

CONTENTS

Introduction	xxiii
Acknowledgments	xxxv

PART ONE SUPPLY AND DEMAND BEHAVIORS 1

CHAPTER 1 LABOR SUPPLY 3

1 The Neoclassical Theory of Labor Supply	5
1.1 The Choice Between Consumption and Leisure	5
1.1.1 The Basic Model	5
1.1.2 The Properties of Labor Supply	9
1.2 Labor Supply with Household Production and Within the Family	14
1.2.1 Household Production	14
1.2.2 Intrafamilial Decisions	16
1.3 Life Cycle and Retirement	19
1.3.1 Intertemporal Labor Supply	19
1.3.2 Economic Analysis of the Decision to Retire	24
2 Empirical Aspects of Labor Supply	27
2.1 Introduction to the Econometrics of Labor Supply	28
2.1.1 The Principal Ingredients of a Labor Supply Equation	28
2.1.2 A Short Guide to Estimating Labor Supply	32
2.1.3 Nonlinear Budget Constraint	35
2.2 Main Results	38
2.2.1 Form and Elasticity of Labor Supply	38
2.2.2 Natural Experiments	41
2.2.3 Amount of Time Worked and Labor Force Participation Rate	45
3 Summary and Conclusion	51
4 Related Topics in the Book	52
5 Further Readings	52
6 Appendices	53
6.1 Appendix 1: Properties of Indifference Curves	53
6.2 Appendix 2: Properties of the Labor Supply Function	53

	6.3 Appendix 3: Compensated and Noncompensated Elasticity	54
C H A P T E R	2 EDUCATION AND HUMAN CAPITAL	59
	1 Some Facts	61
	1.1 Spending on Education	61
	1.2 Graduation Rates	61
	1.3 Education and Performance on the Labor Market	64
	2 The Theory of Human Capital	69
	2.1 Investment in Human Capital	69
	2.2 Schooling and Wage Earnings	71
	2.3 Education, Training, and Life-Cycle Earnings	73
	3 Education as a Signaling Device	79
	3.1 A Model with Signaling	80
	3.2 Overeducation or Undereducation?	83
	4 Evaluations of the Returns to Education	85
	4.1 The Theory of Human Capital: From the Model to Estimates	86
	4.2 Identifying the Causal Relation Between Education and Income	88
	4.3 The Theory of Human Capital: Measuring the Benefits and Costs of Education	91
	4.4 Some Empirical Results	95
	5 Summary and Conclusion	102
	6 Related Topics in the Book	103
	7 Further Readings	103
C H A P T E R	3 JOB SEARCH	107
	1 Basic Job Search Theory	109
	1.1 The Basic Model	109
	1.1.1 The Search Process and the Reservation Wage	110
	1.1.2 Comparative Statics of the Basic Model	113
	1.1.3 The Choice Among Nonparticipation, Job- Seeking, and Employment	115
	1.2 Extensions of the Basic Model	118
	1.2.1 Eligibility and Unemployment	118
	1.2.2 On-the-Job Search	120
	1.2.3 Choosing How Hard to Look	122
	1.2.4 Nonstationary Environment	124

2	The Equilibrium Search Model and the Theory of Optimal Unemployment Insurance	125
2.1	Job Search and Labor Market Equilibrium	126
2.1.1	The Inadequacies of the Basic Model	126
2.1.2	An Equilibrium Search Model	127
2.1.3	Labor Market Equilibrium	129
2.1.4	Final Remarks on Equilibrium Search Models	131
2.2	The Trade-off Between Insurance and Incentive in Compensating for Unemployment	133
2.2.1	An Agency Model for the Study of Unemployment Insurance	134
2.2.2	The Optimal Contract When the Search Effort Is Verifiable	136
2.2.3	The Optimal Contract When the Search Effort Is Unverifiable	138
3	Empirical Aspects of Job Search	146
3.1	The Econometrics of Duration Models	146
3.1.1	The Hazard Function	147
3.1.2	Parametric Estimation	149
3.1.3	Introducing Explanatory Variables	151
3.2	Main Results	155
3.2.1	Measuring Unemployment Insurance Benefit	155
3.2.2	The Determinants of Unemployment Duration	156
4	Summary and Conclusion	164
5	Related Topics in the Book	165
6	Further Readings	166
7	Appendix: The Discounted Cost of an Unemployed Person	166
CHAPTER 4	LABOR DEMAND	171
1	The Static Theory of Labor Demand	173
1.1	Labor Demand in the Short Run	173
1.2	The Substitution of Capital for Labor	176
1.2.1	Minimization of Total Cost	176
1.2.2	The Properties of the Conditional Factor Demands	179
1.3	Scale Effects	182
1.3.1	Unconditional Factor Demands	182
1.3.2	The "Laws" of Demand	183

1.4	Beyond Two Inputs	187
1.4.1	Conditional Demands	187
1.4.2	Unconditional Demands	191
1.5	The Trade-off Between Workers and Hours	193
1.5.1	The Distinction Between Workers and Hours	193
1.5.2	The Optimal Number of Hours	196
1.5.3	Cost of Labor and Demand for Workers	198
2	From Theory to Estimates	205
2.1	Specific Functional Forms for Factor Demands	206
2.1.1	The Choice of a Production Function	206
2.1.2	The Choice of a Cost Function	209
2.2	Main Results	210
2.2.1	Aggregate Labor Demand	210
2.2.2	Complementarity and Substitution Between Inputs	211
3	Labor Demand and Adjustment Costs	212
3.1	The Costs of Labor Adjustment	212
3.1.1	Definition and Size of Adjustment Costs	212
3.1.2	The Specification of Adjustment Costs	215
3.2	The Adjustment of Employment in a Deterministic Environment	216
3.2.1	Quadratic and Symmetric Adjustment Costs	217
3.2.2	Linear and Asymmetric Adjustment Costs	219
3.3	The Adjustment of Labor Demand in a Stochastic Environment	222
3.3.1	Quadratic and Symmetric Adjustment Costs	222
3.3.2	Linear and Asymmetric Adjustment Costs	225
3.4	Empirical Aspects of Labor Demand in the Presence of Adjustment Costs	229
3.4.1	On Estimates	230
3.4.2	Main Results	230
4	Summary and Conclusion	232
5	Related Topics in the Book	233
6	Further Readings	234
7	Appendices	234
7.1	Appendix 1: The Convexity of Isoquants	234
7.2	Appendix 2: The Properties of Cost Functions	234
7.3	Appendix 3: The Optimal Value of Hours Worked	238

PART TWO	WAGE FORMATION	243
CHAPTER 5	COMPENSATING WAGE DIFFERENTIALS AND DISCRIMINATION	245
	1 Perfect Competition and Compensating Wage Differentials	248
	1.1 Perfect Competition with Jobs of Equal Difficulty	248
	1.2 Compensating Wage Differentials and the Hedonic Theory of Wages	250
	1.3 Social Norms and the Inefficiency of Perfect Competition	254
	1.3.1 Social Norms and Wage Formation	254
	1.3.2 An Illustrative Model	255
	2 Obstacles to Perfect Competition (1): Barriers to Entry	257
	2.1 Monopsony	257
	2.1.1 Wage, Employment, and Monopsony Power	257
	2.1.2 Monopsony and Discrimination	261
	2.2 Specific Irreversible Investment and Rent- Sharing	263
	2.2.1 Incomplete Contracts, Renegotiation, and Rents	263
	2.2.2 The Holdup Problem	264
	3 Obstacles to Perfect Competition (2): Imperfect Information	265
	3.1 Selection Problems	266
	3.1.1 Adverse Selection	266
	3.1.2 Adverse Selection and Efficiency Wage	268
	3.2 Selection and Statistical Discrimination	270
	3.2.1 Statistical Discrimination as a Source of Individual Discrimination	271
	3.2.2 Statistical Discrimination as a Source of Persistent Inequality Among Groups	272
	3.2.3 The Limits of Affirmative Action	275
	4 What Empirical Studies Tell Us	276
	4.1 Does the Hedonic Theory of Wages Really Apply?	276
	4.1.1 Considerations of Method	276
	4.1.2 The Weight of Unobserved Characteristics: An Application to the Evaluation of the Price of a Human Life	278

	4.2 Wage Discrimination	280
	4.2.1 Questions of Method	280
	4.2.2 How to Estimate Changes in Discrimination	282
	4.2.3 Direct Assessment of Discrimination	286
	4.2.4 Main Results	288
	4.3 Industry and Firm Wage Differentials	295
	4.3.1 The Traditional Approach	295
	4.3.2 The Importance of Unobserved Worker Ability Differences	296
	4.3.3 Industry Effect and Firm Effect	297
	5 Summary and Conclusion	298
	6 Related Topics in the Book	299
	7 Further Readings	299
C H A P T E R	6 CONTRACTS, RISK-SHARING, AND INCENTIVE	305
	1 The Labor Contract	307
	1.1 Explicit and Implicit Clauses	307
	1.2 Complete and Incomplete Contracts	308
	1.3 The Agency Model	309
	2 Risk-Sharing	309
	2.1 Symmetric or Verifiable Information	311
	2.1.1 An Individual Insurance Contract Model	311
	2.1.2 The Properties of the Optimal Contract	313
	2.1.3 Insurance and Labor Mobility	314
	2.2 Asymmetric or Unverifiable Information	317
	2.2.1 The Revelation Principle	318
	2.2.2 An Example with Two States of Nature	320
	3 Incentive in the Presence of Verifiable Results	322
	3.1 The Principal–Agent Model with Hidden Action	323
	3.2 Should Remuneration Always Be Individualized?	328
	3.3 Some Reasons Why Performance Pay May Be Inefficient	330
	3.3.1 Multitasking	330
	3.3.2 Supervision and Rent-Seeking	331
	4 Incentive in the Absence of Verifiable Results	333
	4.1 Promotions and Tournaments	334
	4.1.1 A Tournament Model	334
	4.1.2 Empirical Illustrations	339
	4.2 The Role of Seniority	341

4.2.1	The “Shirking” Model	341
4.2.2	Seniority, Experience, and Wage	346
4.3	Empirical Elements on Experience, Seniority, and Wages	349
4.3.1	Estimating the Return to Seniority	349
4.3.2	On the Mechanism of Deferred Payment	353
4.4	Efficiency Wage and Involuntary Unemployment	353
4.4.1	The Model of Shapiro and Stiglitz (1984)	354
4.4.2	Final Remarks on Efficiency Wage Theory	358
5	Summary and Conclusion	360
6	Related Topics in the Book	361
7	Further Readings	361

CHAPTER	7	COLLECTIVE BARGAINING	369
1		Unions and Collective Bargaining	371
1.1		The Characteristics and Importance of Collective Agreements	371
1.1.1		Collective Bargaining Coverage and Union Density	371
1.1.2		The Level at Which Bargaining Takes Place	374
1.1.3		The Aim of Collective Bargaining	376
1.2		The Behavior of Unions	376
1.2.1		Union Preferences and Individual Preferences	377
1.2.2		Union Goals According to Empirical Studies	379
2		Bargaining Theory	380
2.1		The Precursors	381
2.2		The Axiomatic Approach	382
2.3		The Strategic Approach	383
2.3.1		A Noncooperative Bargaining Game	383
2.3.2		Bargaining with a Finite Horizon (Stahl, 1972)	385
2.3.3		Bargaining with an Infinite Horizon (Rubinstein, 1982)	387
2.3.4		The Relationship Between the Axiomatic and the Strategic Approaches	388
2.4		Labor Conflict: Strikes and Arbitration	390
2.4.1		Strikes	390
2.4.2		Arbitration	391

3	Standard Models of Collective Bargaining	393
3.1	The Right-to-Manage Model	393
3.1.1	The Negotiated Wage and the Employment Level	393
3.1.2	Markup and Union Power	395
3.2	Efficient Contracts	397
3.2.1	Weakly Efficient Contracts	397
3.2.2	Strongly Efficient Contracts	399
3.2.3	Collective Bargaining and Wage Dispersion	401
3.3	Is Bargaining Efficient?	403
3.3.1	Negotiations over Employment	403
3.3.2	Negotiations over Unemployment Benefits or Severance Payments	405
4	Insiders and Outsiders	405
4.1	Insiders and the Persistence of Unemployment	406
4.1.1	The Wage–Employment Relationship	406
4.1.2	An Explanation for the Persistence of Unemployment	408
4.2	Insiders and Labor Market Segmentation	409
4.2.1	Bargaining Leading to a Competitive Level of Employment	409
4.2.2	Discrimination or Unemployment?	410
5	Investment and Hours	411
5.1	Negotiations and Investment	411
5.1.1	Contracts Without Renegotiation	412
5.1.2	Contracts with Renegotiation	413
5.2	Bargaining over Hours	414
5.2.1	A Model of Bargaining over Work Schedules	414
5.2.2	The Optimal Number of Hours Worked	416
5.2.3	The Consequences of a Reduction in Working Time on Wage and Employment	417
6	Empirical Evidence Regarding the Consequences of Collective Bargaining	419
6.1	Wages	419
6.1.1	The Union/Nonunion Wage Differential	419
6.1.2	The Impact of Unions on Wage Dispersion	423
6.2	Profitability	424
6.2.1	Productivity and Profits	424
6.2.2	Investment	425

6.3	Employment	425
6.3.1	Tests of Efficient Contract Models	426
6.3.2	Tests of the Right-to-Manage Model	427
6.3.3	Direct Estimations	428
7	Summary and Conclusion	429
8	Related Topics in the Book	431
9	Further Readings	431
10	Appendices	431
10.1	Appendix 1: Unicity of Solution (x^*, y^*)	431
10.2	Appendix 2: The Correspondence Between the Nash Axiomatic Solution and the Subgame Perfect Equilibrium of Rubinstein's Model	432

PART THREE UNEMPLOYMENT AND INEQUALITY 441

CHAPTER 8 UNEMPLOYMENT AND INFLATION 443

1	Some Facts	445
1.1	The Different Unemployment Experiences	445
1.2	Changes in Employment, Unemployment, and Labor Force	447
1.3	Long-Term Unemployment	451
1.4	Fluctuations in Real Wages and Employment	452
2	From the Classical Model to the Keynesian View	454
2.1	The Classical Theory	455
2.2	The Inflation–Unemployment Trade-off	460
2.2.1	The Phillips Curve	460
2.2.2	The NAIRU	462
2.3	The Consequences of Macroeconomic Policy	463
2.3.1	Demand Side Policies	463
2.3.2	The Phillips Curve in the United States and France	467
2.3.3	Supply Side Policies and Supply Shocks	469
3	Nominal Rigidities: The Critiques of Friedman and Lucas	471
3.1	The Friedman Version	472
3.2	Rational Expectations and the “New Classical Macroeconomics”	474
4	Real Rigidities: Hysteresis and the Wage Curve	476
4.1	The Hysteresis of Unemployment	476
4.1.1	The Sources of Persistent Unemployment	477
4.1.2	The Heterogeneity of the Unemployed and the Hysteresis Effect	479

	4.2 The Relationship Between the Level of Wages and the Unemployment Rate	482
	4.2.1 A Reexamination of the Wage Equation	482
	4.2.2 The Phillips Curve and the Error Correction Term	483
	5 Estimates of the NAIRU and Wage Equations	485
	5.1 Estimates of Wage Equations	485
	5.2 Estimates of the NAIRU	489
	6 Summary and Conclusion	491
	7 Related Topics in the Book	493
	8 Further Readings	493
	9 Appendices	493
	9.1 Appendix 1: The Microeconomic Foundations of the Linear Model	493
	9.2 Appendix 2: The Dynamics of an Economy Where the Unemployed Are Heterogeneous	497
C H A P T E R	9 JOB REALLOCATION AND UNEMPLOYMENT	503
	1 Job Flows and Worker Flows	505
	1.1 Job Creation and Destruction	505
	1.1.1 The Extent of Within-Sector Reallocation	506
	1.1.2 The Persistence of Job Creation and Destruction	507
	1.1.3 Movements in Employment and Business Cycles	508
	1.2 Worker Reallocation	508
	1.2.1 Employment Inflows and Outflows	508
	1.2.2 On Displacements	509
	1.2.3 Unemployment Inflows and Outflows	510
	1.2.4 Worker Reallocation and the Business Cycle	511
	1.2.5 The Beveridge Curve	512
	2 The Competitive Model with Job Reallocation	514
	2.1 Job Reallocation and Labor Market Equilibrium	514
	2.2 The Efficiency of the Competitive Equilibrium	516
	2.3 The Limitations of the Competitive Model	516
	3 The Matching Model	517
	3.1 Transaction Costs in the Labor Market	518
	3.1.1 The Matching Function	518
	3.1.2 Equilibrium of Flows and the Beveridge Curve	522
	3.2 The Behavior of Firms	523

3.2.1	Expected Profits	523
3.2.2	Labor Demand	525
3.3	The Behavior of Workers	526
3.4	Wage Bargaining	526
3.4.1	Surplus Sharing	526
3.4.2	The Wage Curve	528
3.5	Labor Market Equilibrium	530
3.5.1	The Determination of Wages, Tightness, and the Unemployment Rate	530
3.5.2	Comparative Statics	531
3.5.3	Some Quantitative Elements	534
4	Investment and Employment	537
4.1	Interest Rate, Investment, and Unemployment	537
4.1.1	The Investment Decision	537
4.1.2	Wage Bargaining	539
4.1.3	The Impact of the Interest Rate on Unemployment	540
4.2	Investment in Specific Capital, “Holdup,” and Unemployment	542
4.2.1	Investment with a Complete Contract	543
4.2.2	Investment with an Incomplete Contract	544
5	Out-of-Stationary-State Dynamics	545
5.1	Bargaining and the Dynamics of the Surplus	545
5.2	Aggregate Shock and Reallocation Shock	547
5.2.1	Diagnosing the Nature of Shocks	548
5.2.2	The Propagation of Shocks	549
6	The Efficiency of Market Equilibrium	550
6.1	Trading Externalities	550
6.2	The Social Optimum	551
6.2.1	A Useful Particular Case	551
6.2.2	The General Case	553
6.3	Is Labor Market Equilibrium Necessarily Inefficient?	554
7	Summary and Conclusion	557
8	Related Topics in the Book	558
9	Further Readings	558
CHAPTER 10	TECHNOLOGICAL PROGRESS, GLOBALIZATION, AND INEQUALITIES	563
1	Does Technological Progress Destroy More Jobs Than It Creates?	565
1.1	Technological Progress and Productivity	565

1.1.1	Different Forms of Technological Progress	565
1.1.2	Technological Progress and Growth	566
1.2	The Capitalization Effect	569
1.2.1	The Discount Rate and the Capitalization Effect	569
1.2.2	When Technological Progress Reduces Unemployment	571
1.3	Creative Destruction	573
1.3.1	A Model with Endogenous Job Destruction	573
1.3.2	The Balanced Growth Path	576
1.3.3	The Efficiency of Creative Destruction	578
1.4	Empirical Illustrations	581
2	Globalization, Inequality, and Unemployment	582
2.1	The Facts	583
2.2	Biased Technological Progress	587
2.2.1	Exogenous Technological Progress	588
2.2.2	What Empirical Research Tells Us	590
2.2.3	Technological Progress and Labor Supply	594
2.3	International Trade	596
2.3.1	The Facts	596
2.3.2	An Illustration of the Stolper and Samuelson Theorem	599
2.3.3	Empirical Results	601
2.4	Migrations	605
2.4.1	The Characteristics of Migrations	605
2.4.2	Theory	607
2.4.3	Empirical Results	611
2.5	Reorganizations, Institutional Changes, and Inequality	614
2.5.1	Unions and the Minimum Wage	614
2.5.2	Organizational and Institutional Changes	616
2.6	The Anglo-Saxon Model versus the European Model	617
2.6.1	A Matching Model with Two Types of Workers	618
2.6.2	An “Anglo-Saxon” Labor Market	620
2.6.3	A “European” Labor Market	621
2.6.4	Does the Minimum Wage Help to Make the European Model More Egalitarian Than the Anglo-Saxon Model?	623
3	Summary and Conclusion	625
4	Related Topics in the Book	626

5	Further Readings	626
6	Appendix	626
PART FOUR	INSTITUTIONS AND ECONOMIC POLICY	633
CHAPTER 11	LABOR MARKET POLICIES	635
1	Labor Market Policies: An International Perspective	636
1.1	What Are Labor Market Policies?	637
1.1.1	The OECD Classification	637
1.1.2	The Purposes of Active Labor Market Policies	637
1.2	Differences Between Countries	640
1.2.1	The Amount of Public Expenditure on Labor Market Policy	640
1.2.2	How Public Expenditure on Active Employment Policy Is Divided Up	640
1.2.3	Examples of Active Policy in Several Countries	642
2	Active Policies: Theoretical Analysis	644
2.1	Manpower Placement Services	644
2.1.1	A Matching Model with Placement Agencies	644
2.1.2	The Social Optimum in the Presence of Placement Agencies	646
2.1.3	Decentralized Equilibrium with Private Placement Agencies	647
2.2	Why Promote Training?	649
2.2.1	Acquiring General Training	650
2.2.2	Acquiring Specific Training	656
2.3	Employment Subsidies	659
2.3.1	Who Benefits from Employment Subsidies?	660
2.3.2	Quantifying the Effect of Employment Subsidies	663
2.4	The Creation of Public Sector Jobs	664
2.4.1	The Crowding-out Effects of Public Sector Jobs	665
2.4.2	Quantifying the Impact of Public Sector Job Creation	667
3	The Evaluation of Active Labor Market Policies	668
3.1	The Method	668
3.1.1	The Roy-Rubin Model of Potential Outcome	669

3.1.2	Observational Data and Experimental Data	672
3.1.3	The Main Estimators	673
3.2	The Main Empirical Results	676
3.2.1	What American Studies Tell Us	676
3.2.2	What European Research Tells Us	683
3.2.3	A Provisional Summary	687
4	The Macroeconomic Effects of Unemployment Benefits	687
4.1	An Overview of Unemployment Insurance Systems	688
4.1.1	The Replacement Ratio	688
4.1.2	A High Proportion of Uninsured Unemployed Persons	691
4.2	Eligibility and Unemployment	692
4.3	Improvement of Productivity	698
4.4	A Review of Empirical Studies	703
5	Conclusion and Summary	704
6	Related Topics in the Book	707
7	Further Readings	707

C H A P T E R 12 INSTITUTIONS AND LABOR MARKET PERFORMANCE 713

1	The Minimum Wage	715
1.1	A Constraint of Varying Strength from Country to Country	715
1.1.1	Legal Aspects and Importance of the Minimum Wage	715
1.1.2	The Populations Concerned	716
1.2	Economic Analysis of the Minimum Wage	716
1.2.1	Negative Effects on Employment	718
1.2.2	What the Monopsony Model Tells Us	719
1.2.3	Minimum Wage, Labor Market Participation, and Job Search Effort	721
1.2.4	The Quality of Jobs and the Distribution of Incomes	727
1.3	The Impact of the Minimum Wage in Light of Empirical Research	729
1.3.1	Correlations Between Employment and the Minimum Wage	729
1.3.2	Studies Based on “Natural Experiments”	730
1.3.3	Following up Individual Histories	730
1.3.4	The Minimum Wage and Inequality	733

2	Employment Protection	734
2.1	What Is Employment Protection?	734
2.2	The Effects of Employment Protection When Wages Are Exogenous	737
2.2.1	The Matching Model with Endogenous Job Destruction	737
2.2.2	The Impact of Firing Costs on Labor Market Equilibrium	739
2.3	Employment Protection and Wage Bargaining	741
2.3.1	Bargaining in the Presence of Firing Costs	741
2.3.2	The Importance of Wage Setting	745
2.4	What Empirical Studies Show	748
3	Taxation	751
3.1	The Main Features of Taxes in Some OECD Countries	751
3.1.1	Mandatory Contributions	752
3.1.2	The Tax Wedge	753
3.1.3	The Progressivity of Taxes	754
3.2	The Effect of Taxes on the Labor Market	756
3.2.1	The Matching Model with Hours Worked	757
3.2.2	The Contrasting Effects of the Average and the Marginal Tax Rates	760
3.3	What Empirical Studies Tell Us	764
3.3.1	The Incidence of the Tax Wedge	764
3.3.2	The Incidence of Progressivity	767
4	The Level at Which Wage Bargaining Takes Place	768
4.1	Efficiency and Unemployment	768
4.1.1	An Economy Composed of Several Industries	769
4.1.2	Labor Market Equilibrium	770
4.1.3	The Effects of the Bargaining Level	772
4.2	Fragile Empirical Results	773
4.2.1	On the Efficiency of Corporatism	773
4.2.2	On the Inefficiency of Wage Bargaining at the Industry Level	775
5	Macroeconomic Assessments of Institutions	777
5.1	The Impact of Institutions	777
5.2	Interactions and Complementarities of Policies and Institutions	781
6	Summary and Conclusion	783
7	Related Topics in the Book	784
8	Further Readings	785

MATHEMATICAL APPENDICES	791
1 Appendix A: Static Optimization	791
1.1 Unconstrained and Constrained Maximum	791
1.2 The Technique of the Lagrangian	792
1.3 The Interpretation of the Lagrange Multipliers	793
1.4 Summary and Practical Guide to Static Optimization	793
2 Appendix B: Dynamic Optimization	794
2.1 The Optimal Control Problem	794
2.2 The First-Order Conditions	795
2.3 Infinite Horizon	796
2.4 Calculus of Variations and the Euler Equation	796
2.5 Summary and Practical Guide to Optimal Control	797
3 Appendix C: Basic Notions Concerning Random Variables	798
3.1 Random Variables and Probability Densities	798
3.2 Independence and Correlation	799
3.3 The Probability Distributions Utilized in This Book	800
4 Appendix D: The Poisson Process and the Value of an Asset	801
4.1 The Poisson Process	801
4.2 Evolution of the Value of an Asset	802
4.3 An Alternative Proof	803
5 Appendix E: Systems of Linear Difference Equations	803
5.1 A Particular Solution	804
5.2 The General Solution	804
5.3 Stability	806
5.4 A Useful Form for the Stability Conditions	807
5.5 The Phase Diagram	808
5.6 User Guide for the Study of Two-Dimensional Linear Systems	809
Notes	811
Name Index	823
Subject Index	831