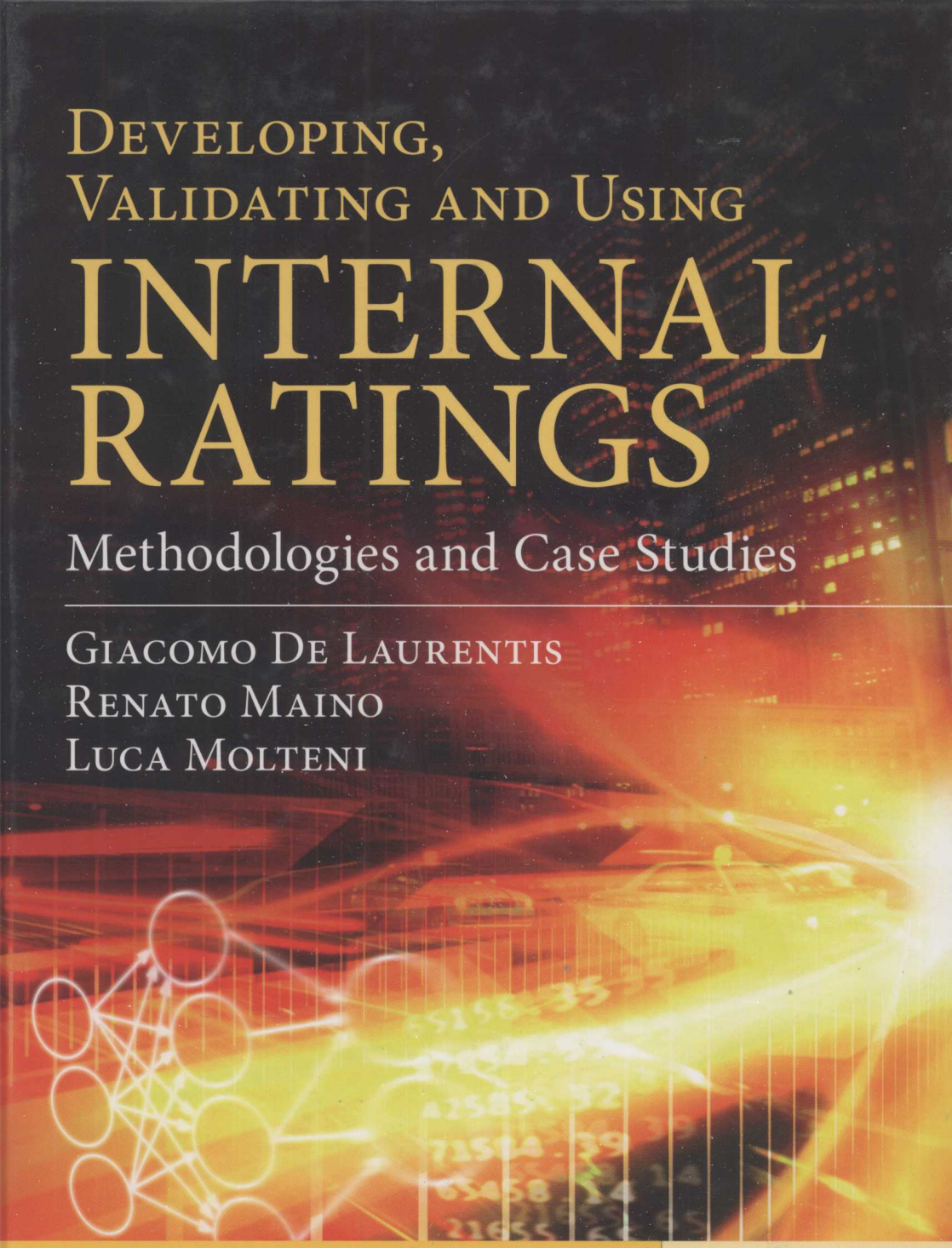
Developing, Validating and Using INTERNAL RATINGS

Methodologies and Case Studies

Giacomo De Laurentis
Renato Maino
Luca Molteni



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Preface

Banks are currently developing internal rating systems for both management and regulatory purposes. Model building, validation and use policies are key areas of research and/or implementation in banks, consultancy firms, and universities. They are extensively analyzed in this book, leveraging on international best practices as well as guidelines set by supervisory authorities. Two case studies are specifically devoted to building and validating statistical based models for borrower ratings.

This book starts by summarizing key concepts, measures and tools of credit risk management. Subsequently, it focuses on possible approaches to rating assignment, analyzing and comparing experts' judgment based approaches, statistical based models, heuristic and numerical tools. The first extensive case study follows. The model building process is described in detail, clarifying the main issues, how to use statistical tools and interpret results; univariate, bivariate, and multivariate stages of model building are discussed, highlighting the need to merge the knowledge of people with quantitative analysis skills with that of bank practitioners. Then validation processes are presented from various perspectives: internal and external (by supervisors), qualitative and quantitative, methodological and organizational. A second case study follows: a document for the internal validation unit, summarizing the process of building a shadow rating for assessing financial institutions creditworthiness, is proposed and analytically examined. Finally, conclusions are drawn: use policies are discussed in order to leverage on potentialities and managing limits of statistical based ratings.

The book is the result of academic research and the professional experience of its authors, mainly developed at the SDA Bocconi School of Management and Intesa Sanpaolo bank, as well as in consulting activities for many other financial institutions, including leasing and factoring companies. It focuses on quantitative tools, not forgetting that these tools cannot completely and uncritically substitute human judgment. Above all, in times of strong economic and financial discontinuities such as the period following the 2008 crisis, models and experience must be integrated and balanced out. This is why one of the fundamental tasks of this book is to merge different cultures, all of which are more and more necessary for modern banking:

- Statisticians must have good knowledge of the economic meaning of the data that they are working with and must realize the importance of human oversight in daily credit decisions.

- Credit and loan officers must have a fair understanding of the contents of quantitative tools, and properly understand how they can profit from their potentialities and what real limitations exist.
- Students attending credit risk management graduate and postgraduate courses must combine competences of finance, statistics and applicative tools, such as SAS and SPSS-PASW.
- Bank managers must set the optimal structure for lending processes and risk control processes, cleverly balancing competitive, management and regulatory needs.

As a consequence, the book tries to be useful to all and each of these groups of people and is structured as follows:

Chapter 1 introduces developments of credit risk management and recent insights gained from the financial crisis.

In Chapter 2, key concepts of credit risk management are summarized.

In Chapter 3, there is a description and a cross-examination of the main alternatives to rating assignment.

In Chapter 4, a case study based on real data is used to examine, step by step, the process of building and evaluating a statistical based borrower rating system for small and medium size enterprises aimed at being compliant with Basel II regulation. The data set is available on the book's website, www.wiley.com/go/validating. In the book, examples and syntax are based on the SPSS-PASW statistical package, which is powerful and friendly enough to be used both at universities and in business applications, whereas output and syntax files based on both SPSS-PASW and SAS are available on the book's website.

In Chapter 5, internal and regulatory validations of rating systems are discussed, considering both the qualitative and quantitative issues.

In Chapter 6, another case study is proposed, concerning the validation of a statistical based rating system for classifying financial institutions, in order to summarize some of the key tools of quantitative validation.

In Chapter 7, important issues related to organization and management profiles in the use of internal rating systems in banks' lending operations are discussed and conclusions are drawn.

Bibliography and a subject index complete the book.

In the book we refer to banks, but the term is used to indicate all financial institutions with lending activities.

The authors are pleased to acknowledge the great contributions of Nadeem Abbas, who has invaluably contributed to proof reading the entire book, and Daniele Tonini, who has reviewed some of the analyses in the book.

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Contents

1

The emergence of credit ratings tools

The 2008 financial crisis has shown that the reference context for supervisors, banks, public entities, non-financial firms, and even families had changed more than expected. From the perspective of banks' risk management, it is necessary to acknowledge the development of:

- New contracts (credit derivatives, loan sales, ABS, MBS, CDO, and so on).
- New tools to measure and manage risk (credit scoring, credit ratings, portfolio models, and the entire capital allocation framework).
- New players (hedge funds, sovereign funds, insurance companies, non-financial institutions entered into the financial arena).
- New regulations (Basel II, IAS/IFRS, etc.).
- New forces pushing towards profitability and growth (the apparently distant banking deregulation of the 1980s, contestable equity markets for banks and non-financial firms, management incentive schemes, etc.).

There are three key aspects to consider:

1. none of the aforementioned innovations can be considered relevant without the existence of the others;
2. each of the aforementioned innovations is useful to achieve higher levels of efficiency in managing banks;
3. all of these innovations are essentially procyclical.

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The problem is that the dynamic interaction among these innovations has created disequilibrium in both the financial and real economies.

As they are individually useful and all interconnected, a new equilibrium cannot be achieved by simply intervening in a few of them.

With this broader perspective in mind, we will focus on credit risk. In recent years, the conceptualization of credit risk has greatly improved. Concepts such as 'rating', 'expected loss', 'economic capital', and 'value at risk', just to name a few, have become familiar to bank managers. Applying these concepts has radically changed lending approaches in both commercial and investment banks, in fund management, in the insurance sector, and also for chief financial officers of large non-financial firms.

Changes concern tools, policies, organizational systems, and regulations related to underwriting, managing, and controlling credit risk. In particular, systems to measure expected losses (and their components: probability of default, loss given default, exposure at default) and unexpected losses (usually using portfolio VAR models) are tools which are nowadays regarded as a basic requirement. The competitive value of these tools pushes for an in-house building of models, also in accordance with the Basel Committee on Banking Supervision hopes.

The rating system is at the root of this revolution and represents the fundamental piece of every modern credit risk management system. According to the capital adequacy regulations, known as Basel II, the term rating system 'comprises all of the methods, processes, controls, and data collection and IT systems that support the assessment of credit risk, the assignment of internal risk ratings, and the quantification of default and loss estimates' (Basel Committee, 2004, p.394).

This signifies that 'risk models' must be part of a larger framework where, on one hand, their limits are perfectly understood and managed in order to avoid their dogmatic use, and, on the other hand, their formalization is not wasted by procedures characterized by excessive discretionary elements. To further outline this critical issue, how the current paradigm of risk measurements has been achieved in history and which decisions can be satisfactorily addressed by models (compared to those that should rest at the subjective discretion of managers) are addressed in this book.

The first provider of information concerning firms' creditworthiness was *Dun & Bradstreet*, which started in the beginning of the nineteenth century in the United States. At the end of the century, the first national financial market emerged in the United States; this financed immense infrastructures, such as railways connecting the east coast with the west coast. The issuing of bonds became widespread, in addition to more traditional shares. This evolution favored the creation of rating agencies, as they offer a systematic, autonomous, and independent judgment of bond quality. Since 1920, Moody's has produced ratings for more than 16 000 issuers and 30 000 issues; today it offers ratings for 4800 issuers. Standard & Poor's presently produces ratings of 3500 issuers. FITCH was created more recently by the merging of three other agencies: Fitch, IBCA, Duff & Phelps.

Internal ratings have a different anecdote. Banks started to internally classify borrowers in the United States in the second half of the 1980s when, after the

collapse of more than 2800 savings banks, the FDIC and OCC introduced a formal subdivision of bank loans in different classes. The regulation required loans to be classified, with an initial confusion on what to rate (borrowers or facilities), in at least six classes, three of which today we would define as 'performing' and three as 'non-performing' (*substandard*, *doubtful* and *loss*). Provisions had to be set according to this classification of loans.

This regulatory innovation had an influential effect for banks, which started to classify counterparties and to accumulate statistical and financial data. During the 1990s, the most innovative banks were able to use a new analytical framework, based on the distinction of:

- the average frequency of default events for each rating class (the probability of default);
- the average loss in case of default (the loss given default);
- the amount involved in recovery processes for each facility (the exposure at default).

The new conceptual framework (initially adopted primarily by the investment banks, which are more involved in corporate finance) has rapidly shown its competitive value for commercial banks, in order to set more precise credit and commercial policies, and for defining pricing policies linked more to risk than to the mere bargaining power of the counterparts.

Quantitative data on borrowers and facilities' credit quality has allowed the creation of tools for portfolio analysis and for active asset management. Concepts such as diversification and capital at risk have been transposed to asset classes exposed to credit risk, and have enabled commercial banks to apply advanced and innovative forms of risk management.

By the end of the 1990s, after more than 10 years of positive experimentation, internal ratings appeared to be a good starting point for setting more risk-sensitive capital requirements for credit risk. The new regulation, known as Basel II, which has been gradually adopted by countries all over the world, has definitively consolidated these tools as essential measurements of credit risk, linking them with:

- The minimum capital requirement for credit risk, according to simplified representations of portfolios of loans (the First Pillar of the Basel II regulation).
- Capital requirements for concentration risk and the integration of credit risk with other risks (financial, operating, liquidity, business and strategy risks) in a holistic vision of capital adequacy (a key aspect of ICAAP, the *Internal Capital Adequacy Assessment Process* of the Second Pillar).
- Higher levels of disclosure of banks' exposure to risks in their communications to the market (the Third Pillar); this is functional to enhance the 'market discipline' by penalizing on financial markets those banks that take too much risk.

2

Classifications and key concepts of credit risk

2.1 Classification

2.1.1 Default mode and value-based valuations

Credit risk can be analyzed and measured from different perspectives. Table 2.1 shows a classification of diverse credit risk concepts. Each of the listed risks depends on specific circumstances. Default risk (also called counterparty risk, borrower risk and so forth, with minor differences in meaning) is an event related to the borrower's default. Recovery risk is related to the possibility that, in the event of default, the recovered amount is lower than the full amount due. Exposure risk is linked to the possible increase in the exposure at the time of default compared to the current exposure. A default-mode valuation (sometimes also referred to as 'loss-based valuation') considers all these three risks.

However, there are other relevant sources of potential losses over the loan's life. If we can sell assets exposed to credit risk (such as available-for-sale positions), we also have to take into account that the credit quality could possibly change over time and, consequently, the market value. Credit quality change is usually indicated by a rating migration; hence this risk is known as 'migration risk'.

In the new accounting principles (IAS 39), introduced in November 2009 by the International Accounting Standard Board (IASB), the amortized cost of financial instruments and impairment of 'loans and receivables' and of 'held-to-maturity positions' also depend on migration risk. Independently from the fact that 'true' negotiations occur, a periodic assessment of credit quality is required and, if

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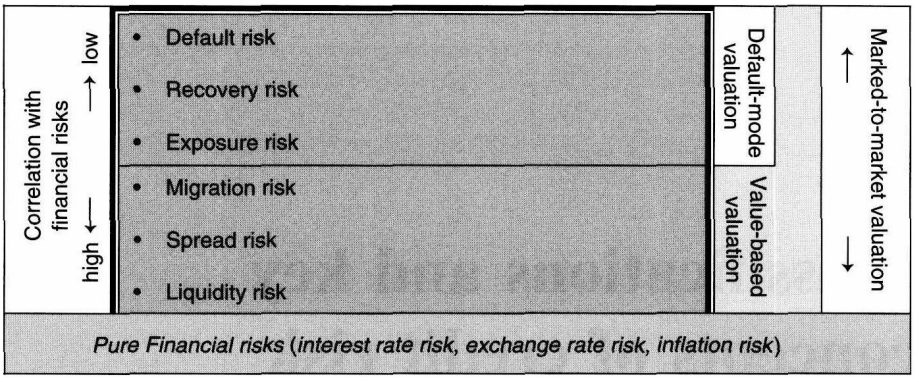
Table 2.1 A classification of credit risk.



meaningful changes in credit quality arise, credit provisions have consequently to be arranged, and both losses and gains have to be recorded.

Finally, if positions exposed to credit risk are included in the trading book and valued at market prices, a new source of risk arises. In fact, even in the case of no rating migrations, investors may require different risk premiums due to different market conditions, devaluating or revaluating existing exposure values accordingly. This is the spread risk, and it generates losses and gains as well.

The recent financial crisis has underlined an additional risk (asset liquidity risk) related to the possibility that the market becomes less liquid and that credit exposures have to be sold, accepting lower values than expected (Finger, 2009a).

Credit ratings are critical tools for analyzing and measuring almost all these risk concepts. Consider for instance that risk premiums are usually rating sensitive, as well as market liquidity conditions.

2.1.2 Default risk

Without a counterparty's credit quality measure, in particular a default probability, we cannot pursue any modern credit risk management approach. The determination of this probability could be achieved through the following alternatives:

- The observation of historical default frequencies of borrowers' homogeneous classes. The borrowers' allocation to different credit quality classes has traditionally been based on subjective analysis, leveraging on analytic competences of skilled credit officers. Rating agencies have an almost secular track record of assigned ratings and default rates observed *ex post* per rating class.
- The use of mathematical and statistical tools, based on large databases. The bank's credit portfolios, which have thousands of positions observed in their historical behavior, allow the application of statistical methods. Models

combine various types of information in a score that facilitates the borrowers' assignment to different risk classes. The same models permit a detailed *ex ante* measure of expected probability and facilitate monitoring over time.

- The combination of both judgmental and mechanical approaches (hybrid methods). Automatic classification is generated by statistical or numerical systems. Experts correct results by integrating qualitative aspects, in order to reach a classification that combines both potentialities (i.e., the systematic statistical analysis, expert competence and their ability to deal with soft information). Even in this case, the historical observation, combined with statistical methods, permits a default probability associated to each rating class to be reached.

- A completely different approach 'extracts' the implicit probability of default embedded in market prices (securities and stocks). The method can obviously only be applied to public listed counterparties on equity or securities markets.

The measure of default risk is the 'probability of default' within a specified time horizon, which is generally one year. However, it is also important to assess the cumulative probabilities when exposure extends beyond one year. The probability may be lower when considering shorter time horizons, but it never disappears. In overnight lending, too, we have a non-zero probability, given that sudden adverse events or 'hidden' situations to analysts may occur.

2.1.3 Recovery risk

The recovery rate is the complement to one of 'the loss in the event of default' (typically defined as LGD, Loss Given Default, expressed as a percentage). Note that here default is 'given', that is to say that it has already occurred.

In the event of default, the net position proceeds dependent on a series of elements. First of all, recovery procedures may be different according to the type of credit contracts involved the legal system and the court that has jurisdiction. The recovery rate also depends on the general economic conditions: results are better in periods of economic expansion. Defaulted borrowers' business sectors are important because assets values may be more or less volatile in different sectors. Also, covenants are important; these agreements between borrower and lender raise limits to borrower's actions, in order to provide some privileges to creditors. Some covenants, such as those limiting the disposal of important assets by the borrower, should be considered in LGD estimation. Other types of collateral may reduce the probability of default rather than the LGD; these are delicate aspects to models (Altman, Resti and Sironi, 2005; Moody's Investor Service, 2007).

Ex ante assessment of recovery rate (and corresponding loss given default) is by no means less complex than assessing the probability of default. Recovery rate data are much more difficult to collect, due to many reasons. Recoveries are often managed globally at the counterparty's position and, as a consequence,

their reference to the original contracts, collaterals, and guarantees is often lost. Default files are mainly organized to comply with legal requirements, thus losing uniformity and comparability over time and across positions. Even when using the most sophisticated statistical techniques it is very difficult to build comprehensive models. Then, less sophisticated procedures are applied to these assessments, often adopting 'top down' procedures, which summarize the average LGD rates for a homogeneous set of facilities and guarantees. 'Loss given default ratings' (also known as 'severity ratings') are tools used to analyze and measure this risk.

2.1.4 Exposure risk

Exposure risk is defined as the amount of risk in the event of default. This amount is quite easily determined for term loans with a contractual reimbursement plan. The case of revolving credit lines whose balance depends more on external events and borrower's behavior is more complex. In this case, the due amount at default is typically calculated using model's specification, such as the following:

$$\text{Exposure at default} = \text{drawn} + (\text{limit} - \text{drawn})^* \text{LEQ}$$

where:

- drawn is the amount currently used (it can be zero in case of back-up lines, letters of credit, performance bonds or similar),
- limit is the maximum amount granted by the bank to the borrower for this credit facility,
- LEQ (Loan Equivalency Factor) is the rate of usage of the available limit, beyond the ordinary usage, in near-to-default situations.

In other cases, such as account receivables' financing, additional complexities originate from commercial events of non-compliance in contractual terms and conditions that can alter the amounts which are due from the buyer (the final debtor) to the bank. For derivative contracts, the due value in the event of default depends on market conditions of the underlying asset. The Exposure at Default (EAD) may therefore assume a probabilistic nature: its amount is a forecast of future events with an intrinsically stochastic approach. EAD models are the tools used to measure EAD risk.

2.2 Key concepts

2.2.1 Expected losses

A key concept of credit risk measurement is 'expected loss': it is the average loss generated in the long run by a group of credit facilities. The 'expected loss rate' is expressed as a percentage of the exposure at default.