

## The Economics of Financial Markets

Roy E. Bailey



## Contents

| List of figures |  | page xv                                       |    |
|-----------------|--|---|----|
| Preface         |  | xvii  |    |
| 1               | Asse   | Asset markets and asset prices                |    |
|                 | 1.1  | Capital markets                               | 2  |
|                 | 1.2  | Asset price determination: an introduction    | 5  |
|                 | 1.3  | The role of expectations                      | 9  |
|                 | 1.4  | Performance risk, margins and short-selling   | 11 |
|                 | 1.5  | Arbitrage                                     | 15 |
|                 | 1.6  | The role of time                              | 20 |
|                 | 1.7  | Asset market efficiency                       | 22 |
|                 | 1.8  | Summary                                       | 23 |
|                 | Appendix 1.1: Averages and indexes of stock prices |   | 24 |
|                 | Appendix 1.2: Real rates of return                 |   | 28 |
|                 | Appendix 1.3: Continuous compounding and the force |   |    |
|                 |  | of interest                                   | 29 |
|                 | References   |   | 32 |
| 2               | Asset market microstructure                        |   | 33 |
|                 | 2.1  | Financial markets: functions and participants | 34 |
|                 | 2.2  | Trading mechanisms                            | 36 |
|                 | 2.3  | Industrial organization of financial markets  | 41 |
|                 | 2.4  | Trading and asset prices in a call market     | 45 |
|                 | 2.5  | Bid-ask spreads: inventory-based models       | 48 |
|                 | 2.6  | Bid-ask spreads: information-based models     | 49 |
|                 | 2.7  | Summary                                       | 52 |
|                 | References   |   | 54 |
|                 |  |   |    |

| Contents |
|----------|
| Comenis  |

| Predictability of prices and market efficiency                | 56  |
|---|-----|
| 3.1 Using the past to predict the future                      | 57  |
| 3.2 Informational efficiency                                  | 64  |
| 3.3 Patterns of information                                   | 70  |
| 3.4 Asset market anomalies                                    | 72  |
| 3.5 Event studies   | 75  |
| 3.6 Summary   | 77  |
| Appendix 3.1: The law of iterated expectations                |     |
| and martingales   | 79  |
| References  | 81  |
| Decision making under uncertainty                             | 83  |
| 4.1 The state-preference approach                             | 85  |
| 4.2 The expected utility hypothesis                           | 90  |
| 4.3 Behavioural alternatives to the EUH                       | 98  |
| 4.4 The mean-variance model                                   | 101 |
| 4.5 Summary   | 105 |
| Appendix 4.1: Useful notation                                 | 107 |
| Appendix 4.2: Derivation of the FVR                           | 108 |
| Appendix 4.3: Implications of complete asset markets          | 109 |
| Appendix 4.4: Quadratic von Neumann-Morgenstern utility       | 110 |
| Appendix 4.5: The FVR in the mean-variance model              | 111 |
| References  | 112 |
| Portfolio selection: the mean-variance model                  | 114 |
| 5.1 Mean-variance analysis: concepts and notation             | 115 |
| 5.2 Portfolio frontier: two risky assets                      | 118 |
| 5.3 Portfolio frontier: many risky assets                     |     |
| and no risk-free asset  | 121 |
| 5.4 Portfolio frontier: many risky assets                     |     |
| with a risk-free asset  | 125 |
| 5.5 Optimal portfolio selection in the mean-variance model    | 131 |
| 5.6 Summary   | 133 |
| Appendix 5.1: Numerical example: two risky assets             | 134 |
| Appendix 5.2: Variance minimization: risky assets only        | 135 |
| Appendix 5.3: Variance minimization with a risk-free asset    | 139 |
| Appendix 5.4: Derivation of $Ao > = pjpCTpkaj$                | 140 |
| Appendix 5.5: The optimal portfolio with a single risky asset | 141 |
| References  | 142 |

|    |        | Contents   | xi  |
|----|--------|--|-----|
| 6  | The ca | apital asset pricing model                               | 143 |
|    | 6.1    | Assumptions of the CAPM                                  | 144 |
|    | 6.2    | Asset market equilibrium                                 | 145 |
|    | 6.3    | The characteristic line and the market model             | 149 |
|    | 6.4    | The security market line                                 | 151 |
|    | 6.5    | Risk premia and diversification                          | 154 |
|    | 6.6    | Extensions   | 157 |
|    | 6.7    | Summary  | 159 |
|    | Appen  | dix 6.1: The CAPM in terms of asset prices               | 160 |
|    | Appen  | dix 6.2: Linear dependence of Sj in the CAPM             | 162 |
|    | Appen  | dix 6.3: The CAPM when all assets are risky              | 162 |
|    | Refere | nces   | 165 |
| 7  | Arbiti | rage   | 166 |
|    | 7.1    | Arbitrage in theory and practice                         | 166 |
|    | 7.2    | Arbitrage in an uncertain world                          | 168 |
|    | 7.3    | State prices and the risk-neutral valuation relationship | 173 |
|    | 7.4    | Summary  | 176 |
|    | Appen  | dix 7.1: Implications of the arbitrage principle         | 177 |
|    | Refere | nces   | 182 |
| 8  | Factor | r models and the arbitrage pricing theory                | 183 |
|    | 8.1    | Factor models  | 184 |
|    | 8.2    | APT  | 187 |
|    | 8.3    | Predictions of the APT                                   | 190 |
|    | 8.4    | Summary  | 194 |
|    | Appen  | idix 8.1: The APT in a multifactor model                 | 195 |
|    | Appen  | idix 8.2: The APT in an exact single-factor model        | 197 |
|    | Refere | ences  | 199 |
| 9  | Empi   | rical appraisal of the CAPM and APT                      | 200 |
|    | 9.1    | The CAPM   | 201 |
|    | 9.2    | Tests of the CAPM: time series                           | 202 |
|    | 9.3    | Tests of the CAPM: cross-sections                        | 206 |
|    | 9.4    | Sharpe ratios and Roll's criticism                       | 214 |
|    | 9.5    | Multiple-factor models and the APT                       | 215 |
|    | 9.6    | Summary  | 219 |
|    | Apper  | ndix 9.1: The Black CAPM in terms of excess returns      | 220 |
|    | Refere | ences  | 221 |
| 10 | Prese  | nt value relationships and price variability             | 222 |
|    | 10.1   | Net present value  | 223 |
|    | 10.2   | Asset price volatility                                   | 228 |

|    | 10.3  | Behavioural finance, noise trading and models of        |     |
|----|-------|---|-----|
|    |       | dividend growth   | 235 |
|    | 10.4  | Extreme asset price fluctuations                        | 237 |
|    | 10.5  | Summary   | 243 |
|    | Appe  | ndix 10.1: Present values in continuous time            | 245 |
|    | Appe  | ndix 10.2: Infinitely lived assets: constant growth     | 246 |
|    | Appe  | ndix 10.3: The RNVR with multiple time periods          | 246 |
|    | Refer | ences   | 248 |
| 11 | Inter | temporal choice and the equity premium puzzle           | 250 |
|    | 11.1  | Consumption and investment in a two-period world        |     |
|    |       | with certainty  | 251 |
|    | 11.2  | Uncertainty, multiple assets and long time horizons     | 254 |
|    | 11.3  | Lifetime portfolio selection                            | 258 |
|    | 11.4  | The equity premium puzzle and the risk-free rate puzzle | 262 |
|    | 11.5  | Intertemporal capital asset pricing models              | 269 |
|    | 11.6  | Summary   | 273 |
|    | Appe  | ndix 11.1: Intertemporal consumption and portfolio      |     |
|    |       | selection   | 274 |
|    | Appe  | endix 11.2: Simplifying the FVR                         | 276 |
|    | Appe  | endix 11.3: The consumption CAPM                        | 278 |
|    | Refer | rences  | 280 |
| 12 | Bond  | l markets and fixed-interest securities                 | 281 |
|    | 12.1  | What defines a bond?                                    | 282 |
|    | 12.2  | Zero-coupon bonds                                       | 286 |
|    | 12.3  | Coupon-paying bonds                                     | 291 |
|    | 12.4  | Bond valuation  | 295 |
|    | 12.5  | Risks in bond portfolios                                | 297 |
|    | 12.6  | Immunization of bond portfolios                         | 298 |
|    | 12.7  | Summary   | 300 |
|    | Appe  | endix 12.1: Some algebra of bond yields                 | 302 |
|    | Refe  | rences  | 305 |
| 13 | Terr  | n structure of interest rates                           | 306 |
|    | 13.1  | Yield curves  | 307 |
|    | 13.2  | Index-linked bonds                                      | 310 |
|    | 13.3  | Implicit forward rates                                  | 313 |
|    | 13.4  | The expectations hypothesis of the term structure       | 317 |
|    | 13.5  | Allowing for risk preferences in the term structure     | 322 |
|    | 13.6  | Arbitrage and the term structure                        | 326 |
|    | 13.7  | Summary   | 328 |

xii

|    | Contents   | xiii  |
|----|--|---|
|    | <ul><li>Appendix 13.1: The expectations hypothesis<br/>with explicit uncertainty</li><li>Appendix 13.2: Risk aversion and bond portfolios<br/><i>References</i></li></ul>  | 329<br>331<br>334   |
| 14 | <ul> <li>Futures markets I: fundamentals</li> <li>14.1 Forward contracts and futures contracts</li> <li>14.2 The operation of futures markets</li> <li>14.3 Arbitrage between spot and forward prices</li> <li>14.4 Arbitrage in foreign exchange markets</li> <li>14.5 Repo markets</li> <li>14.6 Summary and conclusion</li> <li>Appendix 14.1: Forward and futures prices</li> <li>Appendix 14.2: Revaluation of a forward contract</li> <li><i>References</i></li> </ul> | 336<br>337<br>342<br>349<br>354<br>355<br>357<br>359<br>360<br>362  |
| 15 | <ul> <li>Futures markets II: speculation and hedging</li> <li>15.1 Speculation</li> <li>15.2 Hedging strategies</li> <li>15.3 Optimal hedging</li> <li>15.4 Theories of futures prices</li> <li>15.5 Manipulation of futures markets</li> <li>15.6 Summary</li> <li>Appendix 15.1: Futures investment as portfolio selection</li> <li>Appendix 15.2: Derivation of h</li> <li><i>References</i></li> </ul>   | 363<br>363<br>365<br>374<br>378<br>383<br>386<br>387<br>390<br>392  |
| 16 | Futures markets III: applications16.1Weather futures16.2Financial futures contracts16.3Short-term interest rate futures16.4Long-term interest rate, or bond, futures16.5Stock index futures16.6The fall of Barings Bank16.7SummaryReferences   | <ul> <li>393</li> <li>393</li> <li>397</li> <li>400</li> <li>404</li> <li>406</li> <li>412</li> <li>414</li> <li>416</li> </ul> |
| 17 | <ul> <li>Swap contracts and swap markets</li> <li>17.1 Swap agreements: the fundamentals</li> <li>17.2 Why do swaps occur?</li> <li>17.3 Risks associated with swaps</li> <li>17.4 Valuation of swaps</li> </ul>   | 417<br>417<br>423<br>429<br>429   |

| Contents |
|----------|
|----------|

|               | 17.5 Metallgesellschaft: a case study                | 431    |
|---------------|--|--------|
|               | 17.6 Summary   | 435    |
|               | References   | 437    |
| 18            | <b>Options markets I: fundamentals</b>               | 438    |
|               | 18.1 Call options and put options                    | 439    |
|               | 18.2 Varieties of options                            | 446    |
|               | 18.3 Option-like assets                              | 448    |
|               | 18.4 Upper and lower bounds for option prices        | 449    |
|               | 18.5 Put-call parity for European options            | 454    |
|               | 18.6 The Modigliani-Miller theorem                   | 457    |
|               | 18.7 Summary   | 459    |
|               | Appendix 18.1: Lower bound for a European call       |        |
|               | option premium                                       | 460    |
|               | Appendix 18.2: Lower bound for a European put        |        |
|               | option premium                                       | 461    |
|               | Appendix 18.3: Put-call parity for European options  | 462    |
|               | Appendix 18.4: The Modigliani-Miller theorem: a proc | of 463 |
|               | References   | 466    |
| 19            | <b>Options markets II: price determination</b>       | 467    |
|               | 19.1 The fundamentals of option price models         | 468    |
|               | 19.2 A two-state option-pricing model                | 471    |
|               | 19.3 The Black-Scholes model                         | 480    |
|               | 19.4 Contingent claims analysis                      | 486    |
|               | 19.5 Summary   | 490    |
|               | References   | 492    |
| 20            | <b>Options markets III: applications</b>             | 494    |
|               | 20.1 Stock index options                             | 495    |
|               | 20.2 Options on futures contracts                    | 496    |
|               | 20.3 Interest rate options                           | 500    |
|               | 20.4 Options and portfolio risks                     | 504    |
|               | 20.5 Portfolio insurance                             | 507    |
|               | 20.6 Combinations and spreads                        | 512    |
|               | 20.7 Summary   | 514    |
|               | Appendix 20.1: Put-call parity for European options  |        |
|               | on futures   | 515    |
|               | References   | 518    |
| Subject index |  |        |
| Author index  |  | 576    |
| Author index  |  | 520    |

xiv