

Financial Economics

Classics & Contemporary

Antonio Mele

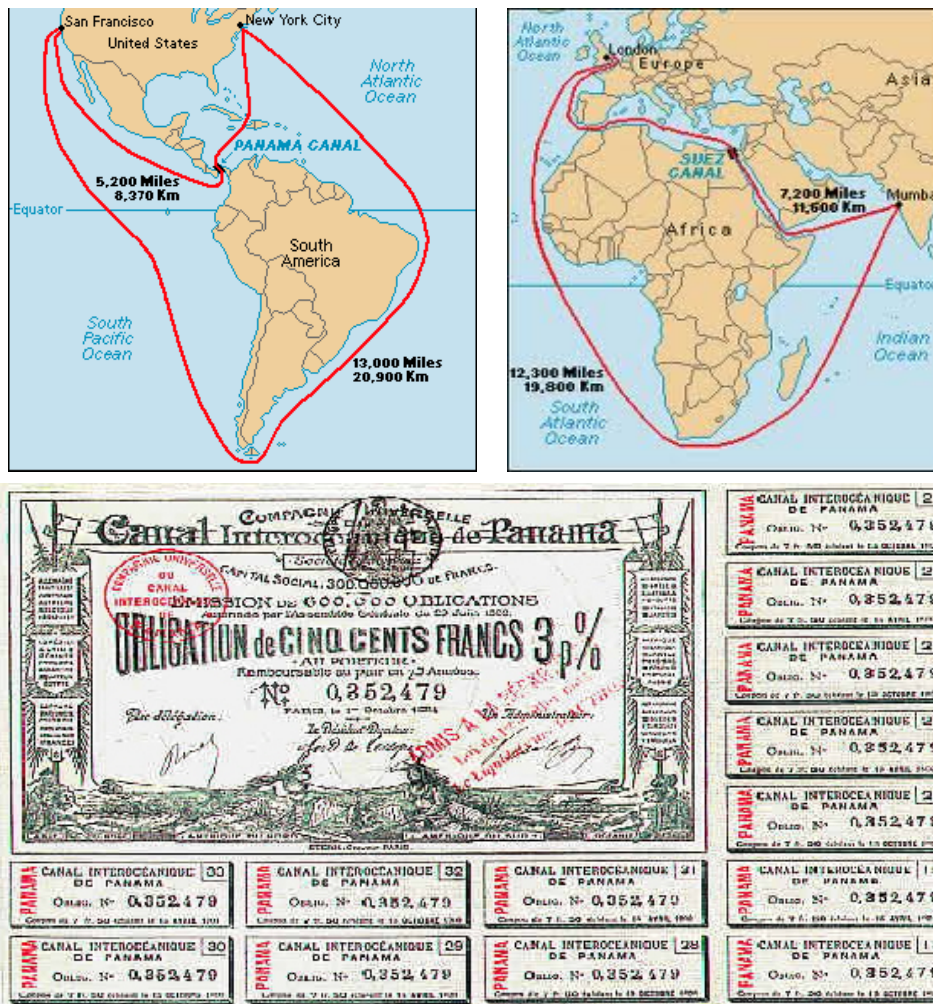
Università della Svizzera Italiana, Swiss Finance Institute, and
Centre for Economic Policy Research



September 2020

MIT Press, Forthcoming

© 2003-2017, Antonio Mele; © 2018-2020, MIT Press



Front cover explanations

Top: Illustration of the increased efficiency in maritime routing allowed by the Suez Canal (right panel) opened in 1869, and the Panama Canal (left panel) opened in 1913, two amongst the most enduring technological marvels with global economic and political implications.

Bottom: A 75 year 3% coupon bearing bond issued by the Panama Canal Company (“Compagnie Universelle du Canal Interocéanique de Panama”) in October 1884. The company defaulted in 1889 under the leadership of the Count Ferdinand de Lesseps, who during 1858 had also founded the Suez Canal Company (“Compagnie Universelle du Canal Maritime de Suez”).

Information about the author

Antonio Mele is a Professor of Finance at Università della Svizzera Italiana in Lugano and holds a Senior Chair at the Swiss Finance Institute, after a decade spent as a tenured faculty at the London School of Economics. He is also a Research Fellow for the Financial Economics program at the Centre for Economic Policy Research (CEPR) in London. He holds a PhD in Economics from the University of Paris and a BSc in Economics from LUISS University in Rome. His work spans a variety of fields in financial economics, including financial market volatility, information in securities markets, interest rates and credit markets, financial markets and the macroeconomy, and has appeared in journals such as the *Journal of Financial Economics*, the *Review of Economic Studies*, the *Review of Financial Studies*, and the *Journal of Monetary Economics*. He authored or co-authored three books on themes regarding financial market volatility.

His work outside academia has led to real-time indicators of uncertainty in fixed income markets that have been adopted by Chicago Board Options Exchange (Cboe) and S&P Dow Jones Indices and instruments to hedge volatility of interest rates and credit spreads. He is the co-inventor of the first volatility indices and related tradable instruments operated through an exchange, designed to standardize and simplify interest rate volatility trading much in the spirit of the Cboe VIX index in the equity space. He also acted as a member of the *Securities and Markets Stakeholder Group* of the European Securities Markets Authority (ESMA), the supra-national supervisor of European financial markets.

Contents

Introduction	13
I Foundations	26
1 The classic capital asset pricing model	27
1.1 Introduction	27
1.2 Portfolio selection	29
1.2.1 Wealth constraints	29
1.2.2 Portfolio choice: the “Capital Market Line”	30
1.2.3 Without the safe asset: the “Efficient Portfolio Frontier”	30
1.2.4 Risk-return trade-offs in the two asset case	31
1.2.5 Risk-parity and the global minimum variance portfolio	33
1.2.6 The market portfolio	34
1.3 The CAPM	36
1.3.1 Restrictions on securities expected returns	37
1.3.2 The low-beta anomaly	38
1.3.3 Zero-beta CAPM	39
1.3.4 An excursion into risk premiums and certainty equivalents	40
1.3.5 Back to CAPM: Equilibrium with expected utility	44
1.3.6 Black-Litterman	47
1.3.7 Knightian uncertainty and global minimum variance portfolio	49
1.4 The APT	50
1.4.1 Exact APT	50
1.4.2 Risk-neutral tilts, or the fundamental theorem of asset pricing	52
1.4.3 Uncertainty and asset evaluation	55
1.4.4 The APT with idiosyncratic risk and a large number of assets	56
1.5 Empirical evidence	57
1.5.1 Fama-MacBeth two-step regressions	57

1.5.2	Macroeconomic forces	58
1.5.3	Fama & French model	58
1.5.4	“Smart beta,” or factor investing	60
1.5.5	“Lucky factors”	61
	Appendix 1.A. Portfolio choice	63
	Appendix 1.B. Market portfolio and security market line	66
	Appendix 1.C. Risk and risk aversion	68
	Appendix 1.D. Money demand and liquidity traps	73
	Appendix 1.E. Parameter uncertainty	75
	References	76
2	Arbitrage, equilibrium and pricing	79
2.1	Introduction	79
2.2	The static general equilibrium in a nutshell	81
2.2.1	Walras’ Law	82
2.2.2	Competitive equilibrium	82
2.2.3	Optimality	83
2.3	The role of financial securities in markets with uncertainty	86
2.3.1	Commodity markets	86
2.3.2	Financial securities and rational expectations	87
2.3.3	Laws of Large Numbers, risk-aversion, and the slicing of risks	88
2.3.4	Arrow-Debreu securities	91
2.4	Arbitrage and replication: examples	93
2.4.1	Rain and sunshine	94
2.4.2	Replication and pricing: the role of complete markets	96
2.5	No-arbitrage: theory	96
2.5.1	Lands of Cockaigne	97
2.5.2	Enforced asset prices	98
2.6	Equivalent martingales and equilibrium	99
2.6.1	Equilibrium with financial markets: definition	99
2.6.2	Rational expectations	100
2.6.3	Pricing kernels	101
2.6.4	Equilibrium, risk sharing and incomplete markets	103
2.7	Consumption-CAPM	108
2.7.1	Risk-neutral pricing and macroeconomic risks	109
2.7.2	CCAPM vs CAPM	110
	Appendix 2.A. Proof of selected results	111
	References	113
3	Infinite horizon economies	114
3.1	Introduction	114
3.2	Consumption-based asset evaluation	115
3.2.1	Recursive plans: introduction	115
3.2.2	Asset pricing: the marginalist argument	116
3.2.3	Elasticity of intertemporal substitution	117
3.2.4	Lucas’ model	118
3.3	Production: foundational issues	122

3.3.1	Decentralized economy	122
3.3.2	The social planner solution	123
3.3.3	Dynamics	124
3.3.4	Stochastic economies	126
3.4	Production-based asset pricing	130
3.4.1	Firms	130
3.4.2	Consumers	134
3.4.3	Equilibrium	135
3.5	Production, money and asset prices in overlapping generations models	135
3.5.1	Introduction: endowment economies	136
3.5.2	Monetary economies	138
3.5.3	Capital accumulation and bubbles	142
3.6	Dynamic efficiency	144
3.6.1	Production economies	145
3.6.2	Money	146
	Appendix 3.A. Finite difference equations and determinacy	147
	Appendix 3.B. Neoclassical growth in continuous time	151
	Appendix 3.C. Optimization in continuous time	155
	References	158
4	Continuous time models	160
4.1	Introduction	160
4.2	An introduction to no-arbitrage and equilibrium	162
4.2.1	Time	162
4.2.2	The origins: Black & Scholes	162
4.2.3	Asset prices as Feynman-Kac representations	168
4.2.4	The Girsanov theorem	169
4.2.5	The APT in continuous time	172
4.2.6	Example: no-arbitrage in Lucas tree	175
4.3	Martingales and arbitrage I: Viability	180
4.3.1	Trees	180
4.3.2	Martingale restrictions	181
4.3.3	Market completeness	182
4.4	Martingales and arbitrage II: Optimization	184
4.4.1	Complete markets and single budget constraints	184
4.4.2	Optimization	185
4.4.3	Marginal utility of income	186
4.4.4	Example: log-utility	187
4.4.5	Equilibrium	187
4.5	Martingales and arbitrage III: Distorsions and numéraires	188
4.5.1	Leading example: consumption-based probabilities	189
4.5.2	Numéraire pricing	190
4.6	Equilibrium with state variables and a representative agent	194
4.6.1	Constant investment opportunity sets	194
4.6.2	Stochastic opportunity sets	195
4.6.3	Arrow-Debreu densities and restrictions on expected returns	199
4.6.4	Interest rates	203

4.7	Portfolio constraints	205
4.7.1	Admissible portfolio choices	205
4.7.2	Artificial markets	208
4.8	Inaction: the economics of American options	208
4.8.1	Early exercise premiums: an introductory example	209
4.8.2	Risk-aversion	210
4.8.3	Real options theory	211
4.8.4	Perpetual puts	212
4.8.5	Perpetual calls	214
4.8.6	Further topics on real options and controlled Brownian motions	216
4.9	Jumps	219
4.9.1	Poisson jumps	219
4.9.2	Rare events interpretation	220
4.9.3	Properties and related distributions	221
4.9.4	Cox processes	222
4.9.5	Asset prices as jump-diffusion processes	222
4.9.6	An option pricing formula	223
	Appendix 4.A. Introduction to stochastic calculus for finance	226
	Appendix 4.B. Self-financed strategies	241
	Appendix 4.C. Proof of selected results	244
	Appendix 4.D. The Green's function	248
	Appendix 4.E. Portfolio constraints	250
	Appendix 4.F. Jumps	252
	References	255
5	Information, security design and financial contracting	258
5.1	Introduction	258
5.2	Conceptual challenges to frictionless markets: information problems	259
5.2.1	The economics of information	259
5.2.2	Information problems in financial markets	259
5.3	Three information problems	261
5.3.1	Adverse selection and trading	261
5.3.2	Moral hazard and securitization	263
5.3.3	Signaling: callable bonds, equity and short-term debt	269
5.3.4	Other classical problems: short-term debt and equity sales	275
5.4	The classics: capital structure and Modigliani-Miller propositions	279
5.4.1	Irrelevance of capital structure	279
5.4.2	Dynamic versions of irrelevance	282
5.5	Debt and moral hazard	282
5.5.1	Symmetric information again: full insurance	282
5.5.2	Moral hazard	283
5.6	Debt and adverse selection with costly state verification	285
5.6.1	Symmetric information	286
5.6.2	Asymmetric information	286
5.6.3	Investments and agency costs	287
5.7	Liquidity management and dynamic security design	288
5.7.1	Liquidity constraints and optimal dividend policy	289

5.7.2	A model of continuous time contracting	294
	Appendix 5.A. The Spence-Mirrlees condition	300
	Appendix 5.B. Debt and moral hazard	301
	Appendix 5.C. Dynamic problems	302
	References	305
6	Taking models to data	308
6.1	Introduction	308
6.2	Data generating processes	309
6.2.1	Models: specification and identification	309
6.2.2	Restrictions on the DGP	309
6.2.3	Parameter estimation	310
6.2.4	Basic properties of density functions	311
6.2.5	The Cramer-Rao lower bound	311
6.3	Maximum likelihood estimation	312
6.3.1	Definition	312
6.3.2	Factorizations	312
6.3.3	Asymptotic properties	312
6.4	M-estimators	314
6.5	Pseudo, or quasi, maximum likelihood	315
6.6	GMM	316
6.6.1	Theory	316
6.6.2	Early asset pricing tests	319
6.7	Simulation-based estimators	319
6.7.1	Three simulation-based estimators	320
6.7.2	Asymptotic normality	322
6.7.3	A fourth estimator: Simulated maximum likelihood	325
6.7.4	Progress	327
6.7.5	In practice? Latent factors and identification	327
	Appendix 6.A. Primers	329
	Appendix 6.B. Maximum likelihood	332
	Appendix 6.C. Dependent processes	334
	References	336
II	Empirical lessons and market inefficiencies	338
7	Neo-classical kernels and puzzles	339
7.1	Introduction	339
7.2	The equity premium puzzle	340
7.2.1	A single-factor model	340
7.2.2	Equity premium and interest rate puzzles	343
7.3	Hansen-Jagannathan cup	345
7.4	Multifactor extensions: the aggregate equity market	348
7.4.1	Exponential affine pricing kernels	349
7.4.2	With lognormal returns	350
7.5	Relations to the classic CAPM	352

7.5.1	Market portfolios and pricing kernel bounds	352
7.5.2	A semantic digression on market portfolios	353
7.5.3	The maximum correlation portfolio	353
7.5.4	Duality	354
7.6	The Conditional CAPM	356
	Appendix 7.A. Proof of selected results	358
	References	362
8	Aggregate fluctuations in equity markets	363
8.1	Introduction	363
8.2	Empirical evidence: bird's eye view	364
8.2.1	Equity markets and the business cycle	365
8.2.2	Predictability	369
8.2.3	Risk-return trade-offs	371
8.3	Volatility: a business cycle perspective	372
8.3.1	Volatility cycles	373
8.3.2	Understanding the empirical evidence	374
8.3.3	What to do with stock market volatility?	379
8.3.4	What did we learn?	383
8.4	Rational market fluctuations	384
8.4.1	The dynamics of asset returns	384
8.4.2	Markov pricing kernels, asset returns and volatility	385
8.5	Time-varying risk premiums	387
8.5.1	External habit	388
8.5.2	Countercyclical statistics	389
8.5.3	Some additional literature	392
8.5.4	The term-structure of interest rates	393
8.6	Large price swings as a learning induced phenomenon	394
8.6.1	Information	395
8.6.2	An introductory model of learning	395
8.6.3	Convexity again, and two models of learning	399
8.7	Retained earnings and market-to-book ratios	403
8.7.1	Plowbacks and growth opportunities	403
8.7.2	Random dividends distribution	404
	Appendix 8.A. Estimation and calibration methodology	407
	Appendix 8.B. A multifactor security model	411
	Appendix 8.C. Arrow-Debreu PDEs	412
	Appendix 8.D. Increasing risk and convexity	413
	Appendix 8.E. Linearity-generating processes	422
	Appendix 8.F. Habit	424
	Appendix 8.G. Learning in continuous time	426
	Appendix 8.H. Market-to-book ratios	428
	References	429
9	Macrofinance	434
9.1	Introduction	434
9.2	Non-expected utility	436

9.2.1	Recursive formulations	437
9.2.2	Preferences for early resolution of uncertainty, and long-run risks	438
9.2.3	Testable restrictions	441
9.2.4	Risk premiums and interest rates	442
9.2.5	Campbell-Shiller approximation	443
9.2.6	Risks for the long-run	444
9.3	Heterogeneous agents and “catching up with the Joneses”	446
9.4	Idiosyncratic risk	448
9.4.1	A static model	448
9.4.2	Self-insurance and persistence of idiosyncratic shocks	450
9.4.3	A model with countercyclical income inequality	450
9.5	Incomplete markets with homogeneous and heterogenous agents	452
9.5.1	Idiosyncratic shocks unrelated to aggregate risk	452
9.5.2	A two-agents economy	453
9.6	Disagreement and learning	456
9.6.1	Learning with multiple signals	457
9.6.2	Overconfidence and bubbles	457
9.6.3	General equilibrium without frictions	461
9.7	Coping with Knightian uncertainty	470
9.7.1	Prelude	470
9.7.2	Uncertainty aversion and Ellsberg paradox	471
9.7.3	Portfolio selection and market participation	473
9.7.4	A model of multiple likelihoods	477
9.8	Government spending and asset prices	482
9.8.1	Assumptions	482
9.8.2	Government debt	482
9.8.3	Ricardian equivalence	483
9.8.4	Government size and asset prices	484
9.9	Leverage and volatility	485
9.9.1	Primitives	486
9.9.2	Equity volatility and leverage	486
9.9.3	Bankruptcy	487
9.10	Multiple trees and the cross-section of asset returns	488
9.10.1	A model of the cross-section of expected returns	489
9.10.2	Exogenous aggregate output and habit formation	492
9.10.3	Discussion: predictability	494
9.10.4	Stochastic strings	495
9.11	Prices, quantities and the separation hypothesis	496
9.11.1	Production puzzles	497
9.11.2	Risk-sensitive models	498
9.11.3	Irrelevance	500
9.11.4	Preferences for robustness and error detection probabilities	501
9.12	Endogenous risk and the financial accelerator doctrine	502
9.12.1	Procyclicality	502
9.12.2	Credit cycles I: Propagation	504
9.12.3	Credit cycles II: Amplification	509
9.12.4	Amplification with a banking sector	513

9.12.5 Additional literature	516
Appendix 9.A. Non-expected utility	521
Appendix 9.B. Economies with heterogenous agents	528
Appendix 9.C. Knightian uncertainty	534
Appendix 9.D. Credit rationing	536
References	539
10 Information and other market frictions	546
10.1 Introduction	546
10.2 Prelude: imperfect information in macroeconomics	548
10.3 Informational efficiency: roadmap	551
10.4 Walrasian equilibria as informationally inefficient outcomes	552
10.5 Rational Expectations Equilibrium	554
10.6 Noisy Rational Expectations Equilibrium	556
10.6.1 Asymmetric information: information transmission	557
10.6.2 Differential information: information aggregation	563
10.6.3 Higher order beliefs and beauty contests	566
10.7 Dealers markets: Introduction	568
10.7.1 Markets with symmetric information	569
10.7.2 With asymmetric information: bid-ask spreads	570
10.7.3 Inventory risk and bid-ask spreads	573
10.7.4 Empirical measures of liquidity	574
10.8 Markets with strategic players	575
10.8.1 The Kyle's baseline model	576
10.8.2 Markets with multiple traders and dealers	578
10.8.3 Dynamic markets	584
10.8.4 Gravitational pull problems	587
10.8.5 Mandatory disclosure	590
10.9 Limits of arbitrage and further frictions	592
10.9.1 A simple model of risky arb	593
10.9.2 Funding and early liquidation constraints	595
10.9.3 Market segmentation and bond supply shocks	599
10.9.4 Liquidity and runs	602
10.10 Over-the-counter markets	607
10.10.1 Background	607
10.10.2 Search	608
10.10.3 A model with symmetric information	608
Appendix 10.A. Projection theorem	612
Appendix 10.B. Proof of selected results	613
Appendix 10.C. Market segmentation	617
Appendix 10.D. Search	618
Appendix 10.E. Introduction to pricing behavior in macroeconomics	619
References	622

III	Asset pricing and reality	626
11	Options and volatility	627
11.1	Introduction	627
11.2	Forwards and futures	629
11.2.1	Forwards: definition and pricing in frictionless markets	629
11.2.2	Forwards as a means to borrow money, and pricing again	630
11.2.3	Marking to market	631
11.2.4	Futures	631
11.2.5	Backwardation and contango	632
11.3	Optionality and no-arb bounds	637
11.3.1	Model-free properties	637
11.3.2	Limiting behavior and arbitrage bounds	639
11.3.3	Wasting assets and convexity	640
11.3.4	Hedging	641
11.3.5	A case study: accumulators, decumulators	641
11.4	Classical evaluation and properties	643
11.4.1	A pricing formula	643
11.4.2	Black & Scholes	644
11.4.3	Future options and Black’s formula	646
11.4.4	Surprising cancellations and “preference-free” formulae	647
11.4.5	Properties of options in diffusive models	647
11.5	Stochastic volatility	650
11.5.1	Statistical models of changing volatility	650
11.5.2	Implied volatility, smiles and skews	652
11.5.3	Option pricing under stochastic volatility	657
11.6	Trading volatility with options	666
11.6.1	The need of options portfolios, and a taxonomy	666
11.6.2	Delta-neutral portfolios	668
11.6.3	Delta-hedged strategies and variance risk premiums	672
11.6.4	Perfect hedging: price-independence	676
11.7	Local volatility	678
11.7.1	Issues	678
11.7.2	Implied binomial trees	679
11.7.3	The perfect fit, in continuous time	682
11.7.4	Relations with implied volatility	683
11.8	The price of (equity) volatility	685
11.8.1	One introductory example: range-based volatility	687
11.8.2	“Fear gauge” contracts	688
11.8.3	Hedging variance swaps	692
11.8.4	Forward volatility trading	692
11.8.5	Marking to market	693
11.8.6	Stochastic interest rates	694
11.8.7	A digression on skewness	694
11.9	VIX derivatives	696
11.9.1	Model-free future pricing	696
11.9.2	A simple VIX future pricing model	698

11.9.3	Options and the volatility of volatility	699
11.9.4	Replicating variance futures	700
11.10	Endogenous volatility and market dysfunctionalities	703
11.10.1	Cyclical hedging	704
11.10.2	Crashes	705
Appendix 11.A.	The original formulation of Black & Scholes	706
Appendix 11.B.	Black (1977)	707
Appendix 11.C.	Stochastic volatility	708
Appendix 11.D.	Local volatility	711
Appendix 11.E.	Spanning, and variance contracts	713
References	716
12	Engineering of fixed income securities	720
12.1	Introduction	720
12.1.1	No-arbitrage models	721
12.1.2	Relative pricing in fixed income markets	721
12.1.3	Many evaluation paradigms	722
12.1.4	Plan of the chapter	722
12.2	Markets and interest rate conventions	723
12.2.1	Markets for interest rates	723
12.2.2	Mathematical definitions of interest rates	725
12.2.3	Yields to maturity on coupon bearing bonds	727
12.2.4	Accruals, invoice, and clean prices on coupon bearing bonds	728
12.3	Duration and convexity hedging and trading	730
12.3.1	Duration	731
12.3.2	Convexity	732
12.3.3	Asset-liability management	733
12.4	Foundational issues in interest rate modeling	740
12.4.1	Tree representation of the short-term rate	742
12.4.2	Tree pricing	746
12.4.3	Introduction to calibration	746
12.4.4	Calibrating probabilities through derivative data	759
12.4.5	Extensions to trinomial trees	766
12.5	The Ho and Lee model	766
12.5.1	The tree	767
12.5.2	Price movements and the martingale restriction	768
12.5.3	The recombining condition and interest rate volatility	769
12.5.4	Model solution	770
12.5.5	Model calibration	772
12.5.6	An example	772
12.5.7	Continuous-time approximations, with an application to barbell trading	776
12.6	Beyond Ho and Lee: Calibration through Arrow-Debreu securities	780
12.6.1	Extracting Arrow-Debreu securities from the yield curve	781
12.6.2	Two model examples	784
12.7	Callables, puttables and convertibles with trees	793
12.7.1	Definitions and rationale	793
12.7.2	Callable bonds	796

12.7.3	Convertible bonds	800
12.8	Probabilities of Fed Funds target changes	803
Appendix 12.A.	Bootstrapping and no-arbitrage restrictions	806
Appendix 12.B.	Bond Sharpe ratios	810
Appendix 12.C.	Ho & Lee representations	812
References	814
13	Interest rates	815
13.1	Introduction	815
13.2	Bond prices and interest rates	817
13.2.1	A first representation of bond prices	817
13.2.2	Forward rates	818
13.2.3	A second representation of bond prices	819
13.3	Stylized facts	820
13.3.1	The expectation hypothesis	820
13.3.2	Bond returns predictability	821
13.3.3	The yield curve and the business cycle	823
13.3.4	Additional stylized facts about the U.S. yield curve	825
13.3.5	Common factors affecting the yield curve	826
13.4	Models of the short-term rate: Introduction	829
13.4.1	Models versus representations	829
13.4.2	The bond pricing equation	830
13.4.3	Stochastic duration	834
13.4.4	Some famous models	835
13.4.5	Interest rate volatility and the business cycle	842
13.4.6	Jumps, volatility and default	846
13.5	Multifactor models of the short-term rate	852
13.5.1	Stochastic volatility	852
13.5.2	Three-factor models	856
13.5.3	Affine and quadratic term-structure models	857
13.5.4	Unspanned stochastic volatility	859
13.5.5	Topics regarding estimation and trading strategies	860
13.6	No-arbitrage models: early formulations	862
13.6.1	Fitting the yield-curve, perfectly	862
13.6.2	Ho & Lee	863
13.6.3	Hull & White	865
13.7	The Heath-Jarrow-Morton framework	865
13.7.1	Framework	865
13.7.2	The model	867
13.7.3	The dynamics of the short-term rate	867
13.7.4	Embedding	868
13.7.5	Stochastic string shocks models	869
13.8	Interest rate derivatives	872
13.8.1	Persistence and volatility in fixed income markets	872
13.8.2	Hypothetical continuous payoffs	875
13.8.3	Forward martingale probabilities	876
13.8.4	European options on bonds	877

13.8.5	Callable bonds and convexity risks	881
13.8.6	Options on fixed coupon bonds	886
13.8.7	Interest rate swaps	887
13.8.8	Caps & floors	891
13.8.9	Swaptions	892
13.9	Market models	893
13.9.1	Models and market practice	893
13.9.2	No-arb restrictions	894
13.9.3	Applications to derivatives evaluation	895
13.9.4	Multiple curves	899
13.10	Volatility surfaces	902
13.10.1	Implied volatilities	902
13.10.2	Local volatilities and SABR models	903
Appendix 13.A.	The FTAP and bond prices	906
Appendix 13.B.	Forward probabilities	908
Appendix 13.C.	Factors and components	910
Appendix 13.D.	Jumps	912
Appendix 13.E.	Exponential-affine models	915
Appendix 13.F.	Expectation theory and embedding	917
Appendix 13.G.	Strings	919
Appendix 13.H.	Changes of numéraire	920
Appendix 13.I.	Convexity risks in Gaussian markets	922
References	923
14	Risky debt and credit derivatives	928
14.1	Introduction	928
14.1.1	A brief history of credit risk and financial innovation	928
14.1.2	Plan of the chapter	931
14.2	Conceptual approaches to the evaluation of defaultable securities	932
14.2.1	Firm value, or structural, approach	932
14.2.2	The structural approach in theory: strategic defaulting	943
14.2.3	In practice: the pricing of convertible bonds	947
14.2.4	Sovereign risk	950
14.2.5	Reduced form approaches: rare events, or intensity, models	953
14.2.6	Ratings	959
14.3	Credit derivatives and structured products based thereon	963
14.3.1	Options and spreads	963
14.3.2	Credit Default Swaps	964
14.3.3	Evaluation with random intensity rates	969
14.3.4	The pricing of credit products	976
14.3.5	Collateralized Debt Obligations (CDOs)	982
14.4	Managing loan losses	995
14.4.1	Regulatory framework	996
14.4.2	Foundations of risk-management	999
14.4.3	Measures of systemic risk	1003
14.4.4	Credit risk, correlation and loss probabilities	1005
14.5	The global financial crisis of the late 2000s	1009

14.5.1	Credit bubbles, procyclicality and quantitative easing	1009
14.5.2	The 2007 subprime crisis	1011
14.5.3	Procyclicality	1016
14.5.4	Credit crunches and quantitative easing	1022
14.5.5	Where did QE go?	1025
Appendix 14.A.	Strategic defaulting	1030
Appendix 14.B.	Proof of selected results	1031
Appendix 14.C.	Transition probability matrices and pricing	1032
Appendix 14.D.	Stochastic default intensity and bond spreads	1034
Appendix 14.E.	Bond and CDS spreads	1035
Appendix 14.F.	Conditional probabilities of survival	1036
Appendix 14.G.	CDS index swaps and swaptions	1037
Appendix 14.H.	Copulae	1040
Appendix 14.I.	Pricing CDOs with imperfect correlation	1042
References	1043

Introduction

A. A brief description of the book

This book originates from a set of notes I wrote in support of graduate and advanced undergraduate lectures in financial economics, macroeconomic dynamics, financial econometrics and financial engineering. These notes have circulated for about 20 years under the title *Lectures on Financial Economics*. Unifying these notes into a coherent book was tantamount to engage into a long and patient journey into historical intellectual developments as well as the interactions of ideas and theories with actual markets behaviors. The book attempts at a “synthesis” of the state of knowledge accumulated during 70 years of initially intermittent but, later, incessant contributions to this very important field of economics.¹

Finance has the potential to oil the wheels of the real economy. While economists still debate about the benefits of finance for our society, more than a dozen of scholars researching into this field may be counted as Nobel Memorial Prize laureates in Economic Sciences. Progress was sometimes faster than any attempts at organizing our thoughts. Initially, efforts at synthesis were focussing on the mathematical structures of the pioneering work underlying the foundations of finance. Later, synthesis became more problematic as research work proliferated through such disparate domains including, among others, the evaluation of derivatives instruments, the behavior of markets over the business cycle, information problems in corporate finance and asset markets and, last but not least, the then nascent econometrics of financial markets. The initial “classics” would often cover non-overlapping spaces, as reviewed in Section C of this Introduction. We are still struggling with the creation of a comprehensive treatment of financial economics. This book is an attempt at such a treatment, an attempt at linking various theories and ideas to empirical puzzles and, sometimes, established market practice.

Financial economics relies on sophisticated methods that have already received a comprehensive textbook treatment, since at least the early classics. While this book still aims at providing foundations and methodology, it is intended as a narrative of the historic milestones in the progress of thought. Empirical puzzles have motivated the emergence of new explanations of

¹In fact, nearly one century of contributions, once we account for those portions of this book dealing with markets plagued by Knightian uncertainty (Keynes, 1921; Knight, 1921) and those market failures identified by Keynes (1936). In Section B of this Introduction, I review the early contribution of Bachelier (1900).

financial market behaviors and, then, new foundations; likewise, new theories have prompted for additional testable predictions. This virtuous interaction has led to immense knowledge that I try to account for while trying to connect various areas in a single piece. I would have liked to write a “history of financial economics,” but, as noted, I only attempt at a synthesis of as much as I can. Section B of this Introduction provides motivation and historical perspective regarding the progress of knowledge that occurred during the last many decades, and a broad outline of the book.

Writing an account on the state of knowledge in financial economics is a significant challenge. I may count more than 200 models underlying the explanations in this book. Does model uncertainty disqualify financial economics from being a science? I am writing this Introduction with a humble but decisively optimistic view, even though underlying this view is the acknowledgment that we are dealing with such a large and sometimes fragmented field, and still far from being unified. But while we cannot rely on controlled experiments as in other fields, our models lead to predictions that are typically testable through the availability of myriads of data. I hope that this book will make the reader comfortable with the idea that financial economics is progressing on a well-defined path, that the two-hundred models I discuss belong to a common paradigm and, finally, that each of these models is very important, by shedding light into specific angles of the varied and complex structure of financial markets. This project has the potential to produce a durable impact once these learning objectives are met.

B. Overview and coverage

This book aims to track the milestones achieved in the history of thought in financial economics. Its objective is to provide a comprehensive reference while attempting at organizing almost one century of work, while relying on a rigorous analytical framework and, finally, while providing methodological tools that make it self-contained. At the same time, it endeavors to help explain real phenomena and how these phenomena and, sometimes, market practice, have helped economists reformulate previous theories. Furthermore, the book includes many examples and solved problems that illustrate the main lessons conveyed by the models analyzed in the book. I don’t provide supplementary material such as solutions, answers or other material to accompany the book. The book tries to be self-contained.

While our field is very large, the present work tries to cover as much as I can, while maintaining a balance between theoretical explanations and empirical evidence and identifying the practical relevance of our knowledge. The outcome might still appear to be patchy—again, a reflection of the nature of our field, but also of my limited abilities. However, I hope that I am managing to provide the reader with a coherent treatment of many disparate aspects of financial markets, those arising in idealized explanations (be they based on abstract or empirical methodologies), those that are most relevant to the market practice and, finally, those that may be of interest to scholars working in related fields.

The book is organized in three parts: (I) Foundations, (II) Empirical lessons and market inefficiencies, and (III) Asset pricing and reality.

“*Part I: Foundations*” develops primordial tools of analysis while striving to keep track of historical backgrounds. For example, Chapter 1 deals with portfolio selection problems arising in the early 1950s and the initial theories of asset prices of the 1960s, works that are understood

to be at the origins of financial economics. The next chapters in this Part provide refinements of the initial theories, based on subsequent breakthroughs made to understand the role of asset prices in the general equilibrium of economies subject to uncertainty, in both static (Chapter 2) and dynamic settings (Chapter 3 through 5). Historically, the apex of these developments was reached with the advent of ‘continuous time finance’ and its methods occurring during the 1970s. Continuous time models would elegantly address difficult problems including no-arbitrage pricing of redundant securities (derivatives, in some cases), or portfolio choices through dynamic programming. The ‘martingale methods’ of the 1980s-1990s would seal this toolbox with additional instruments, but they also paved the way to the analysis of incomplete markets and other market imperfections. It is the ‘golden age’ of financial theory, a famous expression proposed by Darrell Duffie in his classic *Dynamic Asset Pricing Theory* (2001, p. xiii).

This Part covers details of this progress but it also provides perspective into its economic significance. The goal of this book is to understand financial market fluctuations and, sometimes, the behavior of firms subject to financial constraints, or the role that these fluctuations and behaviors play in conveying information and resources back to society. Information asymmetries and market imperfections are actually a recurrent theme in this book. Thus, Chapters 1 through 3 deal with the idealized markets leading to the initial explanations of asset prices; for example, Chapter 3 deals with financial markets while attempting at taking a broad perspective, one in which finance is part of a general ecosystem; however, our discussions in this chapter (often, not always) rely on models without frictions. In these markets, asset prices relate to consumption, production, money, and the links arise through the behavior of fully rational individuals. Next, Chapter 4 shows the beauties of continuous time finance applied to classical problems such as no-arbitrage pricing or portfolio selection (relying on dynamic programming), but also incomplete markets or the theory of irreversible investments and real options. In a real option problem, decisions are triggered when some underlying signals reach some values. For example, one may decide to exercise an American option only when the underlying asset hits some level. Likewise, a firm subject to cash constraints may decide to distribute dividends only when its reserves are sufficiently large. Finally, some investors subject to short-sell constraints may wish to sell the securities they hold only when the underlying fundamentals reach a certain threshold. These frictions are, then, dealt with in more detail in other chapters (see, e.g., the liquidity and capital structure problems analyzed in Chapters 5 and 14; or how, in Chapter 9, real option theory may help explain bubble formation in markets subject to short-sell constraints).

Chapter 5 explains some famous conceptual difficulties in defining a general equilibrium. These issues exist due to asymmetric information, and potentially lead to question the very existence of markets or the process of securities creation. Indeed, information problems have always been valuable sources of inspiration for economists. More in detail, Chapter 5 does rely on these information problems and provides the reader with an overview of theories of financial contracting and theories of capital structure. According to classical irrelevance results, capital structure does not affect the value of a firm. Why do, then, corporations issue debt or equity, i.e., financial assets that may subsequently trade on secondary markets? Or, suppose that a firm receives funds to undertake a project; shouldn’t then the same firm lose some of its initial motivation in undertaking the necessary care while handling the project? How to incentivize this firm’s manager to exert the efforts that would make his interests aligned to those of the investors? What is a firm’s dividend distribution policy in the presence of liquidity constraints? Can we understand a firm capital structure while making reference to theories of dynamic contracts? The chapter often relies on powerful tools in real option theory to illustrate theories of recursive contracts in continuous time.

Some theories are important because of their main qualitative conclusions, and it may not be needed to test for their ‘functional form’. But financial economics is also a field that lends itself so naturally to vast empirical investigations, especially in contexts in which models may predict different outcomes according to parameter values. We need to assess the statistical relevance of certain theories and, even more fundamentally, we need to estimate a model to be used by decision makers, be they policy makers or private investors. Chapter 6 deals with theories and methods of statistical inference needed to deal with models arising in financial economics, relying on classical econometric tools such as maximum likelihood, methods of moments, and the relatively more modern simulation-based inference methods.

The purpose of “*Part II: Empirical lessons and market inefficiencies*” is to explain the main empirical facts and the challenges that these facts pose to financial economists. The first puzzles regard excess price volatility, that is, the difficulty of the early dynamic models to explain aggregate market behavior. According to the early models, market volatility (and the premium required by investors to invest in a volatile environment) is one order of magnitude less than that we observe in the markets. Chapter 7 is an introduction to these critical problems and in particular to their measurement methods. These methods were developed mainly during the 1980s-1990s and, in part, the 2000s, and are obviously statistical in nature. At the same time, they rely on the principle of no-arbitrage: there are many ways we can price assets while only requiring absence of arbitrage; however, there is a benchmark amongst these ways, solely relying on securities market data, which can be used to assess whether a model under scrutiny implies implausible parameter values (such as, say, the investors’ risk appetite).

To address the volatility puzzles, financial economists added explanations of financial market behavior based on a variety of assumptions: investors’ attitude to risk-taking (e.g., non-expected utility, or habit formation), idiosyncratic risk, incomplete markets or restricted market participation, heterogeneous beliefs, learning in contexts with incomplete information, a fully specified production sector, or Knightian uncertainty. This progress was based on the foundational work made during the ‘golden age’ of financial theory described in Part I. It occurred in the 2000s-2010s and is described in Chapters 8 and 9. Interestingly, these new models address relatively older issues; for example, they predict that, under conditions, the aggregate equity premium and stock market volatility are both countercyclical, a fact known from earlier empirical research. But while these models were developed, financial economists also realized that they could explain additional ‘cross-sectional anomalies’ such as the value premium (the tendency for firms with low multiples to perform better in the future than those with high), or the hoary issue of predictability (the tendency of the market to reverse its trends after a while, maybe in tandem with the business cycle).

A common trait of these models is their adoption of the ‘separation hypothesis’, that is, the assumption that the real economy is not affected by financial market developments. Perhaps due to the dramatic counterfactual evidence brought about by the Great Recession of the late 2000s, a new research agenda relaxed this assumption, aiming to revitalize previous work made by macroeconomists on ‘financial accelerator’ mechanisms—the power of financial markets to exacerbate business cycles. Integrating financial markets into the real sphere of the economy is the explicit intellectual acknowledgment of the crucial role that financial markets (frictions) play in society. Chapter 9 contains many links to this literature, and these links form the basis for additional discussions in various junctures of Part III.

Chapter 10 concludes this Part while pointing to other famous puzzles and frictions. Do financial markets provide useful information? How deep ‘price discovery’ is, that is, how well

asset prices reflect the fundamentals in a world with heterogenous information? This chapter begins with the classical analysis of markets plagued with information problems. Investors obviously have different pieces of information, and some of them are even known to possess superior information. A ‘lemons problem’ arises: what are the incentives to trade with better informed investors? One answer is that trading may only arise when markets are somehow (informationally) inefficient: when information is not available symmetrically in the marketplace, we can only trade once we know that our would-be trading counterparty is not necessarily better informed than us. One implication of this reasoning is that agents with less information would never be able to reverse-engineer the information of better informed traders from the price; but this inefficiency (a price that is only partially revealing) may actually be what makes markets function.

For longtime, this price inefficiency has been modeled as a result of the presence of exogenous liquidity shocks. In fact, liquidity and information problems have long been understood as the two sides of the same coin. But liquidity is not only information, and this chapter describes alternative explanations for it. Remarkably, these information and related problems were tackled while, at the same time, economists were in the process of developing market microstructure theory, i.e., the theory of price formation in trading venues relatively more realistic than those hypothesized during the golden age. However, financial markets and trading venues can be even much more complex than the literature had initially hypothesized: Chapter 10 explains that the presence of irrational traders, information networks, limits of arbitrage, segmented markets, or decentralized trading systems (e.g., over-the-counter markets), were all exciting topics of research from the 1990s through the 2010s, which still promise to improve our understanding of such a complex phenomenon as the price formation process. Chapter 10 also contains surveys of topics regarding coordination failures and higher-order beliefs in financial markets. Why do bank crises arise? What are the determinants of a bank-run? What makes agents coordinate to equilibrium outcomes where prices can deviate from fundamentals, as in the famous beauty contests introduced by John Maynard Keynes in his *General Theory of Employment, Interest and Money* (1936, chapter 12)? Remember, in these contests, the winners are those who pick up the most popular faces from many photographs, and are thus incentivized to forecast the forecasts of others, where everyone is doing the same thing. How do higher order beliefs affect price dynamics?

“*Part III: Asset pricing and reality*” aims to bring to fruition the lessons drawn from Part II and cope (through the main analytical tools in Part I) with the main challenges posed by actual financial markets, such as those arising from option pricing and trading, interest rate modeling, or credit risk and the associated derivatives. In a sense, Part II is about the big puzzles we face in fundamental research, while Part III is about how to live within our current and certainly unsatisfactory paradigms, so as to cope with demand for intellectual expertise.

The importance of these topics can never be emphasized enough. Investments or business cycles are clouded with uncertainty. While investing, decision makers put their jobs and the security of their families at risk, thereby affecting human capital accumulation and, hence, the life of future generations. Sometimes, the effects of poorly informed choices can be devastating. The 2007-subprime crisis and the subsequent Great Recession certainly illustrate these mechanisms. In general, financial market volatility is huge, for one reason or another, illustrated by the theories and facts in Part II. It is, thus, a naturally human response to try and find a solution to cope with these risks.

Derivative securities are instruments to insure against risks related to certain investment decisions. As is well known, they are called ‘derivatives’ because their value is drawn from that of other securities. For example, if we are long a number of shares, we may wish to purchase put options on these shares (or on a dedicated index of them), which pay off when the shares’ value is down; intuitively, then, the price of these options decreases with the price of the underlying securities. Louis Bachelier’s *Théorie de la spéculation* in 1900 is the first attempt at tackling these evaluation problems—problems that were tackled again during the golden age, based on no-arbitrage principles.

At the heart of this principle lie different assumptions, and one of them dictates that the underlying securities (or, in general, risks) should be well understood by all market participants. For example, the shares underlying the previous options should be traded in reasonably liquid markets, a condition for price discovery. It is most likely the case with many derivative securities such as the equity index options or the U.S. Treasury derivatives that are traded in well functioning Exchanges, but also with a variety of derivatives traded in over-the-counter markets (e.g., interest rate swaps or credit related products). However, if risks are poorly understood and price discovery is scarce, derivatives may be mispriced. A case of ‘toxicity’ may then arise: investors may inadvertently add too high doses of complex derivatives in their portfolios than justified by their risk-return trade-off profile. Unfortunately, financial history shows many cases of toxicity. The last chapter of Part III examines some details of one of them, related to the process of securitization of very risky mortgages.

Engineering can be defined as a set of processes and methods that attempt to use established scientific knowledge to solve practical problems, as with the case of steam engines utilized during the first Industrial Revolution. In fact, if it wasn’t for the previous mishaps, it would have been very tempting to title this Part “*Financial engineering.*” Instead, “Asset pricing and reality” reminds us that while our engines do certainly rely on scientific and rigorous knowledge, this knowledge seems to be more limited than in the domains of the physical sciences. It does not mean that financial economists are not in the process of building up financial engineering. Nor does it mean that financial innovation is unnecessary or toxic. We shall learn throughout the whole book that financial innovation may allow for risk-sharing (the transfer of some risks from those who are not willing to bear them to those who are) when the pre-existing markets are not diverse enough (i.e., incomplete). In fact, and interestingly, financial economists not only are inspired by the events they see (as with the previous revival of the financial accelerator hypothesis motivated by the Great Recession); sometimes, they lead to institutional changes: option markets would most probably not exist today without the golden age revolution of the 1970s.

Yet our most successful inventions regard risks that can at least be identified. Some of these inventions attract liquidity, which, in turn, generates price discovery and, then, liquidity again, over a virtuous circle. Liquidity begets liquidity: a product is more likely to trade if a trader knows he could easily trade it when, in the future, he will decide to get out from his current trade. Financial products are a little bit like a fax machine was at the time of its introduction: they are worth because others are willing to use them. Potential market makers and financial economists alike (see Chapter 10) are well aware of this chicken-and-egg problem: coordination may fail even when risks are well identified. The exposition in this Part is affected by a sort of survivorship bias: it regards products, trading methods and processes that have been successful. The exception is the description of credit related products at the epicenter of the 2007-2009 crisis.

Chapter 11 illustrates well the scope of Part III: while Part II describes theories and facts regarding asset market volatility, this chapter analyzes ways to trade it in the equity space. The technicalities can be actually complex: we have realized volatility, stochastic volatility, implied volatility and volatility surfaces, implied binomial trees and local volatility. Some models can be useful to buy-side institutions; others to sell-side firms engaged into pure intermediation activities. Furthermore, some unexpected developments occurred in financial theory during the 1990s-2000s, which gave rise to financial innovations regarding the way volatility is traded. It is another episode of financial history when theory had preceded market practice.

Chapter 12 and Chapter 13 repeat these analyses in the much more complex field that is fixed income. Fixed income securities are complex due to theoretical reasons (they track the time value of money), technical reasons (they have multiple dimensions, such as expiration or tenors of the various contracts) and, last but not least, because price discovery in these markets may be somehow hindered by their trading mechanisms (over-the-counter markets). Yet fixed income securities allow pension funds and other asset managers to mitigate interest rate risk, which can be much, much higher than that in equity markets. Interest rates have also very interesting business cycle properties, which policy-makers rely on while trying to predict the business cycle: for this reason, Chapter 13 also contains some links to fascinating topics arising in macroeconomics. Finally, Chapter 14 deals with the evaluation of debt subject to default risk and derivatives based thereon. It is a chapter focussed on practical aspects, with the exception of a few junctures devoted to the analysis of strategic default (by both firms and governments) or the origins of the 2007-subprime crisis.

Engineering can be civil or electronic engineering, amongst many others. Likewise, a would-be “financial engineering” field should not be only about derivatives. For example, it should also deal with such issues as portfolio optimization in contexts with short-sale constraints, time-varying volatility (ARCH models, for example), Bayesian learning, and also with variance shrinkage methods. In general, this field should be a chameleon, just as it happens in the physical sciences: it should take the colors of the specific set of problems that is helping to address, in order to facilitate financial transactions, information processes (including, for instance, the design of volatility indexes with data stemming out from over-the-counter markets) and methods both in the buy-side and sell-side worlds. Some of these topics are covered throughout the book although their systematic treatment goes well beyond the scope of this work.

C. Discussion of related work

Financial economics has evolved while crossing a variety of boundaries. How did we track this progress? Ingersoll (1987), Huang and Litzenberger (1988) and Duffie (2001) are the first classics organizing more than thirty years of conceptual analysis, while O’Hara (1995) is the first classic organizing the theories of the 1980s on liquidity and market microstructure.

These works led to a sophisticated and consistent framework at the basis of subsequent progress, progress that occurred mostly in response to empirical challenges faced by the initial analyses; for example, during the mid 1990s and the early 2000s, new models were proposed to explain how aggregate market behavior links to the business cycle. Cochrane (2005), Back (2010) and Campbell (2017) provided further momentum to standardization of knowledge, teaching how part of this progress relates to the initial analyses. The early work of Campbell, Lo and MacKinlay (1997) offered a quite exhaustive overview of many statistical instruments that

are still of paramount importance in the empirical modeling or statistical testing of financial markets phenomena.

Foucault, Pagano and Röell (2013) summarized further progress related to studies of market liquidity and microstructure. During the 2000s, Amaro de Matos (2001) and Tirole (2006) provided us with the first attempts at organizing knowledge acquired in the theory of corporate finance, while during the 1990s, Freixas and Rochet (1997) had already written a classic in the theory of banking. In the references section of this Introduction, I list additional references on works that attempt at organizing knowledge in financial economics.

I like to represent this book as being complementary to these very important works. The added value of mine is to provide general perspective into a large variety of topics, as well as details of the historical progress leading to our current understanding of each of these topics.

To illustrate, the Handbooks of the Economics of Finance (Constantinides, Harris and Stultz, 2003, 2013) currently undertake the ambitious task of dealing with many disparate topics arising in financial economics. However, these works are contributed by several authors and they are only partially coordinated. This book provides explicit linkages across chapters, which may help a reader interested in learning or reviewing several topics while accessing to a common language. For example, the book may be used as a reference in several courses in advanced training programs: adopting this book for a single course (e.g., a course in macro-finance) should allow the reader to access material for related courses (one in financial markets with frictions, say) while relying on a style that he or she is already familiar with. But the most remarkable feature of the efforts I have tried to accomplish in this book is the ambition to cover a wide range of topics, the milestones in the history of thought in this field, while maintaining a balance across theory, empirical evidence, historical contexts and, also, market practice. As explained, in the references section of this Introduction, I would like to bring a few additional textbook treatments of the field to the reader's attention, noting that these represent my own preferred readings, and apologizing with all omitted authors.

D. Audience and pre-requisites

The main audience for this book will be academics studying, teaching and researching in financial economics. The book also aims to appeal to applied researchers and other professionals servicing investment banks, institutional investors, central banks and governments. The inclusion of policy makers as part of the audience for this book is motivated by the widespread acknowledgment of the many interconnections between financial markets and the macroeconomy. Macro-financial linkages arising through the business cycle (or, say, market liquidity, microstructure and volatility) are themes that have motivated important work by financial economists; this work is very useful reading for those engaged in designing supervisory standards and macro-prudential policies. The main audience for this book will be financial economists, though. I shall return to additional factors explaining potential audience in Section E below.

The style of the book is eminently academic. It is primarily quantitative, even while, on many occasions, the book provides descriptions of markets and historical contexts. But appreciating this book in its entirety relies on a predisposition to quantitative reasoning. At the same time, quantitative reasoning is the means, not the goal of this work. Thus, in general, appreciating this book also requires to be genuinely passionate about economics. Finally, the book is suitable to both theorists and empiricists or fellows searching for concrete applications. Applied researchers will have access to a clear theoretical background needed prior to undertaking meaningful

empirical research. Theorists will learn the nature of the empirical regularities and puzzles that have characterized our field since its very beginnings, knowledge that is indispensable prior to undertaking meaningful theoretical research.

Reading the book requires knowledge of economics and mathematics at a level required from a candidate to a Master of Science in Finance and Economics at the London School of Economics or to a PhD in Finance at the Swiss Finance Institute, two programs where I delivered many of the lectures inspiring this work. I also believe that the book may be accessed by a well-motivated student enrolled into a program such as, say, a Bachelor of Science in Economics and Statistics at University College London. Therefore, reading this book requires maturity in both microeconomics and macroeconomics at the level of Varian (1992) and Blanchard (2017) textbooks, respectively. Moreover, some readers might already have gained motivation for finance while exposed to introductory finance textbooks such as Berk and DeMarzo (2016) and Bodie, Kane and Marcus (2014). Additional pre-requisites include knowledge of calculus, basic knowledge of time series and statistics, and an introductory exposure to stochastic calculus. Many technicalities are introduced and explained in appropriate junctures of the book, along with references to more advanced material.

E. Usage of the book

The reader of this book is a scholar in financial economics, a market practitioner, a policymaker, or a scholar in related fields such as macroeconomics.

A scholar in financial economics may (i) recommend this book to a specialized readership for a survey of work linked to his or her research articles; (ii) recommend portions of the book to advanced graduate or PhD classes as complements to his or her lecture notes; and, finally, (iii) value a book that attempts at a synthesis: for example, reading this book may help a young scholar develop a critical view of our current understanding of financial markets, thereby stimulating further and hopefully important research.

A market practitioner or a policy maker with an appropriate background (see Section D) may find a source of valuable information in this book. For example, certain parts of the book (Part III as well as some chapters in Part II) may provide a quantitative strategist or a risk manager with guidance on elaborating, estimating and implementing models for signal generation. Even more important, the book may help gain intellectual perspective into the many details that arise in market or policy practice.

Finally, a reader of this book may be a scholar in other fields. For example, a macroeconomist might be interested in financial economics from a broad and still rigorous perspective; this book may help shed light into his or her own research and, perhaps, motivate to recommend portions of it to his or her PhD classes. For example, some financial economists grew up by learning from some of the classics described in Section C of this Introduction, while at the same time reading the beautiful *Lectures on Macroeconomics* of Blanchard and Fischer (1989), which helped shape some research into macro-finance. Similarly, one objective of this book is to attract the attention of scholars in other fields. Oftentimes did scholars in other fields make “excursions” into financial economics and provide marvelous contributions, e.g., on the role of information in securities markets, idiosyncratic risk or financial accelerator mechanisms. I hope that the general perspective I endeavor to follow in this book may attract scholars from other fields and help render such excursions more frequent.

The book contains material that may be accessed to while learning about a number of topics, and/or be used as a reference for a number of courses, such as:

- Foundations of portfolio selection (Chapter 1)
- Foundations of financial economics (selected portions of Chapters 2, 3, 4, 5 and 10)
- Introduction to quantitative methods in finance (selected portions of Chapters 3; Chapter 4)
- Statistical methods of financial model validation (Chapters 6 and 7)
- Financial markets and the macroeconomy (Chapters 8 and 9)
- Information and financial markets (Chapters 5 and 10)
- Financial markets, debt and frictions (Chapters 5, 10 and 14)
- Option pricing and volatility trading (Chapter 11)
- Fixed income markets and derivatives (Chapters 12 and 13)
- Credit markets and derivatives (Chapter 14)
- Derivatives and financial engineering (selected portions of Chapters 11 through 14)

The chapters indicated in parenthesis contain the relevant material for the suggested courses, which I have indeed experimented during the last 20 years or so.

F. Acknowledgments and disclaimers

I thank three anonymous reviewers of MIT Press for their invaluable comments and Emily Taber for her enthusiasm and patience on this project. Special words of gratitude go to Christian Di Marco, Andrey Pankratov, Gianpaolo Parise, Alessio Ruzza and Federico Severino for their excellent research assistance while in Lugano. Finally, I thank the Swiss National Science Foundation for research support. It goes without saying that I retain full responsibility for omissions and mistakes. However, I am not able to accept liabilities for any losses related to the use of models, data, and methods described or developed in this book.

Antonio Mele

September 2020

References

- [1] Amaro de Matos, J. (2001): *Theoretical Foundations of Corporate Finance*. Princeton: Princeton University Press.
- [2] Bachelier, L. (1900): “Théorie de la spéculation.” *Annales Scientifiques de l’École Normale Supérieure* 3 (17), 21-86.
- [3] Back, K. (2010): *Asset Pricing and Portfolio Choice*. Oxford: Oxford University Press.
- [4] Berk, J. and P. DeMarzo (2016): *Corporate Finance*. Boston: Pearson Education.
- [5] Bodie, Z., A. Kane and A.J. Marcus (2014): *Investments*. Berkshire, U.K.: McGraw-Hill Education.
- [6] Blanchard, O. (2017): *Macroeconomics*. Boston: Pearson Education.
- [7] Blanchard, O. and S. Fisher (1989): *Lectures on Macroeconomics*. Cambridge: MIT Press.
- [8] Campbell, J.Y., A. W. Lo and C. MacKinlay (1997): *The Econometrics of Financial Markets*. Princeton: Princeton University Press.
- [9] Campbell, J. (2017): *Financial Decisions and Markets: A Course in Asset Pricing*. Princeton: Princeton University Press (forthcoming).
- [10] Cochrane, J. (2005): *Asset Pricing*. Princeton: Princeton University Press.
- [11] Constantinides, G.M., M. Harris and R. Stultz (2003): *Handbooks of the Economics of Finance* (Volume 1). Amsterdam: Elsevier.
- [12] Constantinides, G.M., M. Harris and R. Stultz (2013): *Handbooks of the Economics of Finance* (Volume 2). Amsterdam: Elsevier.
- [13] Duffie, D. (2001): *Dynamic Asset Pricing Theory*. Princeton: Princeton University Press.
- [14] Foucault T., M. Pagano and A. Röell (2013): *Market Liquidity: Theory, Evidence and Policy*. Oxford: Oxford University Press.
- [15] Freixas, X. and J-Ch. Rochet (1997): *Microeconomics of Banking*. Cambridge: MIT Press.
- [16] Huang, C-f. and R.H. Litzenberger (1988): *Foundations for Financial Economics*. New York: North-Holland.
- [17] Ingersoll, J.E. (1987): *Theory of Financial Decision Making*. New York: Rowman & Littlefield Publishers.
- [18] Keynes, J.M. (1921): *A Treatise on Probability*. London: MacMillan and Co.
- [19] Keynes, J.M. (1936): *The General Theory of Employment, Interest and Money*. London: Palgrave Macmillan.
- [20] Knight, F.H. (1921): *Risk, Uncertainty, and Profit*. New York: Houghton Mifflin.
- [21] O’Hara, M. (1995): *Market Microstructure Theory*. Cambridge: Blackwell Publishers.
- [22] Tirole, J. (2006): *The Theory of Corporate Finance*. Princeton: Princeton University Press.
- [23] Varian, H. (1992): *Microeconomic Analysis*. New York: W.W. Norton & Company.

Further readings

Generic references

- [24] LeRoy, S.F. and J. Werner (2014): *Principles of Financial Economics*. Cambridge: Cambridge University Press.
- [25] Lengwiler, Y. (2014): *Microfoundations of Financial Economics*. Princeton: Princeton University Press.
- [26] Munk, C. (2013): *Financial Asset Pricing Theory*. Oxford: Oxford University Press.
- [27] Pennacchi, G. (2008): *Theory of Asset Pricing*. Boston: Pearson Addison Wesley.

Financial markets and the macroeconomy

- [28] Altug, S. and P. Labadie (2008): *Asset Pricing for Dynamic Economies*. Cambridge: Cambridge University Press.
- [29] Hansen, L.P. and T.J. Sargent (2008): *Robustness*. Princeton: Princeton University Press.

Information and other market frictions

- [30] Allen, F. and D. Gale (2007): *Understanding Financial Crises*. Oxford: Oxford University Press.
- [31] Bianconi, M. (2003): *Financial Economics, Risk and Information*. Singapore: World Scientific Publishing.
- [32] Brunnermeier, M.K. (2001): *Asset Pricing under Asymmetric Information*. Oxford: Oxford University Press.
- [33] Duffie, D. (2012): *Dark Markets*. Princeton: Princeton University Press.
- [34] Schleifer, A. (2000): *Inefficient Markets*. Oxford: Oxford University Press.
- [35] Shin, H.S. (2010): *Risk and Liquidity*. Oxford: Oxford University Press.
- [36] Vives, X. (2008): *Information and Learning in Markets*. Princeton: Princeton University Press.

Derivatives

- [37] Brigo, D. and F. Mercurio (2006): *Interest Rate Models: Theory and Practice*. New York: Springer Verlag.
- [38] Derman, E. and M.B. Miller (2016): *The Volatility Smile*. Hoboken, NJ: John Wiley & Sons.
- [39] Duffie, D. and K.J. Singleton (2003): *Credit Risk*. Princeton: Princeton University Press.
- [40] Lando, D. (2004): *Credit Risk Modeling*. Princeton: Princeton University Press.
- [41] McDonald, R.L. (2006): *Derivatives Markets*. Boston: Pearson Addison Wesley.
- [42] Veronesi, P. (2010): *Fixed Income Securities*. Hoboken, NJ: John Wiley & Sons.