

# Table of contents

<b>Introduction</b>	<b>1</b>
<b>1 Financial markets</b>	<b>5</b>
1.1 Introduction	5
1.2 Markets, investors, contracts, management, and assets: an introduction	6
1.3 Financial instruments	10
1.3.1 Bonds	10
1.3.2 Stocks	11
1.3.3 Asset classes	12
1.3.4 Public and private assets	14
1.3.5 Corporate governance as an infrastructure for protecting financiers	16
1.4 Financial markets	17
1.4.1 Public firms	17
1.4.2 Primary and secondary markets	19
1.4.3 The cost and benefit of listing in stock markets	19
1.5 Uses and misuses of markets	20
1.5.1 What are financial markets used for?	20
1.5.2 Markets, business objectives, and investors	21
1.5.3 Critical issues in the use of markets	22
1.6 Collective investment vehicles	23
1.6.1 Mutual funds/UCITS	23
1.6.2 Exchange traded funds	26
<b>2 Asset returns</b>	<b>29</b>
2.1 Introduction	29
2.2 The rate of return	29
2.2.1 Arithmetic returns	29
2.2.2 Logarithmic returns	31
2.3 Measuring risk in financial portfolios	32
2.3.1 The rate of return as a random variable	32
2.3.2 The probability function	32
2.3.3 Relevant intervals in the normal distribution	35

2.4	Unconditional probability distributions	37
2.4.1	The unconditional expected return and volatility	37
2.4.2	Skewness and kurtosis	38
2.4.3	The limits of normality	40
2.5	Long-run average excess returns	42
2.5.1	Indices	42
2.5.2	Empirical evidence	43
2.5.3	Compounded growth	46
2.5.4	Biases in stock indices	46
2.5.5	Interpretation of stock indices returns	47
2.5.6	Asymmetry in the distribution of returns	48
2.6	Conditional probability distributions	49
2.6.1	The conditional expectation	49
2.6.2	The conditional expectation of the rate of return	50
2.6.3	Computing the conditional mean: an example	53
2.6.4	Actual return, expected return, and shock	54
2.7	Value at Risk	55
2.7.1	What is the maximum potential loss?	55
2.7.2	What is VaR?	56
2.7.3	Computing VaR from volatility	57
2.7.4	The sensitivity of VaR to parameters	58
2.8	Estimating volatility	60
2.8.1	The VIX index	60
2.8.2	Conditional variance computation	61
2.8.3	The variance dynamics: an equivalent description	62
2.8.4	Unconditional non-normality and conditional variance	64
2.8.5	Evaluating the performance of a VaR model	64
<b>3</b>	<b>Rational financial choices and the utility function</b>	<b>71</b>
3.1	Introduction	71
3.2	Risk and uncertainty	72
3.3	The utility function	73
3.3.1	Expected utility	73
3.3.2	Utility functions and risk aversion	76
3.3.3	The CRRA utility function	77
3.3	The mean/variance utility function	79
3.3.1	Preferences over mean and variance	79
3.3.2	The indifference curve	82
3.4	The risk premium	85
3.5	Estimating risk aversion	86
3.5.1	Estimating risk aversion from surveys	86
3.5.2	Psychology, neuroscience and risk aversion	88

<b>4</b>	<b>Behavioral finance</b>	<b>93</b>
4.1	Introduction	93
4.2	Behavioral finance	94
4.3	Examples of behavioral finance theories	96
4.3.1	Thinking, fast and slow	96
4.3.2	Heuristics (rules of thumb)	97
4.3.3	Loss avoidance	100
4.4	Human behavior and undesirable outcomes	104
4.4.1	Behavioral biases	105
4.4.2	Emotional biases	108
4.5	Typical mistakes in financial choice	111
4.5.1	Underinvesting in stocks	111
4.5.2	Excessive trading	112
4.5.3	Insufficient diversification	114
4.6	Solutions	114
4.6.1	Policy solutions	114
4.6.2	Financial education	115
<b>5</b>	<b>Sovereign bonds</b>	<b>119</b>
5.1	Introduction	119
5.2	Bond price in secondary markets	119
5.2.1	Compound interest and present value	119
5.2.2	Invoice price and flat price	120
5.2.3	Price determination	121
5.2.4	The relationship between price and interest rate	122
5.2.5	The holding period return	123
5.2.6	The yield to maturity	126
5.3	The term structure of interest rates	127
5.3.1	The spot rate: definition	127
5.3.2	The term structure and bond pricing	127
5.3.3	The term structure of interest rates	128
5.3.4	The forward rate	131
5.4	Why does the term structure move over time?	132
5.4.1	The expectations theory of interest rates	132
5.4.2	Segmentation theory	133
5.4.3	The predictive power of the term structure	134
<b>6</b>	<b>Risk and management of bond portfolios</b>	<b>141</b>
6.1	Introduction	141
6.2	Duration	141
6.2.1	Definition	141
6.2.2	Duration and maturity	142
6.2.3	Duration and rate risk	143
6.2.4	Convexity	144

6.3	Immunization	145
6.3.1	Duration, reinvestment risk, and price risk	145
6.3.2	Immunization	146
6.4	Corporate bonds	149
6.4.1	General features	149
6.4.2	Credit ratings	151
6.4.3	Probability of default and loss given default	151
6.4.4	Corporate bond returns	153
6.4.5	Corporate bond risk measurement	154
<b>7</b>	<b>The expected return/risk trade-off and the benefits of diversification</b>	<b>159</b>
7.1	Introduction	159
7.2	From individual assets to the portfolio	160
7.2.1	Portfolio return	160
7.2.2	Expected return and volatility with a risky and a risk-free asset	160
7.3	The capital allocation line	162
7.3.1	The relationship between expected return and risk	162
7.3.2	Leverage	164
7.4	The benefits of diversification	166
7.4.1	Two risky assets	166
7.4.2	The risk/reward trade-off for extreme values of the correlation coefficient	168
7.4.3	The general case for a two-risky-asset portfolio	170
7.4.4	Currency risk	173
7.5	The risk-free asset and two risky securities	174
<b>8</b>	<b>The efficient frontier and the optimal portfolio</b>	<b>185</b>
8.1	Introduction	185
8.2	Equally balanced portfolio	186
8.3	The Markowitz model	188
8.3.1	Portfolio optimization	188
8.3.2	Notation	188
8.3.3	Efficiency without a risk-free asset	189
8.3.4	Efficiency with a risk-free asset	192
8.4	The Markowitz model and investors' portfolios	198
8.4.1	The capital allocation line and the two-fund separation theorem	198
8.4.2	Qualitative investment implications	199
8.4.3	Choosing the optimal portfolio: graphical solution	200
8.4.4	Choosing the optimal portfolio: analytical solution	201
8.4.5	Reverse engineering the optimal portfolio solution	202
8.4.6	The Markowitz model and the democratization of finance	202
8.5	Wealth management: liabilities, time diversification, and non-traded assets	204

8.5.1	A general approach to hedging liabilities	204
8.5.2	Time diversification	206
8.5.3	Non-traded assets: the case of human capital	208
8.6	Asset management and the practice of portfolio optimization	209
8.6.1	Asset allocation terminology and benchmarks	209
8.6.2	Parameter estimation	210
8.6.3	Non-negativity constraints	211
<b>9</b>	<b>The capital asset pricing model</b>	<b>217</b>
9.1	Introduction	217
9.2	An asset marginal contribution to portfolio risk	217
9.3	The CAPM	221
9.3.1	Introduction: the Markowitz relation between risk and expected return	221
9.3.2	The equilibrium interpretation of the Markowitz relation between risk and expected return	222
9.3.3	The CAPM pricing equation	224
9.4	The index model	225
9.4.1	The index model and alpha	225
9.4.2	The index model and risk	226
9.5	Econometric testing of the CAPM	229
9.5.1	The index model and CAPM testing	229
9.5.2	CAPM testing: graphical analysis	229
9.5.3	CAPM testing: econometric analysis	231
9.5.4	Increasing the power of the test	233
<b>10</b>	<b>Picking stocks and investing with style</b>	<b>239</b>
10.1	Introduction	239
10.2	Alpha and small portfolios	240
10.2.1	Alphas	240
10.2.2	Undiversified alpha portfolios	240
10.3	Optimal selection of an active portfolio: the model by Treynor and Black	242
10.4	Long-short diversified portfolios	245
10.4.1	Searching for alpha	245
10.4.2	Building long-short portfolios	245
10.5	The most relevant anomalies/portfolio strategies	246
10.5.1	The size premium	246
10.5.2	The value premium	248
10.5.3	The momentum premium	249
10.5.4	The carry premium	250
10.5.5	The low-risk premium	251
10.5.6	The quality premium	252

10.5.7 Other anomalies	253
10.6 Why are there anomalies?	254
10.6.1 Rational risk premia	254
10.6.2 Behavioral errors	255
10.6.3 Agency issues	255
10.6.4 Lack of information	256
10.6.5 Inappropriate statistical methodologies	256
10.6.6 Transaction costs neglect	257
10.6.7 Leverage	257
10.7 Investment implications	258
10.7.1 Using anomalies	258
10.7.2 Hedge funds	259
<b>11 Theory and practice of multifactor models</b>	<b>263</b>
11.1 Introduction	263
11.2 The multifactor model and arbitrage	263
11.2.1 The multifactor model	264
11.2.2 Arbitrage and the pricing equation	264
11.2.3 Arbitrage with equal betas	265
11.2.4 Arbitrage with different betas	267
11.2.5 The APT pricing equation	268
11.2.6 Pricing individual stocks	269
11.3 Factor identification	270
11.3.1 Macroeconomic factors	270
11.3.2 Factor replicating portfolios	271
11.3.3 The Fama–French model	272
11.4 Application of the Fama–French model	274
11.4.1 Liquidity risk	274
11.4.2 Pricing in international markets	275
11.5 Performance evaluation	277
11.5.1 Introduction to performance evaluation	277
11.5.2 The index model and the CAPM	277
11.5.3 Performance evaluation and the Fama–French model	278
11.5.4 Evidence	279
<b>12 Prices and values</b>	<b>285</b>
12.1 Introduction	285
12.2 Valuation and infinite horizon	286
12.2.1 Value with a one-period horizon	286
12.2.2 Value with an infinite horizon	287
12.3 Gordon’s model	288
12.3.1 Simplifying assumptions	288
12.3.2 Growth and earnings reinvestment	289

12.3.3	How much are growth opportunities worth?	291
12.4	The multi-phase model	291
12.5	Applications	293
12.5.1	The price–earnings ratio	293
12.5.2	The book-to-price ratio	295
12.5.3	Market value and expected return	296
12.5.4	The price-to-earnings ratio and expected return	297
12.6	Speculative bubbles	298
12.7	Fundamentals and unexpected returns	299
<b>13</b>	<b>Market efficiency</b>	<b>305</b>
13.1	Introduction	305
13.2	The definition of an efficient market	306
13.2.1	Characteristics of market efficiency	306
13.2.2	Why efficiency is important	306
13.2.3	Brief remarks on information efficiency	307
13.3	Efficiency tests	308
13.4	Valuation efficiency and return variance	308
13.4.1	Excess volatility	308
13.4.2	Asset pricing and consumption	310
13.5	Valuation efficiency and predictability of returns	311
13.5.1	Predictive regressions	311
13.5.2	Predictive regressions and market efficiency with a constant risk premium	312
13.5.3	The random walk	312
13.5.4	Predictability, efficiency, and time-varying risk premium	313
13.5.5	Prediction and alternative data	314
13.6	Valuation efficiency and price reactions	315
13.6.1	News and prices	315
13.6.2	Event studies	315
13.7	The equity premium	317
13.7.1	The equity premium and the mean/variance utility function	317
13.7.2	The equity premium and covariance with consumption	318
13.7.3	The equity premium puzzle	320
13.8	Psychological drivers of market prices	324
13.9	Risky arbitrage	326
<b>14</b>	<b>Private assets</b>	<b>329</b>
14.1	Introduction	329
14.2	Private assets	330
14.3	Private equity	331
14.4	Private debt	333
14.4.1	Private debt and business development companies	333
14.4.2	Why private debt	335
14.5	Real estate	336

14.5.1	How to invest in real estate	336
14.5.2	Indirect investment in real estate stocks	336
14.5.3	Funds and investment in real estate	337
14.6	Art	338
14.6.1	Art as an alternative asset	338
14.6.2	Investing in art	339
14.7	Performance evaluation of private assets	340
14.7.1	The internal rate of return	340
14.7.2	Other performance indicators	343
14.7.3	Value creation in private equity funds	344
14.8	Private market price indices	345
14.8.1	Why is it difficult to measure the performance of private markets?	345
14.8.2	Unsmoothing	345
14.8.3	Hedonic prices	346
14.8.4	Prices obtained from repeat sales	349
14.8.5	Long-term average returns for real estate	350
14.8.6	Long-term average returns for art investing	351
14.9	Alternative assets	352
14.9.1	Real estate and optimization	352
14.9.2	Does CAPM explain the expected return from real estate?	354
14.9.3	Real estate and optimization	355
<b>15</b>	<b>Sustainability and ESG investing</b>	<b>359</b>
15.1	Introduction	359
15.2	What is sustainability?	360
15.2.1	Sustainable development	360
15.2.2	Accounting for environmental and social goods and services	361
15.2.3	Challenges in accounting for environmental and social goods and services	362
15.3	CSR, ESG investing, and sustainability	363
15.3.1	CSR	363
15.3.2	SRI/ESG investing	364
15.3.3	Measurement and ratings	366
15.4	ESG investing, portfolio choice and risk premia	367
15.4.1	Preferences for ESG factors	367
15.4.2	ESG factors, asset demand, and risk premia	368
15.4.3	Expected returns, volatilities, and ESG factors	370
15.5	Finance and climate change	371
15.5.1	Climate change and financial risk	371
15.5.2	Climate change and risk premia	372
15.5.3	Climate change and real estate	374
	<b>Bibliography</b>	<b>377</b>