

Econometrics of Financial Markets

by Campbell, Lo, and MacKinlay

Chapter 1. Introduction

Authors begin with observation about highly empirical nature of financial economics. Some parts of the academic finance literature may seem very abstract at first, but there is always a practical relevance that they must satisfy – they must relate to real-world financial markets.

Like other social sciences, financial economics is non-experimental, notwithstanding the previous comment about its empirical nature. The primary method of inference for financial economics is model-based statistical inference, or financial econometrics.

⇒ What distinguishes financial economics from other disciplines that use econometrics is the central role of uncertainty, both in:

- financial theory, and in
- empirical implementation.

Authors make the observation that, without uncertainty, the problems of financial economics reduce to exercises in basic microeconomics. The inclusion of uncertainty is really the starting point for financial economics as a separate discipline.

This role of uncertainty will have important implications in the study of financial econometrics. There will be a close connection between the theory and the empirical analysis, which doesn't always exist in the social sciences, but is the hallmark of the natural sciences.

Outline of Chapter 1 is as follows:

- Section 1.1. Discuss topics for the book, and their organization. Suggestions of possible strategies for covering the material in a 1-semester course.
- Section 1.2. Background material most useful for financial econometrics, and suggestions of references for filling out the reader's background. Encouragement to try to read this book, even if you're not completely strong in every area – perhaps you get more motivated to learn the background material after you see how it's going to be applied.
- Section 1.3. Description of notational conventions to be used in the book.
- Section 1.4. Extension of notational conventions, by defining terms for the usual objects of financial study: prices, returns, methods of compounding, probability distributions.
- Section 1.5. Discussion of the Efficient Markets Hypothesis. Brief discussion of the issues involved, just because it is such a hot-button topic. Though the authors state that the validity of the hypothesis is empirically undecidable, because it is based on what they call “theological” tenets. Since it is empirically undecidable, it is beyond the scope of this text.

Section 1.1. Organization of the Book

There are two general principles for the organization of the book:

- 1) Early chapters concentrate on stock markets, though much of the material applies equally well to other asset markets. They focus on stock markets in an attempt to keep the discussion concrete. In later chapters, they cover:
 - a) Derivative securities. Chapters 9 and 12.
 - b) Fixed-income. Chapters 10-11.
 - c) Chapter 12 presents nonlinear methods, with applications to both stocks and derivatives.
- 2) The authors start by presenting statistical models of asset returns, and then move on to more highly structured economic models. (*Ken: Read as: They start off with models of returns for*

a specific company, then increase the complexity by moving on to more general economic models.) Specifically, the evolution of their approach follows something like:

- a) Chapter 2. Methods for predicting stock returns from their own past history. Not much attention to institutional detail.
- b) Chapter 3. Show how microstructure of market affects short-run behavior of returns.
- c) Chapter 4. Simple statistical models of cross-sections of individual returns, and application of these models to event studies.
- d) Chapters 5 and 6. Show how CAPM and multi-factor models such as APT restrict the parameters of the statistical models. (*Ken: I don't quite follow this statement. They show how the CAPM/APT models restrict the parameters of the models? Possibly, they show how the assumptions/derivations of these models lead to specific forms which the parameters must fit into?*)
- e) Chapter 7. Discuss longer-run evidence of predictability of stock returns from variables other than stock returns.
- f) Chapter 8. Dynamic equilibrium models which can generate persistent time-variation in expected returns.
- g) Chapters 10 and 11. Same approach is used to separate a basic treatment of fixed-income securities in Ch.10 from a discussion of equilibrium term-structure models in Ch. 11.

Next follows a discussion of different strategies a teacher might use in structuring a 1-semester course using this book. 2 possible strategies are given as examples.

There have been some very important topics which are not included in the book:

- Focus is almost exclusively on US markets. No attempt to try to cover issues such as exchange-rate behavior, or the home-bias puzzle, in which investors hold a disproportionate share of their own country's securities in their portfolios.
- Omit important econometric subjects such as
 - Bayesian analysis
 - Frequency-domain methods of time-series analysis.
- Focus on econometric issues, sometimes at expense of equally interesting material, which is econometrically straightforward, such as behavioral finance.

Dual objectives of book:

- Explain the methods of financial econometrics
- Review the empirical literature in finance.

Section 1.2. Useful Background

Mathematics Background recommended:

- Multiple integration
- Multivariate constrained optimization
- Matrix algebra
- Basic rules of matrix differentiation
- For option- and derivative-pricing models, readers should be familiar with Ito, or stochastic calculus.

References are given for all subjects.

Probability Background. Key concepts recommended include:

- Definition of a random variable
- Independence

- Distribution and density functions
- Conditional probability
- Modes of convergence
- Laws of large numbers
- Central limit theorems

Most important with these concepts to concentrate on intuition and subtleties of elementary probabilistic reasoning.

Statistics background. Key concepts here include:

- Neyman-Pearson hypothesis testing
- Linear regression
- Maximum likelihood
- Basic time-series analysis (Stationarity, Autoregressive and ARMA processes, Vector autoregressions, Unit roots, etc.)
- Elementary Bayesian inference
- And for continuous-time financial models, reader should know something of stochastic processes

References are given for finding good discussions on all these topics.

Financial models. Background should include knowledge of:

- Risk aversion and expected-utility theory
- Static mean-variance portfolio theory
- Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT)
- Dynamic asset pricing models
- Option pricing theory

And as before, references are given for reading up on these topics.

Section 1.3. Notation

Notation may not be completely consistent through book, because the authors try use notation consistent with the practitioners of each sub-discipline they survey. However, the authors do maintain the following conventions throughout the book:

- Boldface for vectors, matrices, regular for scalars. Bold uppercase (**X**) for matrices, bold lowercase (**x**) for vectors.
- Uppercase letters (P) for variables, lowercase (p) for logs of the same variables.
- Standard notation for an innovation is ε , followed by η , ξ , and ζ . (*Ken: What's an 'innovation?' A 'small change,' perhaps?*)
- Greek letters used to denote parameters, parameter vectors.
- Greek letter ι used to denote a vector of ones.
- Hats used to denote sample estimates. $\hat{\beta}$ is estimate of β . (*Ken: Note the limitations of Word here. The ^ should be right over the β .*)
- With subscripts, use upper case letters for the upper limits of subscripts. k runs from 1 to K , t runs from 1 to T . Exception: i runs from 1 to N .
 - t, τ time subscripts
 - i asset subscript
 - k, m , and n for lead and lag subscripts. (*Ken: Time lead and lag?*)
 - j as generic subscript
- Timing convention: variable is dated t if it's known by end of period t . Example: R_t denotes return on asset held from end of period $t-1$ to end of period t .

- Variance-covariance matrices:
 - $\mathbf{\Omega}$ for asset returns
 - $\mathbf{\Sigma}$ for residuals from time-series or cross-sectional model
 - \mathbf{V} for parameter estimators
- Script letters used sparingly. Script N used for normal distribution, script L used for log likelihood function.
- $Pr(\cdot)$ denotes probability of an event