

University of Pennsylvania
The Wharton School
Empirical Methods in Asset Pricing FNCE-934
Fall 2015

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I. OBJECTIVES

This course is intended for PhD students in finance and related fields. It is designed to teach students how to conduct and interpret empirical research and quantitative analysis in the broadly defined area of asset pricing. The course provides a mix of asset pricing topics, various numerical methods for solving models, and applications in the intersection of asset pricing and corporate finance. By the end of this semester students should:

1. have a comprehensive understanding of research in empirical asset pricing
2. have acquired the skills to conduct, interpret, and present original research in empirical asset pricing.

II. Prerequisite

To register for or audit FNCE 934 it is highly recommended that you have completed FNCE 911 and FNCE 921.

III. Lectures

Lectures: Tuesdays 4:30-7:30 PM, JMHH G94

IV. Communication

You are always welcome to drop by my office or set an appointment. Email will be my main mode of communication. I will use email to send assignments and administrative notices to all registered students. The official information source for FNCE 934 is at the Canvas site

<http://canvas.upenn.edu>

It holds all lecture notes and assignments that I hand out. If you cannot login into the Canvas, please let me know so I can allow you to access the site.

V. Time Requirement

This is a demanding course, irrespective of whether you are registered or just auditing. The average student can expect to spend at least 15 hours per week outside of class with assigned readings, problem sets/projects and reviewing lectures.

VI. Grading

To make this class work, everyone has to work through every assigned reading before class. I expect that you become an active participant in the class. You should ask questions, raise issues, contribute your knowledge, and challenge the opinions of others, including mine. This class will be a lot more enjoyable for everyone if you participate and therefore will reward people who do.

The following components make up your course grade:

- **Homework Assignments:**

About every other week I will assign a fairly lengthy homework. These assignments can be worked in groups up to 3 people each, but should be handed in individually. You should hand in the assignments at or before the beginning of class on the day they are due. You should start working on the assignments as soon as possible. Some of the assignments could take several days to complete. Under no circumstances will I accept late homework.

The assignments are designed to help you understand the material, digest the assigned papers that I do not cover in class, and familiarize yourself with empirical research. Many problems will require the use of computers. You must know or quickly learn a statistical programming language. I recommend that you use Matlab, although other software packages like Gauss, SAS, STATA, EVIEWS may work. Of course, you may be a hard-core programmer and use C, C++, Fortran, or the more user friendly Fortran90.

- **Paper Presentation:**

I will ask each of you to present a paper during the last week of the class. Think about it as preparing a discussion of the paper for the conference. This presentation shouldn't be long (e.g., about 20-30 min), but should be carefully and thoughtfully executed to summarize the main points and contributions and highlight possible issues and shortcomings of the work. This will teach you to form an opinion about whether a piece of research is outstanding or only mediocre. You will not be graded on whether your opinion agrees with mine, but rather on how you come to your conclusions and how well you back them up.

- **Research Paper:**

You will have to submit a semi-original research paper by a start of the Spring semester. I realize that this is not your thesis, but my hope that it will have a potential to become so in the future. You should think of a topic that (a) uses a methodology introduced in this course, or more advanced, to answer an empirical question of interest to you and/or (b) improve on someones answer to an empirical question by refining a methodology of interest to you. The paper should be no longer than 15 pages, one-half spaced, not including tables and figures. I am more interested in seeing your mind at work than in reading a well polished research with extensive literature review. In preparing your research proposal, you should choose a topic and bring yourself to the frontier of the existing literature.

- **Final Exam:**

There will be a final examination. Since life after graduate school is an open-book experience, it will be a take-home exam.

VII Topics

This is a preliminary list of topics. The order of topics might change as the class progresses, and I might add new topics or skip over others if I think that improves the class.

1. Introduction
 - Fundamental Concepts and Tools of Asset-Pricing
 - Fundamental Puzzles
2. Estimation Methods and Inference
 - Classical Methods (GMM, MLE)
 - Bayesian Methods, MCMC
 - Other Methods: SMM, EMM, Particle Filtering, Perturbation
3. Consumption Based Asset Pricing
 - Habits, Long Run Risks, Disasters
 - Other approaches: Ambiguity Aversion, Robustness and Model Uncertainty, Heterogeneity, Difference in Beliefs
4. Term Structure
 - Facts and Puzzles
 - Affine Term Structure Models
 - Structural Term Structure Models
5. Other Asset Markets
 - Foreign Exchange
 - Options
6. Imperfect Information and Learning
 - Kalman Filter, other filters
 - Equilibrium Implications
7. Portfolio Choice
8. Other Topics
 - Defaults
 - Capital Structure
 - Investment and Production

VII. Texts & Readings

You should have access to the following books:

- Campbell, J., A. Lo, and A.C. MacKinlay, 1997, *The Econometrics of Financial Markets*, Princeton University Press.
- Cochrane, J., 2001, *Asset Pricing*, Princeton University Press.
- Hamilton, J., 1994, *Time Series Analysis*, Princeton University Press.
- Judd Kenneth, 1998, *Numerical Methods in Economics*
- Singleton Kenneth *Empirical Dynamic Asset Pricing*, Princeton University Press.

Other books that you might find useful for this course are:

- Cont R. and P. Tankov, *Financial modelling with Jump Processes*.
- Robert, Christian and George Casella, 2005, *Monte Carlo Statistical Methods*, New York, Springer.
- Duffie, D., *Dynamic Asset Pricing Theory*.
- Gilks, W., S. Richardson, and D. Spiegelhalter, *Markov Chain Monte Carlo in Practice*.
- Gouriéroux, C., and J. Jasiak, 2001, *Financial Econometrics: Problems, Models, and Methods*, Princeton University Press.
- Judge, G., et al., *The Theory and Practice of Econometrics*.
- Karlin, S., and H. Taylor, *A First Course in Stochastic Processes*.
- Ljungqvist, Lars, and Thomas J. Sargent, 2004, *Recursive Macroeconomic Theory*, 2nd edition, The MIT Press.
- Marimon, Ramon, and Andrew Scott, 1999, *Computational Methods for the Study of Dynamic Economies*, Oxford University Press.
- Merton, R., *Continuous-Time Finance*.

This course will evolve throughout the semester. Here is a preliminary reading list for the semester.

The approach is to list important topical areas within the overall literature and a sample of papers from each area. The choice of articles is a mix of classic papers and recent contributions so that you can trace the evolution of the research in each area to the present. The lectures will be devoted to discussing the genesis of important ideas in the literature and concurrent developments that stimulated many of the ideas. I will also try to critically evaluate the findings and research designs employed in past research. The main objective is to offer competing hypotheses and interpretations for the observed findings, and to present unresolved issues and directions for future research.

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1 Introduction

1. *Campbell, John Y., 2000, Asset Pricing at the Millennium, Journal of Finance, LV (4), 1515-1567.

2 Estimation Methods

1. *Singleton Kenneth, Empirical Dynamic Asset Pricing, Chapters 2,3,4, 6
2. *Michael Johannes and Nicholas Polson, 2009, "MCMC Methods for Financial Econometrics," in Handbook of Financial Econometrics.
3. Hamilton, "Time Series Analysis," Chapters 5, 11, 12, 14
4. A. Ronald Gallant and George Tauchen, "Simulated Score Methods and Indirect Inference for Continuous-Time Models," in Handbook of Financial Econometrics.
5. Ogaki, M., 1993, Generalized Method of Moments: Econometric Applications, in Handbook of Statistics, Vol. 11.
6. Hansen, L.P., 1982, Large Sample Properties of Generalized Method of Moments Estimators, Econometrica 50, 1029–1054.
7. Lee, B., and B. Ingram, 1991, Simulation Estimation of Time-Series Models, Journal of Econometrics 47, 197–205.
8. Duffie, D., and K. Singleton, 1993, Simulated Moments Estimation of Markov Models of Asset Prices, Econometrica 50, 987-1007.
9. Tauchen G. and R. Hussey, 1991, "Quadrature-Based Methods for Obtaining Approximate Solutions to Nonlinear Asset Pricing Models," Econometrica, Volume 59, No. 2, pp. 371–396.

3 Consumption Based Asset Pricing Models

3.1 Preferences & Equilibrium Endowment

1. *Singleton — Chapters 10
2. *Hansen, L.P., and R. Jagannathan, 1991, Implications of Security Market Data for Models of Dynamic Economies, Journal of Political Economy 99, 225 – 262.
3. Lucas Robert Jr., 1978, "Asset Prices in an Exchange Economy", Econometrica, 46, 1429-1446.
4. Mehra, R., and E. Prescott, 1985, The Equity Premium: A Puzzle, Journal of Monetary Economics 15, 145 – 161.
5. Epstein, L., and S. Zin, 1989, Substitution, Risk Aversion, and the Temporal Behavior of Consumption and Asset Returns: An Empirical Analysis, Journal of Political Economy 99, 263-286.

3.2 Habits

1. Abel, Andrew B., 1990, Asset prices under habit formation and catching up with the Joneses, *American Economic Review* 80, 38–42.
2. *Campbell, John Y., and John H. Cochrane, 1999, By Force of Habit: A Consumption-Based Explanation of Aggregate Stock Market Behavior, *Journal of Political Economy*, 107, 205 - 251.
3. Constantinides, George, 1990, Habit Formation: A Resolution of the Equity Premium Puzzle, *Journal of Political Economy* 98, 519 – 543.

3.3 Long Run Risks

1. *Bansal, Ravi, and Amir Yaron, 2004, “Risk for the Long Run: A Potential Resolution of Asset Pricing Puzzles,” *Journal of Finance*, 59(4), 1481-1509,
2. *Ravi Bansal, Dana Kiku and Amir Yaron, 2010, ”Long Run Risks, the Macroeconomy and Asset Prices,” *American Economic Review papers and proceedings*, 100(2).
3. *Emi Nakamura, Dmitriy Sergeyev, and Jn Steinsson, 2012, ”Growth-Rate and Uncertainty Shocks in Consumption: Cross-Country Evidence,” NBER Working Paper
4. *Ravi Bansal, Chris Lundblad, and Robert Dittmar, ”Consumption, Dividends, and the Cross-Section of Equity Returns,” *Journal of Finance*, 2005, 60, 1639-1672.
5. *Bansal, Ravi, Robert F. Dittmar, and Dana Kiku. 2009. Cointegration and Consumption Risks in Asset Returns. *Review of Financial Studies*, 22: 1343 1375
6. Bansal Ravi, Khatachtarian Varoujan, and Amir Yaron, ”Interpretable Asset Markets?”, *European Economic Review*. 49, April 2005: 531-560.
7. Hansen, Lars Peter, John C. Heaton, and Nan Li, 2008, ”Consumption strikes back? Measuring long-run risk,” *Journal of Political Economy* 116, 260302.
8. Kiku, Dana. 2006. Is the Value Premium a Puzzle? Working paper.
9. Ravi Bansal, Dana Kiku and Amir Yaron (2012) ”An Empirical Evaluation of the Long-Run Risks Model for Asset Prices”, *Critical Finance Review*: Vol. 1:No 1, pp 183-221.
10. Jason Beeler and John Y. Campbell (2012) ”The Long-Run Risks Model and Aggregate Asset Prices: An Empirical Assessment”, *Critical Finance Review*: Vol. 1:No 1, pp 141-182.
11. Bansal, Ravi, Dana Kiku, and Amir Yaron, 2010, “Long Run Risks: Estimation and Inference”.

3.4 Rare Disasters

1. *Barro, Robert, 2006, ”Rare disasters and asset markets in the Twentieth century,” *Quarterly Journal of Economics* 121.
2. *Barro, Robert and Jose Ursua, 2011, ”Rare Macroeconomic Disasters,” Working Paper

3. Jessica Wachter, Can time-varying risk of rare disasters explain aggregate stock market volatility?, forthcoming, Journal of Finance.
4. Barro, Robert J., Nakamura, Emi, Steinsson, Jon, Ursua, Jose F., "Crises and Recoveries in an Empirical Model of Consumption Disasters," Working paper
5. Rietz, Thomas, 1988, The equity risk premium: A solution, Journal of Monetary Economics 22, 117131.

3.5 Other Approaches

1. *Backus Dave, Brian Routledge, Stan Zin, 2004, Exotic preferences for macroeconomists, NBER Macroannual.
2. *Hansen Lars Peter and Thomas Sargent, Fragile beliefs and the price of uncertainty, 2010, Quantitative Economics, first volume.
3. Lars Hansen and J. Scheinkman, 2009, "Long Term Risk: an Operator Approach," Econometrica, 77(1): 177-234.
4. Martin, Ian, 2008, Consumption-based asset pricing pricing with higher cumulants, working Paper.

4 Term Structure

1. *Singleton — Chapters 12 and 13
2. *Refet S. Gurkaynak, Jonathan H. Wright, "Macroeconomics and the Term Structure," Working Paper
3. *Bansal Ravi and Ivan Shaliastovich, 2012, "A Long-Run Risks Explanation of Predictability Puzzles in Bond and Currency Markets," forthcoming in Review of Financial Studies
4. *Wachter, Jessica, 2006, A consumption-based model of the term structure of interest rates, Journal of Financial Economics 79, 365–399.
5. *Cochrane, John, and Monika Piazzesi, 2004, Bond Risk Premia, American Economic Review.
6. A. Cieslak and P. Povala, "Understanding Bond Risk Premia," Working paper.
7. Ang, Andrew, and Monika Piazzesi, 2002, A No-Arbitrage Vector Autoregression of Term Structure Dynamics with Macroeconomic and Latent Variables, Journal of Monetary Economics
8. Bansal, R. and H. Zhou (2002). Term Structure of Interest Rates with Regime Shifts. Journal of Finance 57, 1997 - 2043.
9. Campbell John Adi Sunderam, Luis Viceira, 2009, "Inflation Bets or Deflation Hedges: The Changing Risks of Nominal Bonds".
10. Dai Q. and K. Singleton, 2000, "Analysis of Affine Term Structure Models," Journal of Finance, Vol. LV, 1943-1978.
11. Duffie, D., and R. Kan, 1996, A Yield-Factor Model of Interest Rates, Mathematical Finance 6, 379-406.

5 Other Asset Markets

5.1 Foreign Exchange

1. *Backus, David K., Silverio Foresi, and Chris I. Telmer, 2001, Affine term structure models and the forward premium anomaly, *The Journal of Finance* 56, 279304.
2. *Lustig, Hanno, and Adrien Verdelhan, 2007, The cross section of foreign currency risk premia and consumption growth risk, *American Economic Review* 97, 89117.
3. *Hanno Lustig, Nikolai Roussanov, and Adrien Verdelhan, "Common Risk Factors in Currency Markets," *Review of Financial Studies*, November 2011.
4. *Verdelhan, Adrien, 2005, A habit-based explanation of the exchange rate risk premium, *Journal of Finance*.
5. Jakub Jurek, "Crash-Neutral Currency Carry Trades," Working paper.
6. Hanno Lustig, Nikolai Roussanov, Adrien Verdelhan, "Common Risk Factors in Currency Markets," forthcoming in RFS.
7. Karen Lewis, 2011, Global Asset Pricing, *Annual Review of Financial Economics*.

5.2 Options

1. *Singleton — Chapters 15
2. *Broadie, Mark, Mikhail Chernov, and Michael Johannes, 2007, Model specification and risk premia: Evidence from futures options, *Journal of Finance* 62, 1453 1490.
3. Drechsler Itamar and Amir Yaron "What's Vol Got To Do With It", 2011, January, *Review of Financial Studies*.
4. Shaliastovich, Ivan. 2009. Learning, Confidence and Option Prices. Working paper.
5. Eraker, Bjorn, M. Johannes, and N.G. Polson, 2003, The impact of jumps in returns and volatility, *Journal of Finance* 53, 12691300
6. Liu, Jun, Jun Pan, and Tan Wang, 2005, An equilibrium model of rare-event premia and its implication for option smirks, *Review of Financial Studies* 18, 131164.
7. Benzoni Luca, Pierre Colin Dufrense, and Robert Goldstein "Can Standard Preferences Explain the Prices of Out-of-the-Money S&P 500 Put Options?"

6 Imperfect Information and Learning

1. *Hamilton, "Time Series Analysis," Chapter 22
2. *Pietro Veronesi, 2000, "How Does Information Quality Affect Stock Returns?" *Journal of Finance* , 55, 2.
3. *Ravi Bansal and Ivan Shaliastovich, 2010, Confidence Risks and Asset Prices, *American Economic Review*, papers and proceedings, 100(2): 537-41

4. Ai Hengjie, 2010, "Information about Long-Run Risk: Asset Pricing Implications," *Journal of Finance*
5. Abel, Andrew, Janice Eberly, and Stavros Panageas, 2007, Optimal inattention to the stock market, *American Economic Review* 97, 244-249.
6. Ravi Bansal and Ivan Shaliastovich, 2011, Learning and Asset-Price Jumps, *The Review of Financial Studies*, 24(8): 2738-80
7. Veronesi and Pastor, 2009, "Learning in Financial Markets," *Annual Review of Financial Economics*, 1, 361 – 381.
8. Andrea Buraschi, Fabio Trojani and Andrea Vedolin, "When Uncertainty Blows in the Orchard: Comovement and Equilibrium Volatility Risk Premia," Working paper
9. Alexander David, Pietro Veronesi, "What Ties Return Volatilities to Price Valuations and Fundamentals?"
10. Veldkamp, Laura, 2006, Slow boom, sudden crash, *Journal of Economic Theory* 124, 230-257.

7 Portfolio Choice

1. *John Campbell, "Household Finance," *Journal of Finance*, August 2006.
2. *John Campbell and Luis Viceira, "Consumption and Portfolio Decisions When Expected Returns are Time Varying," *Quarterly Journal of Economics*, May 1999.
3. *Luca Benzoni, P. Collin-Dufresne and R. S. Goldstein. "Portfolio Choice over the Life-Cycle when the Stock and Labor Markets are Cointegrated," *Journal of Finance* 62(5), 2123-2167, Oct 2007.
4. Laurent E. Calvet, John Y. Campbell and Paolo Sodini. "Down or Out: Assessing the Welfare Costs of Household Investment Mistakes," *Journal of Political Economy* 115:707-747, October 2007.