

The Economics of Financial Markets

The Economics of Financial Markets presents a concise overview of capital markets, suitable for advanced undergraduates and for embarking graduate students in financial economics. Following a brief overview of financial markets – their microstructure and the randomness of stock market prices – this textbook explores how the economics of uncertainty can be applied to financial decision making. The mean-variance model of portfolio selection is discussed in detail, with analysis extended to the capital asset pricing model (CAPM). Arbitrage plays a pivotal role in finance and is studied in a variety of contexts, including the arbitrage pricing theory (APT) model of asset prices. Methods for the empirical evaluation of the CAPM and APT are also discussed, together with the volatility of asset prices, the intertemporal CAPM and the equity premium puzzle. An analysis of bond contracts leads into an assessment of theories of the term structure of interest rates. Finally, financial derivatives are explored, focusing on futures and options contracts.

Roy E. Bailey is a Reader in Economics at the University of Essex.





The Economics of Financial Markets

Roy E. Bailey





CAMBRIDGEUNIVERSITY PRESS

University Printing House, Cambridge CB2 8BS, United Kingdom

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of education, learning and research at the highest international levels of excellence.

www.cambridge.org
Information on this title: www.cambirdge.org/9780521612807

© R. E. Bailey 2005

This publication is in copyright. Subject to statutory exception and to the provisions of relevantcollective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published 2005 11th printing 2014

Printed in the United Kingdom by Clays, St Ives, plc.

A catalogue record for this publication is available from the British Library

ISBN 978-0-521-84827-5 Hardback ISBN 978-0-521-61280-7 Paperback

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external or third-party internet websites referred to in this publication, and does not guarantee that any content on such websites is, or will remain, accurate or appropriate. Information regarding prices, travel timetables and other factual information given in this work are correct at the time of first printing but Cambridge University Press does not guarantee the accuracy of such information thereafter.



The Theory of Economics does not furnish a body of settled conclusions immediately applicable to policy. It is a method rather than a doctrine, an apparatus of the mind, a technique of thinking, which helps its possessor to draw correct conclusions. It is not difficult in the sense in which mathematical and scientific techniques are difficult; but the fact that its modes of expression are much less precise than these, renders decidedly difficult the task of conveying it correctly to the minds of learners.

J. M. Keynes

When you set out for distant Ithaca, fervently wish your journey may be long, – full of adventures and with much to learn.

C. P. Cavafy





Contents in brief

Con	tents	page 1x
List	of Figures	XV
Pref	face	xvii
1	Asset markets and asset prices	1
2	Asset market microstructure	33
3	Predictability of prices and market efficiency	56
4	Decision making under uncertainty	83
5	Portfolio selection: the mean-variance model	114
6	The capital asset pricing model	143
7	Arbitrage	166
8	Factor models and the arbitrage pricing theory	183
9	Empirical appraisal of the CAPM and APT	200
10	Present value relationships and price variability	222
11	Intertemporal choice and the equity premium puzzle	250
12	Bond markets and fixed-interest securities	281
13	Term structure of interest rates	306
14	Futures markets I: fundamentals	336
15	Futures markets II: speculation and hedging	363
16	Futures markets III: applications	393
17	Swap contracts and swap markets	417
18	Options markets I: fundamentals	438
19	Options markets II: price determination	467
20	Options markets III: applications	494

vii





Contents

List	t of figu	ires	page xv
Pre	face		xvii
1	Asse	et markets and asset prices	1
	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
	App	endix 1.1: Averages and indexes of stock prices	24
	App	endix 1.2: Real rates of return	28
	App	endix 1.3: Continuous compounding and the force	
		of interest	29
	Refe	rences	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
	Refe	rences	54



X		Contents	
3	Pred	lictability 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
	App	endix 3.1: The law of iterated expectations	
		and martingales	79
	Refe	rences	81
4	Deci	sion 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
	App	Appendix 4.5: The FVR in the mean-variance model	
	Refe	rences	112
5	Port	folio 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 $\Delta \sigma_P = \beta_{iP} \sigma_P \Delta a_i$		140
	Appendix 5.5: The optimal portfolio with a single risky asset		141
	References		142



		Contents	X
6	The c	capital 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
	Appe	ndix 6.1: The CAPM in terms of asset prices	160
	Appendix 6.2: Linear dependence of ε_i in the CAPM		162
	Appe	ndix 6.3: The CAPM when all assets are risky	162
	Refer	ences	165
7	Arbit	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
	Appe	ndix 7.1: Implications of the arbitrage principle	177
	Refer		182
8	Factor 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
	Appe	ndix 8.1: The APT in a multifactor model	195
	Appe	ndix 8.2: The APT in an exact single-factor model	197
	Refer	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
	Appe	ndix 9.1: The Black CAPM in terms of excess returns	220
	Refer		221
10	Prese	ent value relationships and price variability	222
	10.1	Net present value	223
	10.2	Asset price volatility	228



xii	Contents	
	10.3 Behavioural finance, noise trading and models of	
	dividend growth	235
	10.4 Extreme asset price fluctuations	237
	10.5 Summary	243
	Appendix 10.1: Present values in continuous time	245
	Appendix 10.2: Infinitely lived assets: constant growth	246
	Appendix 10.3: The RNVR with multiple time periods	246
	References	248
11	Intertemporal 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 pu	zzle 262
	11.5 Intertemporal capital asset pricing models	269
	11.6 Summary	273
	Appendix 11.1: Intertemporal consumption and portfolio	
	selection	274
	Appendix 11.2: Simplifying the FVR	276
	Appendix 11.3: The consumption CAPM	278
	References	280
12	Bond 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
	Appendix 12.1: Some algebra of bond yields	302
	References	305
13	Term 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



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



X1V	Contents	
	17.5 Metallgesellschaft: a case study	431
	17.6 Summary	435
	References	437
18	Options markets I: fundamentals	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 proof	463
	References	466
19	Options markets II: price determination	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	Options markets III: applications	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		519
Author index		526



Figures

1.1	Market equilibrium for a single asset	6
2.1	Flow demand and supply for a single asset	37
3.1	A method for appraising asset market efficiency	67
4.1	States in a two-period world	87
4.2	The value function, $z(W)$, in prospect theory	100
4.3	Indifference curves in μ_P , σ_P space	104
5.1	The efficiency frontier with two assets	119
5.2	The efficiency frontier with two assets and $\rho_{12} = \pm 1$	119
5.3	The efficiency frontier allowing for short-sales	120
5.4	The efficiency frontier with three assets	122
5.5	Efficient portfolios with a risk-free asset	126
5.6	Efficient portfolios with different lending and borrowing rates	128
5.7	The Sharpe ratio and risk-adjusted performance	131
5.8	Optimal portfolio selection	132
5.9	The portfolio frontier with risky assets	137
6.1	The capital market line	147
6.2	The characteristic line for asset j	150
6.3	The security market line	152
6.4	Disequilibrium in the CAPM	153
6.5	Zero-beta portfolios	158
8.1	A single-factor model	185
8.2	The APT in a single-factor model	191
9.1	A test of the CAPM	208
10.1	Observed US stock prices, \tilde{p}_t , and <i>ex post</i> rational prices, \tilde{p}_t^*	232
11.1	Two-period consumption plans	253
12.1	A zero-coupon bond's price, p , as a function of its yield, y	289
13.1	Yield curves	308
13.2	Estimated yield curves	309



xvi	List of figures	
13.3	Estimated real yield curves	312
14.1	Pay-offs from long and short futures positions	345
15.1	The slope of the fitted line is an estimate of the pure hedge ratio, h^*	376
18.1	Pay-offs at exercise for call and put options: long positions	443
18.2	Pay-offs at exercise for call and put options: short positions	444
18.3	Absence of arbitrage opportunities (AoAO) regions for European	
	options	452
18.4	Bounds for American and European put option prices	456
19.1	Call and put option prices as a function of the asset price, S	470
19.2	The pattern of underlying asset prices: the two-period case	477
19.3	Sample paths for asset prices in continuous time	479
20.1	Interest rate caps and floors	501
20.2	Portfolio insurance with a put option	509
20.3	A long straddle	514



Preface

How can yet another book on finance be justified? The field is already well served with advanced works, many of impressive technical erudition. And, towards the other end of the academic spectrum, an abundance of mammoth texts saturates the MBA market. For the general reader, manuals confidently promising investment success compete with sensational diagnoses of financial upheavals to attract attention from the gullible, avaricious or unwary.

Alas, no one can expect to make a fortune as a consequence of reading this book. It has a more modest objective, namely to explore the economics of financial markets, at an 'intermediate' level – roughly that appropriate for advanced undergraduates. It is a work of exposition, not of original research. It unashamedly follows Keynes's immortal characterization of economic theory as 'an apparatus of the mind, a technique of thinking'. Principles – rather than assertions of doctrine, policy pronouncements or institutional description – are the focus of attention. If the following chapters reveal no get-rich-quick recipes, they should at least demonstrate why all such nostrums merit unequivocal disbelief.

This book evolved, over more years than the author cares to admit, from lecture notes for a course in financial economics taught at the University of Essex. For reasons of space, one topic – corporate finance – has been omitted from the book, though its core insight – the Modigliani–Miller theorem – is slipped in under options (chapter 18, section 6). While the chapters are intended to follow a logical sequence, pedagogy may require a different order. Any such tensions should be straightforward to resolve. For example, chapter 2 (market microstructure) appears early but was covered later in the course. Other changes of the order in which the chapters are studied should be easy to implement. Several obvious groupings are, however, readily apparent: portfolio selection in chapters 4 and 5; asset pricing in 6 to 9; bond markets in 12 and 13; futures in 14 to 16; and options in 18 to 20.

xvii



xviii Preface

Taxing though it may be, chapter 7, on arbitrage, is so fundamental that it deserves study as early as possible. The overused and commonly abused notion of 'efficiency' infects much of finance: here it is confronted in chapter 3, though its presence cannot escape notice elsewhere (especially in chapters 10 and 11). 'Behavioural finance' perhaps warrants greater attention than it gets. Rather than segregate the topic into a ghetto of its own, an attempt is made to disperse its message across chapters of particular relevance (especially 3, 4 and 10). No apology is offered for adhering to a conventional treatment of financial markets, eschewing as far as possible the caprice of academic fashion.

Students enrolled for the lecture course were absolved responsibility for the technical appendices, included to justify and amplify claims in the text. The appendices were much the most satisfying sections to write and, it is hoped, will interest at least those readers embarking on graduate study. Lest there be misconception that the coverage of any topic is definitive, each chapter includes brief suggestions for further reading. A student's work is never done.

The undergraduates to whom the lectures were addressed had a background in economics but most had not previously encountered the subject of finance. Consequently, while the book should be accessible to any moderately well-educated undergraduate, an acquaintance with microeconomics and quantitative methods is desirable. No more than the rudiments of differential calculus and probability theory, together with a smattering of statistics, are really necessary.

Successive generations of Essex students have contributed more to the final product than they can possibly have realized. Their toleration resembles that of opera audiences, which, in repeatedly shouting for an encore, imagine that the singer will eventually get it right. Individuals – too many to identify by name – have pointed out errors, queried obscurities and, most importantly, asked critical questions that revealed shortcomings. Attempts have been made to remedy the most glaring faults. Others undoubtedly lurk, as yet undiscovered.

A Website has been established at www.cambridge.org/0521612802. It is intended that this will form a repository for updates, feedback, exercises used in the lecture course and other supporting ancillary material. Given the unpredictable appearance, disappearance and revision of Web URLs, with a few exceptions these have been omitted from the text. The book's Website should – notwithstanding the vicissitudes of the Web – enable rapid access to relevant locations via the links listed there.

The author's procrastination in completing the manuscript would have exhausted the patience of a saint. But not of Patrick McCartan and Chris Harrison, at Cambridge University Press, the forbearance of whom has been remarkable. Persistent encouragement from Marcus Chambers and Abhinay Muthoo nudged the project back to life on countless occasions when the author would have



Preface xix

cheerfully abandoned it. Without their unwavering support, the entire enterprise would surely have been aborted. They must, therefore, be rendered partially culpable for the appearance of the book, though they are innocent of its remaining blemishes, infelicities and errors. For these, the author accepts exclusive responsibility.

R. E. Bailey Wivenhoe Park November 2004