Contents

List of Spreadsheets xix
List of Appendices xxi
Acknowledgements xxiii
About the Author xxv

1 Introduction 1

2 The Global Financial Crisis 3
   2.1 Pre-crisis 3
   2.2 The crisis 5
   2.3 Regulatory reform 8
   2.4 Backlash and criticisms 8
   2.5 A new world 10

3 The OTC Derivatives Market 11
   3.1 The derivatives market 11
      3.1.1 Derivatives 11
      3.1.2 Exchange traded and OTC derivatives 12
      3.1.3 Market size 12
      3.1.4 Market participants 14
      3.1.5 Credit derivatives 16
      3.1.6 The dangers of derivatives 17
      3.1.7 The Lehman experience 17
   3.2 Derivative risks 18
      3.2.1 Market risk 18
      3.2.2 Credit risk 19
      3.2.3 Operational and legal risk 19
      3.2.4 Liquidity risk 20
      3.2.5 Integration of risk types 20
3.2.6 Counterparty risk 20
3.3 Risk management of derivatives 20
3.3.1 Value-at-risk 20
3.3.2 Models 23
3.3.3 Correlation and dependency 23

4 Counterparty Risk 25

4.1 Background 25
4.1.1 Counterparty risk versus lending risk 25
4.1.2 Settlement and pre-settlement risk 26
4.1.3 Mitigating counterparty risk 28
4.1.4 Exposure and product type 29
4.1.5 Setups 31

4.2 Components 32
4.2.1 Mark-to-market and replacement cost 33
4.2.2 Credit exposure 33
4.2.3 Default probability, credit migration and credit spreads 34
4.2.4 Recovery and loss given default 35

4.3 Control and quantification 36
4.3.1 Credit limits 36
4.3.2 Credit value adjustment 38
4.3.3 CVA and credit limits 38
4.3.4 What does CVA represent? 39
4.3.5 Hedging counterparty risk 41
4.3.6 The CVA desk 42

4.4 Beyond CVA 43
4.4.1 Overview 43
4.4.2 Economic costs of an OTC derivative 43
4.4.3 xVA terms 44

4.5 Summary 46

5 Netting, Close-out and Related Aspects 47

5.1 Introduction 47
5.1.1 Overview 47
5.1.2 The need for netting and close-out 47
5.1.3 Payment and close-out netting 48

5.2 Default, netting and close-out 49
5.2.1 The ISDA Master Agreement 49
5.2.2 Events of default 49
5.2.3 Payment netting 50
5.2.4 Close-out netting 51
5.2.5 Product coverage and set-off rights 52
5.2.6 Close-out amount 53
5.2.7 The impact of netting 55

5.3 Multilateral netting and trade compression 56
5.3.1 Overview 56
5.3.2 Multilateral netting 56
6.7 Regulatory collateral requirements 100
6.7.1 Background 100
6.7.2 Covered entities 101
6.7.3 General requirements 102
6.7.4 Haircuts 104
6.7.5 Segregation and rehypothecation 105
6.7.6 Initial margin calculations 105
6.7.7 Standardised initial margin method (SIMM) 106
6.8 Converting counterparty risk into funding liquidity risk 107
6.9 Summary 108

7 Credit Exposure and Funding 109
7.1 Credit exposure 109
7.1.1 Definition 109
7.1.2 Bilateral exposure 110
7.1.3 The close-out amount 111
7.1.4 Exposure as a short option position 111
7.1.5 Future exposure 112
7.1.6 Comparison to value-at-risk 113
7.2 Metrics for exposure 114
7.2.1 Expected future value 114
7.2.2 Potential future exposure 115
7.2.3 Expected exposure 116
7.2.4 EE and PFE for a normal distribution 116
7.2.5 Maximum PFE 117
7.2.6 Expected positive exposure 117
7.2.7 Negative exposure 118
7.2.8 Effective expected positive exposure (EEPE) 118
7.3 Factors driving exposure 119
7.3.1 Loans and bonds 119
7.3.2 Future uncertainty 120
7.3.3 Periodic cashflows 120
7.3.4 Combination of profiles 125
7.3.5 Optionality 126
7.3.6 Credit derivatives 128
7.4 The impact of netting and collateral on exposure 129
7.4.1 The impact of netting on future exposure 129
7.4.2 Netting and the impact of correlation 130
7.4.3 Netting and relative MTM 132
7.4.4 Impact of collateral on exposure 133
7.5 Funding, rehypothecation and segregation 135
7.5.1 Funding costs and benefits 135
7.5.2 Differences between funding and credit exposure 136
7.5.3 Impact of segregation and rehypothecation 136
7.5.4 Impact of collateral on credit and funding exposure 138
7.5.5 Examples 140
7.6 Summary 141
8 Capital Requirements and Regulation

8.1 Background to credit risk capital
8.1.1 Standardised approach
8.1.2 Internal ratings-based approach (IRB)
8.1.3 Double default
8.1.4 Exposure at default (EAD)
8.1.5 Incurred CVA

8.2 Current exposure method (CEM)
8.2.1 Add-ons
8.2.2 Netting and collateral treatment

8.3 The internal model method (IMM)
8.3.1 Background
8.3.2 The alpha factor and EEPE

8.4 Standardised approach for counterparty credit risk (SA-CCR)
8.4.1 Background
8.4.2 Basic approach
8.4.3 Netting
8.4.4 Collateral
8.4.5 Overcollateralisation and negative MTM

8.5 Comparison of EAD methods
8.5.1 Impact of maturity
8.5.2 Collateral
8.5.3 Negative MTM
8.5.4 Initial margin and threshold
8.5.5 Netting

8.6 Basel III
8.6.1 Overview
8.6.2 Stressed EPE
8.6.3 Increased margin period of risk
8.6.4 Backtesting
8.6.5 Wrong-way risk
8.6.6 Stress testing

8.7 CVA capital charge
8.7.1 Rationale
8.7.2 Standardised formula
8.7.3 Advanced approach
8.7.4 Example
8.7.5 Criticisms
8.7.6 US implementation
8.7.7 The European exemptions

8.8 Other important regulatory requirements
8.8.1 Fundamental review of the trading book
8.8.2 Leverage ratio
8.8.3 Floors
8.8.4 Liquidity coverage ratio and net stable funding ratio
8.8.5 Prudent value

8.9 Summary
9 Counterparty Risk Intermediation

9.1 Introduction

9.2 SPVs, DPCs, CDPCs and monolines

9.2.1 Default remoteness and “too big to fail”

9.2.2 Special purpose vehicles

9.2.3 Derivative product companies

9.2.4 Monolines and CDPCs

9.3 Central counterparties

9.3.1 The clearing mandate

9.3.2 OTC clearing

9.3.3 The CCP landscape

9.3.4 CCP risk management

9.3.5 Comparing bilateral and central clearing

9.3.6 Advantages and disadvantages of CCPs

9.3.7 CCP capital charges

9.3.8 What central clearing means for xVA

9.4 Summary

10 Quantifying Credit Exposure

10.1 Introduction

10.2 Methods for quantifying credit exposure

10.2.1 Parametric approaches

10.2.2 Semi-analytical methods

10.2.3 Monte Carlo simulation

10.3 Monte Carlo methodology

10.3.1 Simulation model

10.3.2 Scenario generation

10.3.3 Revaluation

10.3.4 Aggregation

10.3.5 Post-processing

10.3.6 Extraction

10.4 Real-world or risk-neutral

10.4.1 Two fundamentally different approaches

10.4.2 Drift

10.4.3 Volatility

10.4.4 Correlation

10.4.5 Market practice

10.5 Model choice

10.5.1 Risk-neutral or real-world?

10.5.2 Level of complexity

10.5.3 General comments

10.5.4 Correlations

10.6 Examples

10.6.1 Data set

10.6.2 Exposures profiles

10.7 Allocating exposure

10.7.1 Simple two-transaction, single-period example
10.7.2 Incremental exposure 237  
10.7.3 Marginal exposure 240  
10.8 Summary 243

11 Exposure and the Impact of Collateral 245  
11.1 Overview 245  
11.1.1 General impact of collateral 245  
11.1.2 Modelling approach 246  
11.2 Margin period of risk 247  
11.2.1 Setup 247  
11.2.2 Amortisation 248  
11.2.3 Conditionality 249  
11.2.4 Disputes 249  
11.2.5 MPR discretisation and cashflows 250  
11.2.6 MPR modelling 251  
11.3 Numerical examples 252  
11.3.1 Collateral assumptions 252  
11.3.2 Margin period of risk impact 253  
11.3.3 Simple approximations 255  
11.3.4 Discretisation and cashflows 256  
11.3.5 Impact of threshold 257  
11.3.6 Do two-way CSAs always reduce exposure? 258  
11.3.7 Non-cash collateral 260  
11.3.8 Collateral and funding liquidity risk 261  
11.4 Initial margin 262  
11.4.1 Impact of initial margin on exposure 262  
11.4.2 Dynamic initial margins 263  
11.4.3 Segregation and funding exposure 264  
11.5 Summary 265

12 Default Probabilities, Credit Spreads and Funding Costs 267  
12.1 Overview 267  
12.2 Default probability 267  
12.2.1 Real-world and risk-neutral 267  
12.2.2 The move to risk-neutral 269  
12.2.3 Defining risk-neutral default probabilities 271  
12.2.4 Term structure 272  
12.2.5 Loss given default 273  
12.3 Credit curve mapping 275  
12.3.1 Overview 275  
12.3.2 The CDS market 276  
12.3.3 Loss given default 278  
12.3.4 General approach 278  
12.4 Generic curve construction 280  
12.4.1 General approach 280  
12.4.2 Third party curves 281  
12.4.3 Mapping approach 282
12.4.4 Cross-sectional approach 283
12.4.5 Hedging 284
12.5 Funding curves and capital costs 285
  12.5.1 Background 285
  12.5.2 Funding costs 286
  12.5.3 Defining a funding curve 286
  12.5.4 Cost of capital 288
12.6 Summary 289

13 Discounting and Collateral 291
  13.1 Overview 291
  13.2 Discounting
    13.2.1 Introduction 291
    13.2.2 OIS rates 292
    13.2.3 The risk-free rate 293
    13.2.4 Perfect collateralisation and discounting 294
    13.2.5 OIS discounting 295
    13.2.6 OIS methodology 296
  13.3 Beyond perfect collateralisation 297
    13.3.1 The push towards perfect collateralisation 297
    13.3.2 The xVA terms 297
  13.4 Collateral valuation adjustments 300
    13.4.1 Overview 300
    13.4.2 Collateral rate adjustments 300
    13.4.3 Collateral optionality 303
    13.4.4 Non-cash collateral 307
    13.4.5 The end of ColVA 307
  13.5 Summary 308

14 Credit and Debt Value Adjustments 309
  14.1 Overview 309
  14.2 Credit value adjustment
    14.2.1 Why CVA is not straightforward 309
    14.2.2 History of CVA 310
    14.2.3 CVA formula 311
    14.2.4 CVA example 312
    14.2.5 CVA as a spread 313
    14.2.6 Exposure and discounting 313
    14.2.7 Risk-neutrality 314
    14.2.8 CVA semi-analytical methods 314
  14.3 Impact of credit assumptions 315
    14.3.1 Credit spread impact 315
    14.3.2 Recovery impact 316
  14.4 CVA allocation and pricing
    14.4.1 Netting and incremental CVA 317
    14.4.2 Incremental CVA example 319
    14.4.3 Marginal CVA 319
14.4.4 CVA as a spread 321
14.4.5 Numerical issues 321
14.5 CVA with collateral 323
  14.5.1 Impact of margin period of risk 324
  14.5.2 Thresholds and initial margins 324
14.6 Debt value adjustment 326
  14.6.1 Overview 326
  14.6.2 Accounting standards and DVA 326
  14.6.3 DVA and pricing 327
  14.6.4 Bilateral CVA formula 327
  14.6.5 Close-out and default correlation 328
  14.6.6 Example 330
  14.6.7 DVA and own-debt 331
  14.6.8 DVA in derivatives 332
14.7 Summary 334

15 Funding Value Adjustment 335
  15.1 Funding and derivatives 335
    15.1.1 Why there are funding costs and benefits 335
    15.1.2 The nature of funding costs and benefits 336
    15.1.3 Relationship to CVA and DVA 338
    15.1.4 FVA in financial statements 339
  15.2 Funding value adjustment 341
    15.2.1 Intuitive definition 341
    15.2.2 Discounting approach 343
    15.2.3 More complex cases 345
    15.2.4 Contingent FVA 347
    15.2.5 Allocation of FVA 348
  15.3 The practical use of FVA 349
    15.3.1 Link to DVA 349
    15.3.2 CVA/DVA/FVA framework 350
    15.3.3 Is FVA really symmetric? 351
    15.3.4 Defining the funding rate 351
    15.3.5 The Hull and White and accounting arguments 352
    15.3.6 Resolving the FVA debate 354
    15.3.7 Remaining issues 355
    15.3.8 Example 356
  15.4 Summary 357

16 Margin and Capital Value Adjustments 359
  16.1 Overview 359
  16.2 Margin value adjustment 360
    16.2.1 Rationale 360
    16.2.2 IM profiles 361
    16.2.3 MVA formula 364
    16.2.4 Example 365
  16.3 Capital value adjustment 366
16.3.1 Rationale
16.3.2 Capital profiles
16.3.3 Formula
16.3.4 Term structure behaviour
16.3.5 Behavioural aspects and regulatory change
16.3.6 Example
16.3.7 KVA and MVA
16.3.8 Overlaps and hedging
16.3.9 KVA reporting
16.4 Summary

17 Wrong-way Risk
17.1 Overview
17.2 Overview of wrong-way risk
17.2.1 Simple example
17.2.2 Classic example and empirical evidence
17.2.3 General and specific WWR
17.2.4 WWR challenges
17.3 Quantification of wrong-way risk
17.3.1 Wrong-way risk and CVA
17.3.2 Simple example
17.3.3 Wrong-way collateral
17.4 Wrong-way risk modelling approaches
17.4.1 Hazard rate approaches
17.4.2 Structural approaches
17.4.3 Parametric approach
17.4.4 Jump approaches
17.4.5 Credit derivatives
17.4.6 Wrong-way risk and collateral
17.4.7 Central clearing and wrong-way risk
17.5 Summary

18 xVA Management
18.1 Introduction
18.2 The role of an xVA desk
18.2.1 Motivation
18.2.2 Role
18.2.3 Profit centre or utility?
18.2.4 Operation and rollout
18.3 Hedging xVA
18.3.1 Motivation
18.3.2 xVA as an exotic option
18.3.3 Misalignment
18.3.4 Market risk
18.3.5 Credit, funding and capital hedging
18.3.6 Cross-gamma
18.3.7 P&L explain
| 18.3.8 Capital relief from hedges | 407 |
| 18.3.9 Market practice and hedging | 411 |
| 18.4 xVA systems | 412 |
| 18.4.1 Overview | 412 |
| 18.4.2 Optimisations | 413 |
| 18.4.3 Shared or separate implementations | 414 |
| 18.4.4 Internal and vendor systems | 416 |
| 18.4.5 IMM approval | 418 |
| 18.5 Summary | 419 |
| 19 xVA Optimisation | 421 |
| 19.1 Overview | 421 |
| 19.2 Market practice | 422 |
| 19.2.1 General approach to xVA | 422 |
| 19.2.2 Totem | 424 |
| 19.3 Examples | 425 |
| 19.3.1 xVA assumptions | 425 |
| 19.3.2 Uncollateralised | 426 |
| 19.3.3 Off-market | 427 |
| 19.3.4 Partially collateralised | 428 |
| 19.3.5 One-way collateralised | 429 |
| 19.3.6 Collateralised | 430 |
| 19.3.7 Overcollateralised (initial margin) and backloading | 430 |
| 19.4 Costs and the balance of xVA terms | 433 |
| 19.4.1 Spectrum of transaction | 433 |
| 19.4.2 Optimising xVA | 434 |
| 19.4.3 Impact of credit quality and maturity | 436 |
| 19.4.4 Summary | 437 |
| 19.5 xVA optimisation | 437 |
| 19.5.1 Intermediation | 437 |
| 19.5.2 Restrikes | 438 |
| 19.5.3 Uncollateralised to collateralised | 439 |
| 19.5.4 Backloading to a CCP | 440 |
| 19.6 Summary | 441 |

20 The Future 443

Glossary 445

References 447

Index 457