, then, EVE risk, which is made of the leverage adjusted duration gap ($D_A - D_L k$) (the larger the gap the more a bank is exposed to EVE risk, when it is positive an increase in interest rates make equity decrease), the bank size (A), and the interest rate shock size.

In the extreme case of perfect immunization, the leverage adjusted duration gap can be brought to zero so to eliminate EVE risk. This can be done (starting from a scenario with a positive leverage adjusted duration gap) either reducing the duration of the assets, increasing the duration of the liabilities, or increasing leverage.
However, interest rates can change at any point during the holding period, and once they do it is necessary to immunize another time, but it is costly to do it continuously (transaction costs). Therefore, managers choose to rebalance their assets and liabilities at discrete intervals (e.g. quarterly) or opt for off-balance sheet immunization.
A **problem** with the duration model is that the changes in bond prices relative to interest rate changes are only approximated and this approximation works well with a 1% change, but the error gets too large with larger interest rate shocks because of convexity. Indeed, when rates decrease prices are underestimated (and the gain as well) while when they increase the prices are underestimated and the loss is overestimated. So, it is useful to use the **convexity adjustment** to improve the approximation:

$$\frac{\Delta P}{P} = -MD \times \Delta R + \underbrace{\frac{1}{2} \times CX \times (\Delta R)^2}_{\text{convexity adjustment}},$$

where

$$CX = \frac{1}{P\,(1 + R/m)^2} \sum_{t=1/m}^{T} PV_t \times t \times \left(t + \frac{1}{m}\right)$$

Similar to duration, convexity is additive in a portfolio of fixed-income securities, with portfolio convexity being the value-weighted average of individual convexities. Therefore, this adjustment could be extended to measuring the change in assets and liabilities:

$$\Delta A = -\frac{D_A A}{1+R}\Delta R + \frac{1}{2} \times CX_A \times (\Delta R)^2 \times A$$

2) FORWARDS & FUTURES

Another option to act on the balance sheet to hedge interest rate risk is doing so through the use of derivatives, securities with payoffs explicitly linked to the payoff of some underlying security. A **forward contract** is an agreement between a buyer (long position) and a seller (short position) at the present time to exchange the underlying asset at a specific future time for cash.
At maturity of the contract, the buyer makes a profit of $bond\ value\ at\ T - P_F$ while the seller of a forward makes a profit of $P_F - bond\ value\ at\ T$.
A **future contract** is normally arranged through a centralized exchange and is very similar to a forward, only that it is standardized and is marked-to-market on a daily basis to reflect it value change to eliminate counterparty risk.
Treating forwards and futures as identical, they can be used for microhedging (individual bond) or macrohedging (entire balance sheet duration gap).
If I buy a bond at price *B* with maturity *N* and then I'm worried that the interest rates might increase, I can hedge that risk by selling a forward/future, with a change in value of the hedged position equal to:

$$\underbrace{\text{bond value at } T - B}_{\text{spot (bond) position}} + \underbrace{P_F - \text{bond value at } T}_{\text{forward position}} = P_F - B$$

Which is not affected by interest rate movements.
Changes in the underlying asset's value can be cashed in by a buyer taking a short position in the future contract before maturity (**offsetting**). That way, at maturity the trader receives the asset and pays for the pre-established amount and then delivers it to the second buyer for the second (higher) amount.

In order to pre-estimate the eventual losses or gains on the spot position before deciding to take a forward position, we can use the duration approximation as done previously if we have an expectation of the interest rate change.
Letting the value of the futures position be $N_F \times P_F$ we can calculate the variation of the position's value, knowing that it depends on the duration of the underlying bond D_F:

$$\Delta F = -D_F \times \underbrace{N_F \times P_F}_{=F} \times \frac{\Delta R}{1+R}$$

Therefore, we can immunize our position (microhedging) by taking a future position such that $\boldsymbol{\Delta B + \Delta F = 0}$
Therefore, having an expectation of change in interest rates, we can use *futures hedging* by calculating the change in bond value, the duration of the underlying bond, and then select the number of futures we have to sell (or buy) such that the equation holds.
Contract size = size (units of assets) X price quote
Contract notional amount = size (units) X bond price
To fully hedge against interest rate risk (macrohedging), we have to take a future position such that $\boldsymbol{\Delta E + \Delta F = 0}$ which by substituting becomes:

$$\left[-(D_A - kD_L) \times A \times \frac{\Delta R}{1+R}\right] + \left[-D_F \times N_F \times P_F \times \frac{\Delta R}{1+R}\right] = 0$$

so that

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

Thus, if the duration gap is positive, the changes in interest rates are hedged by a short futures hedge. Still, it is true that in this course we suppose a flat yield curve, but as in practice interest rates on spot and futures position may not be perfectly correlated (basis risk), it would be necessary to change the equation to calculate the change in the value of the future position to:

$$\Delta F = -D_F \times N_F \times P_F \times \frac{\Delta R_F}{1+R_F}$$

For microhedging we now have

$$N_F = -\frac{D \times B \times \Delta R/(1+R)}{D_F \times P_F \times \Delta R_F/(1+R_F)},$$

or, letting

$$br = [\Delta R_F/(1+R_F)]/[\Delta R/(1+R)],$$

this is the same as

$$N_F = -\frac{D \times B}{D_F \times P_F \times br}.$$

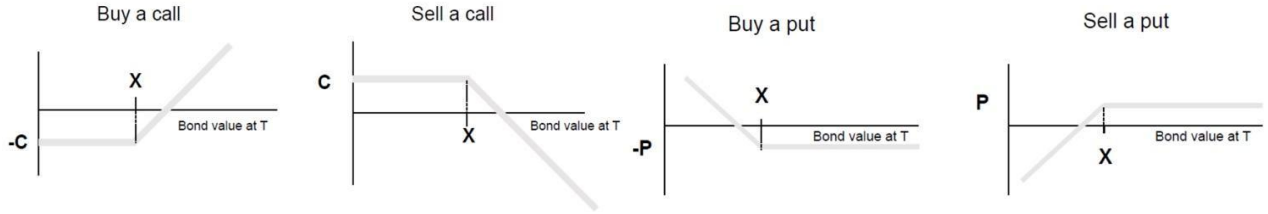
For macrohedging one follows the same logic, i.e. $\Delta E + \Delta F = 0$, so that eq. (4) is replaced by

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

3) OPTIONS

A European call option contract gives the buyer the right to buy the underlying asset for a certain price (exercise/strike price) which is fixed at the present time (settlement date) at a certain future time (maturity date). The purchase of this right requires an upfront payment (premium). An European put option gives you the right to sell that underlying asset the same way you buy it through the call option.
The main difference with futures and forwards is that options entail rights (not obligations) and that an upfront payment is required. On the other hand, they are similar to futures as they are standardized and marked-to-market, but the payment is made upfront. For naked option positions, which are usually done for speculative reasons rather than hedging, even though you can avoid having the underlying asset there are usually collateral requirements.

At maturity, the buyer of a call option will exercise the right if $bond\ value\ at\ T \geq X$, in which case the profit will be $(bond\ value\ at\ T - X) - C$, however, he will not exercise the right if $T < X$, in which case the profit will be $-C$.
In case o
The buyer of a put option will exercise it if $bond\ value\ at\ T \leq X$, with profits $(bond\ value\ at\ T - X) - P$. But with market value higher than the strike price the right will not be exercised and its loss will just be its price (*P*).



If you believe interest rates are going to rise (lowering the price of the bond you're holding), you can hedge your position by buying a put option on the bond with $X \approx B$. Then, the change in value of the hedged position is:

$$= \begin{cases} X - B - P \simeq -P & \text{if bond value at } T \leq X \\ \text{bond value at } T - B - P & \text{if bond value at } T > X \end{cases}$$

Letting N_C be the number of call options such that the value of the call option positions is $V = N_C \times C$ and letting *B* be the value of the underlying bond, we have:

$$\Delta V = N_c \times \underbrace{\left[\frac{dC}{dB} \times \frac{dB}{dR} \times \Delta R\right]}_{\text{change in value of one option}}$$

Where *dC/dB* is the change in value of one call option for a $1 change in bond price (option delta) and is always between 0 and 1, while *dB/dR* is the change in value of the underlying bond for each unit of basis points the interest rate change, which is equal to:

$$\frac{dB}{dR} = -\frac{D \times B}{1+R}$$

Thus the formula above becomes:

$$\Delta V = -N_c \times \delta \times D \times B \times \frac{\Delta R}{1+R}$$

Meaning that knowing the necessary data the trader will only need to solve an equation to know the amount of options to buy so that $\Delta \boldsymbol{B} + \Delta \boldsymbol{V} = \boldsymbol{0}$. Still, setting up such hedge will have a cost equal to the option premium paid.
In case of *macrohedging*, we need $\Delta \boldsymbol{E} + \Delta \boldsymbol{V} = \boldsymbol{0}$.

which, substituting eqs. (4) and (6), gives

$$\left[-(D_A - kD_L) \times A \times \frac{\Delta R}{1+R}\right] + \left[-N_p \times \delta \times D \times B \times \frac{\Delta R}{1+R}\right] = 0$$

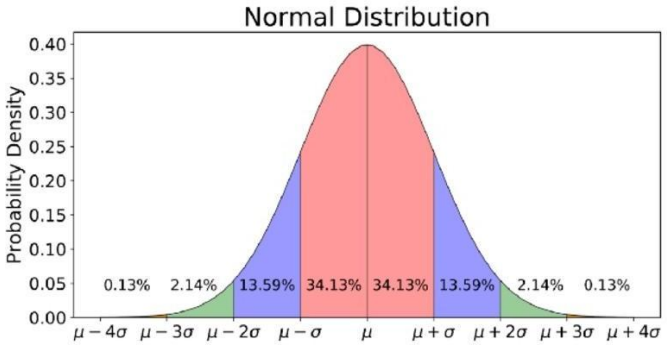
so that

$$N_p = \frac{-(D_A - kD_L) \times A}{\delta \times D \times B}.$$

4) MARKET RISK

The banking book refers to instruments that are expected to be held up until maturity, while instruments held for short-term resale are included in the trading book. Those instruments incur **market risk**, the risk associated with extreme changes in market conditions, that can be measured through VaR (Value at Risk) or ES (expected shortfall).
"I am α% sure that the portfolio will not lose more than $VaR in the next N days" where α is a confidence level and N the holding period. So, to find VaR we need to know the distribution of future portfolio values over the chosen holding period.

VaR is used internally if the bank wants to limit the risks taken by its traders, or externally by a regulator limiting the risk taken by the baking system.
The **parametric approach** assumes that portfolio returns are normally distributed with mean μ and standard deviation σ, meaning that it is easy to aggregate individual assets into portfolio returns, and portfolio returns are independent and identically distributed across time.



The idea is therefore to work with the distribution of future portfolio returns, rather than values.
Letting R be the portfolio net return over holding period *N*, we have that $\boldsymbol{W = W_0(1 + R)}$.
And thus P&L are $\boldsymbol{\Pi = W - W_0 = W_0 R}$
In a normal distribution with mean = 0, the threshold daily portfolio return R* at the 0.05-th percentile corresponds to -1.65σ while at the 0.01-th percentile corresponds to -2.33σ.
Finally, in order to calculate **VaR**, first set the current portfolio market value W_0, the confidence level α, and the holding period *N*. Then, measure the daily volatility of the portfolio (or asset) returns σ, and, finally, obtain the α-associated $(1-\alpha)$-th percentile of the return R* distribution so that

$$\text{VaR}\,(\alpha, 1) = -W_0 \times \underbrace{\sigma \times (1-\alpha)\text{-th centile}_{SN}}_{R^*}.$$

- Since *SN* is symmetric around 0 (see above), the latter is equivalent to

$$W_0 \times \underbrace{\sigma \times \alpha\text{-th centile}_{SN}}_{\text{downside volatility}}.$$

For $\boldsymbol{\mu \neq 0}$, we have that the 0.05-th centile is $(\mu - 1.65\sigma)$, while the 0.01-th centile is $(\mu - 2.33\sigma)$ so that since typically R*<0

$$\text{VaR}\,(\alpha, 1) = -W_0 \times \underbrace{(\mu + \sigma \times (1-\alpha)\text{-th centile}_{SN})}_{R^*}$$

If we want to change the analyzed holding period from 1 day to another value of N days:

$$\text{VaR}\,(\alpha, N) = \text{VaR}\,(\alpha, 1) \times \sqrt{N}$$

In case of some fixed-income securities, though, there is no enough historical data to calculate its volatility σ. Still, we can use the Delta-normal method based on security sensitivity to the risk factor, which we know being:

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

Therefore, we can proxy volatility with this variable, but what we really need is *downside* volatility, which as we know the inverse relation between prices and interest rates we can consider as a large increase in R (*adverse movement*=so that only 1% it can be worse) that we'll call ΔR^*, so that:

$$\text{VaR}(\alpha, N) = W_0 \times MD \times \Delta R^*$$

Now, we can aggregate individual VaRs into **portfolio VaR**. Consider two positions 1 and 2, and let $W_0 = W_1 + W_2$ be the initial portfolio value, which is normally distributed as it is composed of normally distributed position, its value is:

$$\begin{aligned}\tilde{W} &= \overbrace{W_1\left(1+\tilde{R}_1\right)}^{\text{future value of asset 1}} + W_2\left(1+\tilde{R}_2\right) \\ &= W_0 + \underbrace{W_1\tilde{R}_1}_{\text{gain on asset 1}} + W_2\tilde{R}_2\end{aligned}$$

Now, define the *portfolio weights* as $X_1 = W_1/W_0$ and $X_2 = W_2/W_0$ and *portfolio net return* as $R_p = X_1R_1 + X_2R_2$, then the *future portfolio value* can be rewritten as:

$$\begin{aligned}\tilde{W} &= W_0 + W_0 \overbrace{\tilde{R}_p}^{=X_1\tilde{R}_1+X_2\tilde{R}_2} \\ &= W_0\left(1+\tilde{R}_p\right).\end{aligned}$$

Everything that applies to individual positions applies to the *trading book* as well, thus we continue to have that P&Ls are $\boldsymbol{\Pi = W - W_0 = W_0R_p}$. Furthermore, also the standard VaR formula applies to portfolios as well, with the only difference that the volatility to use is *portfolio volatility* σ_p

Or

$$\sigma_p = \sqrt{X_1^2\sigma_1^2 + X_2^2\sigma_2^2 + 2\rho_{1,2}\sigma_1\sigma_2X_1X_2}$$

$$\sigma_p = \frac{1}{W_0}\sqrt{W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2\rho_{1,2}\sigma_1\sigma_2W_1W_2}$$

Making VaR:

$$\begin{aligned}&-\sqrt{W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2\rho_{1,2}\sigma_1\sigma_2W_1W_2} \times (1-\alpha)\text{-th centile}_{SN} \\ =\ &\sqrt{[\text{VaR}_1]^2 + [\text{VaR}_2]^2 + 2\rho_{1,2}\text{VaR}_1\text{VaR}_2}\end{aligned}$$

Therefore, unless the assets are perfectly positively correlated, then the VaR of a portfolio is less that the sum of individual VaRs -> diversification effect.

Adding more and more assets to a portfolio requires estimation of individual volatilities as well as correlations. In order to simplify the variance-covariance matrix structure it is useful to think in terms of *risk factors* (delta-normal method). This, though, cannot be done for FX as each currency is an individual source of risk.

According to the CAPM,

$$R_{i,t} = \alpha_i + \beta_iR_{m,t} + \varepsilon_{i,t}$$

Meaning that the stock total variance is:

$$\sigma_i^2 = \overbrace{\beta_i^2\sigma_m^2}^{\text{systematic}} + \underbrace{\sigma_{\varepsilon_i}^2}_{\text{idiosyncratic}}.$$

Similar to durations also betas are additive:

$$\beta_p = \sum_{i=1}^{N} X_i\beta_i$$

In a well-diversified portfolio, idiosyncratic risk is eliminated, and only **systematic risk** remains and it will be equal to $\beta_p\sigma_m$, therefore with $\mu_p = 0$ VaR rewrites as:

$$\text{VaR}_p(\alpha, 1) = W_0 \times \underbrace{\beta_p \times \sigma_m \times \alpha\text{-th centile}_{SN}}_{\text{downside volatility}}$$

In case of a portfolio of fixed-income securities, under the assumption of a flat term structure, we have that the risk factor for all bonds is the interest rate *R*. In addition, knowing that durations are additive, we know how to calculate *portfolio modified duration* MD_p, and, thus, we can readily use:

$$\text{VaR}_p(\alpha, 1) = W_0 \times MD_p \times \sigma_R \times \alpha\text{-th percentile}_{SN}$$

To sum up, the *delta-normal method* requires to compute VaR as:

$$\text{VaR}_p(\alpha, 1) = W_0 \times \underbrace{\text{sensitivity} \times \text{factor vol} \times \alpha\text{-th percentile}_{SN}}_{\text{downside volatility}}$$

where, for equities, we set

$$\beta_p \times \sigma_m,$$

while for bonds

$$MD_p \times \sigma_R.$$

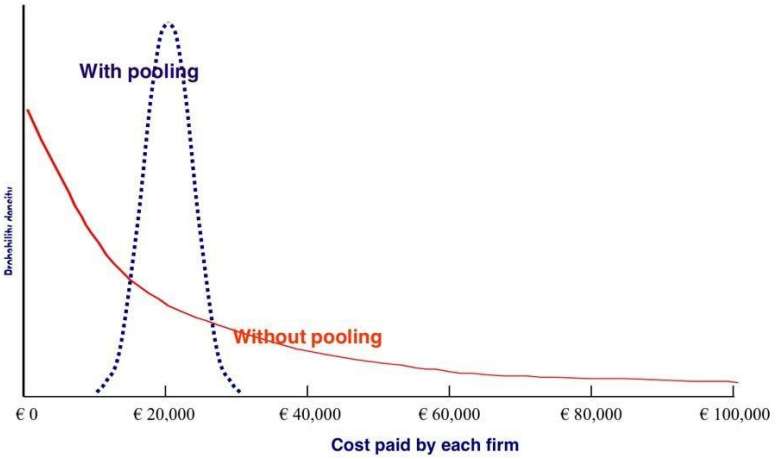
Still, it is important to remember that when aggregating across asset classes one has to estimate the correlations among risk factors on top of their volatility to compute portfolio VaR.
An alternative measure of market risk is the **expected shortfall**, which is the expected value of losses which are beyond the confidence level used for VaR. It is the area of the tail at the left of the VaR value, given by:

$$\text{ES}(\alpha, N) = \frac{1}{1-\alpha}\int_{\alpha}^{1} \text{VaR}(u, N)\,du$$

PART 4 – INSURANCE

1) RISK & INSURANCE

Another mechanism to deal with risk is insurance. Risk is the possibility of a future uncertain event, necessary to be distinguished into: the object in relation to which an exposure to risk exists (*risk unit*) the aleatory event which could impact the risk unit (*peril*), the circumstances which create a connection between the risk unit and the peril (*risk exposure*), the type of effect that the combination of peril and exposure could generate to the risk unit (*damage*).
Insurance is typically related to the treatment of uncertain events which would only produce negative effects (*pure risks*). Events that could generate either a profit or a loss are instead *speculative risks*.
People can deal with pure risks retaining it, avoiding it, reducing its possibility, saving in order to accumulate resources to cover any damages, transferring the risk, or transferring the risk using the **insurance process**. It is based on collecting advance contributions from a group of units exposed to the same risk, in order to be able to compensate the losses of the units in the group who have been hit by the unfortunate event, therefore being based on risk-transferal and loss-sharing.
A key feature of insurance is determining the probability of uncertain future event, which is done through a posteriori probability, computed after an empirical study of historical data, law of large numbers, as the number of trials approaches infinity the observed frequency approaches the a priori probability, and the a priori probability itself, based on the underlying conditions that cause the event. Therefore, thanks to the law of large numbers the a priori probability can be approximated by using the a posteriori probability. This process is more difficult the smaller the sample and the group of risk units to which it applies to, the larger the dispersion of the individual value, and the less stable are the risk conditions.
A do-nothing strategy (risk retaining) does not require any risk evaluation process, but it doesn't fund losses, while a retention and self-insurance strategy funds the losses but some of them might be difficult to predict and the setting the money aside entails an opportunity cost. Still, this last strategy is neither efficient nor effective, as it would be much more through a **pooling arrangement**, which does not reduce expected losses but do reduce their standard deviation, thus reducing risk, as the probability of an extreme event in which all firms experience the same damage decreases every time a firm joins the agreement.



When losses are independent and equally distributed pooling arrangements have an important effect, and as the number of participants gets larger the standard deviation of each participant's expected loss gets closer to zero, thus reducing the risk of gaps between expectation and actual occurrence and getting the distribution of possible outcome for the pool's losses closer to their expected value. And this risk reduction also works if the losses are not fully independent nor identically distributed. It is just important that they're not perfectly positively correlated. Still, that kind of strategy makes higher the probability of having to pay something and might incur in counterparty risk, as some participants may refuse to pay their contribution. That is why a funded mutual insurance plan involving an advance payment is the best solution, and it is nothing else than the **insurance process** itself.

For such pool of participants, the remaining risk is to have uncertain profits or losses based on the amount deposited for risk provision, therefore it transforms pure risk into speculative risk for the participants. In addition, as each participant's risk provision becomes larger than the expected loss, the probability that the overall provision is able to fund the pool's actual total losses increases.

The insurance process is based on the systematic application of risk pooling and it is efficient and has an inverted production cycle.

Still, we can infer that not all pure risks are insurable, as there has to be a large number of homogeneous and independent exposed units and the loss must be measurable and accidental. If such damaging event (peril) is catastrophic, it may damage many of the firms in the pool and such process doesn't work as well.

In this process, the **insurance firm** is the arranger of the pooling risk management solution, as it collects from the exposed units, computes the required advance payment, manages the monetary resources and pays policyholders' claims and benefits when they fall due.

In essence, its main tasks are the underwriting activity (collecting as many numerous, equally distributed and independent risk units as possible), pricing (calculation of the advance payment to be made), and the appropriate investment of the collected resources in view of the future expected payments. Still, it is not easy to conduct them as the objective of a numerous portfolio is negatively correlated to the objective of independence, and competition may pressure to a rapid selection and collection of premiums rather than an accurate selection and pricing.

As a consequence, the main risks an insurance firm incurs are **insurance risk** (risk that the portfolio of insured clients is more costly than expected) and **investment risk** (the possibility that return on the investment activity is negative or not sufficient.

2) INSURANCE BUSINESS MODEL

The main way of funding of the insurance firm is the underwriting activity, on which the production cycle is *inverted* as they receive the payment before providing the service.

Therefore, it is important that the premium is priced correctly, that they are invested temporarily, and that the activity is controlled by public authorities. Indeed, the typically risk for the insurer is the **underwriting risk**, which is the risk of a gap between the actual damages in the portfolio of risk units and the estimated damage that is at the basis of premium calculation. As we know, the frequency and intensity of such gaps mainly depends on homogeneity, number of the firms in the portfolio, independency, and stability of conditions, and optimizing them through portfolio selection is not easy. Still, after selecting the units, an insurer can impose contractual conditions and limitations, use specific pricing methods and reinsurance to further reduce the riskiness of the portfolio.

The **insurance contract** is a contract in which one party commits to pay a fixed price to an insurer for the right to receive a benefit following the occurrence of a specified adverse event. They differ from other risk transfer arrangements by its legal aspects, the kind of obligations and the type of risk mitigated. Then, a key to recognize it as insurance is the presence of an insurable interest. That means that the purchaser of an insurance coverage must be at risk to sustain economic losses as a precondition for receiving a benefit under the insurance contract.

The kind of obligations related to insurance contracts are the premium and the benefit, which will be paid depending on the occurrence of the event and the policy condition, and it can be *reimbursement of expenses*, an *indemnity*, or a *forfeiture amount*, with the last one being common in life insurance.

Insurance contracts are known as "random" or "aleatory" contracts because the insurer payment depends on an uncertain future event, as the *trigger* and the *amount* of the benefit depend on that uncertain future event. Still, we cannot say that they are unfair as what the insured party certainly gets is the protection against the risk of loss, moving himself to a certain condition.

The principle of indemnity is what grants the insurer not to pay more than the actual amount of the loss borne by the insured person to reduce *moral hazard*, so that the insured is not profiting from such loss. On the other side, the insurer should rely on the correct determination of indemnity by the insurer, and such fair treatment is enforced by the competent supervisory authority.

With respect to the benefit granted, insurance contracts are divided into:

- Indemnity contract: the amount of the benefit is determined after the occurrence of the damage and is proportionate to it.
- Valued contract: the amount is established at the inception of the contract.

When selecting units to be included in the portfolio, the insurer can incur *adverse selection*, when he cannot distinguish the quality of the units because of unknown information on their riskiness and, as a consequence, the premium will be based on some average estimation, and *moral hazard*, when the insurance contract lessens the insured party attention to risk prevention. In order to mitigate adverse selection, insurers use **risk rating methodologies** to price the risk associated to each unit in the best way. The best way to assess that would be through individual ratings based on the actual loss experience of the specific risk unit, but for practical reasons it is done more rapidly through class ratings, in which first different classes based on risk intensity for each peril are defined and then each risk unit is classified into the best fitting one. In order to limit its inaccuracy, experience rating is used, by which method the price is gradually adjusted based on the actual loss experience of the specific risk unit. A way to deal with moral hazard, on the other hand, is to insert **contractual clauses that limit coverage** in non-life contracts, determining: deductibles, by which a specified amount (or percentage of the amount) is subtracted by the total loss payment and can be straight (applies to each and any single loss) or aggregate (applies to the sum of all losses occurring in a specified time period); franchises, thresholds of loss that need to be exceeded for the insurer to be liable for the claim and that together with deductibles have the purpose to eliminate small

claims, reduce premiums and moral hazard; policy limits establish an upper limit to the amount of coverage and are always used in liability insurance policies; exclusions are provisions that exclude coverage for specific type of losses like the ones deriving from war or catastrophic events or that are not needed by the policyholder.
The **life insurance contract** is a valued contract whose adverse event is bound to occur but whose timing is uncertain. Their classified by type of underlying event, by type of premium, and by time of return.
The type of underlying event can either be early death on which can be applied a *term insurance,* in which a fixed amount is paid to the beneficiaries indicated in the contract in case of occurrence in the definite timeframe, or a *whole life insurance*, whose duration corresponds to the life of the policyholder; or survival/need for resources at retirement, which protects the policyholder from the risk of living too long and is distinguished into *pure endowment insurance*, by which the risk unit pays a premium and will get the agreed amount at maturity if he's alive, or *annuities*, by which some fixed or with-profit annuities are paid from a certain date if the insurer is alive.
The type of premium can be split into three categories: single premium, recurring premium (payments whenever the policyholder wishes), and annual or regular premiums.
Finally, we have the different type of benefits. In traditional contracts they may be fixed and set with premiums at the beginning of the contract, or with-profit, in which policyholders also participate in excess profits of investments, given to them in the form of "bonuses" and on a discretionary basis, and in which the insurer incurs interest rate risk. In linked contracts, in which the policyholder bears the investment risk, the insured person buys unit-linked products, in which the value of the benefit is linked to the value of an underlying mutual fund, or index-linked products, in which the benefit is linked to the value of a financial index, both not posing any investment risk for the insurer.
A final important element of the life insurance contract is the **surrender**, as life insurance contracts often give the policyholder the chance to end the contract before maturity and cash the benefit, normally with penalties. This option introduces additional uncertainty in the amount and timing of the payments of the insurer.
A **fair insurance premium** is the one that is just sufficient to cover the expected benefit costs and the expenses incurred by the insurer, also based on investment income, expense loading, and risk loading. The determination of the expected benefit cost is based on statistical determination of the probability distribution of the expected frequency and intensity of the loss, and that is the product of the means of such estimations $P(B) = E(B) = E(frequency) \times E(intensity)$.
When the premium is determined, the insurer could take into consideration its ability to earn investment income, and grant a lower premium known as *discounted expected benefit cost*, depending on the advance interest rate used and the length of the contract to which the premium applies. Indeed, in order to have enough money to be able to cover the claim, the insurer will have to make the insured party a premium such that $\boldsymbol{P = benefit\ payment/(1 + r)^t}$, implying additional risk for the insurer. In case of with-profit contracts, in addition to the pre-determined interest rate that is transferred to policyholders by the discounted premium, they also earn on the investment of such premiums, but in that case the risk of the insurer is actually lower as the interest rate is not transferred to the policyholder at a fixed rate and is not normally guaranteed.
Still, the calculation of the premium also include expense loading, as the administrative costs (general expenses, distributing expenses, and loss adjustment expenses) are included, and risk loading. This last factor is important as insurance companies bear a risk for transforming the risk units' pure risks into speculative risks and id they priced the premium as the sum of expected benefit costs, investment income, and administrative costs, their expected profit for bearing such risk would be equal to zero. Therefore, as no one would bear risk of loss in exchange of a null

expected profit, insurer charge premiums in excess of that sum through risk loading (profit loading).

Which factors do affect the profit/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 riskyness of expose units
(+/-) any other factor that influence the functioning of the insurance process

and also, obviously:
(–) the pressure from competitors
(+) the return required by capital providers
(…)

Therefore, the risk loading is directly proportionate to the riskiness of the portfolio of risk units, and, in statistical terms, to the dispersion of the loss probability distribution around its best estimate.

Example: suppose that we want to find a fair premium for a group of non-life insurance policies each having a $10,000 loss with probability 0.1 and 0$ with probability of 0.9, that all claims will be made at the end of 1 year in which we have a 10% interest rate, that there are immediate 20% of the expected claim administrative expenses, and that this policies requires a 5% of the expected claim payment as profit loading.

Then:

- Discounted expected benefit cost = $\frac{10{,}000(0.1)}{1.1} = \$909.09$
- Expense loading = $10{,}000(0.1)(0.2) = \$200$
- Profit loading = $10{,}000(0.1)(0.05) = \$50$
- FAIR PREMIUM = $\$909.09 + \$200 + \$50 = \$1{,}159.09$

3) RISK MITIGATION & POLICYHOLDER PROTECTION

An insurance firm, as said, incurs a series of risks and normally faces the following trade-off dilemma:

$$\frac{\text{Applied Risk loading} + \text{Available Own funds}}{\text{Riskiness of portfolio}} = \text{Solvency index}$$

(standard deviation of claims probability distribution)

The major source of risk in non-life insurance is underwriting risk, while as life contracts are long term, they are exposed to longevity risk, the risk relative to the decreasing mortality trend. In order to mitigate underwriting risks some techniques can be used: legal limitations, portfolio selection, contractual limitations, and experience rating. In addition, once that the policy is issued, insurer can reduce risk through **reinsurance**. That is insurance for insurers based on the same principles of sharing and transfer as insurance itself, in which the insurer seeking reinsurance is known as ceding company and the other part simply the reinsurer. Still, this creates no relationship between the policyholder and the reinsurer but replaces the uncertainty of claim volatility for the insurer for a known cost (reinsurance premium), thus reducing the riskiness of its portfolio and optimizing its solvency index. Therefore the main purposes of reinsurance are: increasing of insurance capacity (companies can underwrite risks which could otherwise not be taken), improving quantitative harmonization of portfolio (removing excess of certain risks), and improving segmentation and diversification of risks. A reinsurance contract can be proportional, distinguished into quota share (in which the parties agree to share an amount of each risk on some percentage basis, helping insurance capacity and segmentation but with no effect on harmonization) and

surplus (the reinsurer accepts to bear some amount of each risk in excess of a specified net retention, having also harmonization); or non-proportional, distinguished into excess loss (reinsurer pays when a loss on a single claim exceeds a certain amount, works better than proportional as it protects against a wrong determination of the premium) and stop loss (same as the other but related to the whole portfolio of a certain risk, most protective one, insurance against poor performance of the insurance process of that portfolio).
Another kind of risk incurred by insurance firms is **asset risk** (market, interest rate, equity, real estate, exchange, counterparty, and liquidity risk). Mitigation of asset risks in insurance companies is done the same as in other financial institutions. However, it is important the integrated consideration of assets and liabilities (on which interest rate, exchange rate, and liquidity risks are pending) but the uncertainty of cash flow deriving from liabilities makes the "matching" objective more difficult in practice. Other risks should be mitigated through appropriate diversification and credit assessment. Regarding interest rate risk, we know that most assets are sensitive to interest rate change, but also the value of insurance liabilities varies depending on them, and life contracts may incorporate long-term financial guarantees. Therefore, insurers are particularly exposed to the decrease of interest rates and affected by a persistently low interest rate scenario. Still, also a sudden increase may create troubles, in particular to life insurers with very liquid liabilities.
With the aim of **protecting policyholders**, a series of measures are taken.
First, at any point after the receival of the premium, the insurer should set aside a portion of the premium to cover its future obligation toward the policyholder. Such portion is called **technical reserves** and represents the current expected value of the insurer's future obligation. Because of that the insurer will implicitly end up recognizing or not a profit or a loss in its financial statements, also in case of a change of circumstances changing the estimations based on which the expected value was calculated. In order to guarantee that the assumptions used to calculate technical reserves are correct and prudent there are authorities responsible to supervise insurance firms and grant that they recognize both positive and negative adjustments. Since they represent the amount of money that they set aside to cover benefit costs, they represent a liability. Technical reserves are divided into loss reserves, the estimation of the cost of all known and unknown claims already incurred but still to be paid (claims reported and adjusted but still unpaid, claims reported but not yet adjusted, and claims incurred but not yet reported), and unearned premium reserves, the expected costs for future claims that should be set aside to cover the cost of claims that could incur in the future.
In the case of **life insurers**, they are required to have the net premium reserve, which is the difference at time *t* between the present value of future benefit payments and the present value of future premium payments. When reserves are based on net premiums and benefits only (taking into consideration demographic and financial assumptions) they are called mathematical reserves, if they also consider expenses, they are modified reserves.
Additionally, there are some rules on the **assets backing technical reserves**, including limitations or conditions, normally set in the prudential regulation of each country. The appropriateness of any asset allocation policy has to be assessed in conjunction to the financial characteristics of the insurance liabilities with the objective that the expected cash flows match. Recently, there has been a distancing from detailed quantitative restrictions towards more general guidelines, known as "*prudent-man"* approach. In principle, it means that the investment policy is in the hands of the manager, but it should be sustained by severe requirements on corporate governance and propriety of managers.
Finally, we have a **solvency requirement** so to serve a prudential buffer to ensure that unexpected losses can be covered, and obligations met. Its purpose is to absorb remaining risk remaining even if liabilities are prudently calculated. Those are set by each and every jurisdiction in the world.

4) PRUDENTIAL REGULATION: SOLVENCY II

The prudential regime is the set of principles, rules, and guidelines applied to insurance companies aiming at ensuring their ability to meet their financial obligations toward policyholders. The existing EU prudential regime is the so called "Solvency II", which substituted **Solvency I**, which was a rule-based regime that could conflict with good risk management, based capital requirements on a simplistic factor-based approach not adequately directed towards the risk of different business lines, inconsistent within EU (national discretion), and with valuation of assets and liabilities either being insurance specific or based on national GAAP, therefore inconsistent with IFRS. On the other hand, **Solvency II**, drastically reformed the previous regime using a market-consistent approach for valuation, risk-sensitive capital requirements, focus on governance and supervision, and increased market transparency through the creation of a harmonized EU regulatory regime.
This new regime is intended to cover all aspects that could influence insurer's solvency and its provisions can be divided into three pillars:

1) **Financial requirements and available capital to cover requirements**:

The capital requirement is determined based on a *market-consistent valuation*, as value of assets and liabilities reflects the value at which they could be traded, regardless of accounting valuation. There are two levels of capital requirement: Solvency Capital Requirement (SCR), calculated in terms of potential loss of an adverse scenario calibrated to a confidence interval of 99.5% VaR over a 1-year time horizon; and Minimum Capital Requirement (MCR), below which ultimate supervisory action is triggered. Supervisors use solvency ratios (available capital/capital requirements) to get an indication of the financial strength and the closer capital gets to the SCR and breaches it, the more intense are the supervisory action, while when MCR is breached they should take ultimate actions under the assumption that the company can still transfer all its assets and liabilities at market price.

2) **Governance requirements and harmonized supervisory review process**:

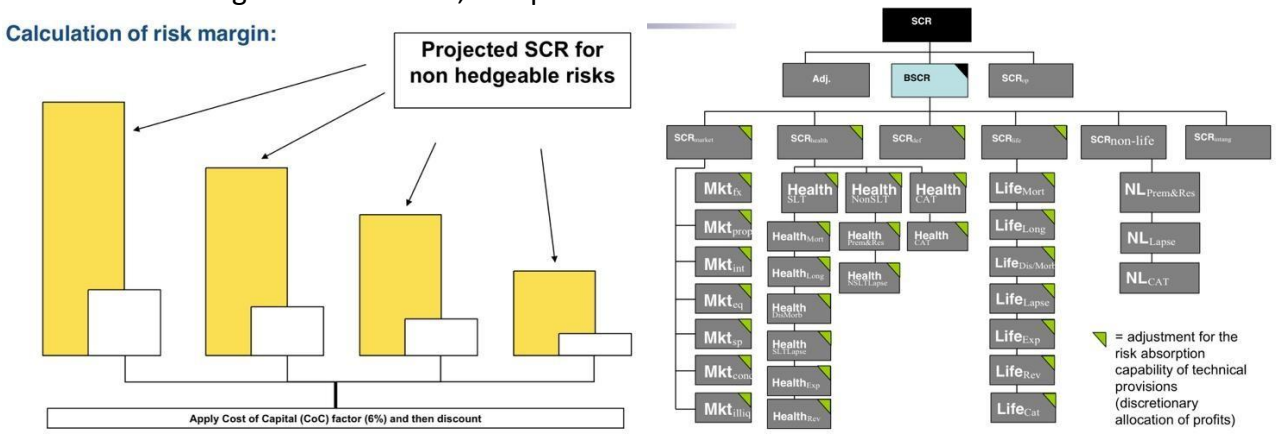
Solvency II makes explicit requirements on the quality of governance such as requirements for fit and proper managers, an appropriate internal control system, and severe qualitative risk governance standards in order to ensure that risk assessment and management plays a central role in management with direct responsibility of the board and to explain to supervisors how the insurer measures and manages risk through a specific report. Another tool is the ORSA, which establishes a process to support internal business decision (based on risk implications) and reports to supervisors how the company assesses its risk profile. The assumptions and methodologies used in the ORSA may differ from the ones used for SCR, but any divergence should be highlighted. The analysis of the ORSA helps supervisors check if risk is appropriately captured by SCR calculation. Finally, regarding the supervisory review process, supervisors must have the power and resources to review the compliance to requirements and based on such review they can demand capital add-ons, that can be temporary because of governance and internal control deficiency, or definitive because of a deviation of the actual risk profile of the company from the assumptions underpinning the ordinary calculation of SCR.

3) **Supervisory reporting and public disclosure**:

In order to foster market discipline new public disclosure requirements were established, not only demanding companies to show their financial position, but also to explain how their risk profile and appetite fit in with their business strategy and how they assess and manage risk. In addition, supervisors should get even more information to ensure that it is sufficient to fully understand the risk profile.

Going back to pillar 1, the first step to calculate capital requirements is to determine the so-called "Solvency II balance sheet" in which assets and liabilities are valued according to market-consistent

valuation, or better, *transfer value*. This is needed to calculate both available capital and capital requirements. Such valuation is also depending on the presence of deep and liquid markets relative to the asset or liability. It is market value if they are traded in deep and liquid markets, while they are *marked to model* otherwise. For insurance liabilities unless the cash flows can be replicated by an instrument with some market price, their value is also modelled based on the Solvency II criteria. To use that model, it is necessary to determine the amount and timing of all relative cash outflows, discounting them through a pre-determined risk-free interest rate (least risky financial interest available), obtaining *best estimate* (PV of probability-weighted average of future cash flows), and finally adding a *risk margin*. In case of life insurance, best estimate is calculated separating guaranteeing guaranteed and discretionary benefits under the assumption that the discretionary ones can be avoided under stress conditions. As to the discount rate, it is made up when no reliable market values exist, and it is regularly adjusted to compensate its changes (volatility adjustment), thus influencing valuation of A&L, available capital, and the capital requirements. Regarding the risk margin, instead, it is the amount to ensure that the value of the technical provision is equivalent to the amount expected to be needed to meet the relevant insurance obligations, equal to the cost of providing eligible own capital equal to SCR (6% of it). Since the risk margin considers SCR, it depends on the riskiness of the liabilities.



According to SII, the standard calculation approach starts with defining and considering individually each quantifiable risk, based on a modular approach, then using factor- or scenario-based calculations for each of them to define the capital charge in order to cover all unexpected losses under a predefined adverse stress scenario with an annual probability of 0.5%, and finally aggregating each risk in a correlation matrix. As the main purpose of pillar I is to define a capital requirement coherent to individual risk profile of the company, there is the chance to use simpler calculations, internal models or entity-specific data, based on the approval of supervisors based on several strict standards if insurer demonstrate effective use and sound governance of the model used. Internal models can also be required by supervisors if the firm's risk profile deviates significantly from the assumptions implicit in the standard formula.
Minimum capital requirements, on the other hand, work as a trigger for ultimate supervisory actions, but are also a safety net against model errors. For this reason, it is based on an *objective calculation approach* consistent with SCR so to allow a reasonable distance for the ladder of interventions. They can be between 25% (floor) and 45% (cap) of the SCR.
As discussed, capital requirements should be covered by eligible elements of available capital, including available capital, subordinated debt and ancillary own funds (promises to subscribe elements of capital). Those eligible elements are distinguished into three quality tiers each having quantitative limits to ensure an overall minimum level of quality.

In addition, SII doesn't involve any limit on investments. Still, they should follow the *prudent person principle* and invest in the best interest of the policyholder, thing that is complemented by the fact that all risks undertaken are reflected in capital requirements.
As for the expected challenges of SII, we know that supervisory tools are much more complex and supervisors have increased discretion in their actions, creating a new supervisory culture. Regarding this, there is now the need to converge in day-to-day EU supervisory practices and work jointly at EU level. As for businesses, the regime didn't put the sector under stress on average but required the firms to understand and embed the regulation, impacting governance and business strategy. In addition, the complex requirements, the allowance for risk diversification and the use of internal models, strongly penalized small firms, driving consolidation in the market.
Finally, in case of pro-cyclical effects (times of crisis) SII includes a package of measures aiming at taking them into account by softening the effects on the balance sheets of excessive or short-term market volatility, limiting pro-cyclical market interventions.

Banks exchange reserves in the Fed Funds market safely and rapidly.

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