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Risk Management: History, Definition and Critique[†]

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Abstract. The study of risk management began after World War II. Risk management has long been associated with the use of market insurance to protect individuals and companies from various losses associated with accidents. Other forms of risk management, alternatives to market insurance, surfaced during the 1950s when market insurance was perceived as very costly and incomplete for protection against pure risk. The use of derivatives as risk management instruments arose during the 1970s, and expanded rapidly during the 1980s, as companies intensified their financial risk management. International risk regulation began in the 1980s, and financial firms developed internal risk management models and capital calculation formulas to hedge against unanticipated risks and reduce regulatory capital. Concomitantly, governance of risk management became essential, integrated risk management was introduced and the chief risk officer positions were created. Nonetheless, these regulations, governance rules and risk management methods failed to prevent the financial crisis that began in 2007.

Keywords: History risk management, risk management and financial crisis, regulation, Basel Accords, banking.

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1. Introduction

Risk management began to be studied after World War II. Several sources (Crockford, 1982; Harrington and Niehaus, 2003; Williams and Heins, 1995) date the origin of modern risk management to 1955-1964. Snider (1956) observed that there were no books on risk management at the time, and no universities offered courses in the subject. The first two academic books were published by Mehr and Hedges (1963) and Williams and Hems (1964). Their content covered pure risk management, which excluded corporate financial risk. In parallel, engineers developed technological risk management models. Operational risk partly covers technological losses; today, operational risk has to be managed by firms and is regulated for banks and insurance companies. Engineers also consider the political risk of projects.

Risk management has long been associated with the use of market insurance to protect individuals and companies from various losses associated with accidents (Harrington and Niehaus, 2003). In 1982, Crockford wrote: “Operational convenience continues to dictate that pure and speculative risks should be handled by different functions within a company, even though theory may argue for them being managed as one. For practical purposes, therefore, the emphasis of risk management continues to be on pure risks.” In this remark, speculative risks were more related to financial risks than to the current definition of speculative risks.

New forms of pure risk management emerged during the mid-1950s as alternatives to market insurance when different types of insurance coverage became very costly and incomplete. Several business risks were costly or impossible to insure. During the 1960s, contingent planning activities were developed, and various risk prevention or self-protection activities and self-insurance instruments against some losses were put in place. Protection activities and coverage for work-related illnesses and accidents also arose at companies during this period.

The use of derivatives as instruments to manage insurable and uninsurable risk began in the 1970s, and developed very quickly during the 1980s.¹ It was also in the 1980s that companies began to consider financial management or portfolio management. Financial risk management has become complementary to pure risk management for many companies. Financial institutions,

¹ Before the 1970s, derivatives were rarely used to cover financial products. They were mainly limited to agricultural products.

including banks and insurance companies, intensified their market risk and credit risk management activities during the 1980s. Operational risk and liquidity risk management emerged in the 1990s.

International regulation of risk also began in the 1980s. Financial institutions developed internal risk management models and capital calculation formulas to protect themselves from unanticipated risks and reduce regulatory capital. At the same time, governance of risk management became essential, integrated risk management was introduced, and the chief risk manager (CRO) position was created.

In the wake of various scandals and bankruptcies resulting from poor risk management, the Sarbanes-Oxley regulation was introduced in the United States in 2002, stipulating governance rules for companies. Stock exchanges, including the NYSE (New York Stock Exchange) in 2002 (Blanchard and Dionne, 2004), also added risk management governance rules for listed companies. However, all these regulations, rules, and risk management methods did not suffice to prevent the financial crisis that began in 2007. It is not necessarily the regulation of risks and governance rules that were inefficient, but rather their application and enforcement. It is well known that managers in various markets regularly skirt the regulation and rules. However, it seems that deviant actions had become much more common in the years preceding the financial crisis, a trend the regulatory authorities did not anticipate, notice, or, evidently, reprimand.

This paper reviews the history of corporate financial and nonfinancial risk management. We present the major milestones and analyze the main stages and events that fuelled its development. We also discuss risk governance and regulation, and critique risk management application in the years preceding the recent financial crisis.

2. History of risk management

2.1. Insurance and risk management

Risk management is a relatively recent corporate function. Historical milestones are helpful to illustrate its evolution. Modern risk management started after 1955. Since the early 1970s, the concept of financial risk management evolved considerably. Notably, risk management has become less limited to market insurance coverage, which is now considered a competing protection tool that complements several other risk management activities. After World War II,

large companies with diversified portfolios of physical assets began to develop self-insurance against risks, which they covered as effectively as insurers for many small risks. Self-insurance covers the financial consequences of an adverse event or losses from an accident (Erlach and Becker, 1972; Dionne and Eeckhoudt, 1985). A simple self-insurance activity involves creating a fairly liquid reserve of funds to cover losses resulting from an accident or a negative market fluctuation. Risk mitigation, now frequently used to reduce the financial consequences of natural catastrophes, is a form of self-insurance.

Self-protection activities have also become very important. This type of activity affects the probabilities of losses or costs before they arise. It can also affect the conditional distribution of losses *ex ante*. Accident prevention is the most natural form of self-protection. Precaution is a form of self-protection applied to suspected but undefined events for which the probabilities and financial consequences are unknown. A pandemic is one such event (Courbage et al., 2013). All protection and prevention activities are part of risk management.

Insurers' traditional role was seriously questioned in the United States in the 1980s, particularly during the liability insurance crisis characterized by exorbitant premiums and partial risk coverage. In that decade, alternative forms of protection from various risks emerged, such as captives (company subsidiaries that insure various risks and reinsure the largest ones), risk retention groups (groups of companies in an industry or region that pool together to protect themselves from common risks), and finite insurance (distribution of risks over time for one unit of exposure to the risk rather than between units of exposure).

The concept of risk management in the financial sector was revolutionized in the 1970s, when financial risk management became a priority for many companies including banks, insurers, and non-financial enterprises exposed to various price fluctuations such as risk related to interest rates, stock market returns, exchange rates, and the prices of raw materials or commodities.

This revolution was sparked by the major increase in the price fluctuations mentioned above. In particular, fixed currency parities disappeared, and prices of commodities became much more volatile. The risks of natural catastrophe also magnified considerably. Historically, to protect themselves from these financial risks, companies used balance sheets or real activities

(liquidity reserves). To increase flexibility or to reduce the cost of traditional hedging activities, derivatives were then increasingly used.

Derivatives are contracts that protect the holder from certain risks. Their value depends on the value and volatility of the underlier, or of the assets or value indices on which the contracts are based. The best-known derivatives are forward contracts, options, futures, and swaps. Derivatives were first viewed as forms of insurance to protect individuals and companies from major fluctuations in risks. However, speculation quickly arose in various markets, creating other risks that are increasingly difficult to control or manage. In addition, the proliferation of derivatives made it very difficult to assess companies' global risks (specifically aggregating and identifying functional forms of distribution of prices or returns).

At the same time, the definition of risk management became more general. Risk management decisions are now financial decisions that must be evaluated based on their effect on firm or portfolio value, rather than on how well they cover certain risks. This change in the definition applies particularly to large public corporations, which, ironically, may be the companies that least need risk protection (apart from speculation risk), because they are able to naturally diversify much more easily than small companies. In particular, shareholders can diversify their portfolios on financial markets at a much lower cost than the companies whose shares they hold.

2.2. *Milestones in financial risk management*

The tables below present the important dates in the evolution of risk management (Table 1) and of derivatives or structured financial products (Table 2). The birth of modern financial theory is generally associated with the seminal work of Louis Bachelier in 1900; he was the first to use Brownian motion to analyze fluctuations in a financial asset. However, it was only in the 1930s that research on prices of financial assets began. The American Finance Association (AFA) met for the first time in 1939, in Philadelphia. Its first journal, *American Finance*, appeared in 1942. It became *The Journal of Finance* in 1946. At that time, research in finance specifically dealt with price setting, financial market efficiency, and detection of profitable strategies (including anticipation of stock prices). The year 1932 marked the birth of the American Risk and Insurance Association. The first academic studies of insurance were published in the *Journal of Insurance*, which was renamed the *Journal of Risk and Insurance* in 1964 (Weiss and Qiu, 2008). Other

specialized journals followed, including *Risk Management* (formerly *The National Insurance Buyer*), published by the Risk and Insurance Management Society (RIMS), a professional association of risk managers founded in 1950, along with *The Geneva Papers of Risk and Insurance*, published by the Geneva Association since 1976.

It was only in the 1950s and 1960s that researchers (Markowitz, Lintner, Treynor, Sharpe, and Mossin) undertook fundamental studies of financial decisions. This resulted in the modern theory of portfolio choice based on the CAPM (*Capital Asset Pricing Model*). This period was marked by revolutionary articles in finance whose lead authors earned Nobel Prizes. Yet it was only in the early 1970s that the main financial risk management products appeared, and that the initial theoretical models of modern risk coverage were published.

Black and Scholes's model is undoubtedly the most popular of these early models. These authors were the first to propose an explicit formula for the pricing of a derivative, namely an option. This model was so revolutionary that the major finance journals refused to publish its first version. It was finally published in the *Journal of Political Economy*, in 1973. Later that year, Merton published an extension in the *Bell Journal of Economics and Management Science*. After that, risk coverage derivatives expanded quickly, spawning currency and interest rate swaps, and OTC or *over the counter* options. Mathematical finance and the popularity of computers accelerated the growth and use of derivatives.

This period is the starting point for the intensive development of research on derivatives pricing. Although coverage of agricultural products began in Chicago in 1864 (and in Japan in 1730 for rice prices), it was only in 1972 that derivatives on financial assets surfaced in that American city (*Chicago Board of Trade*, CBOT). The year 1973 marked a turning point in financial history for another reason: the creation of the CBOE (*Chicago Board Options Exchange*), together with a *clearing house*.

The growth of the options market accelerated after the CBOE standardized contracts and developed secondary markets needed to generate sufficient liquid assets for market effectiveness (Smith, Smithson and Wakeman, 1990). During the 1980s and 1990s, the implementation of these hedge products sensitized market players to the risk they incur in their regular investment activities.

Concomitantly, new statistical tools were put in place in banks and rating agencies to select the clientele (e.g. *credit scoring*) and manage credit risk. These tools facilitated assessment of *default/credit risk* and risk pricing. The Basel Accord of 1988 imposed a new regulatory vision of risk.

In the late 1980s, high market volatility spurred the large US investment banks to put in place risk management departments (Field, 2003). JP Morgan developed the two best-known internal risk management models—RiskMetrics for market risk and CreditMetrics for credit risk—in 1994 and 1997. These two models highlighted the idea of measuring risks in portfolio form by considering their dependencies and using value at risk to quantify aggregate portfolio risk. The publication of the RiskMetrics model prompted broad dissemination of the *Value-at-Risk* (VaR) risk measure among professionals and academics alike. It was imported from insurers, which used a similar risk measure to calculate their maximum losses (MPY or Maximum Probable Yearly Aggregate Loss; Cummins and Freifelder, 1978). VaR is the maximum value that a portfolio or company can lose during a given period of time, at a specified level of confidence. This measure also allows one to measure the optimal capital required to protect companies or portfolios from anticipated and unanticipated losses (Scaillet, 2003).

These new risk measurement tools are important instruments for calculating banks' regulatory capital under Basel II and Basel III. They were also used to analyze the first major losses sustained in 1994 and 1995 following misuse of derivatives (Procter and Gamble, Orange County, and Barings). Three credit risk crises followed: the Asian crisis, the Russian crisis, and the collapse of Long Term Capital Management (LTCM). The LTCM hedge fund was overexposed to various risks. When the Asians and Russians steadily defaulted on their obligations, LTCM began to run short of liquid assets to meet its obligations; this shortfall quickly turned into default risk (Jorion, 2000).

Risk management became a corporate affair in the late 1990s. The major orientation decisions in firms' management policy (and monitoring) are now made by the board of directors. Most often, the audit committee monitors these decisions, although some large financial institutions have put risk management committees in place. The position of Chief Risk Officer, or CRO, emerged.

Adequate capital reserves became a major concern in the early 2000s following major defaults in the late 1990s and the Enron bankruptcy in 2001. Basel II introduced more rigorous rules for banks. In addition to modifying the credit risk management rules, the Accord introduced new rules for operational risk. However, the legislators have said little about managing the risks of various management and hedge funds, especially pension funds. Québec was equally lax: the Caisse de dépôt et placement du Québec, a major pension fund, lost over \$30 billion in the last financial crisis, including a \$10-billion write-off caused by disastrous commercial paper risk management, involving misuse of this structured product with a AAA credit rating! US Federal Reserve Chairman Alan Greenspan was particularly negligent: he often gave contradictory speeches on the advantages and risks associated with the use of derivatives and on the financial market's capacity to absorb risks effectively, without additional regulation. In particular, OTC products proliferated without real or regulated verification of counterparty risk.

Table 1
Milestones in the history of risk management

1730	First futures contracts on the price of rice in Japan
1864	First futures contracts on agricultural products at the Chicago Board of Trade
1900	Louis Bachelier's thesis "Théorie de la Spéculation"; Brownian motion
1932	First issue of the <i>Journal of Risk and Insurance</i>
1946	First issue of the <i>Journal of Finance</i>
1952	Publication of Markowitz's article "Portfolio Selection"
1961-1966	Treynor, Sharpe, Lintner and Mossin develop the CAPM
1963	Arrow introduces optimal insurance, moral hazard, and adverse selection
1972	Futures contracts on currencies at the Chicago Mercantile Exchange
1973	Option valuation formulas by Black and Scholes and Merton
1974	Merton's default risk model
1977	Interest rate models by Vasicek and Cox, Ingersoll and Ross (1985)
1980-1990	Exotic options, swaptions and stock derivatives
1979-1982	First OTC contracts in the form of swaps: currency and interest rate swaps.
1985	Creation of the Swap Dealers Association, which established the OTC exchange standards
1987	First risk management department in a bank (Merrill Lynch)
1988	Basel I
Late 1980s	Value at risk (VaR) and calculation of optimal capital
1992	Article by Heath, Jarrow and Morton on the forward rate curve

1992	Integrated Risk Management
1992	RiskMetrics
1994-1995	First bankruptcies associated with misuse (or speculation) of derivatives: Procter and Gamble (manufacturer, rates derivatives, 1994), Orange County (management funds, derivatives on financial securities, 1994) and Barings (futures, 1995)
1997	CreditMetrics
1997-1998	Asian and Russian crisis and LTCM collapse
2001	Enron bankruptcy
2002	New governance rules by Sarbanes-Oxley and NYSE
2004	Basel II
2007	Beginning of the financial crisis
2009	Solvency II (not yet implemented in April 2013)
2010	Basel III

This table presents the main dates related to the history of risk management.

Financial hedging products were developed to cover different types of risk. The four main risks for banks are credit risk (80% of the risk of banks, including default risk), market risk (5%), operational risk (15%), and liquidity risk (not yet well quantified and generally included in yield spread between private and public bonds). Market risk represents the risk of volatile prices or asset returns, and credit risk has been associated to default risk (although recent studies estimate that the default risk corresponds to a maximum ranging from 25% to 85% of the yield spread between private and public bonds; Elton et al., 2001; Dionne et al., 2010). The Basel agreement of 2004 addresses these risks. Only credit risk was covered in 1988; market risk was considered years later, in 1996. It quickly became apparent that regulatory treatment (arbitrary capital) of market risk was ill-adapted to banks' portfolio management of this risk. Regulatory authorities consequently authorized banks to use internal models to measure market risk. In contrast, the portfolio treatment of credit risk began only in 2004 under Basel II.

Table 2 presents the main dates that derivatives and structured products appeared. Its content is taken from Jorion (2001), Crouhy, Galai, and Mark (2000), Roncalli (2001), Field (2003), and other electronic documents. Few derivatives and structured products have been launched since the 2000s. A special issue of the *Journal of Risk and Insurance* published in September 2009 focused on insurers' risk management and their use of derivatives, structured products, and their involvement in securitization. It featured survey articles by Cummins and

Weiss (2009) and Cummins and Trainar (2009). On risk management and insurance demand, see McMinn and Garven (2013) and on regulation of insurers, see Klein (2013).

Table 2

Main dates of the launching of derivatives and structured financial products

1970s	Currency swaps
1972	Foreign currency futures
1973	Equity options
1979	Over-the-counter currency options
1981	Cross-currency interest rate swaps
1983	Equity index options
1983	Interest rate caps/floors
1983	Swaptions
1985	Asset back securities (ABS)
1987	Path-dependent options (Asian, lookback, etc.)
1987	Collateralized debt obligations (CDO)
1992	CAT and futures insurance options
1993	Captions/Floortions
1994	Credit default swaps (CDS)
1994	CAT bonds
1997	Weather derivatives
2002	Collateralized fund obligations (CFO)

This table presents the main appearance dates of derivative and structured financial products.

3. Current definition of corporate risk management

The goal of corporate risk management is to create a reference framework that will allow companies to handle risk and uncertainty. Risks are present in nearly all of firms' financial and economic activities. The risk identification, assessment, and management process is part of companies' strategic development; it must be designed and planned at the highest level, namely the board of directors. An integrated risk management approach must evaluate, control, and monitor all risks and their dependences to which the company is exposed. In general, a pure risk is a combination of the probability or frequency of an event and its consequences, which is usually negative. It can be measured by the volatility of results but higher moments of the distribution are often necessary. Uncertainty is less precise because the probability of an uncertain event is often unknown, as is its consequence. In this case, we would refer to

precautionary rather than preventive activities to protect against uncertainty. Lastly, financial risk consists in undertaking opportunistic activities related to future risks that may generate positive or negative results.

In this article, corporate risk management is defined as a set of financial or operational activities that maximize the value of a company or a portfolio by reducing the costs associated with cash flow volatility (Stulz, 1996, 2003). The main risk management activities are diversification and risk hedging using various instruments, including derivatives and structured products, market insurance, self-insurance, and self-protection. The main costs firms seek to minimize are costs of financial distress, risk premium to partners (*stakeholders*), expected income taxes, and investment financing. Managers' behavior toward risk (risk appetite and risk aversion) and corporate governance also affect the choice of risk management activities.

There are five main risks:

- pure risk (insurable or not, and not necessarily exogenous in the presence of moral hazard);
- market risk (variation in prices of commodities, exchange rates, asset returns);
- default risk (probability of default, recovery rate, exposure at default);
- operational risk (employee errors, fraud, IT system breakdown);
- liquidity risk: risk of not possessing sufficient funds to meet short-term financial obligations without affecting prices. May degenerate into default risk.

4. Regulation of risk management

4.1. Justification for regulation of financial institutions

Banks and insurers have been regulated for several years. Specifically, the risk of default and possible bankruptcy of financial institutions is of interest here. This risk affects shareholders and creditors of banks and insurance companies, but this is not sufficient to justify regulation of financial institutions because these agents are paid for the risks they take and have access to monitoring instruments that give them sufficient information to protect themselves. In addition, they can diversify their private portfolios at a lower cost than that incurred by the financial institutions whose shares they hold.

In contrast, holders of deposits and insurance policies do not necessarily have access to a range of instruments to monitor the suppliers of these products. At the very least, for these parties the costs of using such instruments are higher than those of shareholders and creditors, who have direct access to some information. An inexpensive way to monitor one's bank or insurer is to buy its stock. Investors can then receive quarterly and annual reports and can attend shareholders' meetings. However, this information may not be enough to ensure a sound investment.

The most important thing to consider is the fact that small investors have fewer diversification opportunities than shareholders, creditors, and managers of financial institutions. It is important to remember that bank deposits and insurance policies are traditionally considered as risk-free securities. To protect them, several countries have introduced deposit insurance or insurance guarantee funds, but this protection may generate moral hazard and induce risk-taking behaviors that are not necessarily in the interest of holders of deposits and insurance policies and of the financial system overall, in which banks and insurers play an important role (Crouhy et al, 2000). The rest of this chapter will focus on the banking market, but the same logic applies to the insurance market.

In other words, deposit insurance can encourage financial institutions to take more risks once they have paid their coverage premium (at a fixed rate). In New Zealand, deposit insurance was eliminated to discipline the banks, but investors are no longer protected. The Canada Deposit Insurance Corporation (CDIC), a Crown corporation created in 1967, is responsible for this insurance in the banking system. The Federal Deposit Insurance Corporation (FDIC) plays a similar role in the United States since 1933. The default risk is real. Since 1967, more than 43 banks have gone bankrupt in Canada. During the 2007-2012 period, more than 65 U.S. banks became insolvent and have been taken over by the FDIC.

In general, when we discuss problems of risk hedging, there is always a tradeoff between prevention and the level of risk protection of the client in the presence of moral hazard. For example, it is often observed that holders of automobile theft or accident insurance policies have fewer incentives to reduce the risks of accident than uninsured drivers. Nonetheless, when moral hazard is well-controlled by incentive mechanisms, insurance has been shown to give consumers more welfare than no insurance, because several risks are not truly diversifiable on financial markets.

Contrary to insurer-insured contracts, holders of protected deposits and agents who make decisions on banks' risk are not the same people. Deposit holders (who may be victimized by bank managers' risk-taking) do not have an incentive to self-protect from bank bankruptcy because technically their actions cannot affect the probability of banks' going bankrupt (Dionne, 2004).

The only prevention activity available to them is diversification of deposits between banks, but this form of diversification is not really encouraged by banks and is consequently very costly. At any rate, deposit insurance does not encourage clients to diversify their deposits because it covers up to \$100,000 CAN per account owned by one person in Canada and \$250,000 US per account owned by one person in the United States, which represents full insurance for the large majority of clients. Bank executives do not have strong incentives to limit risk because they know that their customers are protected. They can therefore take huge risks and keep their capital at the lowest level to increase the bank's profitability. They thus generate negative externalities in the financial system, which justifies bank regulation. Evidently, banks play an important role in the functioning of the financial system. This macro-economic dimension gained importance with the last financial crisis. The bankruptcy of a large bank can generate considerable losses for the entire financial system by triggering other bankruptcies. This process is known as systemic risk.

Extern systemic risk is the risk (generally of default and even bankruptcy) of a financial institution that has cascading effects on the financial system and even the economy. If a large bank failed, its financial obligations to other financial institutions could create sizable losses, hence the common expression: "*Too Big to Fail!*" This assertion was seriously questioned with the bankruptcy of Lehman Brothers during the last financial crisis (September 2008). Below we describe the evolution of international bank regulation.

4.2. *Basel Accord*

The evolution of international bank regulation (Basel) is shown in Figure 1.

4.2.1. *Basel I in 1988*

The group of the 10 most industrialized countries (G10) signed an accord in 1988 to regulate banks (it took effect in 1992). Today, many more countries have signed this agreement. Member countries can impose stronger regulations on their banks, but they must abide by the

minimum principles of the agreement. The agreement obliges banks in member countries to hold a minimum amount of required capital to hedge against various risks.

The first accord was limited to credit risk. Each bank was required to set aside a capital reserve of 8% (Cooke ratio) of the value of securities representing the credit risk in its portfolio. This ratio serves to create a solvency reserve for the bank. The weight of financial securities held depends on the risk. The weights used to calculate the average ratio were fairly arbitrary at the start of the regulation. They were modified in 2006 for banks that still use the standard approach to calculate capital related to credit risk. They are now based on external risk ratings issued by independent rating agencies.

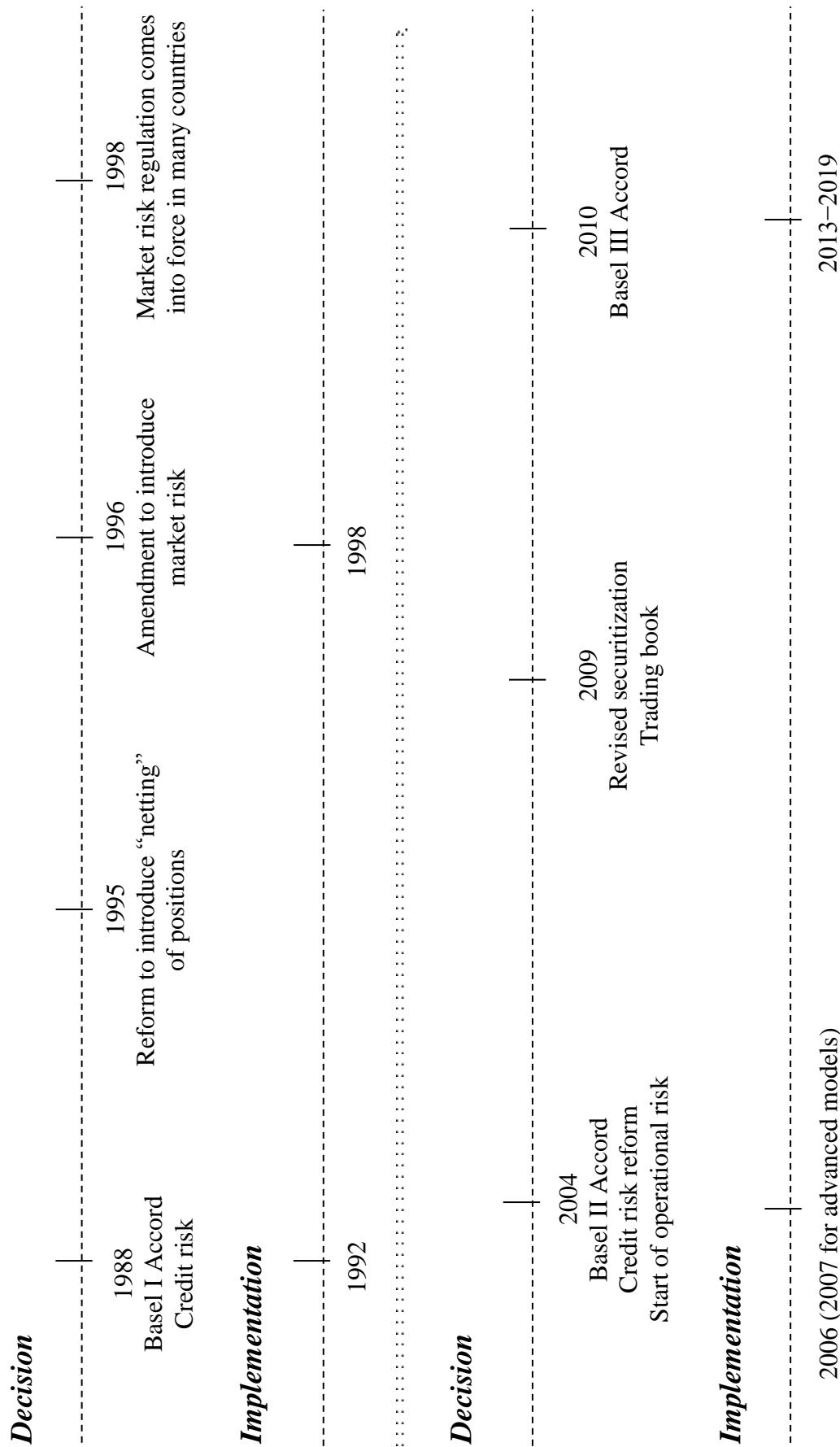
The definition of capital to create reserves encompasses more than bank equity; in 1988, two forms were considered:

- Tier 1, or *core capital*, consisting of common stock, holdings in subsidiaries, and some reserves disclosed to the regulatory body;
- Tier 2, or supplementary capital, made up of hybrid capital instruments (shares and very long-term debentures), subordinated debt with terms to maturity greater than five years, other securities, and other reserves.

50% of the capital must be covered by Tier 1, and the sum must represent at least 8% of the weighted risky assets held by the bank. In addition to the reserves required, the accord imposed restrictions on excessive risk-taking behavior:

- No holding shall exceed 25% of a company's capital;
- Total high risks shall not exceed eight times the required capital, although the Cooke ratio permits up to 12.5 times.

Figure 1: Evolution of International Bank Regulation



This figure presents the decision and implementation dates of the three Basel Accords.

The initial Basel I Accord was heavily criticized because it did not consider market risk. It also took a very conservative stance on credit risk because it overlooked the possibilities of risk diversification and “*netting*” of positions; that is, matching between maturities of long and short positions. In 1995, *netting* of risky positions (for credit risk) was permitted, including those associated with derivatives. In 1996, the first reform of Basel I was proposed to take market risk into account, and the use of internal market risk models was permitted.

The internal model assumes that the bank calculates VaR for asset return risk, interest rate risk, exchange risk, and commodity price risk. Total VaR is the sum of the four VaR. This approach is also very conservative because it does not permit diversification between blocks of risks. In many countries, the new form of regulation of market risk took effect in January 1998.

The rules for the use of VaR for market risk are:

- the VaR horizon is ten market days or two weeks;
- the degree of confidence is 99%;
- the use of historical data goes back one year, with updates of model parameters every three months;
- correlations between all forms of risk can be used;
- capital required for market risk is determined by the higher of the VaR of the previous day or of $k \overline{\text{VaR}}$, where $\overline{\text{VaR}}$ is the average of the last 60 market days. The k-factor is equal to three in many countries. This factor may increase if the losses observed very often exceed those predicted by the VaR;
- because more capital is required since the introduction of market risk, banks may use Tier 3 capital to form reserves, which basically corresponds to subordinated short-term debt. Capital used in Tiers 2 and 3 for market risk must not exceed 250% of Tier 1 capital used for market risk.

4.2.2. *Basel II in 2004*

A major reform related to operational and credit risk took place in 2004 (Basel II) and came into force in 2006 (BIS, 2005), but many countries have not advanced far in its application

because they were distracted by the financial crisis of 2007. For example, the final rules became effective on April 2008 in the United States.

The capital ratio remains at 8% of risky assets (weighted). The main purpose of the reform is to make capital calculation more risk-sensitive. Basel II added capital formulas for credit risk with the internal method (like the CreditMetrics model) to take into account diversification of asset portfolios subject to credit risk. In addition, capital calculation rules (standard and advanced) were introduced for operational risk.

Credit risk is estimated to comprise 80% total risk, 15% operational risk, and 5% market risk. Regarding credit risk, banks may use internal ratings, which are more flexible than those of rating agencies because they can be modified according to economic cycles.

Three pillars support the 2004 regulation:

- 1) Calculation of capital: based more on finance models than on accounting rules.
- 2) Supervision (implementation): more validation of statistical methods and data. More tests of the bank validity of equity, particularly in a crisis situation.
- 3) Market discipline: banks must disclose more financial information to the market. This increases the transparency of banks' risk.

For credit risk, there are now two capital calculation methods:

- Standard approach of 1988 modified for the use of risk ratings.
- Internal approach that may involve the use of the IRB (*Internal Ratings Based*) approach and incorporate the credit VaR in portfolio risk.

The capital formula under the IRB approach involves a detailed calculation of the probability of default (PD), the Loss Given Default (LGD), and the risk exposure at the time of default (EAD). The new method differentiates unanticipated losses from anticipated losses, and the cost of capital is based on unanticipated losses. It specifies separate treatments for different types of debt: government, corporate, bank, individual, and equity. It also considers banks' securitization activities by differentiating traditional securitization (creating asset tranches with different credit risks) and synthetic securitization (credit risk transferred using derivatives).

Lastly, banks that securitize can reduce their required capital under certain conditions, including transfer of the credit risk to third parties. They cannot keep direct or indirect control over positions transferred if they want to eliminate or reduce the capital required.

4.2.3 Basel III in 2010

Basel III adds new adequate capital rules to protect banks and improve control of liquidity risk. The accord requires even more risk management for banks and increases bank supervision. CROs (Chief Risk Officers) of banks must also be more independent from the CEOs (BIS, 2012).

The accord also requires more transparency and more capital in the reserves (long term):

- Total Tier 1 minimum capital: equity portion increases from 2% to 4.5% and the total for Tier 1 rises from 4% to 6% in 2019;
- Minimum total capital remains at 8% in 2013, but an additional safety measure (conservation buffer) has been added: 10.5% in 2019 (to protect banks from recessions or financial crises).

Table 3 summarizes the new regulatory capital rules.

Table 3
Basel III regulatory capital, 2010

	Equity	Total Tier 1	Total Capital
Minimum	4.5	6.0	8.0
Conservation buffer	2.5	2.5	2.5
Minimum plus buffer	7.0	8.5	10.5

This table presents the new regulatory capital rules of the 2010 Basel Accord.

The Tier 3 risk capital market was eliminated, and a Liquidity Coverage ratio was introduced, along with a new control standard for banks' debt ratio. The new regulation will reduce procyclicality by considering systemic risk. There will be more control over securitization, and fewer OTC transactions will be permitted. Lastly, more capital will be required for market risk.

The main anticipated effects of the new regulation, which should be applied from 2013, are:

- More substitutions for assets with lower returns but more liquid.
- More capital per share issue, fewer dividends, and perhaps lower executive compensation.
- Lower debt ratios that should reduce banks' risk level and associated costs, including deposit insurance.
- New liquidity standards, which should increase the development of new liquidity risk management and control policies (renegotiated in January 2013).
- New stress test requirements according to economic cycles, which should improve capital management such that banks can better absorb potential losses during recessions or crises.
- More macroeconomic approach to bank regulation.

These measures should reinforce banks' capital, boost their solvency in crisis situations, and allow financing of the economy during recessions.

5. Financial crisis of 2007-2008 and risk management of structured finance

Structured finance includes all advanced financial arrangements that serve to refinance and effectively hedge against credit risk in all economic activities. It changed the role of banks and insurers and the functioning of financial and money markets. In several countries, structured finance is now a very important economic activity that has completely transformed the link between borrowers, lenders, and investors.

During the last financial crisis, some banks declared bankruptcy, and government and central banks had to rescue many other financial institutions. These *bailouts* protected financial markets over the short term, but did not solve the fundamental problems behind the crisis.

Structured finance is often cited as the cause of the last financial crisis. However, this cause-and-effect relation is not evident. Most likely, the crisis that shook the world is due to poor risk management, namely agency problems in the securitization of mortgage debt, poor rating and poor structured product pricing criteria, conflicts of interest among rating agencies, lack of market transparency, the quest for high returns by top executives of financial institutions, and the inability of central banks and regulatory agencies to fully grasp all the implications of the new financial environment.

5.1. *Risk management problems*

We can isolate four major risk management problems linked to the structured finance market during this period (Dionne, 2009):

5.1.1. *Lack of incentive contracts in the presence of information asymmetry*

Banks and real estate mortgage brokers had little incentive to be vigilant and monitor real estate borrowers' risk because a large portion of their loans were securitized without an optimal contractual clause in the presence of moral hazard. They were thus able to transfer all their default risk (and hence losses) to financial markets without any retention. As a result, these front-line institutions were less inclined to be vigilant about their customers' default risk. Adverse selection was also present: BBB financial products (minimum rating to access CDOs) were sold to trust companies, whereas some were actually BB products with supplemental guarantees provided by insurers via CDS.

5.1.2. *Poor valuation of structured products by rating agencies*

As stakeholders in securitization, intermediaries buy long-term assets such as mortgage loans and finance them with asset-backed securities such as Asset Back Commercial Paper (ABCP) and CDOs. Obtaining a high rating from rating agencies is essential to profitability. When the financial crisis began in 2007, ABCPs were downgraded and intermediaries could no longer roll over their commercial paper. They were consequently obliged to request funding from their sponsors or lose money. This led to the decline of several banks and a liquidity crisis in several markets such as commercial paper in Canada. In the same period, CDOs generated profits by repackaging pools of risky loans and selling them in the form of bond tranches. The profits associated with this structuring activity are larger when the products have a higher credit rating. However, it was difficult for rating agencies to value these increasingly complex assets, because they lacked suitable models or data. They therefore rated these tranches as they would for regular bonds, without considering the real correlations between the tranches of the structured products. It was also very difficult for buyers of these tranches to monitor and replicate the ratings of these structured products, because they lacked adequate data or models.

5.1.3. Poor pricing of complex financial products

Another cause of the 2007 crisis is the price of structured financial instruments, which is often too low and does not reflect their true risk exposure. These products contained systemic risks not considered in pricing. Systemic risk appears when events in one market affect other markets or other institutions in the same market. For example, when difficulties occurred with an ABCP, several money market managers transferred their orders to the Treasury Bill market, thus raising prices and lowering returns. These externalities were amplified by a lack of market transparency. In the case of ABCP in Canada, many investors did not know, in 2007, whether these products were contaminated by US or other *subprime* products, but rumors abounded. We now know that only a few institutions, which signed the Montréal Accord, held contaminated products, representing 6% of the total risk exposure. The rumors of the presence of subprime products made the markets illiquid, forcing several investors such as pension funds and hedge funds to sell good assets at a discount, thus reducing their value.

5.1.4. Poor regulation of structured finance

It is important to note that current risk regulation is limited to banks and insurance companies. Pension funds and hedge funds are not regulated in most countries. The Basel II regulation is to blame here, because it significantly reduced the capital required for AAA assets, including the bonds of European countries. Banks were therefore attracted to these bonds and the new AAA structured products, while the sellers were motivated to obtain the AAA rating for these products. This phenomenon increased the pressure on rating agencies. The AAA ratings of these products also significantly affected the purchasing behavior of pension funds, insurance companies, and mutual funds. Although Treasury Bills offered lower rates, they did not truly represent the lowest risks to investors, who based their decisions solely on the only AAA ratings issued by rating agencies.

5.2. Lessons for risk management

Several lessons must be learned to improve risk management. The first is to always apply the basic risk management rules regardless of the economic context. Many investors lost large sums during the financial crisis for the following reasons:

- Executives' risk appetite is often not defined;
- Integrated risk management is not well-established in many companies;
- Independent risk management policies are not supported by top management.

Before the financial crisis, underestimation of default and liquidity risk of new structured financial products signaled poor risk management. Several products were introduced in the years preceding the crisis, and many investors adopted them without clearly understanding the risk because they lacked appropriate instruments to evaluate it. They therefore purchased these complex financial products as if they were standard products, without performing backtesting and stress testing on the real risks that these products represented. The risk management test function became obsolete for the top management of many funds and companies, which effectively delegated their credit risk analysis to rating agencies. These agencies evidently exhibited dubious knowledge, ethics, and independence.

Issuers of structured products need to be more responsible. They must retain a large fraction of the baskets of loans they issue, possibly the entire equity tranche and a fraction of the more senior tranches in the presence of risk correlation between tranches. This should heighten the incentive to apply better risk management in loan issuance and obtain better portfolios of loans to securitize.

Greater transparency is required in the tranching of structured products. Market participants and researchers should be able to replicate their composition, and public databases containing this information should be offered. The growing complexity of structured financial products poses major challenges related to effective management and dissemination of information. More transparency is therefore indispensable in the credit market, particularly when loans are securitized.

The rating of these products also requires more transparency. Any good researcher or investor can validate standard bond ratings because the data are available and the rating methods can be replicated. This should also be true for structured products; greater transparency in the pricing of these products is necessary.

Institutional changes in several countries are needed to reinforce independence or reduce vulnerability to externalities of international markets. Institutions must understand the technology

available. Common data collection and affordable communication methods between financial institutions should produce effective tools to verify and replicate the analyses of agencies' ratings and the packaging of trust companies' structured products. These data should be available to all groups of investors, similar to other market data. The ABCP market in Canada would not have collapsed in 2007 if the market had been more transparent, because we now know that only 6% of its volume was contaminated by American *subprime* products.

Firms' top management and board of directors must base their investment decisions primarily on risk management. They must use detailed information on integrated risk management at their company and weigh these risks against those of new investments. The board of directors of financial institutions should be made up of individuals who understand the risks of derivatives and structured products. The risk management committee must actively monitor the firm's risks. Top executives' risk appetite must be defined, known, and monitored by the board.

The *Chief Risk Officer* (CRO) is a senior vice-president of risk management or the equivalent. The CRO must have decision-making powers rather than passively monitor risk measurement and analysis. This officer must report to the CEO and periodically meet with the board of directors. Some specialists even suggest that the CRO should have veto rights over transactions considered too risky. The CRO's office must be independent from all of the company's business units. All important transactions must be analyzed rigorously *ex ante* using appropriate data models designed for product rating, pricing, and testing. This implies increased investment in risk management for many investors and for pension and hedge funds, along with greater transparency and appropriate risk disclosure.

These recommendations may seem difficult to apply for money market investors, who must manage numerous assets with 30-day terms to maturity. Appropriate risk management is even more crucial for these investors. If necessary, new forms of risk analysis must be developed in cooperation with independent and transparent agencies that are free of real or perceived conflict of interest.

To summarize, more diligent risk management is necessary.

6. Conclusion

The purpose of this paper was to present a historical review of risk management. In addition to outlining the important dates, we discussed the objectives of risk management and criticized its application in the years preceding the latest financial crisis. The first conclusion is that risk management must encompass more than simply minimizing the company's risk exposure.

The objective of risk management is to maximize firm value via the reduction of costs associated with different risks. The main costs that companies incur are financial distress, income taxes, financing of future investment projects, and premiums payable to *stakeholders*.

Risk management can also improve the firm's capital structure, which suggests that companies in good financial health should use their information advantage to establish strategies to hedge future prices. Companies also need *integrated risk management*, which would let them profit from different forms of natural coverage within the company.

Companies can use internal activities and market activities to protect themselves from risks. The most widespread internal activities are prevention of financial risks and accidents (self-protection) and reduction of the financial consequences of an accident (risk retention, self-insurance, liquidity reserves). Market insurance is a form of protection for losses related to pure risks that cannot be covered by the company. Derivatives are additional instruments that protect companies from unanticipated financial losses.

Risk management is part of corporate governance. Its main orientations must be defined by the board of directors and must be monitored by independent, competent directors in the audit committee or the risk management committee for companies highly exposed to various risks, such as financial institutions.

Nonetheless, financial institutions face a particular problem. Their risk positions, which are intended to increase their returns, expose their customers (holders of deposits and insurance contracts) to major losses. This justifies the actual regulation of the risks of banks and insurance companies. Recent history shows that international regulation of large financial institutions has failed in several respects: unfortunately, it is the taxpayers who have had to shoulder the cost of

the indiscipline of executives of large financial institutions. Regulation can also create perverse unanticipated effects on financial institutions.

In conclusion, effective regulation of financial institutions apparently remains elusive despite the immense progress seen in the last 25 years.

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