

# Brief Contents

Preface xix

## Part 1 *Why Risk Management?* 1

- Chapter 1 Introduction 3
- Chapter 2 Investors and Risk Management 21
- Chapter 3 Creating Value with Risk Management 51
- Chapter 4 A Firm-Wide Approach to Risk Management 77

## Part 2 *Hedging with Forwards, Futures, and Options Contracts* 111

- Chapter 5 Forward and Futures Contracts 113
- Chapter 6 Hedging Exposures with Forward and Futures Contracts 151
- Chapter 7 Optimal Hedges for the Real World 189
- Chapter 8 Identifying and Managing Cash Flow Exposures 223
- Chapter 9 Measuring and Managing Interest Rate Risks 257
- Chapter 10 Hedging with Options 299
- Chapter 11 Option Pricing, Dynamic Hedging, and the Binomial Model 329
- Chapter 12 The Black-Scholes Model 359
- Chapter 13 Risk Measurement and Risk Management with Nonlinear Payoffs 397
- Chapter 14 Options on Bonds and Interest Rates 427

## Part 3 *Beyond Plain Vanilla Risk Management* 467

- Chapter 15 The Demand and Supply for Derivative Products 469
- Chapter 16 Swaps 499
- Chapter 17 Using Exotic Options 533
- Chapter 18 Credit Risks and Credit Derivatives 571
- Chapter 19 Recent Developments in the Practice of Risk Management 605

## Part 4 *Conclusion* 641

Epilogue 643

Glossary 645

Bibliography 653

Index 663

## Part 1 Why Risk Management? 1

### Chapter 1 Introduction 3

- 1.1. The growth of derivatives markets 5
- 1.2. Some basic ideas concerning derivatives as risk management tools 8
  - 1.2.1. Options 8
  - 1.2.2. Forward contracts 10
- 1.3. Using derivatives the right way for risk management 14
- 1.4. What does it take to use derivatives the right way for risk management? 16
  - 1.4.1. Designing a foreign exchange hedging program at Merck 16
  - 1.4.2. Measuring risks at Microsoft 17
- 1.5. Learning to manage risks with derivatives the right way 18
  - Key Concepts 20
  - Literature Note 20

### Chapter 2 Investors and Risk Management 21

- 2.1. Evaluating the risk and the return of individual securities and portfolios 22
  - 2.1.1. The distribution of the return of IBM 23
  - 2.1.2. The distribution of the return of a portfolio 27
- 2.2. Diversification, asset allocation, and expected returns 30
  - 2.2.1. Diversification and the return of a portfolio 30
  - 2.2.2. Asset allocation when there is a risk-free asset 32
  - 2.2.3. The risk of a security in a diversified portfolio 34
  - 2.2.4. The capital asset pricing model 35
- 2.3. Diversification and risk management 36
  - 2.3.1. Risk management and shareholder wealth 40
  - 2.3.2. Risk management and shareholder clienteles 42
  - 2.3.3. The risk management irrelevance proposition 45
- 2.4. Summary 46
  - Key Concepts 46
  - Review Questions 46
  - Questions and Exercises 47
  - Literature Note 48

## Chapter 3 Creating Value with Risk Management 51

- 3.1. Bankruptcy costs and costs of financial distress 53
  - 3.1.1. Bankruptcy costs and firm value 57
  - 3.1.2. Bankruptcy costs, financial distress costs, and the costs of risk management programs 58
  - 3.1.3. Bankruptcy costs, Homestake, and Enron 59
- 3.2. Taxes and risk management 59
  - 3.2.1. The tax argument for risk management 62
  - 3.2.2. The tax benefits of risk management and Homestake 63
- 3.3. Optimal capital structure and risk management 63
  - 3.3.1. The tax shield of debt, costs of financial distress, and risk management 64
  - 3.3.2. Does Homestake have too little debt? 65
- 3.4. Should the firm hedge to reduce the risk of large undiversified shareholders? 66
  - 3.4.1. Large undiversified shareholders can increase firm value 66
  - 3.4.2. Risk and the incentives of managers 67
  - 3.4.3. Large shareholders, managerial incentives, and Homestake 68
- 3.5. Stakeholders 68
  - 3.5.1. When should firms care about stakeholders? 68
  - 3.5.2. Stakeholders and Homestake 69
- 3.6. Risk management, financial distress, and investment 69
  - 3.6.1. Debt overhang 70
  - 3.6.2. Information asymmetries and agency costs of managerial discretion 71
  - 3.6.3. The cost of external funding and Homestake 72
- 3.7. Summary 74
  - Key Concepts 75
  - Review Questions 75
  - Literature Note 75

## Chapter 4 A Firm-Wide Approach to Risk Management 77

- 4.1. Measuring risk for corporations 79
  - 4.1.1. Measuring value at risk in a financial firm 79
  - 4.1.2. Implementing VaR 87
  - 4.1.3. Measuring cash flow at risk in a nonfinancial firm 89
  - 4.1.4. VaR or CaR? 91
- 4.2. VaR, CaR, and firm value 92
  - 4.2.1. The impact of projects on VaR 93
  - 4.2.2. Evaluating the impact of a large project on CaR 97
  - 4.2.3. Allocating the cost of CaR or VaR to existing activities 99

- 4.3. Managing firm risk measured by VaR or CaR 103
  - 4.3.1. Reducing the cost of risk for a given level of VaR or CaR 103
  - 4.3.2. Reducing risk through project choice 106
  - 4.3.3. Using derivatives and other financial instruments to reduce risk 106
- 4.4. Summary 107
  - Key Concepts 108
  - Review Questions 108
  - Questions and Exercises 108
  - Literature Note 110

## Part 2 Hedging with Forwards, Futures, and Options Contracts 111

### Chapter 5 Forward and Futures Contracts 113

- 5.1. Pricing forward contracts on T-bills 115
  - 5.1.1. Valuing a forward position using the method of pricing by arbitrage 115
  - 5.1.2. A general pricing formula 120
  - 5.1.3. Pricing the contract after inception 120
- 5.2. Generalizing our results 122
  - 5.2.1. Foreign currency forward contracts 124
  - 5.2.2. Commodity forward contracts 125
  - 5.2.3. Counterparty risk in forward contracts 130
- 5.3. Futures contracts 131
  - 5.3.1. Counterparty risk with futures contracts 133
  - 5.3.2. A brief history of financial futures 134
  - 5.3.3. Cash versus physical delivery 135
  - 5.3.4. Futures positions in practice 137
- 5.4. How to lose money on futures and forward contracts 139
  - 5.4.1. Pricing futures contracts 139
  - 5.4.2. The role of the expected future spot price 143
  - 5.4.3. The impact of financial market imperfections 145
- 5.5. Summary 146
  - Key Concepts 147
  - Review Questions 147
  - Questions and Exercises 147
  - Literature Note 149

### Chapter 6 Hedging Exposures with Forward and Futures Contracts 151

- 6.1. Measuring risk: Volatility, CaR, and VaR 152
- 6.2. Hedging when there is no basis risk 156

- 6.3. Hedging when the basis is not zero 160
  - 6.3.1. *The volatility-minimizing hedge when there is a deterministic relation between the futures price and the spot price* 161
  - 6.3.2. *Hedging when the basis is random* 165
  - 6.3.3. *The volatility-minimizing hedge and regression analysis* 171
  - 6.3.4. *The effectiveness of the hedge* 176
- 6.4. Putting it all together in an example 179
- 6.5. Hedging when returns rather than level changes are i.i.d. 182
- 6.6. Summary 184
  - *Key Concepts* 185
  - *Review Questions* 185
  - *Questions and Exercises* 186
  - *Literature Note* 187

## **Chapter 7 Optimal Hedges for the Real World 189**

- 7.1. Implementing the minimum-variance hedge in the real world 191
  - 7.1.1. *Hedging, contract maturity, and basis risk* 191
  - 7.1.2. *Basis risk, the hedge ratio, and contract maturity* 193
  - 7.1.3. *Cross-hedging* 195
  - 7.1.4. *Liquidity* 195
  - 7.1.5. *Imperfect divisibility* 196
  - 7.1.6. *The multivariate normal changes model: Cash versus futures prices* 197
- 7.2. The costs of hedging 199
- 7.3. Multiple exposures with same maturity 208
- 7.4. Cash flows occurring at different dates 212
- 7.5. Metallgesellschaft 215
- 7.6. Summary 219
  - *Key Concepts* 220
  - *Review Questions* 220
  - *Questions and Exercises* 220
  - *Literature Note* 221

## **Chapter 8 Identifying and Managing Cash Flow Exposures 223**

- 8.1. Price and quantity risks 225
  - 8.1.1. *Risky foreign currency cash flows* 225
  - 8.1.2. *Optimal hedges with quantity risk* 227
- 8.2. The exposures of Motor Inc. 229
  - 8.2.1. *Cash flow exposure and time horizon* 231
  - 8.2.2. *Competitive exposures* 231
- 8.3. Using the pro forma statement to evaluate exposures 235

- 8.4. Modeling cash flow exposures 236
- 8.5. Using regression analysis to measure exposure 244
- 8.6. Monte Carlo approaches 247
- 8.7. Hedging competitive exposures 252
- 8.8. Summary 253
  - *Key Concepts* 254
  - *Review Questions* 254
  - *Questions and Exercises* 255
  - *Literature Note* 256

## **Chapter 9 Measuring and Managing Interest Rate Risks 257**

- 9.1. Debt service and interest rate risks 258
  - *9.1.1. Optimal floating and fixed rate debt mix* 258
  - *9.1.2. Hedging debt service with the eurodollar futures contract* 259
  - *9.1.3. Forward rate agreements* 265
- 9.2. The interest rate exposure of cash flow and earnings for financial institutions 265
- 9.3. Measuring and hedging interest rate exposures 271
  - *9.3.1. Measuring yield exposure* 273
  - *9.3.2. Improving on traditional duration* 278
- 9.4. Measuring and managing interest rate risk without duration 286
  - *9.4.1. Using zero-coupon bond prices as risk factors* 288
  - *9.4.2. Reducing the number of sources of risk: Factor models* 289
  - *9.4.3. Forward curve models* 292
- 9.5. Summary 295
  - *Key Concepts* 296
  - *Review Questions* 296
  - *Questions and Exercises* 297
  - *Literature Note* 298

## **Chapter 10 Hedging with Options 299**

- 10.1. Using options to create static hedges 301
  - *10.1.1. Options as investment insurance contracts* 301
  - *10.1.2. Options as exchange rate insurance contracts: The case of Export Inc.* 303
  - *10.1.3. Options to hedge contingent exposures* 308
  - *10.1.4. How we can hedge (almost) anything with options* 310
- 10.2. A brief history of option markets 314
- 10.3. Some properties of options 315
  - *10.3.1. Upper and lower bounds on option prices* 315
  - *10.3.2. Exercise price and option values* 317

- 10.3.3. *The value of options and time to maturity* 319
- 10.3.4. *Put-call parity theorem* 319
- 10.3.5. *Option values and cash payouts* 321
- 10.3.6. *American options and put-call parity* 323

#### 10.4. Summary 324

- *Key Concepts* 325
- *Review Questions* 325
- *Questions and Exercises* 325
- *Literature Note* 327

### Chapter 11 Option Pricing, Dynamic Hedging, and the Binomial Model 329

#### 11.1. Arbitrage pricing and the binomial model 331

- 11.1.1. *The replicating portfolio approach to price an option* 331
- 11.1.2. *Pricing options by constructing a hedge* 333
- 11.1.3. *Why the stock's expected return does not affect the option price* 334
- 11.1.4. *The binomial model* 335

#### 11.2. The binomial approach with multiple periods 339

- 11.2.1. *The binomial approach with two periods* 339
- 11.2.2. *Pricing a European option that matures in  $n$  periods* 345

#### 11.3. The binomial model and early exercise 347

- 11.3.1. *Using the binomial approach to price a European call on a dividend paying stock* 347
- 11.3.2. *Using the binomial approach to price an American call on a dividend paying stock* 350
- 11.3.3. *Using the binomial approach to price American puts* 351

#### 11.4. Back to hedging everything and anything 352

#### 11.5. Summary 355

- *Key Concepts* 356
- *Review Questions* 356
- *Questions and Exercises* 356
- *Literature Note* 357

### Chapter 12 The Black-Scholes Model 359

#### 12.1. The Black-Scholes model 360

#### 12.2. The determinants of the call option price 367

#### 12.3. Extensions and limitations of the Black-Scholes formula 374

- 12.3.1. *Pricing puts* 374
- 12.3.2. *Taking dividends into account* 377
- 12.3.3. *What if volatility changes over time?* 379
- 12.3.4. *What if the option is an American option?* 382
- 12.3.5. *What if the stock price is not distributed lognormally?* 383

12.4. Empirical evidence on the pricing of options on stocks	385
12.5. Beyond plain vanilla Black-Scholes	387
• 12.5.1. Pricing currency and futures options	389
• 12.5.2. The Monte Carlo approach	391
12.6. Summary	392
• Key Concepts	392
• Review Questions	393
• Questions and Exercises	393
• Literature Note	394
<b>Chapter 13 Risk Measurement and Risk Management with Nonlinear Payoffs</b>	<b>397</b>
13.1. Estimating the risk of nonlinear payoffs using delta	398
• 13.1.1. The risk of an option: The delta-VaR method	399
• 13.1.2. The risk of a portfolio of options written on the same stock	402
• 13.1.3. The risk of a portfolio of options written on different underlying assets	402
13.2. Beyond delta-VaR	404
• 13.2.1. Measuring the risk of a portfolio of options over longer periods of time	404
• 13.2.2. Alternative methods to computing the VaR of an option or portfolio of options	407
• 13.2.3. Leeson, Barings, delta-VaR, delta-gamma VaR, and Monte Carlo VaR	411
• 13.2.4. Stress tests	416
13.3. Portfolio insurance	418
13.4. Using options to hedge quantity risk	421
13.5. Summary	424
• Key Concepts	424
• Review Questions	424
• Questions and Exercises	425
• Literature Note	426
<b>Chapter 14 Options on Bonds and Interest Rates</b>	<b>427</b>
14.1. Caps and floors	430
• 14.1.1. Hedging with caps	430
• 14.1.2. Pricing caps and floors	430
14.2. Hedging with options and measuring the interest rate exposure of bond options	435
14.3. Beyond Black-Scholes	440
• 14.3.1. The limitations of the Black-Scholes approach	440
• 14.3.2. Alternate approaches	442



- 14.4. Spot interest rate models 443
  - 14.4.1. *Building interest rate and bond price trees* 443
  - 14.4.2. *Spot interest rate models and tree building* 446
  - 14.4.3. *Interest rate models and derivatives pricing* 449
  - 14.4.4. *The Vasicek model and risk management* 452
- 14.5. Building trees from the forward curve:  
The Heath-Jarrow-Morton (HJM) model 455
  - 14.5.1. *The forward rate tree* 455
- 14.6. HJM models as periods become shorter 456
- 14.7. Some empirical evidence 462
- 14.8. Summary 464
  - *Key Concepts* 464
  - *Review Questions* 464
  - *Questions and Exercises* 465
  - *Literature Note* 466

## Part 3 Beyond Plain Vanilla Risk Management 467

### Chapter 15 The Demand and Supply for Derivative Products 469

- 15.1. Comparing payoff production technologies 472
  - 15.1.1. *Exchange-traded option* 472
  - 15.1.2. *Over-the-counter option* 473
  - 15.1.3. *Dynamic replication* 478
  - 15.1.4. *Static replication* 481
  - 15.1.5. *Comparison* 482
- 15.2. The suppliers of derivatives 482
  - 15.2.1. *Exchanges* 483
  - 15.2.2. *Financial intermediaries* 483
  - 15.2.3. *The “do it yourself approach”* 486
- 15.3. Financial innovation and financial engineering 487
  - 15.3.1. *The life-cycle of financial products* 487
  - 15.3.2. *The profits from innovation* 489
- 15.4. Embedded derivatives 490
  - 15.4.1. *Bundling can reduce credit risks associated with the issuer’s debt* 493
  - 15.4.2. *Bundling can offer new investment opportunities to investors* 493
  - 15.4.3. *Bundling can eliminate difficulties with counterparties* 493
  - 15.4.4. *Bundling can reduce transaction costs* 493
- 15.5. Assessing the trade-offs 494

### 15.6. Summary 495

- *Key Concepts* 495
- *Review Questions* 495
- *Questions and Exercises* 496
- *Literature Note* 497

## Chapter 16 Swaps 499

### 16.1. The swap market and its evolution 501

### 16.2. Interest rate swaps 505

- *16.2.1. Pricing a new swap* 506
- *16.2.2. Pricing an outstanding swap* 510
- *16.2.3. Measuring the risk of an interest rate swap* 513
- *16.2.4. Do swaps make something out of nothing?* 514

### 16.3. Beyond simple interest rate swaps 517

- *16.3.1. Pricing, risk evaluation, and hedging currency swaps* 517
- *16.3.2. Swaps where the notional amount changes over time* 520
- *16.3.3. Total return swaps* 522
- *16.3.4. Swaps with options* 523
- *16.3.5. Forwards and options on swaps* 524

### 16.4. Case study: The Procter & Gamble levered swap 526

### 16.5. Summary 529

- *Key Concepts* 530
- *Review Questions* 530
- *Questions and Exercises* 531
- *Literature Note* 532

## Chapter 17 Using Exotic Options 533

### 17.1. Digital options 535

### 17.2. Barrier options 539

- *17.2.1. Why use barrier options?* 540
- *17.2.2. Pricing and hedging barrier options* 543
- *17.2.3. Some surprising properties of barrier options* 544
- *17.2.4. Some practical issues* 548

### 17.3. Options on the average 550

- *17.3.1. A binomial example of an option on the average* 551
- *17.3.2. A replicating portfolio for the average* 551
- *17.3.3. Pricing options on the average using the Monte Carlo approach* 553
- *17.3.4. Evaluation of options on the average during the averaging interval* 558

- 17.4. Options on multiple assets 559
  - 17.4.1. *Basket options* 559
  - 17.4.2. *Quantos* 560
  - 17.4.3. *Exchange options* 561
- 17.5. Risk management and exotic options:  
The lessons from Gibson Greetings Inc. 563
- 17.6. Summary 566
  - *Key Concepts* 567
  - *Review Questions* 567
  - *Questions and Exercises* 567
  - *Literature Note* 569

## **Chapter 18 Credit Risks and Credit Derivatives 571**

- 18.1. Credit risks as options 572
  - 18.1.1. *Finding firm value and firm value volatility* 576
  - 18.1.2. *Pricing the debt of In-The-Mail Inc.* 578
  - 18.1.3. *Subordinated debt* 580
  - 18.1.4. *The pricing of debt when interest rates change randomly* 582
  - 18.1.5. *VaR and credit risks* 585
- 18.2. Beyond the Merton model 586
- 18.3. Credit risk models 588
  - 18.3.1. *CreditRisk+* 590
  - 18.3.2. *CreditMetrics™* 592
  - 18.3.3. *The KMV model* 595
  - 18.3.4. *Some difficulties with credit portfolio models* 596
- 18.4. Credit derivatives 596
- 18.5. Credit risks of derivatives 599
- 18.6. Summary 601
  - *Key Concepts* 601
  - *Review Questions* 601
  - *Questions and Exercises* 602
  - *Literature Note* 603

## **Chapter 19 Recent Developments in the Practice of Risk Management 605**

- 19.1. Long-Term Capital Management (LTCM) 606
- 19.2. The operational risk of risk management 611
  - 19.2.1. *Steps in implementation of VaR* 611
  - 19.2.2. *What can go wrong with implementation?* 612
- 19.3. Is it the right risk measure? 617
  - 19.3.1. *VaR diagnostics* 617

- 19.3.2. *Fat tails and the distribution of extreme returns* 621
- 19.3.3. *Alternative risk measures* 624
- 19.3.4. *Measuring operational risk* 626
- 19.4. The current regulatory environment 627
  - 19.4.1. *SFAS 133* 627
  - 19.4.2. *Disclosure* 630
- 19.5. Empirical evidence on risk management practice 630
  - 19.5.1. *The survey evidence* 631
  - 19.5.2. *Studies relating derivatives usage to firm characteristics* 632
  - 19.5.3. *Risk management, risk, and value* 637
- 19.6. Summary 638
  - *Key Concepts* 638
  - *Review Questions* 638
  - *Questions and Exercises* 639
  - *Literature Note* 640

## Part 4 Conclusion 641

### Epilogue 643

### Glossary 645

### Bibliography 653

### Index 663