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Preface

Derivatives have long diffused into the financial systems as trading, hedging and risk management instruments, on and off balance sheets, embedded in assets and liabilities. In an industry that is increasingly focusing on value-added activities, customer-driven derivatives will continue to play key roles in the retail, private, corporate and institutional derivatives markets.

Managed properly, customer-driven derivatives business can be a rewarding business with high capital efficiency. It offers tailor-made investment and hedging solutions to the customers, and can be a very valuable source of funding for banks, even in a time of crises. The capital efficiency mainly comes from the fact that the bulk of the business is customer-driven. By its nature, this business requires efficiency and flexibility in product offering.

While it is true that the customer-driven derivative products have overall become simpler, manufacturing and managing these products has actually become more complex, due to macro factors such as the multi-curve environments triggered by the recent financial crises, stricter regulatory requirements of consistent modelling and managing frameworks, and the needs to optimize risk/reward profiles.

This book aims to present a holistic view of the customer-driven derivatives business, coupled with forensic quantitative model analyses from a practical perspective:

- It explains the life cycle of the derivative products, the manufacturing process of turning models into products, the key pillars of the business infrastructure and the regulatory framework, including Basel III and beyond.
- It explores quantitative pricing models and their applications, explaining various model paradigms and non-arbitrage models used in real equity and interest rate derivatives business. Smile/skew topics are examined in depth. The multi-curve environment and its practical impact on interest rate derivatives pricing are discussed extensively. Key derivative risks are also highlighted, and the focus is on combining or balancing the model simplicity with the necessity to capture the risks.
- It examines a wide range of customer-driven structured derivative products, their investment or hedging payoff features and associated risk exposures.
- It analyses a number of real-life derivatives embedded in real-life financial products, zooming into their risk characteristics.

Customer-driven derivatives business is a complex business, and it is often surrounded by some mystery. Certain derivatives may look simple, but are actually complex, others may look complex, but are actually simple. Complexity/simplicity does not necessarily equate to or explain the riskiness. This book hopes to demystify some aspects of the customer-driven derivatives and increase the transparency.

The book pays attention to risks and raises risk awareness. The customer-driven derivatives business is always an evolving business. Risks evolve with the business offerings, driven by customers' and banks' risk appetites. Better understanding of derivatives risks and how such risks should be captured and quantified can help managers and practitioners to adopt better organizational setup and control framework.

Acknowledgments

I have been fortunate to have worked with many financial industry professionals, with whom I shared knowledge and insight of the customer-driven derivatives business.

Starting from my early banking career, I was exposed to real-world derivative products and gained first-hand experience of their pricing and hedging. I worked with a number of industry experts including Edmond Levy, Robert Benson, Mario Pytka, Andrew Brogden, William Lyons, Mark Simmons, Tim Mortimer, Peter Glancey, Andrew Law and so on, with whom I had opportunities to deep-dive into pricing and risk managing a wide range of structured derivative products.

I have appreciated the experience of working with some remarkable business executives, including TJ Lim, Guy Laffineur, Tong Lee, Ferdinando Samaria, Terence Tsang, Steven Oon, Richard Williams et al, all of whose business and management wisdom influenced me in many ways. The opportunities to work with Henrik Neuhaus, Peter Jäckel, Russ Bubley, Bruno Dupire, Dariusz Gatarek, Dingqiu Zhu, Frank Mao, Franz Maier et al on derivatives models and techniques have certainly been beneficial and rewarding.

Over the years I have interacted and worked closely with many skilled quants, including Chris Reynolds, Matthew Steiner, Andrew Fenlon, Philip Cowdall, James Roberts, Panta da Silva, Julien Hok, Alexander Giese, Rolando Santambrogio, Simone Costa, Daniel Wilheim, Andreas Geisselmeyer and Bernd Geisselmeyer. Their dedication to the quantitative profession is impressive. I also very much enjoyed my professional interactions with Paul Wilmott, Fabio Mercurio, Han Lee, Lane Hughston, Ken Yan, Marek Lusztyn and Juliusz Jabłecki.

Finally, I'd like to thank my families in UK, China and Poland for their continuous support, which have made my day-to-day professional life and book-writing enjoyable and sustainable.

About the Author

Dong Qu (屈冬宁) obtained a BSc in Physics in China. He came to the UK to pursue a higher degree and completed a PhD in Statistical Laser Optics from Imperial College London. He started working in the City of London in the mid-1990s.

In the late-1990s, working with colleagues, Dong was instrumental in industrializing barrier reverse convertibles, which have since become one of the most popular structured products. The barrier protection mechanism designed to reduce the risk of capital loss is now an industry-standard risk-reduction tool. It has become a stalwart of the structured product markets and is embedded in many products such as autocallables.

Dong is currently the global head of the quantitative product group at UniCredit, having previously worked at banks including HSBC, Nikko and Abbey/Santander. He has in-depth knowledge of customer-driven derivatives across major asset classes, including equity, interest rate, FX, credit and real estate. He has spent many years on derivative pricing and hedging models, associated trading and risk management infrastructures, and has first-hand experience of how the customer-driven derivatives industry is operating in the competitive business and regulatory environments.

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PART

One

Overview of Customer-driven Derivative Business

The derivative business environment has evolved and changed dramatically. Many lessons have been learned, and financial regulations have become more sophisticated and demanding. Product offerings bearing geographic features reflect the importance of the customer-driven derivative business. In order to cope with the evolving business environment and optimize business efficiency and safety, executives need to create an effective organizational structure, streamline the development process for new products and modernize product distribution techniques.

Financial risk management and the banking global rule book Basel III are the generic parts of the business. Executives must manage economic and regulatory capital requirements along with leverage and liquidity, all of which attribute significantly to the business's bottom line.

CHAPTER 1

Evolving Derivative Business Environment

The derivatives business has evolved in terms of customer needs, product ranges and models and infrastructure required for managing the derivatives products. It is a business that requires comprehensive understanding of the quantitative and organizational setup, and one must pay attention to the overall picture, as well as individual components.

CUSTOMER-DRIVEN DERIVATIVE PRODUCT CATEGORIES

Derivative products are explicitly or implicitly embedded in many financial product types:

- retail structured products;
- insurance investment products;
- pension products;
- securitization products;
- real estate (property) products;
- etc.

There are many different ways to categorize customer-driven derivative products: by asset classes, by payoffs, by client sectors, etc. At the high level, they can also be categorized by the intended purposes of the derivative products, as seen in Table 1.1.

Retail structured derivative products are by far the most varied in product types and payoffs innovation across all major asset classes, including equity, commodity, interest rate, FX and credit. Structured derivative products modify the risk/reward profile and hence the risk-adjusted returns. Their returns can therefore be better defined and clarified. One can also incorporate protection barrier features into many types of product to reduce the risk of losing capital.

Structured life insurance products also become popular in the low interest rate environment, whereby insurance companies look into new investment areas and

TABLE 1.1 Customer-driven derivative products

Category	Intended Purpose
Structured Derivative Products	Structured derivative products are primarily intended for investment purposes. They offer investors alternative investment opportunities and access to new asset classes or markets. The buy side includes retail investors, high net worth and private banking customers, and institutional investors.
Derivative Hedging Products	Derivative hedging products are primarily designed for the hedging needs of institutional and corporate clients. They can be and should be used as effective risk management and mitigation tools. Large proportions of such products are interest rate hedging products.

products, in order to fulfil the promised coupons embedded in certain products. As life insurance institutions will be subject to Solvency II capital requirement, the products with low guarantee will attract lower capital requirement.

Structured derivative business has undergone profound changes over the years, in manufacturing processes and distribution mechanisms. The products become more tailor-made, coupled with the fact that distribution channels are moving towards e-platforms, which in turn encourages more individual product features. The manufacturing process encompasses product design, quantitative modelling, trading and risk systems integration, and validation. The overall process has become much more complex and infrastructures must also build in various required regulatory constraints. Therefore an integrated comprehensive manufacturing approach is vital to keep the whole process economically viable. The products' competitions have also been extended towards the longer end, from traditional short-dated (e.g. typically < 5 years) products to long-dated products, including pension products serving the ageing population.

Financial promotions of derivative products not only require the sell sides to get facts right, i.e. what the product does, what the cash and tenure commitment is it is also a compliant requirement to explain clearly to the customers the risks involved. Setting a strict and high standard on products and their risk management ensures a sustainable product design process which is vital for the long-term success of the derivative business.

LESSONS IN DERIVATIVES AND CRISES

Financial derivatives are a double-edged sword. Understanding and using them well, derivatives can be valuable investment tools, and effective risk management and mitigation instruments. Misunderstanding and misusing them can lead to amplified losses. Over the decades, there have been many documented and undocumented derivative losses. Table 1.2 lists some of the well-known and high profile cases dating back to early 1990s. These derivative losses resulted either from outright wrong and misunderstood positions or from unwinding losses because of forced margin calls.

Derivative Losses

As can be seen in Table 1.2, derivative losses have happened frequently in the past. While the frequency of these occurrences may have become less on average, the individual loss amount has actually become larger. This indicates that lessons have not been learned fully. Derivatives are highly leveraged instruments. One must fully understand the risky nature of the derivatives as well as their practical operational details. It is essential to build adequate technical and operational frameworks before embarking on highly leveraged activities. Derivatives business should consist of a comprehensive set of technical, risk management and operational control tools.

Table 1.2 does not include rogue trading that occurred at Barings, Société Générale and UBS. For completeness, they are listed in Table 1.3 and it is striking to see how similar they all look. The last column shows one of the common features of rogue trading; they all involved liquid index futures. Strong internal operational control is the key to prevent such rogue trading activities.

TABLE 1.2 Sample derivative losses

Decade	Organization	LOSSES	Transactions
1990s	Metallgesellschaft	$1.3 billion	Energy futures
1990s	Codelco	$207 million	Copper futures
1990s	Cargill (Minnetonka Fund)	$100 million	Mortgage derivatives
1990s	Kashima Oil	$1.5 billion	Currency derivatives
1990s	Procter & Gamble	$157 million	Leveraged interest rate and currency swaps
1990s	Askin Capital Management	$600 million	Repo and mortgage derivatives
1990s	Air Products and Chemicals	$113 million	Leveraged interest rate and currency swaps
1990s	Piper Jaffray Cos.	$700 million	Mortgage derivatives
1990s	Sears	$237 million	Swaps
1990s	Orange County, Calif.	$1.6 billion	Leveraged repo
1990s	Capital Corporate Federal Credit Union	$126 million	Mortgage derivatives
1990s	Sumitomo Bank	$1.8 billion	Copper futures
1990s	First Capital Strategists	$128 million	Stock index futures
1990s	Postipankki	$110 million	Mortgage derivatives and structured notes
1990s	NatWest	$90 million	Interest rate options
1990s	UBS	$170 million	Equity derivatives

(*continued*)