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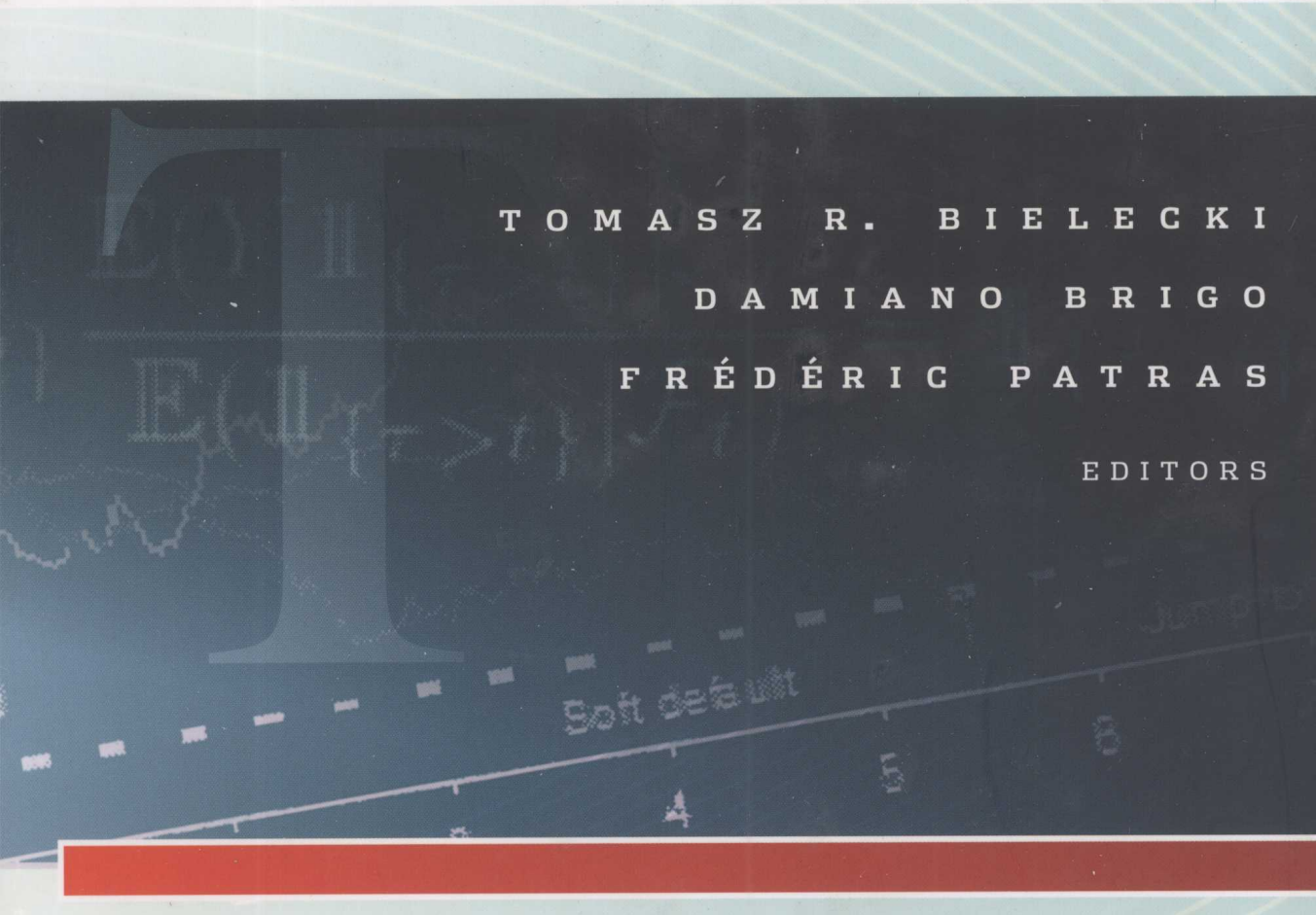

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CREDIT RISK FRONTIERS

SUBPRIME CRISIS, PRICING AND HEDGING, CVA, MBS, RATINGS, AND LIQUIDITY

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Subprime Crisis, Pricing and Hedging, CVA, MBS, Ratings, and Liquidity

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Foreword

The current economic environment, with its unprecedented global financial crisis and slow resolution, has stimulated a wealth of innovative and constructive solutions in credit risk modeling and credit derivatives in particular. While it is true that this volume includes some of the more important research of the past year, significantly, I credit the editors for having facilitated a heightened quality within the individual contributions.

Importantly, chapters are split with a good balance of the theoretical versus the practical. Especially since 2007, credit markets have extraordinarily stressed both theoretical frameworks and empirical calibrations.

Similarly, and refreshingly, contributing authors are evenly split between academic versus practitioners from industry. For example, different contributions on collateralized debt obligations (CDOs) illustrate the diversity.

Parenthetically, I have been continually amazed these past two years to see that new CDO research has been the fastest growing category of research posted on DefaultRisk.com. This is quite ironic because the new issuance of CDOs has collapsed to a small fraction of 2007 levels.

I feel this volume of research is explained by not only the existing/troubling inventory of CDOs that must be managed, but also because CDOs—as a structure—offer a defined microcosm of the larger/general credit portfolio.

There are gratifyingly few redundancies across the contributing authors. Of course, it is beneficial to have a good diversity of views brought from different perspectives. For example, the different collateralized loan obligation (CLO) and residential mortgage-backed security (RMBS) chapters offer complementary discussions.

By contrast, it is not at all surprising that several contributions address the ever more liquid credit default swap (CDS) market, their options, and their liquidity. Other important and very timely contributions concern counterparty risk and credit valuation adjustment (CVA), which are here addressed in five chapters, and hybrid modeling of credit and equity, which is addressed in a novel way.

These are just a few examples of the innovation and originality in a single volume that has, among other merits, the courage to deal in a single source with several urgent topics such as the subprime crisis, pricing and hedging of credit risk, CVA, CDO, CLO, MBS, ratings, and liquidity.

Finally, this volume would not have been possible without the diligent work this past year from many people too numerous to list. Beyond the editors and contributing authors, we are grateful to all the conference attendees and panel members in September 2009 at the Université de Nice Sophia Antipolis. The interaction was spirited and the comments were invaluable. Enjoy.

GREG M. GUPTON
May 2010
DefaultRisk.com
Author of the CreditMetrics Technical Document

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Introduction

The recent decade has witnessed a rapid development of more and more advanced quantitative methodologies for modeling, valuation, and risk management of credit risk, with focus on credit derivatives that constitute the vast majority of credit markets. In part, this rapid development was a response of academics and practitioners to the demands of trading and risk managing in the rapidly growing market of more and more complex credit derivative products. Even basic credit derivatives such as credit default swaps (CDSs) have witnessed considerable growth, reaching a notional value of US$45 trillion by the end of 2007, although notional amounts fell during 2008 to $38.6 trillion.[1] More complex credit derivatives, such as collateralized debt obligations (CDOs), featured a global issuance of $157.8 billion in 2004, reaching $481 billion in 2007, although in 2009 this has gone down to $4.3 billion.[2]

The size and complexity of credit markets in general, and credit derivatives markets in particular, undoubtedly posed a challenge for (quantitative) modelers and for market practitioners. The recent turmoil in the credit markets can be attributed to many factors, but one of the factors is probably the fact that in many respects the challenge has not been properly addressed.

This volume studies aspects of modeling and analysis of credit risk that, in our opinion, have not been adequately understood in the past. This is immediately evident also from the book subtitle, in that counterparty risk, mortgage-backed securities (MBSs), liquidity modeling, ratings, and in general pricing and hedging of complex credit derivatives are all among the areas that have not been fully or adequately addressed.

An important and original feature of this book is that it gathers contributions from practitioners and academics in an equilibrated way. Whereas the practitioners' contributions are deeply grounded in concrete experience of markets and products, the contributing academics are often involved in consulting and similar activities and have therefore a real empirical knowledge of financial products as well.

We indeed found it essential, when conceiving the volume, to keep in mind two guiding principles that, according to us, have to structure the research and practice in credit risk and, more generally, in modern finance. First, research has to be rooted in experience and rely on the knowledge of the empirical behavior of markets. Losing sight of experience or disconnecting the sophisticated mathematics of modern financial theories from the day-to-day practice may be dangerous for obvious reasons, besides compromising the necessary dialogue between decision makers and

quantitative analysts. Second, a high level of technicality is required to deal with current credit markets. A naive approach that would not rely on cutting-edge research would simply be condemned to fail, at least as far as derivatives or tail distributions involved in risk management are concerned. We hope the present volume will contribute to making the difficult synthesis of these two requirements (rooting in experience, technical complexity) effective.

The volume contains expert opinion articles, survey articles, as well as articles featuring the cutting-edge research regarding these aspects. This is important, as we believe that once the dust settles after the recent credit crisis, the credit markets will be facing challenges that this research addresses, so the volume may contribute to improvement of the health of the postcrisis credit universe.

The volume is directed to senior management and quants in financial institutions, such as banks and hedge funds, but also to traders and academics. In particular, academics and students in need of strengthening their understanding of how complex mathematics can be effectively used in realistic financial settings can benefit from its reading.

The volume provides a coherent presentation of the recent advancements in theory and practice of credit risk analysis and management with emphasis on some specific topics that are relevant to the current state and to the future of credit markets. The presented research is high-level on all the involved sides: financial, mathematical, and computational. This is the only way, we believe, that modeling should be presented and discussed so as to be meaningful, constructive, and useful. In addition, readers will also benefit from quality survey articles regarding selected topics.

The present collection of articles is one of several analytical texts that have appeared in recent months as a reaction by the quantitative community to the financial crisis that exploded in 2008. We refer, for example, to Lipton and Rennie (2007), which appeared before the crisis, and Brigo, Pallavicini, and Torresetti (2010), reporting both pre- and postcrisis research. These two books are just two examples of the necessity for the quantitative community to assess its status quo vis-à-vis financial markets in general, and credit markets in particular.

The volume opens with two expert opinion articles reflecting on the role of quantitative modeling in the past and in the future, on how it did or how it did not contribute to the current credit crisis, on what lessons modeling should incorporate from the credit crunch crisis, and on whether modeling should still be relevant.

These opening chapters form the first part of the book and are followed by articles focusing on some specific issues and areas reaching toward the frontiers of credit risk modeling, valuation, and hedging.

The second and third parts are closely related, although we found it convenient to divide their contents into two separate groups. They both deal with credit derivatives. Part II focuses on general methods in multiname credit derivatives, namely derivative products that depend on more than one credit entity at the same time. This part is meant to deal with the usual key issues of multiname credit derivatives but using revisited approaches and analysis. The topics covered include a survey of multiname

credit derivatives methods and approaches, methods to deal with heterogeneity and dynamic features, analysis of hedging behavior of models, filtering and information, and the modeling of options on credit derivatives.

The focus of the third part is more oriented toward products and more specifically toward asset-backed securities (ABSs) in which the analysis of cash flows presents specific difficulties that are not present in the familiar synthetic CDO framework—although we should point out that these contributions involve general ideas and techniques that are relevant for all asset classes in the field of credit. The first chapter of this part introduces the factor models, with a particular emphasis on the ABX indexes. Topics included in the other chapters are a modeling and analysis framework for collateralized loan obligations (CLOs), a valuation and risk analysis framework for residential mortgage-backed securities (RMBSs), together with a survey of postcrisis solutions to various issues such as interest rate modeling and the handling of numerical complexity.

The fourth part is devoted to the valuation of credit valuation adjustment (CVA) and counterparty risk in the current environment. It is well-known that counterparty risk was underestimated before the subprime crisis. This contributed heavily to the crisis when many financial institutions discovered billions of dollars' worth of counterparty exposures were at risk, either directly in case the counterparty would default, or indirectly through downgrades (the downgrades of monoline insurers come to mind). Since then, counterparty risk measurement has become a key issue and has attracted a lot of attention, both from the financial industry and from academia. The first chapter of this part settles the general framework of CVA valuation, including subtle mathematical features. Topics in this part include: models and mathematical tools for CVA on credit derivatives, from both the intensity and the structural points of view; CVA for bonds and swaps; accounting issues; and advanced features related to netted positions and margin agreements.

The fifth part is devoted to equity-to-credit modeling. The idea of unifying the universes of credit and equity into a single mathematical framework is an old dream of mathematical finance. The so-called Merton model, predicting defaults by viewing the stock market value of a listed firm as a call option on its assets with a threshold computed from its debt, offers a general strategy, but the corresponding numerical results are known to be unsatisfactory: hence the need for new models incorporating advanced features such as jumps or random volatility. The two chapters introduce such models and discuss the application domain of equity-to-credit modeling that runs from joint pricing of credit and equity to relative value analysis. One of the papers in the CVA part also deals with equity-to-credit modeling but with a focus on counterparty risk for equity payoffs.

The last "Miscellanea" part gathers various contributions on important topics. They include: liquidity risk (offering a detailed survey of the existing methodologies for liquidity modeling in credit default swaps), ratings (with the case study of constant proportion debt obligations [CPDOs]), modern Monte Carlo methods (with an emphasis on interacting particle systems), and a survey of the theory of risk contributions in credit risk management.

Notes

1. International Swap and Derivatives Association, "Market Survey Year-End 2008."
2. Securities Industry and Financial Markets Association, 2010. "Global CDO data" press release 2010-07-02.

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PART I

Expert Views

CHAPTER 1

Origins of the Crisis and Suggestions for Further Research

Jean-Pierre Lardy
JPLC

We review several of the factual failures that the 2008 subprime crisis has revealed and analyze the root causes for these. Credit rating, regulation, models, accounting, leverage, risk management, and other aspects are reviewed. In each case, we survey solutions proposed as well as suggest directions for further research.

1.1 Introduction

The many roots of the 2008 financial crisis have been well covered in several publications. The aim of this review is to provide a short list of the ones most frequently raised and in each case try to distill one important aspect of the problem, the current proposals, and, possibly, what could be a direction of research to better understand the issue. A lesson from past decades is certainly that crises are not easy to forecast in terms of timing and magnitude, and when they occur (we can only forecast that they *will* occur), it is not always easy to separate, to paraphrase a famous quote from financier J.P. Morgan,[1] what was wrong as a matter of judgment from what was wrong as a matter of principle. These same questions apply in today's modern finance of sophisticated markets, products, and models, with the additional complexity of separating, when something went wrong, a technical failure of the "machine" (or of the principles on which it is built) from a failure of the "user" (or its judgment). To use an analogy (I find it useful)—investing is like riding a bicycle, and there is always a trade-off between performance and risk and improvements from better machines or better driving.

After working 20 years in the financial markets, including roles at two investment banks in equity and credit derivatives,[2] I have witnessed several stages of their development. I was lucky enough to reach levels of responsibility giving me a view on how decisions are made, good and bad, individually or collectively. Being mostly in the "engines room" kept me in the front lines of crises and allowed me to see how things work in practice on investment banks' trading floors. Last, having been present at early stages of the developments of these markets helped me to keep a healthy sense of pragmatism about them: The following paragraphs are personal reflections on the drivers of the crisis.[3]

In the remainder of this article, the various topics are organized into three sections: actors and markets, methods and products, and finally a last section on global risk management. To use an analogy with transportation, the first section would be about geography and population preferences; the second section about engineering of roads, airplanes, railways, and so on; and the third section about the rules of the road, safety procedures, and so forth. The choice of these three sections helps to distinguish the different natures of the topics, but the topics are greatly interrelated and overlap the sections in several ways.

1.2 The Real Economy: Actors and Markets

In this section, I review the issues in the 2008 financial crisis that are more closely related to the natural needs and organization of the real economy. This may be where the most important roots of the crisis lie, but also where alternatives are not easy to propose or to achieve quickly, or even possible to do so, especially when it comes to human behavior.

1.2.1 Loan Origination

With regard to the subprime crisis, it's legitimate to start with loan origination. Although no one yet knows what the full extent of the damage will be, the gradual deterioration of U.S. retail loan quality standards over the years is a fact. The negative incentives of securitization markets (originate to distribute), the flaws (and fraud) on documentation and appraisal values, the political environment supportive to increase home ownership, the lack of intervention by federal regulatory authorities despite several local whistle-blower cases all played a role (Berner and Grow 2008). The irony is that the United States was by far the most advanced country in terms of retail credit scoring (FICO scores, etc.).

The new regulatory proposals will force loan originators to keep more "skin in the game," with a vertical slice of any securitization (not cherry-picking a part of the origination).[4] Further research could also explore what is the right balance between statistical credit scoring and proximity and human judgment, with all its diversity, and for which there is no substitute, in credit decisions.

1.2.2 Macroeconomic Imbalance

The increased Asian savings following the 1997 crisis, compounded with the surplus of China and oil-exporting countries, created a large supply of liquidity and a formidable demand for (apparently) high-quality fixed-income assets. Despite the large supply of notes and bonds from Western government deficits, the low-interest-rate environment fueled a demand for higher-yielding fixed-income assets. Wall Street engineered the products that met such demand, which was broadly characterized by a risk aversion for idiosyncratic risk (first-loss or nonrated products), but generally complacent for systemic risk, favoring highly rated products (especially AAA), albeit from complex structures and rating techniques.

Low interest rates also favored the emergence of the financial bubble in real estate prices, construction, and infrastructure, boosting growth and job creation—all welcomed by politicians and their communities.

The new regulatory proposals favor the creation of a systemic regulator[5] to monitor these imbalances, and to raise concerns with persuasive (yet nonbinding) powers.

Further research could now explore what anticyclical macro policies can be global, targeting all countries at once, to avoid diplomatic crises.[6]

1.2.3 Rating Agencies

Rating agencies regularly and successfully improved their methodologies to take advantage of the increase in computing power and the increased availability of financial and market data. The wider availability of external ratings became a key component of regulation with Basel II, increasing furthermore the need for ratings. The irony is that the rating agencies' worst failures relate to credit products that were, by design, built on credit ratings, such as collateralized debt obligations (CDOs) of mezzanine asset-backed securities (ABSs).

In fact, the rating agencies have been hurt by the consequences of the weak parts of their business models: Who pays obviously makes a difference, sophisticated quantitative methodologies should not be pushed beyond their limits, and critical human judgment must always remain (McCreevy 2009).

As concerns further research, one wonders whether perhaps ratings should incorporate some external or open-source elements (academics' and practitioners' contributions, etc.) to their methodologies or reports to keep pace with innovation and information (in particular for complex or new structures).

1.2.4 Hedge Funds

After the precedent of Long-Term Capital Management (LTCM) in 1998, there had been growing fears in the years before 2007 about the growth of the hedge fund industry, but hedge funds were not at the origin of the 2008 crisis (High-Level Group on Financial Supervision in the EU 2009). A few hedge funds failed (Amaranth, etc.), and many had to trigger gates, causing damage to their investors, but all of these