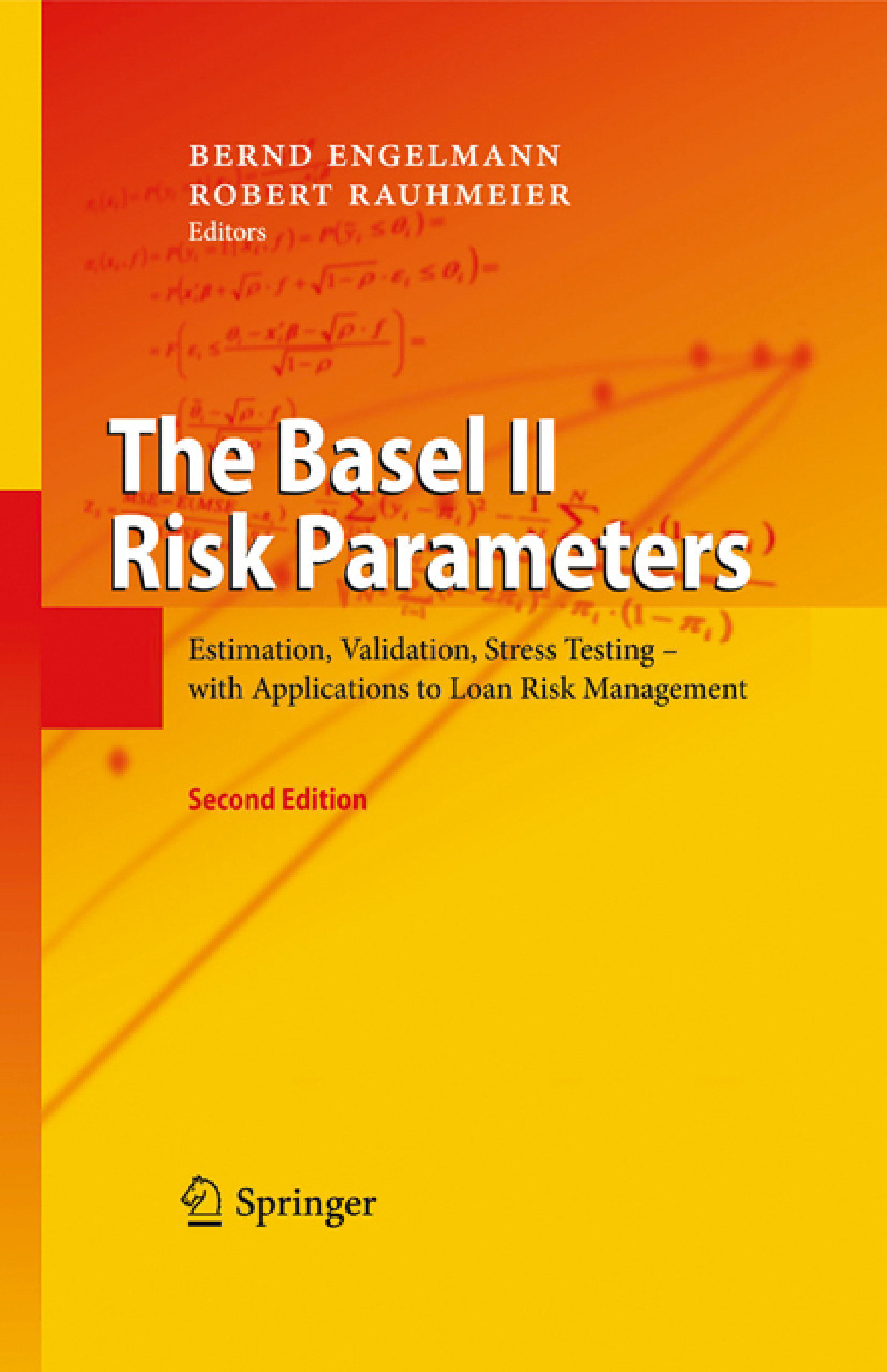

BERND ENGELMANN
ROBERT RAUHMEIER
Editors

The Basel II Risk Parameters

Estimation, Validation, Stress Testing – with Applications to Loan Risk Management

Second Edition

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Preface to the Second Edition

The years after the first edition of this book appeared have been very turbulent. We have seen one of the largest financial crisis in the history of the global financial system. Banks which existed since more than one century have disappeared or had to be rescued by the state. Although Basel II has been implemented by many banks so far and still a lot of effort is spent in improving credit risk management by building up rating systems and procedures for estimating the loan loss parameters PD, LGD, and EAD, there is still a feeling that this is insufficient to prevent the financial system from further crisis.

There are ongoing discussions how the financial system can be stabilized by either improving the regulatory framework or the internal risk management of banks. During the time when we worked on this second edition, the regulatory framework Basel III has been discussed. The basic idea behind Basel III is extending the capital basis of banks. It is not the aim of Basel III to improve the methods and processes of banks' internal credit risk management but simply to improve system stability by increasing capital buffers. Since we did not view this book as a book on regulation (although it was motivated by a regulatory framework) but as a book on risk management, we do not discuss the current regulatory ideas in this edition.

Instead, we focus on one of the causes for the financial crisis, the lending behaviour of banks in the retail sector. By retail, we mean lending to debtors where no market information on their credit quality, like asset swap or credit default swap spreads, is available. This is the case for almost all loans except for loans to large corporations, states or banks. In the recent financial crisis one of the origins was that American banks granted mortagage loans to too many debtors with low income. By assuming that house prices could not fall sharply it was thought that the value of the loan's collateral will be sufficient in the case of a default to ensure that no loss occurs. A large number of bankruptcies among the banks which had invested in the American housing sector and expensive rescue programs for banks that were considered as too important to fail are the result of this wrong assumption.

The consequences of the financial crisis are not yet clear. The question how an optimal financial system has to look like is difficult to answer. On the one hand the lending behaviour of banks should not be too restrictive because this will obstruct the real economy. On the other hand it must be restrictive enough to prevent the creation of bubbles. The same considerations are true for the spectrum of financial products. There should be enough vehicles for banks and corporations to manage their risks but the complexity and the volume of derivative instruments should not lead to a less stable financial system.

We do not attempt to give an answer to this complex question. Contrary to some opinions in the aftermath of the crisis that blamed mathematical models as its main driver, we still believe that mathematics and statistics are valuable tools to quantify risks. However, one has to be aware that this cannot be done with arbitrary precision. The role of a model in our view is more to increase the transparency of a bank's business and to identify key risks. We want to illustrate this view by presenting a pricing framework for retail loans that shows how the Basel II risk parameters can be used in building a simple and transparent framework for the pricing and the risk management of loan portfolios. In our view an increase in transparency in the loan market is a necessary prerequisite of any risk management or regulatory action.

Compared to the first edition, we have extended the book by three new chapters. In Chap.6 estimation techniques for transition matrices are presented and their properties are discussed. A transition matrix is a natural extension of a 1-year default probability since it measures all transitions of a rating system not only the transitions to default. It is an important building block of the loan pricing framework that is presented in Chaps.17 and 18. In Chap.17 it is shown how the Basel II risk parameters can be used to build a risk-adjusted pricing framework for loans that can be applied to compute a loan's term based on RAROC (risk-adjusted return on capital) as performance measure and to calculate general loss provisions for a loan portfolio in an economically sensible way. Furthermore, this framework allows for an easy stress testing and answering of questions like: "What happens if the value of collateral turns out to be 10% lower than assumed?" In Chap.18, the pricing framework is extended in a consistent way to loans with embedded options using option pricing theory. Often a loan contains prepayment rights, i.e. a debtor has the right to pay back parts or all of the notional at certain dates or throughout the loan's lifetime without penalty. We demonstrate that the value of such an option is too large to be neglected and show further how to include embedded options into the RAROC framework of Chap.17.

Finally, we would like to thank Martina Bihn from Springer-Verlag again for her support of this second edition and last but not least our families for their support when we again spent a lot of time working on it.

Questions and comments on this book are welcome. The editors can be reached under their e-mail addresses bernd.engelmann@quantsolutions.de and robert.rauhmeier@arcor.de.

Frankfurt am Main, Germany Bernd Engelmann
Munich, Germany Robert Rauhmeier
December 2010

Preface to the First Edition

In the last decade the banking industry has experienced a significant development in the understanding of credit risk. Refined methods were proposed concerning the estimation of key risk parameters like default probabilities. Further, a large volume of literature on the pricing and measurement of credit risk in a portfolio context has evolved. This development was partly reflected by supervisors when they agreed on the new revised capital adequacy framework, Basel II. Under Basel II, the level of regulatory capital depends on the risk characteristics of each credit while a portfolio context is still neglected.

The focus of this book is on the estimation and validation of the three key Basel II risk parameters, probability of default (PD), loss given default (LGD), and exposure at default (EAD). Since the new regulatory framework will become operative in January 2007 (at least in Europe), many banks are in the final stages of implementation. Many questions have arisen during the implementation phase and are discussed by practitioners, supervisors, and academics. A "best practice" approach has to be formed and will be refined in the future even beyond 2007. With this book we aim to contribute to this process. Although the book is inspired by the new capital framework, we hope that it is valuable in a broader context. The three risk parameters are central inputs to credit portfolio models or credit pricing algorithms and their correct estimation is therefore essential for internal bank controlling and management.

This is not a book about the Basel II framework. There is already a large volume of literature explaining the new regulation at length. Rather, we attend to the current state-of-the-art of quantitative and qualitative approaches. The book is a combination of coordinated stand-alone articles, arranged into 15 chapters so that each chapter can be read exclusively. The authors are all experts from science, supervisory authorities, and banking practice. The book is divided into three main parts: Estimation techniques for the parameters PD, LGD and EAD, validation of these parameters, and stress testing.

The first part begins with an overview of the popular and established methods for estimating PD. Chapter 2 focuses on methods for PD estimation for small and medium sized corporations while Chap.3 treats the PD estimation for the retail segment. Chapters 4 and 5 deal with those segments with only a few or even no default data, as it is often the case in the large corporate, financial institutions, or sovereign segment. Chapter 4 illustrates how PD can be estimated with the shadow rating approach while Chap.5 uses techniques from probability theory. Chapter 6 describes how PDs and Recovery Rates could be estimated under considerations of systematic and idiosyncratic risk factors simultaneously. This is a perfect changeover to the chaps.7–10 dealing with LGD and EAD estimation which is quite new in practice compared to ratings and PD estimation. Chapter 7 describes how LGD could be modelled in a point-in-time framework as a function of risk drivers, supported by an empirical study on bond data. Chapter 8 provides a general survey of LGD estimation from a practical point of view. Chapters 9 and 10 are concerned with the modelling of EAD. Chapter 9 provides a general overview of EAD estimation techniques while Chap.10 focuses on the estimation of EAD for facilities with explicit limits.

The second part of the book consists of four chapters about validation and statistical back-testing of rating systems. Chapter 11 deals with the perspective of the supervisory authorities and gives a glance as to what is expected when rating systems will be used under the BaselII framework. Chapter 12 has a critical discussion on measuring the discriminatory power of rating systems. Chapter 13 gives an overview of statistical tests for the dimension calibration, i.e. the accuracy of PD estimations. In Chap.14 these methods are enhanced by techniques of Monte-Carlo-Simulations which allows e.g. for integration of correlation assumptions as is also illustrated within a back-testing study on a real-life rating data sample.

The final part consists of Chap.15, which is on stress testing. The purpose of stress testing is to detect limitations of models for the risk parameters and to analyse effects of (extreme) worse scenarios in the future on a bank's portfolio. Concepts and implementation strategies of stress test are explained and a simulation study reveals amazing effects of stress scenarios when calculating economic capital with a portfolio model.

All articles set great value on practical applicability and mostly include empirical studies or work with examples. Therefore we regard this book as a valuable contribution towards modern risk management in every financial institution, whereas we steadily keep track on the requirements of Basel II. The book is addressed to risk managers, rating analyst and in general quantitative analysts who work in the credit risk area or on regulatory issues. Furthermore, we target internal auditors and supervisors who have to evaluate the quality of rating systems and risk parameter estimations. We hope that this book will deepen their understanding and will be useful for their daily work. Last but not least we hope this book will also be of interest to academics or students in finance or economics who want to get an overview of the state-of-the-art of a currently important topic in the banking industry.

Finally, we have to thank all the people who made this book possible. Our sincere acknowledgements go to all the contributors of this book for their work, their enthusiasm, their reliability, and their cooperation. We know that most of the writing had to be done in valuable spare time. We are glad that all of them were willing to make such sacrifices for the sake of this book. Special thank goes to Walter Gruber for bringing us on the idea to edit this book.

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Finally we would like to thank our families for their continued support and understanding.

Frankfurt am Main, Germany Bernd Engelmann
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