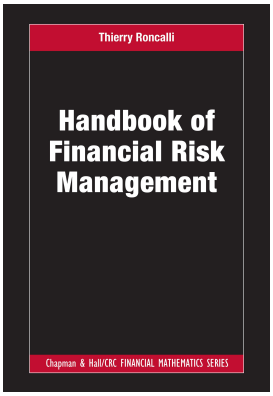

Handbook of Financial Risk Management

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Introduction

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Chapter 1

Introduction

The idea that risk management creates value is largely accepted today. However, this has not always been the case in the past, especially in the financial sector (Stulz, 1996). Rather, it has been a long march marked by a number of decisive steps. In this introduction, we present an outline of the most important achievements from a historical point of view. We also give an overview of the current financial regulation, which is a cornerstone in financial risk management.

1.1 The need for risk management

The need for risk management is the title of the first section of the leadership book by Jorion (2007), who shows that risk management can be justified at two levels. At the firm level, risk management is essential for identifying and managing business risk. At the industry level, risk management is a central factor for understanding and preventing systemic risk. In particular, this second need is the '*raison d'être*' of the financial regulation itself.

1.1.1 Risk management and the financial system

The concept of risk management has evolved considerably since its creation, which is believed to be in the early fifties[1]. In November 1955, Wayne Snider gave a lecture entitled '*The Risk Manager*' where he proposed creating an integrated department responsible for risk prevention in the insurance industry (Snider, 1956). Some months later, Gallagher (1956) published an article to outline the most important principles of risk management and to propose the hiring of a full-time risk manager in large companies. For a long time, risk management was systematically associated with insurance management, both from a practical point of view and a theoretical point of view. For instance, the book of Mehr and Hedges (1963) is largely dedicated to the field of insurance with very few applications to other industries. This is explained by the fact that the collective risk model[2] has helped to apply the mathematical and statistical tools for measuring risk in insurance companies since 1930. A new discipline known as actuarial science has been developed at the same time outside the other sciences and has supported the generalization of risk management in the insurance industry.

Simultaneously, risk became an important field of research in economics and finance. Indeed, Arrow (1964) made an important step by extending the Arrow-Debreu model of general equilibrium in an uncertain environment[3]. In particular, he showed the importance

[1] See Crockford (1982) or Snider (1991) for a retrospective view on the risk management development.
[2] It is also known as the ruin theory or the compound Poisson risk model.
[3] This paper was originally presented in 1952 and was also published in Cahiers du CNRS (1953).

of hedging and introduced the concept of payoff. By developing the theory of optimal allocation for a universe of financial securities, Markowitz (1952) pointed out that the risk of a financial portfolio can be diversified. These two concepts, hedging and diversification, together with insurance, are the main pillars of modern risk management. These concepts will be intensively used by academics in the 1960s and 1970s. In particular, Black and Scholes (1973) showed the interconnection between hedging and pricing problems. Their work had a strong impact on the development of equity, interest rates, currency and commodity derivatives, which are today essential for managing the risk of financial institutions. With the Markowitz model, a new era had begun in portfolio management and asset pricing. First, Sharpe (1964) showed how risk premia are related to non-diversifiable risks and developed the first asset pricing model. Then, Ross (1976) extended the CAPM model of Sharpe and highlighted the role of risk factors in arbitrage pricing theory. These academic achievements will support the further development of asset management, financial markets and investment banking.

In commercial and retail banking, risk management was not integrated until recently. Even though credit scoring models have existed since the fifties, they were rather designed for consumer lending, especially credit cards. When banks used them for loans and credit issuances, they were greatly simplified and considered as a decision-making tool, playing a minor role in the final decision. The underlying idea was that the banker knew his client better than a statistical model could. However, Banker Trust introduced the concept of risk-adjusted return on capital or RAROC under the initiative of Charles Sanford in the late 1970s for measuring risk-adjusted profitability. Gene Guill mentions a memorandum dated February 1979 by Charles Sanford to the head of bank supervision at the Federal Reserve Board of New York that helps to understand the RAROC approach:

> "*We agree that one bank's book equity to assets ratio has little relevance for another bank with a different mix of businesses. Certain activities are inherently riskier than others and more risk capital is required to sustain them. The truly scarce resource is equity, not assets, which is why we prefer to compare and measure businesses on the basis of return on equity rather than return on assets*" (Guill, 2009, page 10).

RAROC compares the expected return to the economic capital and has become a standard model for combining performance management and risk management. Even if RAROC is a global approach for allocating capital between business lines, it has been mainly used as a credit scoring model. Another milestone was the development of credit portfolio management when Vasicek (1987) adapted the structural default risk approach of Merton (1974) to model the loss distribution of a loan portfolio. He then jointly founded KMV Corporation with Stephen Kealhofer and John McQuown, which specializes in quantitative credit analysis tools and is now part of Moody's Analytics.

In addition to credit risk, commercial and retail banks have to manage interest rate and liquidity risks, because their primary activity is to do asset, liquidity and maturity transformations. Typically, a commercial bank has long-term and illiquid assets (loans) and short-term and liquid liabilities (deposits). In such a situation, a bank faces a loss risk that can be partially hedged. This is the role of asset liability management(ALM). But depositors also face a loss risk that is virtually impossible to monitor and manage. Consequently, there is an information asymmetry between banks and depositors.

In the banking sector, the main issue centered therefore around the deposit insurance. How can we protect depositors against the failure of the bank? The 100% reserve proposal by Fisher (1935) required banks to keep 100% of demand deposit accounts in cash or government-issued money like bills. Diamond and Dybvig (1983) argued that the mixing

policy of liquid and illiquid assets can rationally produce systemic risks, such as bank runs. A better way to protect the depositors is to create a deposit insurance guaranteed by the government. According to the Modigliani-Miller theorem on capital structure[4], this type of government guarantee implied a higher cost of equity capital. Since the eighties, this topic has been highly written about (Admati and Hellwig, 2014). Moreover, banks also differ from other companies, because they create money. Therefore, they are at the heart of the monetary policy. These two characteristics (implicit guarantee and money creation) imply that banks have to be regulated and need regulatory capital. This is all the more valid with the huge development of financial innovations, which has profoundly changed the nature of the banking system and the risk.

1.1.2 The development of financial markets

The development of financial markets has a long history. For instance, the Chicago Board of Trade (CBOT) listed the first commodity futures contract in 1864 (Carlton, 1984). Some authors even consider that the first organized futures exchange was the Dojima Rice Market in Osaka in the 18th century (Schaede, 1989). But the most important breakthrough came in the seventies with two major financial innovations. In 1972, the Chicago Mercantile Exchange (CME) launched currency futures contracts after the US had decided to abandon the fixed exchange rate system of Bretton Woods (1946). The oil crisis of 1973 and the need to hedge currency risk have considerably helped in the development of this market. After commodity and currency contracts, interest rate and equity index futures have consistently grown. For instance, US Treasury bond, S&P 500, German Bund, and Euro Stoxx 50 futures were first traded in 1977, 1982, 1988 and 1998 respectively. Today, the Bund futures contract is the most traded product in the world.

The second main innovation in the seventies concerned option contracts. The CBOT created the Chicago Board of Options (CBOE) in 1973, which was the first exchange specialized in listed stock call options. The same year, Black and Scholes (1973) published their famous formula for pricing a European option. It has been the starting point of the intensive development of academic research concerning the pricing of financial derivatives and contingent claims. The works of Fisher Black, Myron Scholes and Robert Merton[5] are all the more significant in that they consider the pricing problem in terms of risk hedging. Many authors had previously found a similar pricing formula, but Black and Scholes introduced the revolutionary concept of the hedging portfolio. In their model, they derived the corresponding dynamic trading strategy to hedge the option contract, and the option price is therefore equivalent to the cost of the hedging strategy. Their pricing method had a great influence on the development of the derivatives market and more exotic options, in particular path-dependent options[6].

Whereas the primary goal of options is to hedge a directional risk, they will be largely used as underlying assets of investment products. In 1976, Hayne Leland and Mark Rubinstein developed the portfolio insurance concept, which allows for investing in risky assets while protecting the capital of the investment. In 1980, they founded LOR Associates, Inc. with John O'Brien and proposed structured investment products to institutional investors (Tufano and Kyrillos, 1995). They achieved very rapid growth until the 1987 stock market

[4]Under some (unrealistic) assumptions, Modigliani and Miller (1958) showed that the market value of a firm is not affected by how that firm is financed (by issuing stock or debt). They also established that the cost of equity is a linear function of the firm's leverage measured by its debt/equity ratio.

[5]As shown by Bernstein (1992), the works of Black and Scholes cannot be dissociated from the research of Merton (1973). This explains why they both received the 1997 Nobel Prize in Economics for their option pricing model.

[6]See Box 1 for more information about the rise of exotic options.

crash[7], and were followed by Wells Fargo, J.P. Morgan and Chase Manhattan as well as other investment banks. This period marks the start of financial engineering applied to structured products and the development of popular trading strategies, such as constant proportion portfolio insurance (CPPI) and option based portfolio insurance (OBPI). Later, they will be extensively used for designing retail investment products, especially capital guaranteed products.

Box 1

Evolution of financial innovations

1864	Commodity futures
1970	Mortgage-backed securities
1971	Equity index funds
1972	Foreign currency futures
1973	Stock options
1977	Put options
1979	Over-the-counter currency options
1980	Currency swaps
1981	Interest rate swaps
1982	Equity index futures
1983	Equity index options
	Interest rate caps/floors
	Collateralized mortgage obligations
1985	Swaptions
	Asset-backed securities
1987	Path-dependent options (Asian, look-back, etc.)
	Collateralized debt obligations
1992	Catastrophe insurance futures and options
1993	Captions/floortions
	Exchange-traded funds
1994	Credit default swaps
1996	Electricity futures
1997	Weather derivatives
2004	Volatility index futures
2006	Leveraged and inverse ETFs
2008	Green bonds
2009	Crypto currencies

Source: Jorion (2007) and author's research.

After options, the next great innovation in risk management was the swap. In a swap contract, two counterparties exchange a series of cash flows of one financial instrument for those of another financial instrument. For instance, an interest rate swap (IRS) is an exchange of interest rate cash flows from a fixed rate to a floating rate or between two floating

[7]In fact, portfolio insurance was blamed by the Brady Commission report (1988) for the stock market crash of October 1987. See for instance Leland and Rubinstein (1988), Shiller (1987), Gennotte and Leland (1990) and Jacklin *et al.* (1992) for a discussions about the impact of portfolio insurance on the October 1987 crash.

rates. Swaps have become an important tool for managing balance sheets, in particular interest rate and currency risks in the banking book. The original mechanism of cash flow exchanges has been extended to other instruments and underlying assets: inflation-indexed bonds, stocks, equity indices, commodities, etc. But one of the most significant advances in financial innovations was the creation of credit default swaps (CDS) in the mid-nineties, and more generally credit derivatives. In the simplest case, the cash flows depend on the default of a loan, a bond or a company. We refer then to single-name instruments. Otherwise, they depend on credit events or credit losses of a portfolio (multi-name instruments). However, the development of credit derivatives was made possible thanks to securitization. This is a process through which assets are pooled in a portfolio and securities representing interests in the portfolio are issued. Securities backed by mortgages are called mortgage-backed securities (MBS), while those backed by other types of assets are asset-backed securities (ABS).

Derivatives are traded either in organized markets or in over-the-counter markets (OTC). In organized exchanges, the contracts are standardized and the transactions are arranged by the clearing house, which is in charge of clearing and settlement. By contrast, in OTC markets, the contracts are customized and the trades are done directly by the two counterparties. This implies that OTC trades are exposed to the default risk of the participants. The location of derivatives trades depends on the contract:

Contract	Futures	Forward	Option	Swap
On-exchange	✓		✓	
Off-exchange		✓	✓	✓

For instance, the only difference between futures and forward contracts is that futures are traded in organized markets whereas forwards are traded over-the-counter. Contrary to options which are negotiated in both markets, swaps are mainly traded OTC. In Table 1.1, we report the outstanding amount of exchange-traded derivatives concerning futures and options published by the Bank for International Settlements (2019). In December 2018, their notional amount is equal to \$94.8 tn, composed of \$39.0 tn in futures (41.2%) and \$55.7 tn in options (58.8%). For each instrument, we indicate the split between interest rates and currencies[8]. We notice that exchange-traded derivatives on interest rates are the main contributor. The evolution of the total notional amount is reported in Figure 1.1. The size of exchange-traded derivative markets has grown rapidly since 2000, peaking in June 2007 with an aggregated amount of \$86.6 tn. This trend ended with the financial crisis since we observe a decrease between 2007 and 2016. This is only recently that the outstanding amount of exchange-traded derivatives exceeds the 2007 figure.

Statistics[9] concerning OTC derivative markets are given in Table 1.2. These markets are between six and ten times bigger than exchange-traded markets in terms of outstanding amount (Figure 1.3). In June 2018, the aggregated amount of forwards, swaps and options is equal to \$594.8 tn. Contrary to exchange-traded derivative markets, the notional outstanding amount of OTC derivative markets continues to increase after the crisis period, but declines recently since 2014 (Figure 1.2). In terms of instruments, swaps dominate and represent 65.0% of the total. Like in exchange-traded markets, the main asset class remains fixed income. We also notice the impact of the 2008 financial crisis on credit default swaps,

[8]The BIS decided in September 2015 to discontinue the compilation of equity index exchange-traded derivatives statistics. This is why these statistics do not include the equity index futures and options. In December 2014, equity index futures and options represented 11.1% of exchange-traded derivatives.

[9]In order to compute these statistics, we have done some assumptions because we don't have a perfect granularity of the data. For equity and commodity buckets, we don't have the split between forwards and swaps. We allocate 50% of the amount in each category. We also attribute the full amount of credit derivatives to the swap bucket.

TABLE 1.1: Notional outstanding amount of exchange-traded derivatives

	2004	2007	2010	2014	2018
Futures	42.6%	37.9%	34.1%	44.4%	41.2%
Interest rate	99.4%	99.3%	99.2%	99.1%	99.3%
Short-term	94.7%	94.0%	94.9%	93.6%	92.6%
Long-term	5.3%	6.0%	5.1%	6.4%	7.4%
Currency	0.6%	0.7%	0.8%	0.9%	0.7%
Options	57.4%	62.1%	65.9%	55.6%	58.8%
Interest rate	99.8%	99.7%	99.6%	99.6%	99.8%
Short-term	98.2%	98.6%	98.9%	97.7%	98.3%
Long-term	1.9%	1.4%	1.1%	2.3%	1.7%
Currency	0.2%	0.3%	0.4%	0.5%	0.3%
Total (in $ tn)	43.0	71.5	62.3	57.6	94.8

Source: Bank for International Settlements (2019) and author's calculations.

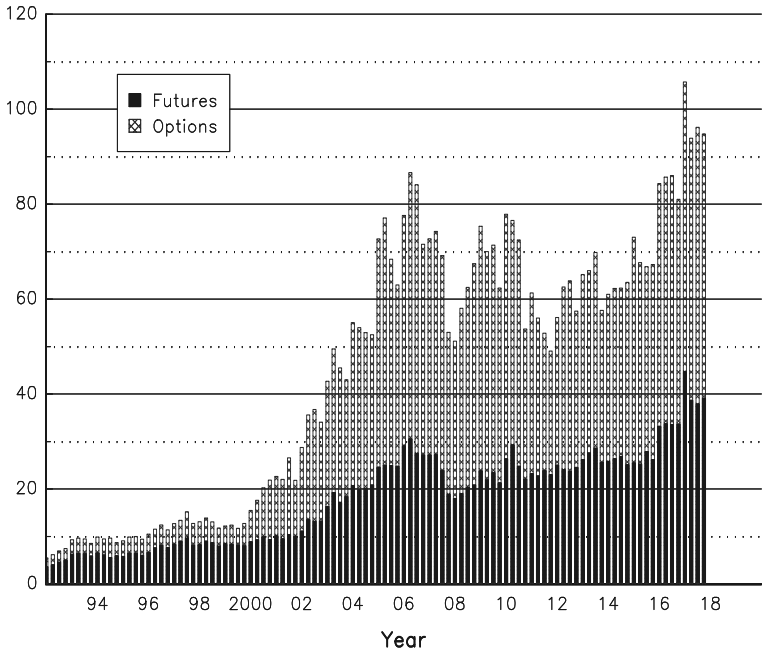

FIGURE 1.1: Notional outstanding amount of exchange-traded derivatives (in $ tn)

Source: Bank for International Settlements (2019) and author's calculations.

which represented more than 10% of the OTC derivative markets in December 2007. Ten years after, they represent less than 2.0% of these markets.

TABLE 1.2: Notional outstanding amount of OTC derivatives

	2004	2007	2010	2014	2018
Forwards	12.9%	11.8%	15.4%	20.2%	24.0%
Swaps	71.1%	73.3%	73.2%	69.4%	65.0%
Options	15.9%	14.9%	11.4%	10.3%	10.8%
Unallocated	0.1%	0.0%	0.0%	0.1%	0.1%
Currency	13.4%	11.4%	11.3%	13.1%	16.1%
Interest rate	79.5%	73.8%	81.9%	82.8%	80.9%
Equity	2.0%	1.6%	1.0%	1.1%	1.2%
Commodity	0.6%	1.6%	0.6%	0.3%	0.4%
Credit	4.5%	11.6%	5.2%	2.7%	1.4%
Unallocated	0.1%	0.0%	0.0%	0.0%	0.0%
Total (in $ tn)	258.6	585.9	601.0	627.8	594.8

Source: Bank for International Settlements (2019) and author's calculations.

Whereas the notional outstanding amount is a statistic to understand the size of the derivatives markets, the risk and the activity of these markets may be measured by the gross market value and the turnover:

- The *gross market value* of outstanding derivatives contracts represents "*the cost of replacing all outstanding contracts at market prices prevailing on the reporting date. It corresponds to the maximum loss that market participants would incur if all counterparties failed to meet their contractual payments and the contracts were replaced at current market prices*" (Bank for International Settlements, 2014).

- The *turnover* is defined as "*the gross value of all new deals entered into during a given period, and is measured in terms of the nominal or notional amount of the contracts. It provides a measure of market activity, and can also be seen as a rough proxy for market liquidity.*" (Bank for International Settlements, 2014).

In June 2018, the gross market value is equal to $10.3 tn for OTC derivatives. It is largely lower than the figure of $34.9 tn in December 2008. This decrease is explained by less complexity in derivatives, but also by a lower volatility regime. For OTC derivatives, it is difficult to measure a turnover, because the contracts are not standardized. This statistic is more pertinent for exchange-traded markets. In December 2018, the daily average turnover is equal to $8.1 tn for futures contacts and $1.8 tn for options. This means that each day, almost $10 tn of new derivative exposures are negotiated in exchange-traded markets. The consequence of this huge activity is a growing number of financial losses for banks and financial institutions (Reinhart and Rogoff, 2009).

1.1.3 Financial crises and systemic risk

A financial institution generally faces five main risks: (1) market risk, (2) credit risk, (3) counterparty credit risk, (4) operational risk and (5) liquidity risk. Market risk is the risk of losses due to changes in financial market prices. We generally distinguish four major types

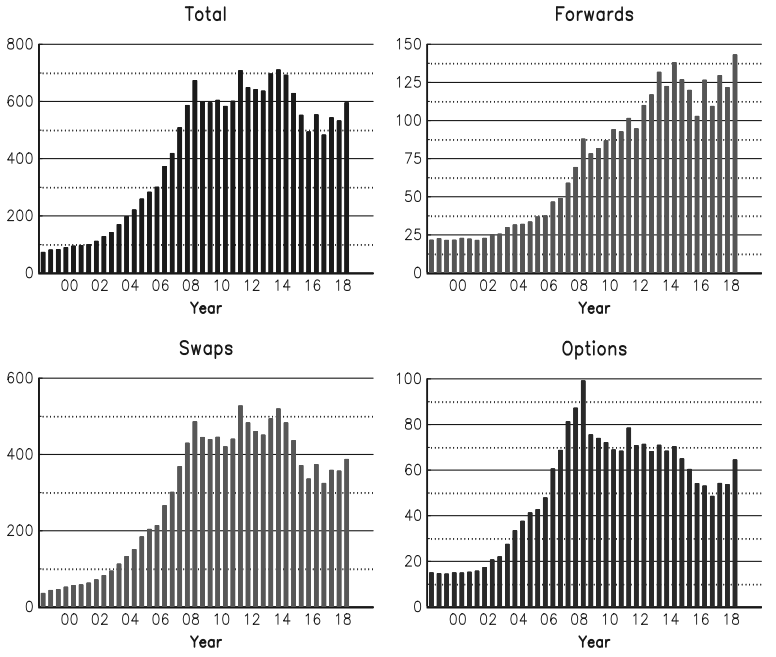

FIGURE 1.2: Notional outstanding amount of OTC derivatives (in $ tn)

Source: Bank for International Settlements (2019).

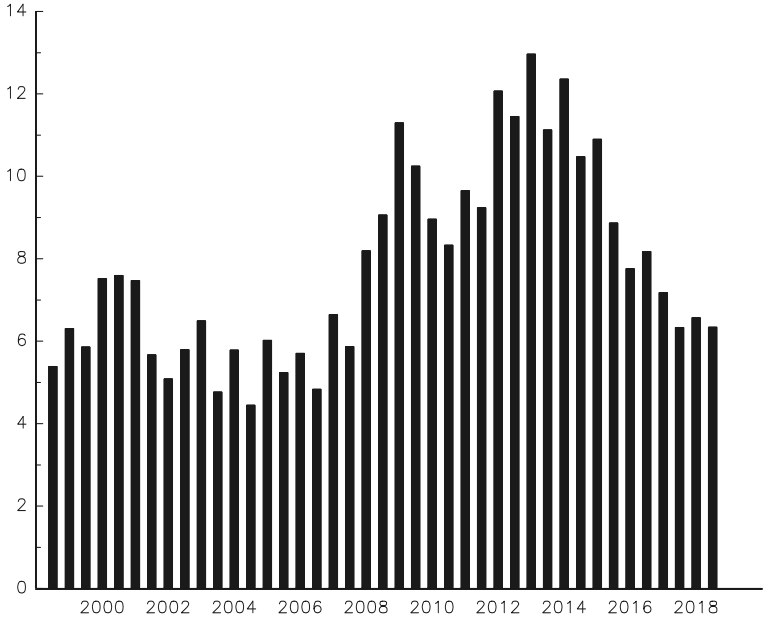

FIGURE 1.3: Ratio OTC derivatives/exchange-traded derivatives

Source: Bank for International Settlements (2019).

of market risk: equity risk, interest rate risk, currency risk and commodity risk. These risks are present in trading activities, but they also affect all activities that use financial assets. Credit risk is the risk of losses due to the default of a counterparty to fulfill its contractual obligations, that is to make its required payments. It principally concerns debt transactions such as loans and bonds. Counterparty credit risk is another form of credit risk, but concerns the counterparty of OTC transactions. Examples include swaps and options, security lending or repo transactions. Operational risk is the risk of losses resulting from inadequate or failed internal processes, people and systems, or from external events. Examples of operational risk are frauds, natural disasters, business disruption, rogue trading, etc. Finally, liquidity risk is the risk of losses resulting from the failure of the financial institution to meet its obligations on time. This definition corresponds more to funding liquidity, but liquidity risk also concerns market liquidity, which is the cost to buy or sell assets on the market.

Box 2

An history of financial losses

1974	Herstatt Bank: \$620 mn (foreign exchange trading)
1994	Metallgesellschaft: \$1.3 bn (oil futures)
1994	Orange County: \$1.8 bn (reverse repo)
1994	Procter & Gamble: \$160 mn (ratchet swap)
1995	Barings Bank: \$1.3 bn (stock index futures)
1997	Natwest: \$127 mn (swaptions)
1998	LTCM: \$4.6 bn (liquidity crisis)
2001	Dexia Bank: \$270 mn (corporate bonds)
2006	Amaranth Advisors: \$6.5 bn (gaz forward contracts)
2007	Morgan Stanley: \$9.0 bn (credit derivatives)
2008	Société Générale: \$7.2 bn (rogue trading)
2008	Madoff: \$65 bn (fraud)
2011	UBS: \$2.0 bn (rogue trading)
2012	JPMorgan Chase: \$5.8 bn (credit derivatives)

Source: Jorion (2007) and author's research.

In Box 2, we have reported some famous financial losses. Most of them are related to the market risk or the operational risk[10]. In this case, these losses are said to be idiosyncratic because they are specific to a financial institution. Idiosyncratic risk is generally opposed to systemic risk: systemic risk refers to the system whereas idiosyncratic risk refers to an entity of the system. For instance, the banking system may collapse, because many banks may be affected by a severe common risk factor and may default at the same time. In financial theory, we generally make the assumption that idiosyncratic and common risk factors are independent. However, there exist some situations where idiosyncratic risk may affect the system itself. It is the case of large financial institutions, for example the default of big banks. In this situation, systemic risk refers to the propagation of a single bank distressed risk to the other banks.

[10]We have excluded the credit risk losses due to the 2008 global financial crisis. Even if the true cost of this crisis will never be known, it is very high, certainly larger than \$10 tn.

The case of Herstatt Bank is an example of an idiosyncratic risk that could result in a systemic risk. Herstatt Bank was a privately German bank. On 26 June 1974, the German Banking Supervisory Office withdrew Herstatt's banking licence after finding that the bank's foreign exchange exposures amounted to three times its capital (BCBS, 2014d). This episode of settlement risk caused heavy losses to other banks, adding a systemic dimension to the individual failure of Herstatt Bank. In response to this turmoil, the central bank governors of the G10 countries established the Basel Committee on Banking Supervision at the end of 1974 with the aim to enhance the financial stability at the global level.

Even if the default of a non-financial institution is a dramatic event for employees, depositors, creditors and clients, the big issue is its impact on the economy. Generally, the failure of a company does not induce a macro-economic stress and is well located to a particular sector or region. For instance, the decade of the 2000s had faced a lot of bankruptcies, e.g. Pacific Gas and Electric Company (2001), Enron (2001), WorldCom (2002), Arthur Andersen (2002), Parmalat (2003), US Airways (2004), Delta Air Lines (2005), Chrysler (2009), General Motors (2009) and LyondellBasell (2009). However, the impact of these failures was contained within the immediate environment of the company and was not spread to the rest of the economy.

In the financial sector, the issue is different because of the interconnectedness between the financial institutions and the direct impact on the economy. And the issue is especially relevant that the list of bankruptcies in finance is long including, for example: Barings Bank (1995); HIH Insurance (2001); Conseco (2002); Bear Stearns (2008), Lehman Brothers (2008); Washington Mutual (2008); DSB Bank (2008). The number of banking and insurance distresses is even more impressive, for example: Northern Rock (2007); Countrywide Financial (2008); Indy Mac Bank (2008); Fannie Mae/Freddie Mac (2008); Merrill Lynch (2008); AIG (2008); Wachovia (2008); Depfa Bank (2008); Fortis (2009); Icelandic banks (2008-2010); Dexia (2011). In Figure 1.4, we report the number of bank failures computed by the Federal Deposit Insurance Corporation (FDIC), the organization in charge of insuring depositors in the US. We can clearly identify three periods of massive defaults[11]: 1935-1942, 1980-1994 and 2008-2014. Each period corresponds to a banking crisis[12] and lasts long because of delayed effects. Whereas the 1995–2007 period is characterized by a low default rate with no default in 2005–2006, there is a significant number of bank defaults these last years (517 defaults between 2008 and 2014).

The Lehman Brothers collapse is a case study for understanding the systemic risk. Lehman Brothers filed for Chapter 11 bankruptcy protection on 15 September 2008 after incurring heavy credit and market risk losses implied by the US subprime mortgage crisis. The amount of losses is generally estimated to be about \$600 bn, because Lehman Brothers had at this time \$640 bn in assets and \$620 bn in debt. However, the cost for the system is far greater than this figure. On equity markets, about \$10 tn went missing in October 2008. The post-Lehman Brothers default period (from September to December 2008) is certainly one of the most extreme liquidity crisis experienced since many decades. This forced central banks to use unconventional monetary policy measures by implementing quantitative easing (QE) programmes. For instance, the Fed now holds more than five times the amount of securities it had prior before September 2008. The collapse of Lehman Brothers had a huge impact on the banking industry, but also on the asset management industry. For instance, four days after the Lehman Brothers bankruptcy, the US government extended temporary guarantee on money market funds. At the same time, the hedge fund industry suffered a lot because of the stress on the financial markets, but also because Lehman Brothers served as prime broker for many hedge funds.

[11] We define these periods when the yearly number of defaults is larger than 15.
[12] They are the Great Depression, the savings and loan crisis of the 1980s and the subprime crisis.

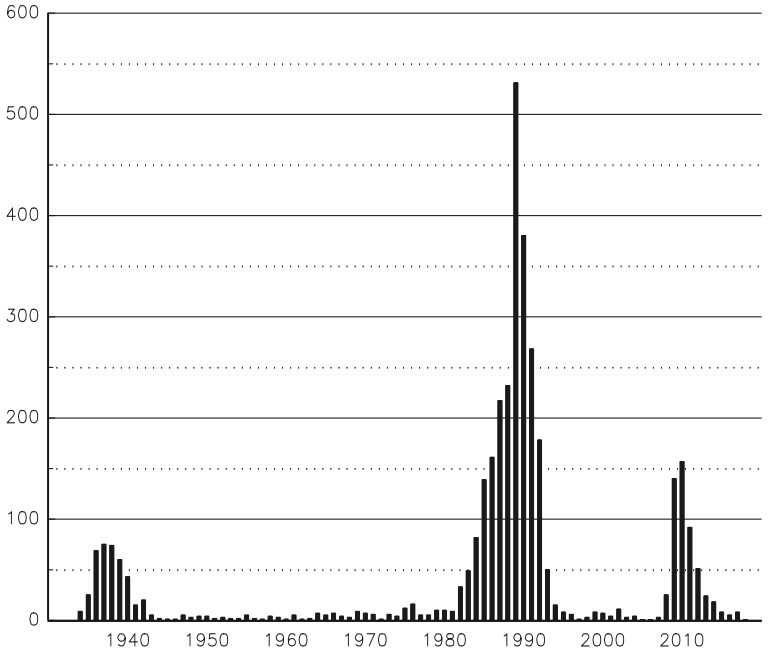

FIGURE 1.4: Number of bank defaults in the US

Source: Federal Deposit Insurance Corporation, Historical Statistics on Banking – Failures & Assistance Transactions, `www.fdic.gov/bank/individual/failed`.

The 2008 Global Financial Crisis also demonstrated that banks are not the only layer of systemic risk. In fact, a systemic risk implies that the entire financial system is seriously affected, but also participates to the creation of this risk:

> "*[...] there are both old and new components in both the origins and the propagation of the subprime shock. Old components include government financial subsidies for bearing risk, accommodative monetary policy, and adverse selection facilitated by asymmetric information. New components include the central role of agency problems in asset management, the ability of financial institutions to raise new capital from external sources, the activist role of the United States Treasury Department and Federal Reserve, and improvements in U.S. financial system diversification resulting from deregulation, consolidation, and globalization*" (Calomiris, 2009, page 6).

This implies that all financial components, and not only the banking system, can potentially be a source of systemic risk. This is why the bankruptcy of a financial institution cannot be compared to the bankruptcy of a corporate company. Nevertheless, because of the nature of the systemic risk, it is extremely difficult to manage it directly. This explains that the financial supervision is principally a micro-prudential regulation at the firm level. This is only recently that it has been completed by macro-prudential policies in order to mitigate the risk of the financial system as a whole. While the development of risk management was principally due to the advancement of internal models before the 2008 financial crisis, it is now driven by the financial regulation, which completely reshapes the finance industry.

1.2 Financial regulation

The purpose of supervision and regulatory capital has been to control the riskiness of individual banks and to increase the stability of the financial system. As explained in the previous section, it is a hard task whose bounds are not well defined. Among all the institutions that are participating to this work (see Table 1.3), four international authorities have primary responsibility of the financial regulation:

1. The Basel Committee on Banking Supervision (BCBS)
2. The International Association of Insurance Supervisors (IAIS)
3. The International Organization of Securities Commissions (IOSCO)
4. The Financial Stability Board (FSB)

The Basel Committee on Banking Supervision provides a forum for regular cooperation on banking supervisory matters. Its main objective is to improve the quality of banking supervision worldwide. The International Association of Insurance Supervisors is the equivalent of the Basel Committee for the insurance industry. Its goal is to coordinate local regulations and to promote a consistent and global supervision for insurance companies. The International Organization of Securities Commissions is the international body that develops and implements standards and rules for securities and market regulation. While these three authorities are dedicated to a specific financial industry (banks, insurers and markets), the FSB is an international body that makes recommendations about the systemic risk of the global financial system. In particular, it is in charge of defining systemically important financial institutions or SIFIs. Among those different regulators, the BCBS is by far the most active and the banking regulation is certainly the most homogeneous between countries.

These four international bodies define standards at the global level and promote convergence between local supervision. The implementation of the rules is the responsibility of national supervisors or regulators[13]. In the case of the European Union, they are the European Banking Authority (EBA), the European Insurance and Occupational Pensions Authority (EIOPA), the European Securities and Markets Authority (ESMA) and the European System of Financial Supervision (ESFS). A fifth authority, the European Systemic Risk Board (ESRB), completes the European supervision system.

The equivalent authorities in the US are the Board of Governors of the Federal Reserve System, also known as the Federal Reserve Board (FRB), the Federal Insurance Office (FIO) and the Securities and Exchange Commission (SEC). In fact, the financial supervision is more complicated in the US as shown by Jickling and Murphy (2010). The supervisor of banks is traditionally the Federal Deposit Insurance Corporation (FDIC) for federal banks and the Office of the Comptroller of the Currency (OCC) for national banks. However, the Dodd-Frank Act created the Financial Stability Oversight Council (FSOC) to monitor systemic risk. For banks and other financial institutions designated by the FSOC as SIFIs, the supervision is directly done by the FRB. The supervision of markets is shared between the SEC and the Commodity Futures Trading Commission (CFTC), which supervises derivatives trading including futures contracts and options[14].

[13]The regulator is responsible of setting rules and policy guidelines. The supervisor evaluates the safety and soundness of individual banks and verifies that the regulation rules are applied. In Europe, the regulator is EBA while the supervisor is ECB.

[14]A complete list of supervisory authorities by countries are provided on page 28.

TABLE 1.3: The supervision institutions in finance

	Banks	Insurers	Markets	All sectors
Global	BCBS	IAIS	IOSCO	FSB
EU	EBA/ECB	EIOPA	ESMA	ESFS
US	FDIC/FRB	FIO	SEC	FSOC

1.2.1 Banking regulation

The evolution of the banking supervision has highly evolved since the end of the eighties. Here are the principal dates:

1988 Publication of "*International Convergence of Capital Measurement and Capital Standards*", which is better known as "*The Basel Capital Accord*". This text sets the rules of the Cooke ratio.

1993 Development of the Capital Adequacy Directive (CAD) by the European Commission.

1996 Publication of "*Amendment to the Capital Accord to incorporate Market Risks*". This text includes the market risk to compute the Cooke ratio.

2001 Publication of the second consultative document "*The New Basel Capital Accord*" of the Basel II framework.

2004 Publication of "*International Convergence of Capital Measurement and Capital Standards – A Revisited Framework*". This text establishes the Basel II framework.

2006 Implementation of the Basel II framework.

2010 Publication of the Basel III framework.

2013 Beginning of the implementation of the Basel III framework. Its finalization is expected for January 2027.

2017 Finalization of Basel III reforms.

2019 Publication of "*Minimum Capital Requirements for Market Risk*". This is the final version of the Basel III framework for computing the market risk.

This list places the three Basel Accords within a timeframe. However, it gives a misleading image of the banking supervision dynamics. In order to have a better view, we have reported the cumulative number of standards[15] that have been published by the Basel Committee on Banking Supervision in Figure 1.5.

In 1988, the Basel Committee introduced the Cooke ratio[16], which is the minimum amount of capital a bank should maintain in case of unexpected losses. Its goal is to:

- provide an adequation between the capital held by the bank and the risk taken by the bank;
- enhance the soundness and stability of the banking system;
- and reduce the competitive inequalities between banks[17].

[15] They can be found by using the website of the BCBS: `https://www.bis.org/bcbs/publications.htm` and selecting the publication type '*Standards*'.

[16] This ratio took the name of Peter Cooke, who was the Chairman of the BCBS between 1977 and 1988.

[17] This was particularly true between Japanese banks, which were weakly capitalized, and banks in the US and Europe.

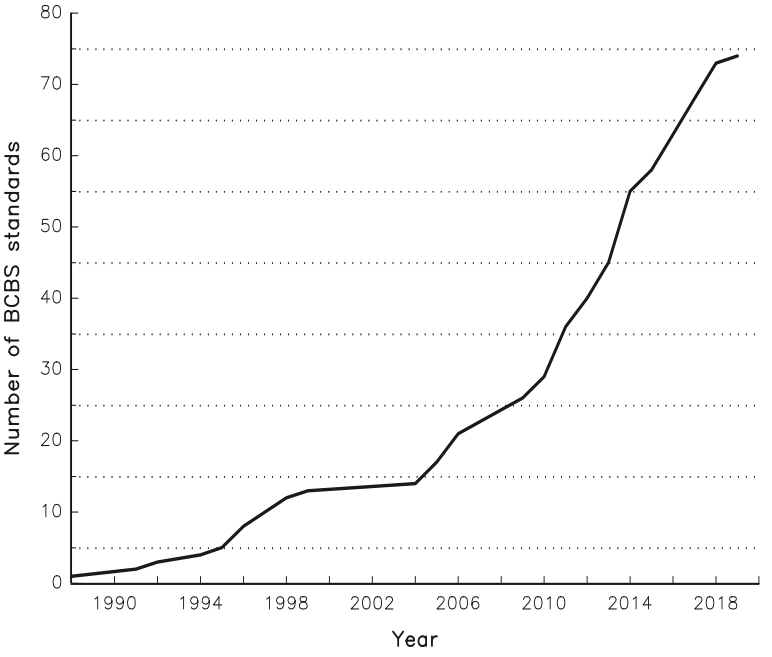

FIGURE 1.5: The huge increase of the number of banking supervision standards

Source: Basel Committee on Banking Supervision and author's calculations.

It is measured as follows:

$$\text{Cooke Ratio} = \frac{C}{\text{RWA}}$$

where C and RWA are the capital and the risk-weighted assets of the bank. A risk-weighted asset is simply defined as a bank's asset weighted by its risk score or risk weight (RW). Because bank's assets are mainly credits, the notional is generally measure by the exposure at default (EAD). To compute risk-weighted assets, we then use the following formula:

$$\text{RWA} = \text{EAD} \cdot \text{RW}$$

The original Basel Accord only considers credit risk and classifies bank's exposures into four categories depending on the value of the risk weights[18] (0%, 20%, 50% and 100%). Concerning off-balance sheet exposures, engagements are converted to credit risk equivalents by multiplying the nominal amount by a credit conversion factor (CCF) and the resulting amounts are risk-weighted according to the nature of the counterparty. Concerning the numerator of the ratio, the Basel Committee distinguishes tier 1 capital and tier 2 capital. Tier 1 capital[19] (or core capital) is composed of (1) common stock (or paid-up share

[18]These categories are defined as follows: (1) cash, gold, claims on OECD governments and central banks, claims on governments and central banks outside OECD and denominated in the national currency are risk-weighted at 0%; (2) claims on all banks with a residual maturity lower than one year, longer-term claims on OECD incorporated banks, claims on public-sector entities within the OECD are weighted at 20%; (3) loans secured on residential property are risk-weighted at 50%; (4) longer-term claims on banks incorporated outside the OECD, claims on commercial companies owned by the public sector, claims on private-sector commercial enterprises are weighted at 100%.

[19]At least 50% of the tier 1 capital should come from the common equity.

capital) and (2) disclosed reserves (or retained earnings), whereas tier 2 capital represents supplementary capital such as[20] (1) undisclosed reserves, (2) asset revaluation reserves, (3) general loan-loss reserves (or general provisions), (4) hybrid debt capital instruments and (5) subordinated debt. The Cooke ratio required a minimum capital ratio of 8% when considering both tier 1 and tier 2 capital, whereas tier 1 capital ratio should be at least half of the total capital or 4%.

Example 1 *The assets of a bank are composed of \$100 mn of US treasury bonds, \$100 mn of Brazilian government bonds, \$50 mn of residential mortgage, \$300 mn of corporate loans and \$20 mn of revolving credit loans. The bank liability structure includes \$25 mn of common stock and \$13 mn of subordinated debt.*

For each asset, we compute the RWA by choosing the right risk weight factor. We obtain the following results:

Asset	EAD	RW	RWA
US treasury bonds	100	0%	0
Brazilian Gov. bonds	100	100%	100
Residential mortgage	50	50%	25
Corporate loans	300	100%	300
Revolving credit	20	100%	20
Total			445

The risk-weighted assets of the bank are then equal to \$445 mn. We deduce that the capital adequacy ratio is:

$$\text{Cooke Ratio} = \frac{38}{445} = 8.54\%$$

This bank meets the regulatory requirements, because the Cooke ratio is higher than 8% and the tier 1 capital ratio[21] is also higher than 4%. Suppose now that the capital of the bank consists of \$13 mn of common stock and \$25 mn of subordinated debt. In this case, the bank does not satisfy the regulatory requirements, because the tier 2 capital cannot exceed the tier 1 capital, meaning that the Cooke ratio is equal to 8.54% and the capital tier 1 ratio is equal to 2.92%.

The Basel Accord, which has been adopted by more than 100 countries, has been implemented in the US by the end of 1992 and in Europe in 1993. In 1996, the Basel Committee published a revision of the original Accord by incorporating market risk. This means that banks have to calculate capital charges for market risk in addition to the credit risk. The major difference with the previous approach to measure credit risk is that banks have the choice between two methods for applying capital charges for the market risk:

- the standardized measurement method (SMM);
- the internal model-based approach[22] (IMA).

Within the SMM, the bank apply a fixed capital charge for each asset. The market risk requirement is therefore the sum of the capital charges for all the assets that compose the bank's portfolio. With IMA, the bank estimates the market risk capital charge by computing the 99% value-at-risk of the portfolio loss for a holding period of 10 trading days. From a

[20] The comprehensive definitions and restrictions to define all the elements of capital are defined in Appendix 1 in BCBS (1988).

[21] The tier 1 capital ratio is equal to $25/445 = 5.26\%$.

[22] The use of the internal model-based approach is subject to the approval of the national supervisor.

statistical point of view, the value-at-risk[23] with a confidence level α is defined as the quantile α associated to the probability distribution of the portfolio loss (see Figure 1.6).

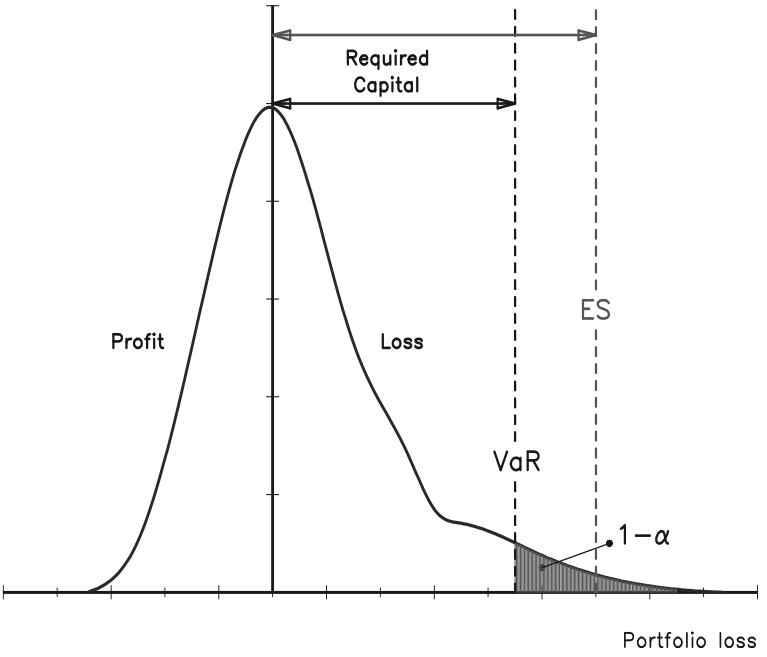

FIGURE 1.6: Probability distribution of the portfolio loss

Another difference with credit risk is that the bank directly computes the market risk capital requirement $\mathcal{K}_{\text{MR}}$ with these two approaches[24]. Therefore, the Cooke ratio becomes[25]:

$$\frac{C_{\text{Bank}}}{\text{RWA} + 12.5 \times \mathcal{K}_{\text{MR}}} \geq 8\%$$

We deduce that:

$$C_{\text{Bank}} \geq \underbrace{8\% \times \text{RWA}}_{\mathcal{K}_{\text{CR}}} + \mathcal{K}_{\text{MR}}$$

meaning that $8\% \times \text{RWA}$ can be interpreted as the credit risk capital requirement $\mathcal{K}_{\text{CR}}$, which can be compared to the market risk capital charge $\mathcal{K}_{\text{MR}}$.

Example 2 *We consider Example 1 and assume that the bank has a market risk on an equity portfolio of* \$25 *mn. The corresponding risk capital charge for a long exposure on a diversified portfolio of stocks is equal to* 12%. *Using its internal model, the bank estimates that the* 99% *quantile of the portfolio loss is equal to* \$1.71 *mn for a holding period of* 10 *days.*

[23]In the Basel III framework, the expected shortfall, which is defined as the average loss beyond the value-at-risk, replaces the value-at-risk for computing the market risk.

[24]We use the symbols C and $\mathcal{K}$ in order to make the distinction between the capital of the bank and the regulatory capital requirement.

[25]When considering market risk, the total capital may include tier 3 capital, consisting of short-term subordinated debt with an original maturity of at least 2 years.

In the case of the standardized measurement method, the market risk capital requirement is equal to \$3 mn[26]. The capital ratio becomes:

$$\text{Cooke Ratio} = \frac{25}{445 + 12.5 \times 3} = 7.88\%$$

In this case, the bank does not meet the minimum capital requirement of 8%. If the bank uses its internal model, the Cooke ratio is satisfied:

$$\text{Cooke Ratio} = \frac{25}{445 + 12.5 \times 1.71} = 8.15\%$$

The Basel Accord has been highly criticized, because the capital charge for credit risk is too simplistic and too little risk sensitive: limited differentiation of credit risk, no maturity, granularity of risk weights, etc. These resulted in regulatory arbitrage through the use of securitization between assets with same regulatory risk but different economic risk. In June 1999, the Basel Committee produced an initial consultative document with the objective to replace the 1988 Accord by a new capital adequacy framework. This paper introduces some features about Basel II, but this is really the publication of the second consultative paper in January 2001 that marks a milestone for the banking regulation. Indeed, the 2001 publication is highly detailed and comprehensive, and the implementation of this new framework seemed very complex at that time. The reaction of the banking industry was negative and somehow hostile at the beginning, in particular because the Basel Committee introduced a third capital charge for operational risk besides credit and market risks and the implementation costs were very high. It has taken a long time until the Basel Committee and the banking industry converge to an accord. Lastly, the finalized Basel II framework is published in June 2004.

TABLE 1.4: The three pillars of the Basel II framework

Pillar 1 Minimum Capital Requirements	Pillar 2 Supervisory Review Process	Pillar 3 Market Discipline
Credit risk Market risk Operational risk	Review & reporting Capital above Pillar 1 Supervisory monitoring	Capital structure Capital adequacy Models & parameters Risk management

As illustrated in Table 1.4, the new Accord consists of three pillars:

1. the first pillar corresponds to *minimum capital requirements*, that is, how to compute the capital charge for credit risk, market risk and operational risk;
2. the second pillar describes the *supervisory review process*; it explains the role of the supervisor and gives the guidelines to compute additional capital charges for specific risks, which are not covered by the first pillar;

[26] We have:

$$\boldsymbol{\mathcal{K}}_{\text{MR}} = 12\% \times 25 = 3$$

3. the *market discipline* establishes the third pillar and details the disclosure of required information regarding the capital structure and the risk exposures of the bank.

Regarding the first pillar, the Cooke ratio becomes:

$$\frac{C_{\text{Bank}}}{\text{RWA} + 12.5 \times \boldsymbol{\mathcal{K}}_{\text{MR}} + 12.5 \times \boldsymbol{\mathcal{K}}_{\text{OR}}} \geq 8\%$$

where $\boldsymbol{\mathcal{K}}_{\text{OR}}$ is the capital charge for operational risk. This implies that the required capital is directly computed for market risk and operational risk whereas credit risk is indirectly measured by risk-weighted assets[27].

Example 3 *We assume that the risk-weighted assets for the credit risk are equal to \$500 mn, the capital charge for the market risk is equal to \$10 mn and the capital charge for the operational risk is equal to \$3 mn.*

We deduce that the required capital for the bank is:

$$\begin{aligned}
\boldsymbol{\mathcal{K}} &= 8\% \times (\text{RWA} + 12.5 \times \boldsymbol{\mathcal{K}}_{\text{MR}} + 12.5 \times \boldsymbol{\mathcal{K}}_{\text{OR}}) \\
&= 8\% \times \text{RWA} + \boldsymbol{\mathcal{K}}_{\text{MR}} + \boldsymbol{\mathcal{K}}_{\text{OR}} \\
&= 8\% \times 500 + 10 + 3 \\
&= \$53 \text{ mn}
\end{aligned}$$

This implies that credit risk represents 75.5% of the total risk.

With respect to the original Accord, the Basel Committee did not change the market risk approach whereas it profoundly changed the methods to compute the capital charge for the credit risk. Two approaches are proposed:

- The standardized approach (SA)
  This approach, which is more sensitive than Basel I, is based on external ratings provided by credit rating agencies. The capital charge is computed by considering a mapping function between risk weights and credit ratings.

- The internal ratings-based approach (IRB)
  This approach can be viewed as an external risk model with internal and external risk parameters. The key parameter is the default probability of the asset, which is deduced from the internal credit rating model of the bank. The Basel Committee makes the distinction between two methods. In the foundation IRB (FIRB), the bank only estimates the probability of default and uses standard values for the other risk parameters of the model. In the advanced IRB (AIRB), the bank may estimate all the risk parameters.

Regarding operational risk, the Basel Committee propose three approaches to compute the required capital:

- The Basic Indicator Approach (BIA)
  In this case, the capital charge is a fixed percentage of the gross income.

- The Standardized Approach (TSA)
  This method consists of dividing bank's activities into eight business lines. For each business line, the capital charge is a fixed percentage β of its gross income. The parameter β depends on the riskiness of the business line. The total capital is the sum of the eight regulatory capital charges.

[27] In fact, we can define risk-weighted assets for each category of risk. We have the following relationships $\text{RWA}_{\mathcal{R}} = 12.5 \times \boldsymbol{\mathcal{K}}_{\mathcal{R}}$ and $\boldsymbol{\mathcal{K}}_{\mathcal{R}} = 8\% \times \text{RWA}_{\mathcal{R}}$ where $\boldsymbol{\mathcal{K}}_{\mathcal{R}}$ is the required capital for the risk $\mathcal{R}$. The choice of defining either $\text{RWA}_{\mathcal{R}}$ or $\boldsymbol{\mathcal{K}}_{\mathcal{R}}$ is a mere convention.

- Advanced Measurement Approaches (AMA)
  In this approach, the bank uses a statistical model with internal data for estimating the total capital.

A summary of the different options is reported in Figure 1.7.

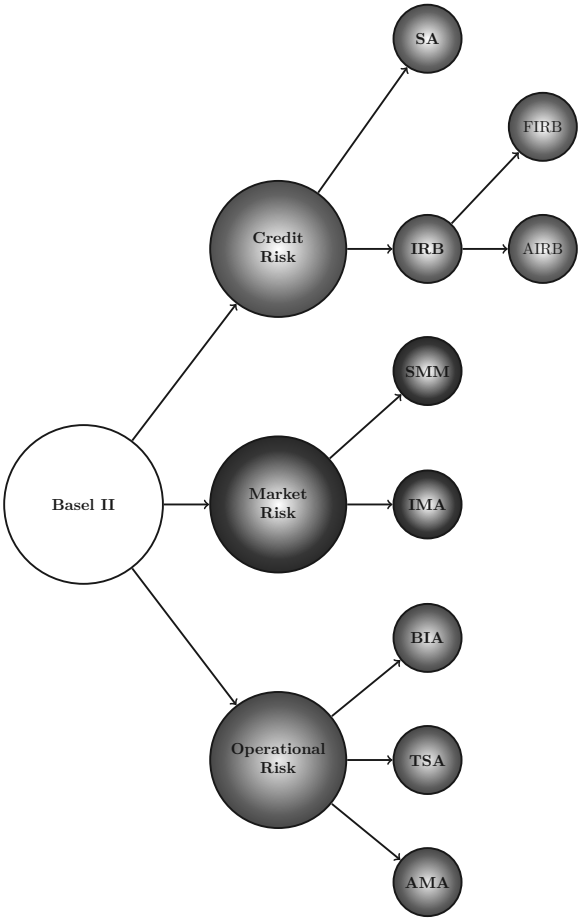

FIGURE 1.7: Minimum capital requirements in the Basel II framework

The European Union has adopted the Basel II framework in June 2006 with the capital requirements directive[28] (CRD). In the United States, Basel II is partially applied since 2006 and only concerns the largest banking institutions (Getter, 2014). Since the 2004 publication, more than 40 countries have fully implemented Basel II (Hong Kong in January 2007, Japan in March 2007, Canada in November 2007, South Korea in December 2007, Australia in January 2008, South Africa in January 2008, etc.). However, the subprime crisis in 2007 and the collapse of Lehman Brothers in September 2008 illustrated the limits of the New Accord concerning the issues of leverage and liquidity. In response to the financial market crisis, the Basel Committee enhances then the New Accord by issuing a set of documents between 2009 and 2010. In July 2009, the Basel Committee approved a package of measures to strengthen the rules governing trading book capital, particularly the market risk associated

[28]It replaces CAD II (or the 98/31/EEC directive), which is the revision of the original CAD and incorporates market risk.

to securitization and credit-related products. Known as the Basel 2.5 framework, these new rules can be summarized into four main elements, which are:

1. the incremental risk charge (IRC), which is an additional capital charge to capture default risk and migration risk for unsecuritized credit products;
2. the stressed value-at-risk requirement (SVaR), which is intended to capture stressed market conditions;
3. the comprehensive risk measure (CRM), which is an estimate of risk in the credit correlation trading portfolio (CDS baskets, CDO products, etc.);
4. new standardized charges on securitization exposures, which are not covered by CRM.

In addition to these elements affecting the first pillar, the Basel Committee also expands the second pillar (largest exposures and risk concentrations, remuneration policies, governance and risk management) and enhances the third pillar (securitization and re-securitization exposures). The coming into force of Basel 2.5 was December 2011 in the European Union[29] and January 2013 in the United States (BCBS, 2015b).

In December 2010, the Basel Committee published a new regulatory framework in order to enhance risk management, increase the stability of the financial markets and improve the banking industry's ability to absorb macro-economic shocks. The Basel III framework consists of micro-prudential and macro-prudential regulation measures concerning;

- a new definition of the risk-based capital;
- the introduction of a leverage ratio;
- the management of the liquidity risk.

The capital is redefined as follows. Tier 1 capital is composed of common equity tier 1 capital (common equity and retained earnings or CET1) and additional tier 1 capital (AT1). The new capital ratios are 4.5% for CET1, 6% for tier 1 and 8% for total capital (T1 + T2). Therefore, Basel III gives preference to tier 1 capital rather than tier 2 capital whereas the tier 3 risk capital is eliminated. BCBS (2010) introduced also a surplus of CET1, which is "*designed to ensure that banks build up capital buffers outside periods of stress which can be drawn down as losses are incurred*". This capital conservation buffer (CB), which is equal to 2.5% of RWA, applies at all the times outside periods of stress. The aim is to reduce the distribution of earnings and to support the business of bank through periods of stress. A macro-prudential approach completes capital requirements by adding a second capital buffer called the countercyclical capital buffer (CCB). During periods of excessive credit growth, national authorities may require an additional capital charge between 0% and 2.5%, which increases the CET1 ratio until 9.5% (including the conservation buffer). The underlying idea is to smooth the credit cycle, to reduce the procyclicality and to help banks to provide credit during bad periods of economic growth. The implementation of this new framework is progressive from April 2013 until March 2019. A summary of capital requirements[30] and transitional periods is given in Table 1.5.

This new definition of the capital is accompanied by a change of the required capital for counterparty credit risk (CCR). In particular, BCBS (2010) adds a credit valuation

[29] The Basel 2.5 framework was adopted in two stages: CRD II (or the 2009/111/EC directive) in November 2009 and CRD III (or the 2010/76/EU directive) in December 2010.

[30] Basel III defines a third capital buffer for systemic banks, which can vary between 1% and 3.5%. This topic will be presented later on the paragraph dedicated to systemically important financial institutions on page 26.

TABLE 1.5: Basel III capital requirements

Capital ratio	2013	2014	2015	2016	2017	2018	2019
CET1	3.5%	4.0%	4.5%				**4.5**%
CB				0.625%	1.25%	1.875%	**2.5**%
CET1 + CB	3.5%	4.0%	4.5%	5.125%	5.75%	6.375%	**7.0**%
Tier 1	4.5%	5.5%	6.0%				**6.0**%
Total	8.0%						**8.0**%
Total + CB	8.0%			8.625%	9.25%	9.875%	**10.5**%
CCB	**0**% − **2.5**%						

Source: Basel Committee on Banking Supervision, `www.bis.org/bcbs/basel3.htm`.

adjustment charge (CVA) for OTC derivative trades. CVA is defined as the market risk of losses caused by changes in the credit spread of a counterparty due to changes in its credit quality. It also corresponds to the market value of counterparty credit risk.

Basel III also includes a leverage ratio to prevent the build-up of excessive on- and off-balance sheet leverage in the banking sector. BCBS (2014a) defines this ratio as follows:

$$\text{Leverage ratio} = \frac{\text{Tier 1 capital}}{\text{Total exposures}} \geq 3\%$$

where the total exposures is the sum of on-balance sheet exposures, derivative exposures and some adjustments concerning off-balance sheet items. The leverage ratio can be viewed as the second macro-prudential measure of Basel III. Indeed, during credit boom, we generally observe compression of risk weight assets and a growth of the leverage, because the number of profitable projects increases during economic good times. For instance, Brei and Gambacorta (2014) show that the Basel III leverage ratio is negatively correlated with GDP or credit growth. By introducing a floor value, the Basel Committee expects that the leverage ratio will help to reduce the procyclicality like the countercyclical capital buffer.

The management of the liquidity is another important issue of Basel III. The bankruptcy of Lehman Brothers was followed by a lack of liquidity, which is one of the main sources of systemic risk. For instance, Brunnermeier and Pedersen (2009) demonstrated that a liquidity dry-up event arising from a fight-to-quality environment can result in runs, fire sales, and asset liquidations in general transforming the market into a contagion mechanism. In order to prevent such events, the Basel Committee proposed several liquidity rules and introduced in particular two liquidity ratios: the liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR). The objective of the LCR is to promote short-term resilience of the bank's liquidity risk profile. It is expressed as:

$$\text{LCR} = \frac{\text{HQLA}}{\text{Total net cash outflows}} \geq 100\%$$

where HQLA is the stock of high quality liquid assets and the denominator is the total net cash outflows over the next 30 calendar days. Therefore, the LCR is designed to ensure that the bank has the necessary assets to face a one-month stressed period of outflows. On the contrary, NSFR is designed in order to promote long-term resilience of the bank's liquidity profile. It is defined as the amount of available stable funding (ASF) relative to the amount of required stable funding (RSF):

$$\text{NSFR} = \frac{\text{Available amount of stable funding}}{\text{Required amount of stable funding}} \geq 100\%$$

The amount of available stable funding is equal to the regulatory capital[31] plus the other liabilities to which we apply a scaling factor between 0% and 100%. The amount of required stable funding is the sum of two components: risk-weighted assets and off-balance sheet exposures.

The implementation of Basel III was due to January 2013, but some countries have delayed the adoption of the full package. According to BCBS (2015b), the rules for risk-based capital are more adopted than those concerning the liquidity ratio or the leverage ratio. In the US, the rules for risk-based capital and the leverage ratio are effective since January 2014, while the LCR rule came into effect in January 2015. In the European Union, the Basel III agreement is transposed on July 2013 into two texts: the CRD IV (or the 2013/36/EU directive) and the capital requirements regulation (CRR) (or the 575/2013 EU regulation). Therefore, Basel III is effective since January 2014 for the rules of risk-based capital and leverage ratio and October 2015 for the LCR rule.

Even before Basel III is fully implemented, the Basel Committee has published a set of consultative documents, which has been viewed as the basis of a future Basel IV Accord. The guiding principle of these works is to simplify the different approaches to compute the regulatory capital and to reduce the risk of arbitrage between standardized and advanced methods. These new proposals concern review of the market risk measurement (BCBS, 2013b, 2014h, 2016a), revision to the standardized approach for credit (BCBS, 2015d) and operational risks (BCBS, 2014f, 2016b), minimum capital requirements for interest rate risk in the banking book (BCBS, 2016d) and a modified framework for the CVA risk (BCBS, 2015c). Finally, the Basel Committee created in 2017 a surprise by announcing that all these reforms correspond to the finalization of the Basel III Accord. The changes are very significant. For instance, it replaces the VaR measure by the expected shortfall measure. The risk weight of residential real estate exposures will depend on the loan-to-value (LTV) ratio. It also imposes some constraints on the use of internal credit risk models, in particular the remove of the IRB approach for bank, large corporate and equity exposures. CVA requirements will be based on two approaches: SA-CVA and BA-CVA. For counterparty credit risk, the IMM-CCR method will be constrained by a floor with respect to the SA-CCR method. In the case of operational risk, the three approaches (BIA, TSA and AMA) are replaced by a unique approach called the Standardized Measurement Approach (SMA). For market risk, the boundary between trading book and banking book is changed, and the standard approach is fully revisited and is based on risk sensitivities. Finally, the interest rate risk of the banking book continues to be monitored in Pillar 2, but its measure is highly reinforced.

1.2.2 Insurance regulation

Contrary to the banking industry, the regulation in insurance is national. The International Association of Insurance Supervisors (IAIS) is an association to promote globally consistent supervision. For that, the IAIS is responsible for developing principles and standards, which form the Insurance Core Principles (ICP). For instance, the last release of ICP was in November 2018 and contained 26 ICPs[32]. However, its scope of intervention is more limited than this of the BCBS. In particular, the IAIS does not produce any methodologies of risk management or formula to compute risk-based capital. In Europe, the regulatory framework is the Solvency II directive (or the 2009/138/EC directive), which harmonizes the insurance regulation and capital requirements in the European Union. In the US, the

[31] Excluding tier 2 instruments with residual maturity of less than one year.

[32] ICP 1 concerns the objectives, powers and responsibilities of the supervisor, ICP 17 is dedicated to capital adequacy, ICP 24 presents the macro-prudential surveillance and insurance supervision, etc.

supervisor is the National Association of Insurance Commissioners (NAIC). In 2008, it has created a Solvency Modernization Initiative (SMI) in order to reform the current framework in the spirit of Solvency II. However, the convergence across the different jurisdictions is far to being reached.

Solvency I (or the 2002/13/EC directive) is a set of rules to define the insurance solvency regime and was put in place on January 2004 in the European Union. It defined how an insurance company should calculate its liabilities and the required capital. In this framework, the capital is the difference between the book value of assets and the technical provisions (or insurance liabilities). This capital is decomposed in the solvency capital requirement (or SCR) and the surplus (see Figure 1.8). One of the main drawbacks of Solvency I is that assets and liabilities are evaluated using an accounting approach (historical or amortized cost).

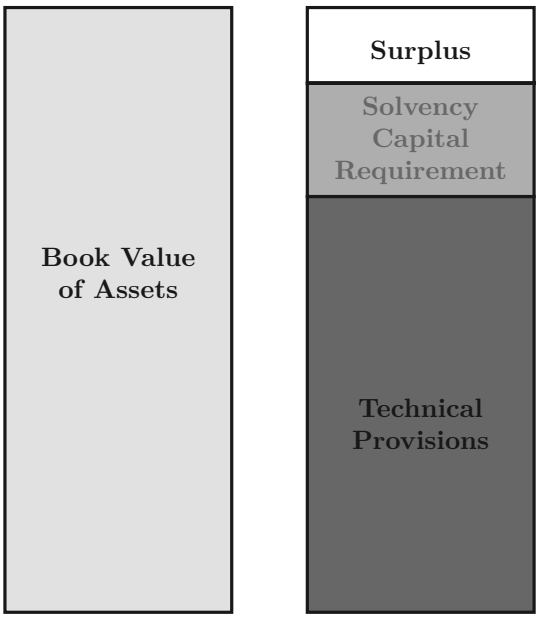

FIGURE 1.8: Solvency I capital requirement

In an address to the European Insurance Forum 2013, Matthew Elderfield, Deputy Governor of the Central Bank of Ireland, justifies the reform of the insurance regulation in Europe as follows:

> "*[...] it is unacceptable that the common regulatory framework for insurance in Europe in the 21st-century is not risk-based and only takes account, very crudely, of one side of the balance sheet. The European Union urgently needs a new regulatory standard which differentiates solvency charges based on the inherent risk of different lines of business and which provides incentives for enhanced risk management. It urgently needs a framework that takes account of asset risks in an insurance company. It urgently needs a framework that encourages better governance and management of risk. And it urgently needs a framework that provides better disclosure to market participants*" (Elderfield, 2013, page 1).

With Solvency II, capital requirements are then based on an economic valuation of the insurer balance sheet, meaning that:

- assets are valued at their market value;
- liabilities are valued on a best estimate basis.

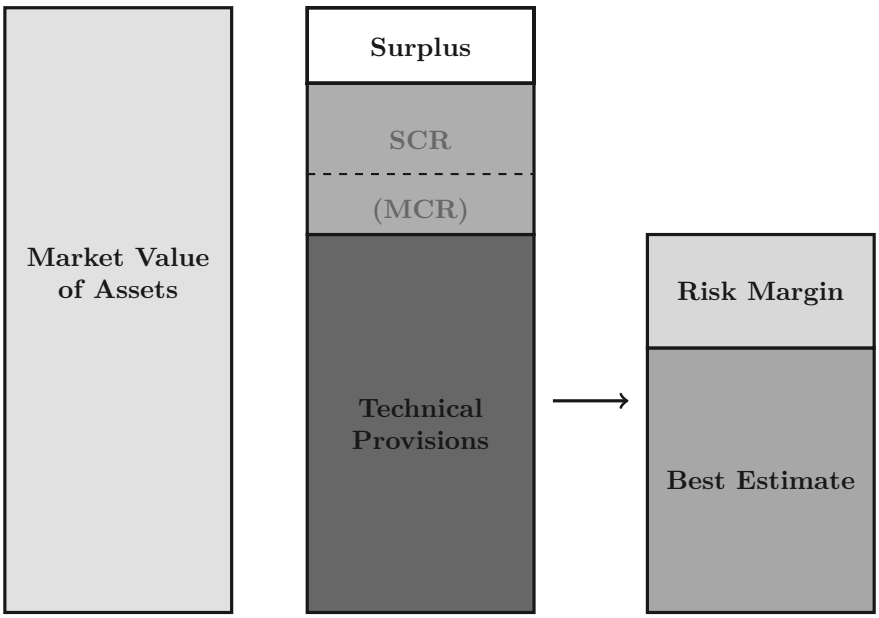

FIGURE 1.9: Solvency II capital requirement

In this framework, the economic value of liabilities corresponds to the expected present value of the future cash flows. Technical provisions are then the sum of the liabilities best estimate and a risk margin (or prudence margin) in order to take into account non-hedgeable risk components. Solvency II defines two levels of capital requirements. The minimum capital requirement (MCR) is the required capital under which risks are considered as being unacceptable. The solvency capital requirement (SCR) is the targeted required capital (SCR $\geq$ MCR). The underlying idea is to cover the different source of risk at a 99.5% confidence level[33] for a holding period of one year. The insurance company may opt for the standard formula or its own internal model for computing the required capital. In the case of the standard formula method, the SCR of the insurer is equal to:

$$\text{SCR} = \sqrt{\sum_{i,j}^{m} \rho_{i,j} \cdot \text{SCR}_i \cdot \text{SCR}_j} + \text{SCR}_{\text{OR}}$$

where SCR_i is the SCR of the risk module i, SCR_{OR} is the SCR associated to the operational risk and $\rho_{i,j}$ is the correlation factor between risk modules i and j. Solvency II considers several risk components: underwriting risk (non-life, life, health, etc.), market risk, default and counterpart credit risk[34]. For each risk component, a formula is provided to compute the SCR of the risk factors. Regarding the capital C, own funds are classified into basic own funds and ancillary own funds. The basic own funds consist of the excess of assets over

[33]It is set to 85% for the MCR.

[34]Solvency II is an ambitious and complex framework because it mixes both assets and liabilities, risk management and ALM.

liabilities, and subordinated liabilities. The ancillary own funds correspond to other items which can be called up to absorb losses. Examples of ancillary own funds are unpaid share capital or letters of credit and guarantees. Own funds are then divided into tiers depending on their permanent availability and subordination. For instance, tier 1 corresponds to basic own funds which are immediately available and fully subordinated. The solvency ratio is then defined as:

$$\text{Solvency Ratio} = \frac{C}{\text{SCR}}$$

This solvency ratio must be larger than 33% for tier 1 and 100% for the total own funds.

The quantitative approach to compute MCR, SCR and the technical provisions define Pillar 1 (Figure 1.9). As in Basel II framework, it is completed by two other pillars. Pillar 2 corresponds to the governance of the solvency system and concerns qualitative requirements, rules for supervisors and own risk and solvency assessment (ORSA). Pillar 3 includes market disclosures and also supervisory reporting.

1.2.3 Market regulation

Banks and insurers are not the only financial institutions that are regulated and the financial regulatory framework does not reduce to Basel III and Solvency II. In fact, a whole variety of legislation measures helps to regulate the financial market and the participants.

In Europe, the markets in financial instruments directive or MiFID[35] came in force since November 2007. Its goal was to establish a regulatory framework for the provision of investment services in financial instruments (such as brokerage, advice, dealing, portfolio management, underwriting, etc.) and for the operation of regulated markets by market operators. The scope of application concerns various aspects such as passporting, client categorization (retail/professional investor), pre-trade and post-trade transparency or best execution procedures. In August 2012, MiFID is completed by the European market infrastructure regulation (EMIR), which is specifically designed to increase the stability of OTC derivative markets by promoting central counterparty clearing and trade repositories. In June 2014, MiFID is revised (MiFID 2) and the regulation on markets in financial instruments (MiFIR) replaces EMIR. According to ESMA[36], this supervisory framework concerns 104 European regulated markets at the date of May 2015. On April 2014, the European parliament completes the framework by publishing new rules to protect retail investors (packaged retail and insurance-based investment products or PRIIPS). These rules complete the various UCITS directives, which organize the distribution of mutual funds in Europe.

In the US, the regulation of the market dates back to the 1930s:

- The Securities Act of 1933 concerns the distribution of new securities.
- The Securities Exchange Act of 1934 regulates trading securities, brokers, and exchanges, whereas the Commodity Exchange Act regulates the trading of commodity futures.
- The Trust Indenture Act of 1939 defines the regulating rules for debt securities.
- The Investment Company Act of 1940 is the initial regulation framework of mutual funds.
- The Investment Advisers Act of 1940 is dedicated to investment advisers.

[35] It corresponds to the 2004/39/EC directive.
[36] See the website `www.esma.europa.eu/databases-library/registers-and-data`.

At the same time, the Securities and Exchange Commission (SEC) was created to monitor financial markets (stocks and bonds). Now, the area of SEC supervision is enlarged and concerns stock exchanges, brokers, mutual funds, investment advisors, some hedge funds, etc. In 1974, the Commodities Futures Trading Commission Act established the Commodity Futures Trading Commission (CFTC) as the supervisory agency responsible for regulating the trading of futures contracts. The market regulation in the US has not changed significantly until the 2008 Global Financial Crisis (GFC). In 2010, President Barack Obama signed an ambitious federal law, the Dodd-Frank Wall Street Reform and Consumer Protection Act also named more simply Dodd-Frank, which is viewed as a response to the crisis. This text has an important impact on various areas of regulation (banking, market, investors, asset managers, etc.). It also introduces a new dimension in regulation. It concerns the coordination among regulators with the creation of the Financial Stability Oversight Council (FSOC), whose goal is to monitor the systemic risk.

1.2.4 Systemic risk

The 2008 financial crisis has an unprecedent impact on the financial regulation. It was responsible for Basel III, Dodd-Frank, Volcker rule, etc., but it has also inspired new considerations on the systemic risk. Indeed, the creation of the Financial Stability Board (FSB) in April 2009 was motivated to establish an international body that monitors and makes recommendations about the global financial system, and especially the associated systemic risk. Its area of intervention covers not only banking and insurance, but also all the other financial institutions including asset managers, finance companies, market intermediaries, investors, etc.

The main task of the FSB is to develop assessment methodologies for defining systemically important financial institutions (SIFIs) and to make policy recommendations for mitigating the systemic risk of the financial system. According to FSB (2010), SIFIs are institutions whose "*distress or disorderly failure, because of their size, complexity and systemic interconnectedness, would cause significant disruption to the wider financial system and economic activity*". By monitoring SIFIs in a different way than other financial institutions, the objective of the supervisory authorities is obviously to address the '*too big too fail*' problem. A SIFI can be global (G-SIFI) or domestic (D-SIFI). The FSB also distinguishes between three types of G-SIFIs:

1. G-SIBs correspond to global systemically important banks.
2. G-SIIs designate global systemically important insurers.
3. The third category is defined with respect to the two previous ones. It incorporates other SIFIs than banks and insurers (non-bank non-insurer global systemically important financial institutions or NBNI G-SIFIs).

The FSB/BCBS framework for identifying G-SIBs is a scoring system based on five categories: size, interconnectedness, substitutability/financial institution infrastructure, complexity and cross-jurisdictional activity (BCBS, 2014g). In November 2018, there were 29 G-SIBs (FSB, 2015b). Depending on the score value, the bank is then assigned to a specific bucket, which is used to calculate the higher loss absorbency (HLA) requirement. This additional capital requirement is part of the Basel III framework and ranges from 1% to 3.5% common equity tier 1. According to FSB (2018b), the most systemically important bank is JPMorgan Chase, which is assigned to an additional capital buffer of 2.5% CET1. This means that the total capital for this banks can go up to 15.5% with the following

decomposition: tier 1 = 6.0%, tier 2 = 2.0%, conservation buffer = 2.5%, countercyclical buffer = 2.5% and systemic risk capital = 2.5%.

For insurers, the assessment methodology is close to the methodology for G-SIBs and is based on five categories: size, global activity, interconnectedness, non-traditional insurance and non-insurance activities and substitutability (IAIS, 2013a). However, this quantitative approach is completed by a qualitative analysis and the final list of G-SIIs is the result of the IAIS supervisory judgment. In November 2015, there were 9 G-SIIs (FSB, 2015c). The associated policy measures are documented in IAIS (2013b) and consist of three main axes: recovery and resolution planning requirements, enhanced supervision and higher loss absorbency requirements.

Concerning NBNI SIFIs, FSB and IOSCO are still in a consultation process in order to finalize the assessment methodologies (FSB, 2015a). Indeed, the second consultation paper considers three categories of participants in the financial sectors that it identifies as potential NBNI SIFIs:

1. finance companies;
2. market intermediaries, especially securities broker-dealers;
3. investment funds, asset managers and hedge funds.

The final assessment methodology was planned for the end of 2015, but it has never been published until now. However, the fact that the FSB already considers that there are other SIFIs than banks and insurers suggests that financial regulation will be strengthened for many financial institutions including the three previous categories but also other financial institutions such as pension funds, sovereign wealth funds, etc.

The identification of SIFIs is not the only task of the FSB. The other important objective is to monitor the shadow banking system and to understand how it can pose systemic risk. The shadow banking system can be described as "*credit intermediation involving entities and activities outside the regular banking system*" (FSB, 2011). It is also called non-bank credit intermediation. The shadow banking system may expose the traditional banking system to systemic risk, because they may be spill-over effects between the two systems. Moreover, shadow banking entities (SBEs) are not subject to tight regulation like banks. However, it runs bank-like activities such as maturity transformation, liquidity transformation, leverage and credit risk transfer. Examples of shadow banking are for instance money market funds, securitization, securities lending, repos, etc. The task force formed by the FSB follows a three-step process:

- the first step is to scan and map the overall shadow banking system and to understand its risks;
- the second step is to identify the aspects of the shadow banking system posing systemic risk or regulatory arbitrage concerns;
- the last step is to assess the potential impact of systemic risk induced by the shadow banking system.

Even if this process is ongoing, shadow banking regulation can be found in Dodd-Frank or 2015 consultation paper of the EBA. However, until now regulation is principally focused on money market funds.

1.3 Financial regulation overview

1.3.1 List of supervisory authorities

We use the following correspondence: **B** for banking supervision, **I** for insurance supervision, **M** for market supervision and **S** for systemic risk supervision.

International authorities

BCBS	Basel Committee on Banking Supervision; `www.bis.org/bcbs`; **B**
FSB	Financial Stability Board; `www.fsb.org`; **S**
IAIS	International Association of Insurance Supervisors; `www.iaisweb.org`; **I**
IOSCO	International Organization of Securities Commissions; `www.iosco.org`; **M**

European authorities

EBA	European Banking Authority; `eba.europa.eu`; **B**
ECB/SSM	European Central Bank/Single Supervisory Mechanism; `www.bankingsupervision.europa.eu`; **B**
EIOPA	European Insurance and Occupational Pensions Authority; `eiopa.europa.eu`; **I**
ESMA	European Securities and Markets Authority; `www.esma.europa.eu`; **M**
ESRB	European Systemic Risk Board; `www.esrb.europa.eu`; **S**

US authorities

CFTC	Commodity Futures Trading Commission; `www.cftc.gov`; **M**
FRB	Federal Reserve Board; `www.federalreserve.gov/supervisionreg.htm`; **B/S**
FDIC	Federal Deposit Insurance Corporation; `www.fdic.gov`; **B**
FIO	Federal Insurance Office; `home.treasury.gov/policy-issues/financial-markets-financial-institutions-and-fiscal-service/federal-insurance-office`; **I**
FSOC	Financial Stability Oversight Council; `home.treasury.gov/policy-issues/financial-markets-financial-institutions-and-fiscal-service/fsoc`; **S**
OCC	Office of the Comptroller of the Currency; `www.occ.gov`; **B**
SEC	Securities and Exchange Commission; `www.sec.gov`; **M**

Some national authorities

Canada

CSA	Canadian Securities Administrators; `www.securities-administrators.ca`; **M**
OSFI	Office of the Superintendent of Financial Institutions; `www.osfi-bsif.gc.ca`; **B/I**
IIROC	Investment Industry Regulatory Organization of Canada; `www.iiroc.ca`; **M**

China

CBRC	China Banking Regulatory Commission; `www.cbrc.gov.cn`; **B**
CIRC	China Insurance Regulatory Commission; `www.circ.gov.cn`; **I**
CSRC	China Securities Regulatory Commission; `www.csrc.gov.cn`; **M**

France

AMF	Autorité des Marchés Financiers; `www.amf-france.org`; **M**
ACPR	Autorité de Contrôle Prudentiel et de Résolution; `acpr.banque-france.fr`; **B/I**

Germany

BAFIN	Bundesanstalt für Finanzdienstleistungsaufsicht; `www.bafin.de`; **B/I/M**

Italy

BdI	Banca d'Italia; `www.bancaditalia.it`; **B**
CONSOB	Commissione Nazionale per le Società e la Borsa; `www.consob.it`; **M**
IVASS	Istituto per la Vigilanza sulle Assicurazioni; `www.ivass.it`; **I**

Japan

FSA	Financial Services Agency; `www.fsa.go.jp`; **B/I/M**

Luxembourg

CAA	Commissariat aux Assurances; `www.caa.lu`; **I**
CSSF	Commission de Surveillance du Secteur Financier; `www.cssf.lu`; **B/M**

Spain

BdE	Banco de España; `www.bde.es`; **B**
CNMV	Comisión Nacional del Mercado de Valores; `www.cnmv.es`; **M**
DGS	Dirección General de Seguros y Pensiones; `www.dgsfp.mineco.es`; **I**

Switzerland

FINMA	Swiss Financial Market Supervisory Authority; `www.finma.ch`; **B/I/M**

United Kingdom

FCA	Financial Conduct Authority; `www.fca.org.uk`; **M**
PRA	Prudential Regulation Authority; `www.bankofengland.co.uk/prudential-regulation`; **B/I**

1.3.2 Timeline of financial regulation

In this section, we give the major dates which marketed the important stages of the financial regulation. We can consider four periods: before 1980, the years 1980 – 2000, the period until the 2008 Global Financial Crisis and the last 10 years.

Before 1980

Before 1980, the financial regulation is mainly developed in the US with several acts, which are voted in after the Great Depression in the 1930s. These acts concerns a wide range of financial activities, in particular banking, markets and investment sectors. The Basel Committee on Banking Supervision was established in 1974. In Europe, two directives established a regulatory framework for insurance companies.

Banking Regulation	1913	Federal Reserve Act (establishment of the Federal Reserve System as the central banking system of the US)
	1933	Glass-Steagall Act (separation of commercial and investment banking in the US)
	1933	US Banking Act (creation of FDIC and insurance deposit)
BCBS	1974	Creation of the Basel Committee on Banking Supervision
Solvency I	1973-07-24	Publication of the non-life insurance directive (73/239/EEC) dedicated to solvency margin requirements
	1979-03-05	Publication of the life insurance directive (79/267/EEC) dedicated to solvency margin requirements
Market Regulation	1933-05-27	Securities Act (registration and prospectus of securities)
	1934-06-06	Securities Exchange Act (regulation of the secondary markets and creation of the SEC)
	1936-06-15	Commodity Exchange Act (regulation of the commodity futures)
	1939-08-03	Trust Indenture Act (regulation of debt securities)
	1940-08-22	Investment Advisers Act (regulation of investment advisers)
	1940-08-22	Investment Company Act (regulation of mutual funds)
	1974-10-23	Commodity Futures Trading Commission Act (the CFTC replaces the Commodity Exchange Commission)

The years 1980 – 2000

The years 1980 – 2000 were marked by the development of the banking regulation and the publication of the Basel Accord dedicated to credit risk. Moreover, the end of the 1990s saw the implementation of the regulatory framework concerning market risks. In Europe, the UCITS directive is also an important step concerning the investment industry. In the US, the insurance regulation is reformed with the risk-based capital framework whereas Solvency I is reinforced in Europe.

Basel I	1987-12-15	Publication of the consultative paper on the Cooke ratio
	1988-07-04	Publication of the Basel Capital Accord
	1996-01-18	Publication of the amendment to incorporate market risks
CAD	1993-03-15	Publication of the Capital Adequacy Directive (93/6/EEC) known as CAD I
	1998-06-22	Revision of the CAD (98/31/EEC) known as CAD II
Solvency I	1988-06-22	Second non-life insurance directive 88/357/EEC
	1990-11-08	Second life insurance directive 90/619/EEC
	1992-06-18	Third non-life insurance directive 92/49/EEC
	1992-11-10	Third life insurance directive 92/96/EEC
RBC	1990	NAIC created the US RBC regime
	1992	Implementation of RBC in US insurance
	1993	Finalization of the RBC formula for life insurance
	1994	Finalization of the RBC formula for property and casuality insurance
	1998	Finalization of the RBC formula for health insurance
Market Regulation	1985-12-20	Publication of the first UCITS Directive (85/611/EEC)
	2000-12-14	Commodity Futures Modernization Act (regulation of OTC derivatives in the US)

The years 2000 – 2008

In the 2000s, banks and regulators have invested significant effort and resources to put in place the Basel II framework. This is during this period that modern risk management was significantly developed in the banking sector. The Solvency II reform emerged in 2004 and intensive work was underway to calibrate this new proposition on insurance regulation.

Basel II	1999-06-02	Publication of the first CP on Basel II
	2001-01-29	Publication of the second CP on Basel II
	2001-11-05	Results of the QIS 2
	2002-06-25	Results of the QIS 2.5
	2003-04-29	Publication of the third CP on Basel II
	2003-05-05	Results of the QIS 3
	2004-06-10	Publication of the Basel II Accord
	2004–2005	Conduct of QIS 4 (national impact study and tests)
	2005-07-30	Publication of "*The Application of Basel II to Trading Activities and the Treatment of Double Default Effects*"
	2006-06-16	Results of the QIS 5
	2006-06-30	Publication of the Basel II Comprehensive Version (including Basel I, Basel II and 2005 revisions)
CRD	2006-05-14	Publication of the directive 2006/48/EC
	2006-05-14	Publication of the directive 2006/49/EC (CRD)
Solvency I	2002-03-05	Non-life insurance directive 2002/13/EC (revision of solvency margin requirements)
	2002-11-05	Life insurance recast directive 2002/83/EC
Solvency II	2004	Initial works on Solvency II
	2006-03-17	Report on the first QIS
	2007	Report on the second QIS
	2007-11-01	Report on the third QIS
Market Regulation	2002-01-22	Publication of the directives 2001/107/EC and 2001/108/EC (UCITS III)
	2004-04-21	Publication of the directive 2004/39/EC (MiFID 1)

The years 2008 – 2019

The 2008 Global Financial Crisis completely changed the landscape of financial regulation. Under political pressures, we assist to a frenetic race of regulatory reforms. For instance, the Basel Committee had published 21 regulatory standards before 2007. From January 2008 to December 2014, this number has dramatically increased with 34 new regulatory standards. With Basel 2.5, new capital requirements are put in place for market risk. The Basel III framework is published at the end of 2010 and introduces new standards for managing the liquidity risk. However, the finalized version of Basel III reforms will be only published in 2017. In Europe, market regulation is the new hot topic for regulators. However, the major event of the beginning of this decade concerns systemic risk. New regulations have emerged and new financial activities are under scrutiny (shadow banking system, market infrastructures, investment management).

Basel 2.5	2007-10-12	Publication of the first CP on the incremental risk charge
	2008-07-22	Proposed revisions to the Basel II market risk framework
	2009-07-13	Publication of the final version of Basel 2.5
Basel III	2010-12-16	Publication of the original version of Basel III
	2011-06-01	Revised version of the Basel III capital rules reflecting the CVA modification
	2013-01-07	Publication of the rules concerning the liquidity coverage ratio
	2013-10-31	Fundamental review of the trading book (FRTB)
	2013-12-13	Capital requirements for banks' equity investments in funds
	2014-01-12	Publication of the leverage ratio
	2014-03-31	Publication of SA-CCR
	2014-04-10	Capital requirements for bank exposures to central counterparties
	2014-04-15	Supervisory framework for measuring and controlling large exposures
	2014-10-31	Publication of the rules concerning the net stable funding ratio
	2016-04-21	Interest rate risk in the banking book (IRRBB)
	2016-07-11	Revisions to the securitization framework
	2017-12-07	Final version of Basel III reforms
	2019-01-14	Publication of the Basel III comprehensive version for market risk
CRD/CRR	2009-09-16	Directive 2009/111/EC (CRD II)
	2010-09-24	Directive 2010/76/EU (CRD III)
	2013-06-26	Directive 2013/36/EU (CRD IV)
	2013-06-26	Publication of the capital requirements regulation 575/2013 (CRR)
	2013-10-15	Council regulation 1024/2013 concerning the European Central Bank and the prudential supervision
	2014-10-10	Commission delegated regulation 2015/62 of on the leverage ratio
	2017-12-12	Regulation 2017/2401 on securitizations
	2019	Publication of CRD V & CRR 2
Solvency II	2008-11-19	Report on the fourth QIS
	2009-11-25	Solvency II directive 2009/138/EC
	2011-03-14	Report on the fifth QIS
	2014-04-16	Publication of the Omnibus II directive 2014/51/UE
	2015-10-10	Publication of the commission delegated regulation 2015/35
	2015-12-02	Commission implementing regulation 2015/2450
Market Regulation	2009-07-13	Directive 2009/65/EC (UCITS IV)
	2010-06-08	AIFM directive (2011/61/EU)
	2012-07-04	EU regulation 648/2012 (EMIR)
	2014-05-15	Directive 2014/65/EU (MiFID II)
	2012-05-15	EU regulation 600/2014 (MiFIR)
	2014-07-23	Directive 2014/91/EU (UCITS V)
	2014-11-26	EU regulation 1286/2014 (PRIIPS)
	2015-11-25	EU regulation 2015/2365 on securities financing transactions
	2016-06-08	EU regulation 2016/1011 on indices and benchmarks
	2017-06-14	EU regulation 2017/1131 on money market funds

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	2009-04	Creation of the Financial Stability Board (FSB)
	2010-07-21	Dodd-Frank Wall Street Reform and Consumer Protection Act
Systemic	2010-07-21	Volcker Rule (§619 of the Dodd-Frank Act)
Risk	2011-11-04	Publication of the G-SIB assessment methodology (BCBS)
	2013-07-03	Update of the G-SIB assessment methodology (BCBS)
	2015-03-04	Second CP on assessment methodologies for identifying NBNI-SIFIs (FSB-IOSCO)