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FUNDAMENTAL ASPECTS OF OPERATIONAL RISK AND INSURANCE ANALYTICS

A HANDBOOK OF OPERATIONAL RISK

Marcelo G. Cruz
Gareth W. Peters
Pavel V. Shevchenko

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To Virginia and Nicholas
Marcel G. Cruz

To my dear wife Chen Mei-Peters, your love, patience support, and encouragement have made this book a reality. To my mother Laraine Peters for teaching me the joy of scientific discovery. To Youxiang Wu, the charity work is complete, thank you for all your support
Gareth W. Peters

To my father Vladimir and mother Galina
Pavel V. Shevchenko

To know, is to know that you know nothing.
That is the meaning of true knowledge.
Socrates

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Preface

Operational risk (OpRisk) has been through significant changes in the past few years with increased regulatory pressure for more comprehensive frameworks. Nowadays, every mid-sized and larger financial institution across the planet has an OpRisk department. However, if we compare the pace of progress of OpRisk to market and credit risks, we would realize that OpRisk is not advancing as fast as its sister risks moved in the past. Market risk management and measurement had its major breakthrough in the early 1990s as J.P. Morgan released publicly its Value-at-Risk (VaR) framework. Only a couple of years after this release, most of the 100 global largest banks had developed a market risk framework and were using, at least to a certain level, VaR methods to measure and manage market risk. A few years later, the Basel Committee allowed banks to use their VaR models for regulatory capital purposes. From the release of JP Morgan's methodology to becoming accepted by Basel and local regulators, it took only about 4 years. This is basically because the methods were widely discussed and the regulators could also see in practice how they would work. As we see it, one of the biggest challenges in OpRisk is to take this area to the same level that market and credit risk management are at. Those two risks are managed proactively and risk managers usually have a say if deals or businesses are approved based on the risk level. OpRisk is largely kept out of these internal decisions at this stage and this is a very worrying issue as quite a few financial institutions have OpRisk as its dominant exposure. We believe that considerable effort in the industry would have to be put into data collection and modeling improvements, and making a contribution to close this gap is the main objective of our book.

Unlike market and credit risks, the methodologies and practices used in OpRisk still vary substantially between banks. Regulators are trying to close the methodological gap by holding meetings with the industry and incentivizing convergence among the different approaches through more individualized guidance. Although some success might be credited to these efforts, there are still considerable challenges and this is where the *Fundamental Aspects of Operational Risk and Insurance Analytics: A Handbook of Operational Risk* can add value to the industry.

In addition, by using this text as a graduate text from which to teach the key components of OpRisk in universities, one will begin to achieve a concensus and understanding of the discipline for junior quantitative risk managers and actuaries. These challenges involve the practical business environment, regulator requirements, as well as the serious and detailed quantitative challenges in the modeling aspects.

This book is a comprehensive treatment of all aspects of OpRisk management and insurance with a focus on the analytical and modeling side but also covering the basic qualitative aspects. The initial chapters cover the building blocks of OpRisk management and measurement. There is broad coverage on the four data elements that need to be used in the

OpRisk framework as well as how a risk taxonomy process should be developed. Considerable focus is given to internal loss data and key risk indicators, as these would be fundamental in developing a risk-sensitive framework similar to market and credit risks. An example is also shown of how OpRisk can be inserted into a firm's strategic decisions. In addition, we cover basic concepts of probability theory and the basic framework for modeling and measuring OpRisk and how loss aggregation should work. We conclude this part of the text with a model to perform stress-testing in OpRisk under the US Comprehensive Capital Analysis and Review (CCAR) program.

We continue by covering more special topics in OpRisk measurement. For example, diverse methods to estimate frequency and severity models are discussed. Another very popular issue in this industry is how to select severity models and this is also comprehensively discussed. One of the biggest challenges in OpRisk is that data used in measurement can be very different, so combining them into a single measure is not trivial. In this part of the book, we show a number of methods to do so.

After the core risk measurement work is done, there are still some issues to address that can potentially mitigate the capital and also indicate how to manage risks. In the third part, we discuss correlation and dependency modeling as well as insurance and risk transfer tools and methods. This is particularly relevant when considering risk mitigation procedures for loss processes that may generate catastrophic losses due to, for instance, nature risk.

This book provides a consistent and comprehensive coverage of all aspects of risk management, more specifically OpRisk–organizational structure, methodologies, policies, and infrastructure–for both financial and nonfinancial institutions. The risk measurement and modeling techniques discussed in the book are based on the latest research. They are presented, however, with considerations based on practical experience of the authors with the daily application of risk measurement tools.

We have incorporated the latest evolution of the regulatory framework. The book offers a unique presentation of the latest OpRisk management techniques and provides one-stop shopping for knowledge in risk management ranging from current regulatory issues, data collection and management to technological infrastructure, hedging techniques, and organizational structure.

It is important to mention that we are publishing at the same time a companion book *Advances in Heavy Tailed Risk Modeling: A Handbook of Operational Risk* (Peters and Shevchenko, 2015), which, although can be seen as an independent tome, covers many important ideas in OpRisk and insurance modeling. This book would be ideally treated as a mathematically detailed companion to this current text, which would go hand in hand with a more advanced graduate course on OpRisk. In this text, we cover in detail significant components of heavy-tailed loss modeling, which is of key importance to many areas of OpRisk.

We would like to thank our families for their patience in our absence while we were writing this book.

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Marcelo G. Cruz, Gareth W. Peters, and Pavel V. Shevchenko

New York, London, Sydney

Acronyms

ABC	Approximate Bayesian Computation
ALP	Accumulated Loss Policy
AMA	Advanced Measurement Approach
APT	Arbitrage Pricing Theory
a.s.	almost surely
AUM	Assets under Management
BDSF	Business Disruption and System Failures
BCBS	Basel Committee on Banking Supervision
BCRLB	Bayesian Cramer–Rao Lower Bound
BEICF	Business Environment and Internal Control Factors
BHC	Banking Holding Company
BIS	Bank for International Settlements
CAT	catastrophe bond
CCAR	Comprehensive Capital Analysis and Review
CD	codifference
CLP	Combined Loss Policy
CPI	Consumer Price Index
CRLB	Cramer Rao Lower Bound
CV	covariation
CVaR	Conditional Value-at-Risk
DFT	Discrete Fourier Transform
ES	Expected shortfall
EVI	Extreme Value Index
EVT	Extreme Value Theory
FED	Federal Reserve Bank
FFT	Fast Fourier Transform
GAM	Generalized Additive Models
GAMLSS	Generalized Additive Models for Location Scale and Shape
GAMM	Generalized Additive Mixed Models
GDP	Gross Domestic Product
GLM	Generalized Linear Models
GLMM	Generalized Linear Mixed Models
HILP	Haircut Individual Loss Policy
HMCR	higher moment coherent risk measure
i.i.d.	independent and identically distributed

ILPC	Individual Loss Policy Capped
ILPU	Individual Loss Policy Uncapped
LDA	Loss Distribution Approach
MC	Monte Carlo
MCMC	Markov chain Monte Carlo
MLE	maximum likelihood estimator
MPT	Modern Portfolio Theory
o.d.e.	ordinary differential equation
OpRisk	operational risk
p.g.f.	probability generating function
PMCMC	particle Markov chain Monte Carlo
PPNR	pre-provision net revenue
r.v.	random variable
SCAP	Supervisory Capital Assessment Program
SMC	Sequential Monte Carlo
SRM	spectral risk measure
TCE	tail conditional expectation
TTCE	tempered tail conditional expectation
VaR	Value-at-Risk
Vco	variational coefficient

List of Distributions

Distribution Name	**Distribution Symbol**
Asymmetric Laplace	$AsymmetricLaplace(\cdot)$
Beta	$Beta(\cdot)$
Binomial	$Binomial(\cdot)$
Chi-Squared	$ChiSquared(\cdot)$
Exponential	$Exp(\cdot)$
g-and-h distributions	$T_{g,h}(\cdot)$
g-and-k distributions	$T_{g,k}(\cdot)$
g distributions	$T_g(\cdot)$
Gamma	$Gamma(\cdot)$
Generalized Inverse Gaussian	$GIG(\cdot)$
Generalized Pareto Distribution	$GPD(\cdot)$
Inverse Gaussian	$InverseGaussian(\cdot)$
Inverse Gamma	$InverseGamma(\cdot)$
LogNormal	$LogNormal(\cdot)$
Normal (Gaussian)	$Normal(\cdot)$
Standard Normal	$\Phi(\cdot)$
Negative Binomial	$NegBinomial(\cdot)$
Normal Inverse Gaussian	$NIG(\cdot)$
Pareto	$Pareto(\cdot)$
Poisson	$Poisson(\cdot)$
Tukey Transform *h*	$T_h(\cdot)$
Tukey Transform *k*	$T_k(\cdot)$
Tukey Transform *j*	$T_j(\cdot)$
Tukey Transform *hjk*	$T_{hjk}(\cdot)$
h distributions	$T_h(\cdot)$
Double *h*–*h* distributions	$T_{h,h}(\cdot)$
Generalized Beta	$GB2(\cdot)$
Log-t	$Log\text{-}t(\cdot)$
Generalized Gamma	$GG(\cdot)$
Singh–Maddala or Burr Type III	$BurrIII(\cdot)$
Dagum or Burr Type XII	$BurrXII(\cdot)$
Log-Cauchy	$LogCauchy(\cdot)$

Lomax	*Lomax*(·)
Generalized Hyperbolic	*GH*(·)
Laplace	*Laplace*(·)
Halphen Type A	*Halphe*(·)

CHAPTER ONE

OpRisk in Perspective

1.1 Brief History

Operational risk (OpRisk) is the youngest of the three major risk branches, the others being market and credit risks. The term OpRisk started to be used after the Barings event in 1995, when a rogue trader caused the collapse of a venerable institution by placing bets in the Asian markets and keeping these contracts out of sight of management. At the time, these losses could be classified neither as market nor as credit risks and the term OpRisk started to be used in the industry to define situations where such losses could arise. It took quite some time until this definition was abandoned and a proper definition was established for OpRisk. In these early days, OpRisk had a negative definition as "every risk that is not market and credit", which was not very helpful to assess and manage this risk. Looking back at the history of risk management research, we observe that early academics found the same issue of classifying risk in general, as Crockford (1982) noticed: "*Research into risk management immediately encounters some basic problems of definition. There is still no general agreement on where the boundaries of the subject lie, and a satisfactory definition of risk management is notoriously difficult to formulate*".

Before delving into the brief history of OpRisk it might be useful to first understand how risk management is evolving and where OpRisk fits in this evolution. Risk in general is a relatively new area that began to be studied only after World War II. The concept of risk management came from the insurance industry and this was clear in the early days' definitions. According to Crockford (1982) the term "risk management", in its earliest incarnations, "*encompassed primarily those activities performed to prevent accidental loss*". In one of the first textbooks on risk, Mehr and Hedges (1963) used a definition that reflected this close identification with insurance: "*[T]he management of those risks for which the organization, principles and techniques appropriate to insurance management is useful*". Almost 20 years later, Bannister and Bawcutt (1981) defined risk management as "*the identification, measurement and economic control of risks that threaten the assets and earnings of a business or other enterprise*", which is much closer to the definition used in the financial industry in the twenty-first century.

The association of risk management and insurance came from the regular use of insurance by individuals and corporations to protect themselves against these "accidental losses". It is interesting to see that even early authors on the subject made a case for the separation between risk management and risk-takers (the businesses). Crockford (1982) wrote that "*operational*

Fundamental Aspects of Operational Risk and Insurance Analytics: A Handbook of Operational Risk, First Edition. Marcelo G. Cruz, Gareth W. Peters, and Pavel V. Shevchenko.

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".

New tools for managing risks started to emerge in the 1950s, in addition to insurance, when many types of insurance coverage became very costly and incomplete; or certainly this "incompletion" started to be better noticed as risk management was beginning to evolve. Several business risks were either impossible or too expensive to insure. Contingent planning activities, an embryo of what is today called Business Continuity Planning (BCP), were developed, and various risk prevention or self-prevention activities and self-insurance instruments against some losses were put in place. Coverage for work-related illnesses and accidents also started to be offered during the 1960s. The 1960s were when a more formal, organized scholarly interest started to blossom in academia on issues related to risk. The first academic journal to show "risk" in their title was the *Journal of Risk and Insurance* in 1964. This journal was actually titled *Journal of Insurance* until then. Other specialized journals followed including *Risk Management*—published by the Risk and Insurance Management Society (RIMS), a professional association of risk managers founded in 1950 and the *Geneva Papers on Risk and Insurance*, published by the Geneva Association since 1976.

Risk management had its major breakthrough as the use of financial derivatives by investors became more spread out. Before the 1970s, derivatives were basically used for commodities and agricultural products; however, in the 1970s but more strongly in the 1980s, the use of derivatives to manage and hedge risks began. In the 1980s, companies began to consider financial risk management of "risk portfolios". Financial risk management has become complementary to pure risk management for many companies. Most financial institutions, particularly investment banks, intensified their market and credit risk management activities during the 1980s. Given this enhanced activity and a number of major losses, it was no surprise that more intense scrutiny drew international regulatory attention. Governance of risk management became essential and the first risk management positions were created within organizations.

A sort of "risk management revolution" was sparked in the 1980s by a number of macroeconomic events that were present during this decade as, for example, fixed currency parities disappeared, the price of commodities became much more volatile, and the price fluctuations of many financial assets like interest rates, stock markets, exchange rates, etc. became much more volatile. This volatility, and the many headline losses that succeeded, revolutionized the concept of financial risk management as most financial institutions had such assets in their balance sheets and managing these risks became a priority for senior management and board of directors. At the same time, the definition of risk management became broader. Risk management decisions became financial decisions that had to be evaluated based on their effect on a firm or portfolio value, rather than on how well they cover certain risks. This change in definition applies particularly to large public corporations, due to the risk these bring to the overall financial system.

These exposures to financial derivatives brought new challenges with regard to risk assessment. Quantifying the risk exposures, given the complexity of these assets, was (and still remains) quite complex and there were no generally accepted models to do so. The first and most popular model to quantify market risks was the famous "Black & Scholes" developed by Black and Scholes (1973) in which an explicit formula for pricing a derivative was proposed—in this case, an equity derivative. The model was so revolutionary that the major finance journals refused to publish it at first. It was finally published in the *Journal of Political Economy* in 1973. An extension of this article was later published by Merton in the *Bell Journal of Economics and Management Science* (Merton, 1973). The impact of the article in the financial industry

was significant and the risk coverage of derivatives grew quickly, expanding to many distinct assets like interest rate swaps, currencies, etc.

As risk management started to grow as a discipline, regulation also began to get more complex to catch up with new tools and techniques. It is not a stretch to say that financial institutions have always been regulated one way or another given the risk they bring to the financial system. Regulation was mostly on a country-by-country basis and very uneven, allowing arbitrages. As financial institutions became more globalized, the need for more symmetric regulation that could level the way institutions would be supervised and regulated increased worldwide. The G10, the group of 10 most industrialized countries, started meetings in the city of Basel in Switzerland under the auspices of the Bank for International Settlements (BIS). The so-called Basel Committee on Banking Supervision or Basel Committee was established by the central bank governors of the group of 10 countries at the end of 1974, and continues to meet regularly four times a year. It has four main working groups, which also meet regularly.

The Basel Committee does not possess any formal supranational supervisory authority, and its conclusions cannot, and were never intended to, have legal force. Rather, it formulates broad supervisory standards and guidelines and recommends statements of best practice in the expectation that individual authorities will take steps to implement them through detailed arrangements, statutory or otherwise, which are best suited to their own national systems. In this way, the Committee encourages convergence toward common approaches and common standards without attempting detailed standardization of member countries' supervisory techniques.

The Committee reports to the central bank governors and heads of supervision of its member countries. It seeks their endorsement for its major initiatives. These decisions cover a very wide range of financial issues. One important objective of the Committee's work has been to close gaps in international supervisory coverage in pursuit of two basic principles: that no foreign banking establishment should escape supervision; and that supervision should be adequate. To achieve this, the Committee has issued a long series of documents since 1975 that guide regulators worldwide on best practices that can be found on the website: www.bis.org/bcbs/publications.htm.

The first major outcome of these meetings was the Basel Accord, now called Basel I, signed in 1988 (see BCBS, 1988). This first accord was limited to credit risk only and required each bank to set aside a capital reserve of 8%, the so-called Cooke ratio, of the value of the securities representing the credit risk in their portfolio. The accord also extended the definition of capital to create reserves encompassing more than bank equity, which were namely:

- **Tier 1 (core capital)**, consisting of common stock, holding in subsidiaries, and some reserves disclosed to the regulatory body;
- **Tier 2 (supplementary capital)**, made up of hybrid capital instruments, subordinated debts with terms to maturity greater than 5 years, other securities, other reserves.

The Basel I Accord left behind one important risk component, which was market risk. In the meantime, JP Morgan released publicly its market risk methodology called Risk Metrics (JP Morgan, 1996), and the popularization of market risk measurement became widespread in the early 1990s. Reacting to that, in 1996 the Basel Committee issued the market risk amendment (BCBS, 1996), which included market risk in the regulatory framework. The acceptance of more sophisticated models like Value at Risk (VaR) as regulatory capital was a significant milestone in risk management. However, this initial rule had a number of limitations as it did

not allow diversification, that is, the total VaR of the firm would be the sum of the VaR for all assets without allowing for correlation between these risks.

As the global financial markets became increasingly interconnected and sophisticated as well as financial products, like credit derivatives, it soon became clear to the Basel Committee that a new regulatory framework was needed. In June 1999, the Committee issued a proposal for a revised Capital Adequacy Framework. The proposed capital framework consisted of the following three pillars:

- **Pillar 1.** Minimum capital requirements, which seek to refine the standardized rules set forth in the 1988 Accord;
- **Pillar 2.** Supervisory review of an institution's internal assessment process and capital adequacy;
- **Pillar 3.** Market discipline focused on effective use of disclosure to strengthen market discipline as a complement to supervisory efforts.

Following extensive interaction with banks, industry groups, and supervisory authorities that are not members of the Committee, the revised framework (referred to as Basel II) BCBS (2004) was issued on June 26, 2004; the comprehensive version was published as BCBS (2006). This text serves as a basis for national rule-making and for banks to complete their preparations for the new framework's implementation.

With Basel II, there also came for the first time the inclusion of OpRisk into the regulatory framework. The OpRisk situation was different from the one faced by market and credit risks. For those risks, regulators were looking at the best practice in the industry and issuing regulation mirroring these. The progress in OpRisk during the late 1990s and early 2000s was very slow. Some very large global banks like Lehman Brothers did not have an OpRisk department until 2004, so the regulators were issuing rules without the benefit of seeing how these rules would work in practice. This was a challenge for the industry.

In order to address these challenges, the Basel Committee allowed a few options for banks to assess capital. The framework outlined and presented three methods for calculating OpRisk capital charges in a continuum of increasing sophistication and risk sensitivity: (i) the Basic Indicator Approach (BIA); (ii) the Standardized Approach (SA); and (iii) Advanced Measurement Approaches (AMA). Internationally active banks and banks with significant OpRisk exposures (e.g., specialized processing banks) are expected to use an approach that is more sophisticated than the BIA and that is appropriate for the risk profile of the institution.

Many models have been suggested for modeling OpRisk under Basel II; for an overview, see Chernobai *et al.* (2007, chapter 4), Allen *et al.* (2005), and Shevchenko (2011, Section 1.5). Fundamentally there are two different approaches used to model OpRisk:

- The top–down approach; and
- The bottom–up approach.

The top–down approach quantifies OpRisk without attempting to identify the events or causes of losses while the bottom–up approach quantifies OpRisk on a microlevel as it is based on identified internal events. The top–down approach includes the Risk Indicator models that rely on a number of operational risk exposure indicators to track OpRisks and the Scenario Analysis and Stress Testing Models that are estimated based on the what-if scenarios. The bottom–up approaches include actuarial-type models (referred to as the Loss Distribution

Approach) that model frequency and severity of OpRisk losses. In this book we provide a detailed quantitative discussion on a range of models some of which are appropriate for top-down modelling whilst others are directly applicable to bottom-up frameworks.

1.2 Risk-Based Capital Ratios for Banks

Until the late 1970s, banks in most countries were in general highly regulated and protected entities. This protection was largely a result of the bitter memories of the Great Depression in the US as well as the role that high (or hyper) inflation played in the political developments in Europe in the 1930s, and banks arguably play a significant part in the spreading of inflation. Due to these memories, the activities banks were allowed to undertake were tightly restricted by national regulators and, in return, banks were mostly protected from competitive forces. This cozy relationship was intended to ensure stability of the banking system, and it succeeded in its goals throughout the reconstruction and growth phases, which followed World War II. This agreement held well until the collapse of Bretton Woods[1] (Eichengreen, 2008) in the 1970s. The resulting strain in the banking system was enormous. Banks suddenly were faced with an increasingly volatile environment, but at the same time had very inelastic pricing control over their assets and liabilities, which were subject not just to government regulation but also to protective cartel-like arrangements. The only solution seen by national authorities at this time was to ease regulations on banks. As the banking sector was not used to competitive pressures, the result of the deregulation was that banks started to take too much risk in search of large pay-offs. Suddenly banks were overlending to Latin American countries (and other emerging markets); overpaying for expansion (e.g., buying competitors looking for geographic expansion), etc. With the crisis in Latin America in the 1980s, these countries could not repay their debts and banks were once again in trouble. Given that the problems were mostly cross-boundary as the less regulated banks became more international, the only way to address this situation was at the international level and the Basel Committee was consequently established under the auspices of the BIS.

In 1988, the Basel Committee decided to introduce an internationally accepted capital measurement system commonly referred to as Basel I, (BCBS, 1988). This framework was replaced by a significantly more complex capital adequacy framework commonly known as Basel II (BCBS, 2004) and, more recently, the Basel Committee issued the Basel III Accord (BCBS, 2011, 2013), which will add more capital requirements to banks. Table 1.1 shows a summary of key takeaways of the Basel Accords.

Basel I primarily focuses on credit risk and developed a system of risk-weighting of assets. Assets of banks were classified and grouped in five categories according to credit risk, carrying risk weights of 0% for the safest, most liquid assets (e.g., cash, bullion, home country debt like Treasuries) to 100% (e.g., most corporate debt). Banks with an international presence were required to at least hold capital equal to 8% of their risk-weighted assets (RWA). The concept of RWA was kept in all Accords with changes on the weights and in the composition of assets by category. An example of how risk-weighting works can be seen in Table 1.2. In this example, the sum of the assets of this bank is $1015; however, applying the risk-weighting rule established in Basel I, the RWA is actually $675.

[1] The Bretton Woods agreement was established in the summer of 1944 and put in place a system of exchange and interest rate stability which ensured that banks could easily manage their exposures.

TABLE 1.1 **Basel framework general summary**

Accord	Year	Key points
Basel I	1988	Introduces minimal capital requirement for the banking book. Introduces tier concept for capital requirement. Incorporates trading book into the framework later on through the Market Risk Amendment (MRA).
Basel II	2004	Allows usage of internal models and inputs in risk measurement. Introduces operational risk.
Basel II/III	2010	Increases capital requirement for trading book, with significant increase for correlation trading and securitizations.
Basel III	2010	Motivated by the great financial crisis of 2008, increases capital requirements, introduces leverage constraints and minimum liquidity and funding requirements.

TABLE 1.2 **Example of risk-weighted assets calculation under Basel I**

Risk-weight (%)	Asset	Amount ($)	RWA ($)
0	Cash	10	0
	Treasury bills	50	0
	Long-term treasury securities	100	0
20	Municipal bonds	20	4
	Items in collection	20	4
50	Residential mortgages	300	150
100	AA+ rated loan	20	20
	Commercial loans, AAA- rated	55	55
	Commercial loans, BB- rated	200	200
	Sovereign loans B- rated	200	200
	Fixed assets	50	50
Not rated	Reserve for loan losses	(10)	(10)
Total		1015	675

Since Basel I, a bank's capital also started to be classified into Tier 1 and Tier 2. Tier 1 capital is considered the primary capital or "core capital"; Tier 2 capital is the supplementary capital. The total capital that a bank holds is defined as the sum of Tier 1 and Tier 2 capitals. Table 1.3 provides a more detailed view of the components of each tier of capital. The key component of Tier 1 capital is the common shareholders equity. This item is so important that a number of banks also report the so-called Tier 1 Common Equity in which only common shareholder equity is considered as Tier 1. As shown in Table 1.3, the Basel Committee made capital requirement much stricter in the latest Basel Accords by changing the definition of some of the current items but also by sending a couple of items to Tier 2 (e.g., trust preferred securities and remaining noncontrolling interest), making it more difficult for banks to comply with these new capital rules.

Another important contribution from Basel I is the concept of capital ratios that remains until today. Basically, a bank needs to assert its capital requirements based on the formula:

$$\text{Capital ratio} = \frac{\text{Eligible capital}}{\text{RWA}}. \tag{1.1}$$