Contents

Foreword

Preface

1 Introduction

PART I OVERVIEW OF FINANCE, MACROECONOMICS, AND RISK CONCEPTS

2 An Overview of Macroeconomics, and Why the Theory of Asset Pricing and Contingent Claims Should Shape its Future

3 Macroeconomic Models

References
4 **Stochastic Processes, Asset Pricing, and Option Pricing** 43

4.1 Stochastic processes 43
4.2 Itô’s lemma 46
4.3 Asset pricing: Arrow–Debreu securities and the replicating portfolio 47
4.4 Put and call option values 48
4.5 Pricing the options using the Black–Scholes–Merton formula 50
4.6 Market price of risk 52
4.7 Implications of incomplete markets for pricing 54
4.8 Summary 55

Appendix 4A Primer on relationship of put, call, and exchange options 55
Appendix 4B Physics, Feynman, and finance 57
References 57

5 **Balance Sheets, Implicit Options, and Contingent Claims Analysis** 59

5.1 Uncertain assets and probability of distress or default on debt 59
5.2 Probability of distress or default 60
5.3 Debt and equity as contingent claims 61
5.4 Payoff diagrams for contingent claims 62
5.5 Understanding why an implicit put option equals expected loss 63
5.6 Using the Merton model and Black–Scholes–Merton formula to value contingent claims 64
5.7 Measuring asset values and volatilities 68
5.8 Estimating implied asset value and asset volatility from equity or junior claims 68
5.9 Risk measures 71
5.10 Summary 72
References 72

6 **Further Extensions and Applications of Contingent Claims Analysis** 73

6.1 Extensions of the Merton model 73
6.2 Applications of CCA with different types of distress barriers and liability structures 74
6.3 Risk-adjusted and actual probabilities using the market price of risk, Sharpe ratios, and recovery rates 78
6.4 Moody’s-KMV approach 80
6.5 CCA using skewed asset distributions modeled with a mixture of lognormals 81
6.6 Maximum likelihood methods 84
6.7 Incorporating stochastic interest rates and interest rate term structures into structural CCA balance sheet models 85
6.8 Other structural models with stochastic interest rates 86
6.9 Summary 87

Appendix 6A Calculating parameters in the Vasicek model 87
References 88
PART II THE MACROFINANCE MODELING FRAMEWORK

7 The Macrofinance Modeling Framework: Interlinked Sector Balance Sheets

7.1 Contingent claim balance sheets for sectors
7.2 Measuring asset values and volatilities
7.3 Measuring risk exposures
7.4 Linkages in a simple four-sector framework
7.5 Integrated value and risk transmission between sectors
7.6 Policy effectiveness parameters in implicit options
7.7 Advantages of an integrated balance sheet risk approach
7.8 Summary
References

8 The Macrofinance Modeling Framework: A Closer Look at the Sovereign CCA Balance Sheet

8.1 CCA balance sheet for the government and monetary authorities
8.2 Sovereign distress
8.3 Calculating implied sovereign assets and implied sovereign asset volatility using CCA for the public sector balance sheet
8.4 Applications of the macrofinancial risk framework to sovereigns
8.5 Sovereign risk-neutral and estimated actual default probabilities on foreign-currency-denominated debt
8.6 Spreads on sovereign foreign currency and local currency debt
8.7 Breaking down sovereign assets into key components
8.8 Risk-based scenario and policy analysis using calibrated sovereign CCA related to spreads on foreign currency debt
8.9 Short-term and long-term government CCA balance sheets with monetary authority
8.10 Summary
Appendix 8A Value and volatility of local currency liabilities and base money
References

9 The Macrofinance Modeling Framework: Linking Interest Rate Models in Finance and Macroeconomics

9.1 Overview of interest rate term structure models in finance
9.2 Two early theories: liquidity preference and the market for loanable funds
9.3 Monetary policy, Taylor rules, and interest rates
9.4 Reconciling different perspectives on interest rate behavior
9.5 What to do when the monetary authority is linked closely to the government balance sheet
9.6 Summary
References
10 Macrofinance Modeling Framework: Financial Sector Risk and Stability Analysis

10.1 Calculating risk indicators for individual banks or financial institutions 139
10.2 Time series of financial system risk indicators 140
10.3 Snapshot of system risk 145
10.4 Expected loss as a portfolio of implicit put options 146
10.5 Using a structural Merton model with stochastic interest rates for capital adequacy estimates 149
10.6 Factor model to assess key drivers of system risk and for scenario analysis 150
10.7 Multifactor risk analysis using copulas 152
10.8 Household balance sheet risk 152
10.9 Linking banking sector loans to corporate, household, and other borrowers 153
10.10 Foreign-currency-denominated loans and the impact of the presence of foreign banks on banking system risk 154
10.11 CCA models, financial stability indicators and links to macro models 155
10.12 Summary 159

Appendix 10A CCA model for banks and borrowers with foreign-currency-denominated debt and lending spreads based on credit risk 160

References 161

11 Macrofinancial Modeling Framework: Extensions to Different Exchange Rate Regimes 163

11.1 Floating exchange rate regimes, interest rates, and the sovereign balance sheet 163
11.2 Fixed exchange rate regimes, interest rates and the sovereign balance sheet 167
11.3 The impact of capital flows on the CCA sovereign balance sheet 172
11.4 Role of quasi-public entities in exchange rate management 173
11.5 Summary 174

References 174

PART III LINKING MACROFINANCIAL AND MACROECONOMIC FRAMEWORKS 175

12 Sovereign Reserve, Debt, and Wealth Management from a Macrofinancial Risk Perspective 177

12.1 Reserves adequacy and asset allocation: moving from simple rules to a national framework 177
12.2 CCA for a firm with a subsidiary and its wealth management 179
12.3 Constructing contingent claim balance sheets for the national economy 180
12.4 Macro risk and wealth management 181
12.5 Summary 184

References 185
## 13 Macrofinancial Modeling Framework: Relationship to Accounting Balance Sheets and the Flow of Funds

13.1 Economy-wide macro contingent claim balance sheets and risk exposures 187
13.2 Recovering traditional macroeconomic budget constraints and flow identities from CCA valuation equations when volatility is zero 191
13.3 Interlinkages between CCA balance sheets, flows, and risk premiums 195
13.4 Using the production function to link corporate and household assets 197
13.5 Macrofinance, macroeconomic flows, and the business cycle 198
13.6 Summary 199

Appendix 13A Cross-holding by households and financial sectors of contingent claims in other sectors 200
Appendix 13B Contingent claim values and returns of different sectors 201
References 202

## 14 Macrofinancial Risk Framework Linked to Macroeconomic Models

14.1 Adding risk analytics to the spectrum of macroeconomic models 203
14.2 The Mundell–Fleming model and default risk 204
14.3 Linking macrofinance outputs to DSGE models 206
14.4 Linking macrofinance outputs to dynamic, stochastic macroeconomic policy models 208
14.5 Linking macrofinance outputs to macroeconometric VAR models 215
14.6 An integrated policy framework 216
14.7 Summary 217
References 217

## PART IV CRISIS AND DISTRESS IN ECONOMIES

## 15 Macroeconomic Models vs. Crisis Models: Why Nonlinearity Matters

15.1 Recent financial crises and crisis models 222
15.2 Summary 229
References 229

## 16 Sensitivity Analysis, Destabilization Mechanisms, and Financial Crises

16.1 Sensitivity analysis, the “Greeks”, and the valuation multiplier effect 232
16.2 The volatility leverage effect 236
16.3 Feedback between the forward rate and domestic interest rates on local currency debt 237
16.4 Feedback between local currency debt issuance and local currency spreads in the presence of contingent liability constraints 241
16.5 Summary 244
References 245

## 17 The Case of Thailand, 1996–1999

17.1 Background 247
17.2 A macrofinance analysis of the Thai crisis 249
17.3 Scenario analysis 253
17.4 Summary 255
Appendix 17A Banking and corporate sector risk analysis with scenarios 257
References 258

18 The Brazil Crisis of 2002–2003 259
18.1 Background 259
18.2 A macrofinance analysis of the Brazil crisis 261
18.3 Summary 266
References 266

PART V MACROFINANCIAL MODEL APPLICATIONS AND ANALYTICAL ISSUES 267

19 International Shocks, Risk Transmission, and Crisis Prevention: Backdrop for Understanding the 2007–08 Global Financial Credit Turmoil 269
19.1 Changing global environment and global risk 270
19.2 Types of global shocks and the interaction with macrofinancial risk models 277
19.3 The international financial system and crisis prevention 281
19.4 Structuring an effective risk-management hierarchy from the international level down to the country authorities 282
19.5 Summary 283
References 283

20 Macro Risk Management: Ways to Mitigate, Control, and Transfer Risk in the Economy 285
20.1 Overview of ways to manage risk 285
20.2 Direct change in financial structure 287
20.3 Risk transfer 288
20.4 Management of guarantees 290
20.5 Longer-term risk management via institutional and policy change 293
20.6 Summary 294
References 294

21 Integrated Framework for Corporate and Sovereign Relative Value and Capital Structure Arbitrage 297
21.1 Capital structure arbitrage for firms and financial institutions 297
21.2 Credit and equity cycles 299
21.3 Sovereign capital structure relative value 300
21.4 Summary 302
References 302

22 Conclusions and New Directions for Macrofinance 303
22.1 Summary of conceptual issues 303
22.2 The roadmap for an integrated contingent claims analysis-macroeconomic Model 306
Reference 309
Appendix A  Mundell–Fleming with a Risk Premium  311
   A.1  The model  311
   A.2  Equilibrium  315
   A.3  Monetary and fiscal policy  317
   A.4  Summary  321
References  322

Index  323