UNIVERSITY OF CALIFORNIA AT SAN DIEGO
Department of Economics

Professor Bruce N. Lehmann
The Theory and Testing of Intertemporal Asset Pricing Models

Economics 214C
Spring 2000

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Class Hours: 1-3:50 P. M., Monday
Office Hours: 11:30 A. M. – 1:00 P. M., Monday

Recommended Texts: Campbell, J. Y., Lo, A. W., & Mackinlay, A. C., 1997, *The Econometrics of Financial Markets* (Princeton, NJ: Princeton University Press), CLM.

Cochrane, John H., 2000 Forthcoming, *Asset Pricing* (www-gsb.uchicago.edu/fac/john.cochrane/research/Papers/finbook.pdf), Cochrane.

Duffie, Darrell, 1992, *Dynamic Asset Pricing Theory* (Princeton: Princeton University Press), Duffie.

Huang, Chi-fu and Robert H. Litzenberger, 1988, *Foundations for Financial Economics* (Amsterdam: Elsevier Science Publishers), HL.

Ingersoll, Jonathan E., 1987, *Theory of Financial Decision Making* (Totowa, New Jersey: Rowman & Littlefield), Ingersoll.

COURSE DESCRIPTION

When I was first exposed to economics as an undergraduate, a professor told me that economics was a branch of applied mathematics that is largely devoted to problems associated with the maximization of continuous bounded functions over compact convex sets. While such a view is extreme to say the least, a common thread throughout most of economics in general and financial asset pricing theory in particular is the identification of the constraints confronting households and business firms and the formulation of hypothetical optimizing models of their behavior given these constraints. In asset pricing applications, the constraints confronting investors are those arising from the random evolution of their wealth while the choices made by investors are taken from models of how optimizing investors should behave in the face of uncertainty.

The asset pricing relations studied in this course follow primarily from specific models of wealth constraints, the ramifications of which follow from the assumption that well-functioning markets do not permit arbitrage opportunities. There is a remarkably tight link between the economics and the econometrics of asset pricing relations that arise in frictionless, arbitrage-free

markets, a fact that helps account for the uncommonly empirical nature of financial economics. This connection makes it possible to be reasonably precise about what can and cannot be learned from asset prices in the progressively more restrictive economic environments that arise in the transition from general arbitrage-free markets to particular equilibrium models.

In fact, a more appropriate course title would be "Learning from Asset Prices in the Absence of Arbitrage" and I will use the modern synthesis of Arrow-Debreu contingent claims valuation as the lens through which to view relations among security prices. Against the fear that this approach will prove needlessly abstract and sterile I would balance the following observation: it has long been a source of surprise to me, as well as a cautionary reminder when I am in my more empirical moods, that Arrow and Debreu's abstract analysis laid the foundations for many, if not most, of the innovations in financial markets over the last two decades. Put differently, one of the most abstract branches of economic theory proved to have remarkably practical consequences for financial services that change the risk sharing and risk pooling opportunities available to households and business firms. The course may not deliver on the promise implicit in this analogy but it will demonstrate the empirical utility of no-arbitrage models. If econometrics is the science of statistical measurement from economic data, asset pricing relations should specify what to measure from asset prices and how to measure it. The no-arbitrage framework permits one to be precise about what can and cannot be learned from asset prices under a variety of assumptions.

A more realistic version of these lofty goals is reflected in the course outline that follows. Throughout the course, my focus will be on the economic content of the assumptions of progressively more restrictive asset pricing models and, to the extent possible, on their precise implications for security price behavior. Each week, I will strive to balance economics and econometrics in this fashion and, when possible, I will provide a sketch of the empirical status of the models in question. That said, my main focus is on theory and methods as is commonplace in graduate classes.

I should have said tentative outline as this is the second time I am teaching this course in this manner and my plans will change as the quarter unfolds. Honesty requires that I also point out that this introduction to the theoretical and empirical aspects of asset pricing models is nonstandard, reflecting the idiosyncrasies of my present understanding of the interplay between theory and measurement. In the past, I taught this course in a more conventional manner, proceeding from static to dynamic asset pricing theory in a way mirrored by a convex combination of the texts listed above. The benefit of this approach is the prospect of receiving a coherent and comprehensive view of the economics and econometrics of learning from asset prices. The costs are the potential for my failure to provide such a view or for the framework to prove to be a Procrustean bed that lops off important issues in asset pricing. I hope the benefits outweigh the costs.

There are five books listed above but they are not required as it should be apparent that my lectures will flow independently of any of these texts. Most of the material will be contained in the class notes that I will distribute on a reasonably timely basis. That said, all of the books address some aspects of the topics I am covering in some detail. Cochrane's book is the one that most closely resembles my coverage, although my approach is almost the mirror image of his as I work from no-arbitrage models to those that follow from particular assumptions about

preferences and technology. Campbell, Lo, and MacKinlay book deals in some manner with most of them, albeit usually from a very different theoretical perspective. Hence, it should prove to be a most useful reference for most of you. I have listed relevant chapters of all books in the outline given below.

I will give students two alternatives for the evaluation of their performance. Traditionally, I have given a take-home final examination and have assigned problem sets as preparation, with student groups preparing answers. While the problems have not counted toward class grades, students who have done the problem sets independently have performed better on the exam. I am open to the examination being an in-class one this quarter. The second alternative is a research project. This project might be a reasonably comprehensive literature review, a piece of empirical work on some nontrivial aspect of asset prices, or the development of computer code for analyzing or simulating some aspect of asset pricing theory or the associated econometrics. Students opting for the second approach need to meet with me by the end of the third week of the quarter.

One final housekeeping detail. This course does not count toward my teaching obligations at IR/PS and I can only justify teaching it if there is sufficient student demand. Hence, I encourage students to register for the course at least on an S/U basis.

Tentative Course Outline

Week 1: Asset Menus, Asset Markets, Payoff Relevant States, and Arrow-Debreu Models
Cochrane, Ch. 4; Duffie, Ch. 1 A, B, F; Ingersoll, Ch. 2.

Week 2: The Two Period No-Arbitrage Model with Payoff Relevant States
Cochrane, Ch. 4; Duffie, Ch. 1 A, B, F; HL, Ch. 5.18, 5.19; Ingersoll, Ch. 2.

Week 3: What is a State of Nature?
Cochrane, Ch. 4; Duffie, Ch. 2; HL, Ch. 7, 8; Ingersoll, Ch. 2.

Week 4: Risk Neutral Probabilities, Pricing Kernels, State Price Deflators, and Stochastic Discount Factors
Cochrane, Ch. 5; CLM, Ch. 8.1, 9.2; Duffie, Ch. 1 A, B, F; HL, Ch. 8; Ingersoll, Ch. 2.

Week 5: Asset Pricing Tautologies and the Arithmetic of the Mean-Variance Efficient Set
Cochrane, Ch. 6, 7; CLM, Ch. 5.2; HL, Ch. 3; and Ingersoll, Ch. 4.

Week 6: Learning from Asset Prices in the Two Period No-Arbitrage Model
Cochrane, Ch. 8; CLM, Ch. 5.3, 5.4, and Appendix A; Duffie, Ch. 4E; HL, Ch. 10.

Week 7: The Two Period Arrow-Debreu Model with Pricing Relevant States and Smooth Approximations of Stochastic Discount Factors
CLM, Ch. 12.3; Duffie, Ch. 2A, 2B, 2G, 2H, 3F, 4C, 6; HL, Ch. 5; Ingersoll, Ch.9, 10.

Week 8: Learning from Asset Prices in Linear Factor Pricing Models
Cochrane, Ch. 10; CLM, Ch. 5 and 6; Duffie, Ch. ; HL, Ch. 10; Ingersoll, Ch. 10.

Week 9: Margins of Substitution and Asset Pricing Models
Cochrane, Ch. 2, 3; CLM, Ch. 5 and 8; Duffie, Ch. ; HL, Ch. 4-8; Ingersoll, Ch. 8-11, 13.

Week 10: An Introduction to Market Microstructure from the No-Arbitrage Point of View
CLM, Ch. 3.