

CHAPMAN & HALL/CRC FINANCIAL MATHEMATICS SERIES

Understanding Risk

The Theory and Practice
of Financial Risk Management

David Murphy



Chapman & Hall/CRC

Taylor & Francis Group

Boca Raton London New York

Chapman & Hall/CRC is an imprint of the
Taylor & Francis Group, an **informa** business

Contents

INTRODUCTION	xv
PART ONE Risk Management and the Behaviour of Products	
CHAPTER 1 ■ Markets, Risks and Risk Management in Context	3
1.1 FINANCIAL MARKETS OVERVIEW	3
1.1.1 Introducing the Markets	3
1.1.2 Securities	5
1.1.3 Other Instruments	7
1.1.4 Equity Markets	9
1.1.5 Interest Rate Instruments	12
1.1.6 Foreign Exchange Markets	21
1.1.7 Derivatives Markets	22
1.1.8 Principal Investment and Private Equity	25
1.1.9 (A Short Section on) Commodities Markets	27
1.2 TRADING AND MARKET BEHAVIOUR	28
1.2.1 The Difficulty of Forecasting Market Levels	29
1.2.2 The Anatomy of a Market Crisis	29
1.2.3 Current and Past Markets	32
1.3 BASIC IDEAS IN RISK MANAGEMENT	39
1.3.1 Types of Risk	39
1.3.2 The Aims of Risk Management	46
1.3.3 Sensitivities	47
1.3.4 Daily Risk Controls: P/L, Limits and P/L Explanation	47
1.3.5 What Do You Own? The Deal Review Process	50
1.3.6 Trader Mandates	51

1.4	CULTURE AND ORGANISATION	52
1.4.1	Risk Management in the Broader Institution	52
1.4.2	Cultural Issues	54
1.4.3	A Taxonomy of Financial Institutions	56
1.4.4	Some Large Losses in the Wholesale Markets	61
1.5	SOME EXTERNAL CONSTRAINTS	63
1.5.1	Regulation	64
1.5.2	Accounting	68
1.5.3	Marking to Fair Value	74
1.5.4	Special Purpose Vehicles and Consolidation	76
CHAPTER 2 ■ Derivatives and Quantitative Market Risk Management		79
2.1	RETURNS, OPTIONS AND SENSITIVITIES	79
2.1.1	Asset Returns and Risk Factors	79
2.1.2	Risk Factor Selection	80
2.1.3	Risk Reporting with a Single Risk Factor	81
2.1.4	Forwards and Arbitrage	84
2.1.5	Models of Market Returns	88
2.1.6	Risk Reporting in a Return Model	91
2.1.7	Introducing Options	93
2.1.8	The Greeks	95
2.1.9	Options Risk Reporting	97
2.1.10	P/L Explanation for Options	99
2.2	PORTFOLIOS AND RISK AGGREGATION	99
2.2.1	The Varieties of Trading Portfolio and Their Management	100
2.2.2	Diversification and Correlation	102
2.2.3	Reporting and Risk in a Return Model: Multiple Factors	105
2.2.4	Scenario Analysis	107
2.2.5	Stress Testing	108
2.3	UNDERSTANDING THE BEHAVIOUR OF DERIVATIVES	112
2.3.1	Overview of the Theory of Options Pricing: Black-Scholes and the Replicating Portfolio	112
2.3.2	Implied Volatility and Hedging	116
2.3.3	Retail Equity-Linked Products: Some Simple Structures and Their Problems	121

2.3.4	A Little More about Exotic Options	123
2.3.5	Local and Stochastic Volatility	126
2.4	INTEREST RATE DERIVATIVES AND YIELD CURVE MODELS	129
2.4.1	Futures and Forwards on Interest Rates	130
2.4.2	Interest Rate and Asset Swaps	131
2.4.3	Credit Risk in Swap Structures	135
2.4.4	Other Interest Rate Swap Structures	136
2.4.5	Cross-Currency Swaps	137
2.4.6	Basis Swaps	137
2.4.7	Caps, Floors and Yield Curve Models	139
2.4.8	Swaptions	142
2.4.9	Exotic Interest Rate Derivatives	143
2.5	SINGLE-NAME CREDIT DERIVATIVES	146
2.5.1	Products	146
2.5.2	Credit Events and Documentation	147
2.5.3	Credit Derivatives Valuation	151
2.5.4	Risk Reporting for Credit Derivatives	152
2.6	VALUATION, HEDGING AND MODEL RISK	153
2.6.1	Mark-to-Market and Mark-to-Model	153
2.6.2	Marking and Model Risk	154
2.6.3	Hedging, P/L and Mark Adjustments	157

PART TWO **Economic and Regulatory Capital Models**

CHAPTER 3	■ Capital: Motivation and Provision	163
3.1	MOTIVATIONS FOR CAPITAL	163
3.1.1	What Is Capital for?	163
3.1.2	Earnings Volatility and Capital	164
3.1.3	The Optimisation Problem	165
3.1.4	Capital, More or Less	167
3.2	CAPITAL INSTRUMENT FEATURES	167
3.2.1	Seniority and Subordination	168
3.2.2	Deferral and Dividends	169
3.2.3	Maturity and Replacement	169
3.2.4	Convertibility and Write-Down	169
3.2.5	Example Capital Securities	170

3.3	REGULATORY CAPITAL PROVISION	171
3.3.1	The Tiers of Basel Capital	171
3.3.2	Insurance Capital	173
3.3.3	Consolidated Capital	173
3.3.4	Capital Management: Issues and Strategies	174
CHAPTER 4 ■ Market Risk Capital Models		177
4.1	GENERAL MARKET RISK CAPITAL MODELS	177
4.1.1	Value at Risk Techniques I: Variance/Covariance	177
4.1.2	Value at Risk Techniques II: Revaluation and Historical Simulation	182
4.1.3	Value at Risk Techniques III: Monte Carlo Approaches	184
4.1.4	Relative VAR	186
4.1.5	Backtesting, VAR Exceptions and the VAR Hypothesis	186
4.2	SOME LIMITATIONS OF VALUE AT RISK MODELS	188
4.2.1	Specific Risk	188
4.2.2	Volatility and Correlation Instabilities	189
4.2.3	The Holding Period Assumption	190
4.2.4	What Is the VAR Good for?	192
4.3	RISK SYSTEMS AND RISK DATA	193
4.3.1	Effective Risk Reporting	193
4.3.2	Market Data	196
CHAPTER 5 ■ Credit Risk and Credit Risk Capital Models		201
5.1	THE BANKING BOOK: INTRODUCING THE PRODUCTS AND THE RISKS	201
5.1.1	Retail Banking	201
5.1.2	Commercial Banking	203
5.1.3	Forces for Change	205
5.2	CREDIT RISK FOR SMALL NUMBERS OF OBLIGATORS	205
5.2.1	Single Transaction Exposure	206
5.2.2	Potential Future Credit Exposure	209
5.2.3	What Is a Credit Spread Compensation for?	211
5.2.4	Partial Credit Mitigation	212
5.2.5	Introducing Basket Credit Derivatives	213

5.3	AN INTRODUCTION TO TRANCHING AND PORTFOLIO CREDIT DERIVATIVES	216
5.3.1	Funding and Loss Absorption	216
5.3.2	Securitisation and Tranching	217
5.3.3	Collateralised Debt Obligations	220
5.3.4	Structuring and the Waterfall	222
5.3.5	Index Credit Products	223
5.3.6	(The Problem with) Credit Event Correlation	224
5.3.7	Practical Credit-Adjusted Pricing	226
5.4	CREDIT PORTFOLIO RISK MANAGEMENT	227
5.4.1	The Portfolio Credit Risk Loss Distribution	227
5.4.2	Some Models of Portfolio Credit Risk	229
5.4.3	Stress Testing Credit Portfolios	233
5.4.4	Active Credit Portfolio Management	234
5.4.5	Credit Scoring and Internal Rating	237
5.5	POLITICAL AND COUNTRY RISK	240
5.5.1	Examples of Country Risk	241
5.5.2	The Effect of Country Risk	242
5.5.3	Measuring Country Risk	243
5.5.4	Country Risk Management	245
CHAPTER 6 ■ Operational Risk and Further Topics in Capital Estimation		247
6.1	AN INTRODUCTION TO OPERATIONAL RISK	247
6.1.1	Operational Risk Classes and Losses	248
6.1.2	Scorecard Approaches to Operational Risk	252
6.1.3	Some Issues in Operational Risk Management	253
6.2	THE TAILS AND OPERATIONAL RISK MODELLING	257
6.2.1	The Tails and Extreme Value Theory	258
6.2.2	The Case of Long Term Capital Management	259
6.2.3	The Stable Process Assumption	263
6.2.4	Operational Risk Modelling	263
6.3	ALLOCATING CAPITAL AND OTHER RISKS	264
6.3.1	Capital Allocation and Portfolio Contributions	265
6.3.2	Reputational and Other Risks	268
6.3.3	Hedging versus Capital	273

CHAPTER 7 ■ Bank Regulation and Capital Requirements	275
7.1 REGULATORY CAPITAL AND THE BASEL ACCORDS	276
7.1.1 Before Basel II: Basel I and the Market Risk Amendment	276
7.1.2 An Overview of Basel II	285
7.1.3 Basel II: Credit Risk without Mitigation	287
7.1.4 Basel II: Credit Risk Mitigation in the IRB Approaches	295
7.1.5 Basel II: Capital Rules for Positions That Have Been Securitised	298
7.1.6 Implications of the Basel Credit Risk Framework	299
7.1.7 Operational Risk in Basel II	300
7.1.8 Floors and Transitional Arrangements	303
7.2 BASEL II: BEYOND THE CAPITAL RULES	303
7.2.1 Pillar 2 in Basel II	303
7.2.2 Pillar 3 and Banks' Disclosures	305
7.2.3 The Impact of Basel II	306
PART THREE Treasury and Liquidity Risks	
CHAPTER 8 ■ The Treasury and Asset/Liability Management	311
8.1 AN INTRODUCTION TO ASSET/LIABILITY MANAGEMENT	311
8.1.1 The Trading Book, the Banking Book and the Treasury	312
8.1.2 Accounting for an Old-Fashioned Bank	314
8.1.3 Assets and Liabilities through Time	316
8.1.4 What Is ALM?	318
8.2 BANKING BOOK INCOME AND FUNDING THE BANK	319
8.2.1 Transfer Pricing	319
8.2.2 Interest Rate Risk in the Banking Book	323
8.2.3 Non-Interest Income and Operating Expenses	325
8.3 ALM IN PRACTICE	326
8.3.1 Risk in the Transfer Pricing Book	326
8.3.2 The Market Value of Portfolio Equity	328
8.3.3 Strategic Risk and Real Options	330
8.3.4 ALM Risk Reporting	331
8.3.5 P/L Translation and Hedging	332
8.3.6 The Role of the ALCO	333

8.4	TRADING BOOK ALM	334
8.4.1	Repo and Other Forms of Secured Funding	334
8.4.2	Practical Issues in the Funding of Trading Books	335
CHAPTER 9 ■ Liquidity Risk Management		337
9.1	LIQUIDITY OF SECURITIES AND DEPOSITS	337
9.1.1	What Is Liquidity Risk?	338
9.1.2	Liability Liquidity	340
9.1.3	Asset Liquidity under Ordinary Conditions	341
9.2	LIQUIDITY MANAGEMENT	345
9.2.1	Measures of Liquidity Risk and the Firm's Liquidity Profile	345
9.2.2	Policies, Procedures and the Regulatory Perspective	347
9.2.3	Upstreaming, Downstreaming and Corporate Structure	348
9.2.4	The Implications of Illiquidity for Pricing and Risk Measurement	348
9.3	OFF-BALANCE-SHEET LIQUIDITY AND CONTINGENT FUNDING	350
9.3.1	Positive Contingent Liquidity	350
9.3.2	Conduits	351
9.3.3	Negative Contingent Liquidity	353
9.4	STRESSES OF LIQUIDITY	353
9.4.1	Liquidity in a Crisis	354
9.4.2	Liquidity Stress Testing	356
9.4.3	The Liquidity Plan	357
 PART FOUR Some Trading Businesses and Their Challenges		
CHAPTER 10 ■ An Introduction to Structured Finance		361
10.1	CONTRACTUAL RELATIONS	361
10.1.1	The Documentation of Derivatives and Credit Risk Mitigation	362
10.1.2	Credit Derivatives in the Form of Insurance	365
10.1.3	Enforceability and the Pros and Cons of Enforcement	367
10.2	ASSET-BACKED SECURITIES	368
10.2.1	Mortgage-Backed Securities	368
10.2.2	Other ABS and Pool Modelling	375
10.2.3	ABS Tranche Analysis	378

10.3	SECURITISATION STRUCTURES	379
10.3.1	CDO, CLO and Related Structures	379
10.3.2	Banking Using Securitisation	382
10.3.3	ABS in Principal Finance and Whole Business Securitisation	383
10.3.4	Some Revolving and Blind Securitisations	387
CHAPTER 11 ■ Novel Asset Classes, Basket Products, and Cross-Asset Trading		391
11.1	INFLATION-LINKED PRODUCTS	391
11.1.1	Inflation Indices	392
11.1.2	Inflation-Linked Bond Design	394
11.1.3	Retail Inflation-Linked Products	396
11.1.4	Lags and the Inflation-Linked Curve	397
11.1.5	Inflation Swaps	399
11.1.6	Pension Fund Risk Management	401
11.2	EQUITY BASKET PRODUCTS	405
11.2.1	Basket Options and Rainbow Products	405
11.2.2	Copulas and the Problem with Gaussian Correlation	407
11.3	CONVERTIBLE BONDS	411
11.3.1	Convertible Bond Structures	412
11.3.2	The Behaviour of Convertible Bonds	413
11.3.3	Modelling Convertibles	414
11.4	EQUITY/CREDIT TRADING	419
11.4.1	The Merton Model of Capital Structure	419
11.4.2	More Sophisticated Capital Structure Models	424
11.4.3	Equity/Credit Optionality and Hybrid Security Modelling	425
11.4.4	Credit Copulas and Credit Event Association	427
11.5	NEW PRODUCTS	429
11.5.1	The New Product Approval Process	429
11.5.2	Managing Product Complexity	432
11.5.3	Hedge Fund Risk Management	433
	CONCLUDING REMARKS	437
	FIGURES	441
	INDEX	445