

# Asset Pricing I: Theory and Evidence

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September 29, 2017

## 1 Course objectives

This course provides an overview of the field of asset pricing. The emphasis of this course is on the theoretical underpinnings of the field and the evaluation of models built to address the empirical regularities observed in the US (and to some extent international) securities data. The emphasis will largely be on discrete-time models, though we will deal with continuous-time methods in some places. The topics covered include: the law of one price and the stochastic discount factor, consumption asset pricing, recursive preferences, habit formation, market frictions and transaction costs, issues in fixed income and currency pricing, empirical evidence on stock returns, and models with asymmetric or limited information.

This is not an econometrics course, nor an empirical asset pricing course. We will cover empirical results to the extent that they provide context for the theory. We will also work with data (a little bit) when it helps to elucidate theoretical concepts. Finally, we will do numerical analysis of some of the models we cover, which will require some programming. The numerical analysis and/or solution of models is so standard in the field, that you might as well get used to these tools at an early stage.<sup>1</sup>

The course is designed for second year doctoral students in finance. Economics doctoral students and other finance doctoral students are also welcome. Other students may take this course if they have previously taken at least one PhD-level finance course on asset pricing and one PhD-level course on statistics or econometrics.

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<sup>1</sup>I recommend either R or Python. Matlab is a good choice also, but it isn't an open source package, which is probably a disadvantage in the long-term.

## 2 Topics

The early lecture topics are largely fixed, but the content of the later lectures may change as the semester progresses.

### 1. Introduction

- Overview of course topics
- Arrow-Debreu state prices with finite states
- Development of Euler equation and kernel representation
- Connection to CAPM
- Empirical review

#### References

Breeden, D., R. Litzenberger, and T. Jia, 2015, “Consumption-based asset pricing, Part 1: Classic theory and tests, measurement issues, and limited participation,” *Annual Review of Financial Economics*, 7, 35–83.

Breeden, D., R. Litzenberger, and T. Jia, 2015, “Consumption-based asset pricing, Part 2: Habit formation, conditional risks, long-run risks, and rate disasters,” *Annual Review of Financial Economics*, 7, 85–131.

\*Campbell, J., 1999, “Asset prices, consumption, and the business cycle,” *Handbook of Macroeconomics*, volume 1, 1231–1303.

Dybvig, P. and S. Ross, 2003, “Arbitrage, state prices and portfolio theory,” *Handbook of the Economics of Finance*.

### 2. Law of one price and principle of no-arbitrage

- Kernel representation:  $P(x) = E[m^*x]$
- Hansen-Jagannathan bounds
- SDF and the mean-variance frontier

#### References

\*Hansen, L. and R. Jagannathan, 1991, “Implications of security market data for models of dynamic economies,” *Journal of Political Economy*, 99 (2), 225–262.

Hansen, L. and R. Jagannathan, 1997, “Assessing specification errors in stochastic discount factor models,” *Journal of Finance*, 52 (2), 557–590.

Hansen, L. and S. Richard, 1987, “The role of conditioning information in deducing testable restrictions implied by dynamic asset pricing models,” *Econometrica*, 55, 587–614.

Hodrick, R. and X. Zhang, 2001, “Evaluating the specification errors of asset pricing models,” *Journal of Financial Economics*, 2001, 62, 327–376.

### 3. Consumption asset pricing

- Dynamic programming
- $m^* \sim U'(c)$
- The consumption CAPM
- The equity premium puzzle
- The term structure of interest rates

#### References

Hansen, L. and K. Singleton, 1983, “Stochastic consumption, risk aversion, and the temporal behavior of asset returns,” *Journal of Political Economy*, 91 (2), 249–265.

Kocherlakota, N., 1996, “The equity premium: It’s still a puzzle,” *Journal of Economic Literature*, 42–71.

Lucas, R., 1978, “Asset prices in an exchange economy,” *Econometrica*, 46, 1429–1446.

Mehra, R. and E. Prescott, 1985, “The equity premium: A puzzle,” *Journal of Monetary Economics*, 15 (2), 145–161.

### 4. Recursive preferences

- Separating risk aversion and intertemporal substitution
- Epstein-Zin
- Bansal-Yaron – risks for the long-run

#### References

Epstein, L. and S. Zin, 1989, “Substitution, risk aversion, and the temporal behavior of consumption and asset returns: A theoretical framework,” *Econometrica*, 57 (4), 937–969.

Epstein, L. and S. Zin, 1991, “Substitution, risk aversion, and the temporal behavior of consumption and asset returns: An empirical analysis,” *Journal of Political Economy*, 99 (2), 263–286.

Bansal, R. and A. Yaron, 2004, “Risks for the long run: A potential resolution of asset pricing puzzles,” *The Journal of Finance*, 59 (4), 1481–1509.

Bansal, R., D. Kiku, and A. Yaron, 2012, “An empirical evaluation of the long-run risks model for asset prices,” *Critical Finance Review*, 1, 183–221.

Beeler, J. and J. Campbell, 2012, “The long-run risks model and aggregate asset prices: An empirical assessment,” *Critical Finance Review*, 1, 141–182.

## 5. Habit formation

- External habit model of Campbell and Cochrane
- Brief introduction to continuous time methods

### References

Abel, A., 1990, “Asset prices under habit formation and catching up with the Joneses,” *American Economic Review*, 38–42.

Campbell, J. and J. Cochrane, 1999, “By force of habit: A consumption-based explanation of aggregate stock market behavior,” *Journal of Political Economy*, 107 (2), 205–251.

Menzly, L., T. Santos, and P. Veronesi, 2004, “Understanding predictability,” *Journal of Political Economy*, 112 (1), 1–47.

## 6. Examining the mechanism

- Euler equation errors
- Dividend strips
- Value and growth firms: a reduced form sdf approach

### References

Lettau, M. and S. Ludvigson, 2009, “Euler equation errors,” *Review of Economic Dynamics*, 12, 255–283.

Lettau, M. and J. Wachter, 2007, “Why is long-horizon equity less risky? A duration-based explanation of the value premium,” *Journal of Finance*, 62 (1), 55–92.

van Binsbergen, J., M. Brandt, and R. Koijen, 2012, “On the timing and pricing of dividends,” *American Economic Review*, 102 (4), 1596–1618.

## 7. Market frictions

- Transaction costs
- Incomplete markets
- Uninsurable income heterogeneity

### References

Brav, A., G. Constantinides, and C. Geczy, 2002, “Asset pricing with heterogeneous consumers and limited participation: Empirical evidence,” *Journal of Political Economy*, 110 (4), 793–824.

Constantinides, G. and D. Duffie, 1996, “Asset pricing with heterogeneous consumers,” *Journal of Political Economy*, 104 (2), 219–240.

Luttmer, E.G.J., 1999, “What level of fixed costs can reconcile consumption and stock returns?” *Journal of Political Economy*, 7 (5), 969–1033.

**\*\*\* PRELIMINARY PAST THIS POINT \*\*\***

## 8. Disaster risk [AND VARIANCE DECOMPOSITION?]

- Rare economic disasters and the equity premium
- Disasters and consumption recoveries

### References

Barro, R., 2006, “Rare disasters and asset markets in the twentieth century,” *Quarterly Journal of Economics*, 121 (3), 823–866.

Gabaix, X., 2008, “Variable rare disasters: A tractable theory of ten puzzles in macro-finance,” *American Economic Review*, 98 (2), 645–700.

Rietz, T., 1988, “The equity risk premium: A solution,” *Journal of Monetary Economics*, 22 (1988), 117–131.

## 9. Cross-section of stock returns

- $m \rightarrow$  Beta and Factor model  $\rightarrow m$
- CAPM
- Empirical issues: Gibbons, Ross, Shanken and Fama-MacBeth
- Other effects: size and book-to-market
- APT and ICAPM
- Fama-French 3 factor model and the intercepts test
  - Distribution of HML
- Daniel and Titman – characteristics sorts
- Momentum
  - Distribution of UMD
- Reversals
- Other asset classes and international evidence
- The five-factor model
- Conditional asset pricing [?]
  - Log-linearization and variance decompositions
  - *cay* consumption to wealth ratio
  - Time variation in betas

### References

Jagannathan, R. and Y. Wang, 2007, “Lazy investors, discretionary consumption, and the cross-section of stock returns,” *Journal of Finance*, 62 (4), 1623–1661. (measure consumption changes based on Q4 consumption)

Lettau, M. and S. Ludvigson, 2001, “Consumption, aggregate wealth, and expected stock returns,” *Journal of Finance*, 56 (3), 815–849.

Linnainmaa and Roberts, 2016, “The history of the cross-section of stock returns”

Malloy, C., T. Moskowitz, and A. Vissing-Jorgensen, 2005, “Long-run stockholder consumption risk and asset returns,” *Journal of Finance*, 64 (6), 2427–2479. (look at consumption covariance of stock holders vs non-holders)

Parker, J., and C. Julliard, 2005, “Consumption risk and the cross-section of expected returns”, *Journal of Political Economy*, 113, 185–222. (measure consumption changes over 11 quarters)

## 10. Fixed income and currencies

- Fixed income models

### References

Ang, A. and M. Piazzesi, 2003, “A no-arbitrage vector autoregression of term structure dynamics with macroeconomic and latent variables,” *Journal of Monetary Economics*, 50, 745–787.

Cochrane, J. and Piazzesi, M., 2005, “Bond risk premia,” *The American Economic Review*, 95 (1), 138–160.

Fama, E. and Bliss, R., 1987, “The information in long-maturity forward rates,” *American Economic Review*, 77 (4), 680–692.

Lettau, M. and Wachter, J., 2011, “The term structures of equity and interest rates,” *Journal of Financial Economics*, 101, 90–113.

- Currencies

### References

Backus, D., S. Foresi, and C. Telmer, 2001, “Affine term structure models and the forward premium anomaly,” *Journal of Finance*, 56 (1), 279–304.

Fama, E., 1984, “Forward and spot exchange rates,” *Journal of Monetary Economics*, 14, 319–338.

Farhi, E. and X. Gabaix, 2016, “Rare disasters and exchange rates,” *The Quarterly Journal of Economics*, 131 (1), 1–52.

Hanson, L. and R. Hodrick, 1980, “Forward exchange rates as optimal predictors of future spot rates: An econometric analysis,” *Journal of Political Economy*, 88 (5), 829–853.

Verdelhan, A., 2010, “A habit-based explanation of the exchange rate premium,” *The Journal of Finance*, 65 (1), 123–146.

- International investing: Brusa, Ramadorai, and Verdelhan (2017) [tentative]

#### 11. Leverage and financial intermediation

- Preference heterogeneity: Longstaff and Wang
- Belief heterogeneity: Fostel and Geanakoplos
- Financial intermediaries: He and Krishnamurthy

#### References

Gabaix, X. and M. Maggiori, 2015, “International liquidity and exchange rate dynamics,” *The Quarterly Journal of Economics*, 130 (3), 1369–1420.

#### 12. Information

- Informational asymmetry
  - Implications for trading volume and momentum
- Capacity constraints
- Empirical evidence

#### 13. Student presentations

- Students can choose to present one of the following papers.
- If you’d like to present a paper not on this list, that may be okay as well, but you have to run the paper by me first.
- In the presentation, you should focus on the paper’s modeling contribution and any empirical tests related to this. Papers contain more material than you will be able to present in 30-40 minutes, so you need to identify the paper’s key contribution and focus on explaining its logic to the class.

#### References

Adam, K., A. Marcet, and J. Nicolini, 2016, “Stock market volatility and learning,” *Journal of Finance*, 71 (1), 33–81.

Belo, F., P. Collin-Dufresne, and R. Goldstein, 2015, “Dividend dynamics and the term structure of dividend strips,” *Journal of Finance*, 70 (3), 1115–1159.

Lettau, M. and J. Wachter, 2011, “The term structure of equity and interest rates,” *Journal of Financial Economics*, 101 (1), 90–113.

van Binsbergen, J. and R. Koijen, 2017, “The term structure of returns: Facts and theory,” *Journal of Financial Economics*, 124, 1–21.

### 3 Materials

The course is self-contained and not based on any one book. John Cochrane’s book *Asset Pricing* comes closest to the course in terms of topics. You may also find useful:

- Ljungqvist and Sargent, *Recursive Macroeconomic Theory* for coverage of dynamic programming, as well as two excellent chapters on asset pricing.
- Duffie, *Dynamic Asset Pricing* for continuous time methods.
- Campbell, Lo, MacKinlay, *The Econometrics of Financial Markets* for empirical topics.
- Back, *Asset Pricing and Portfolio Choice Theory* as a backup reference for the Cochrane book (with slightly more technical details).
- LeRoy and Werner, *Principles of Financial Economics* for coverage of the CAPM and aspects of the stochastic discount factor.

### 4 Logistics

#### Office hours and TA

Office hours are by appointment. Please email me first ([hm2646@columbia.edu](mailto:hm2646@columbia.edu)). Our TA will be Aref Bolandnazar ([MBolandnazar20@gsb.columbia.edu](mailto:MBolandnazar20@gsb.columbia.edu)). He will have office hours on Mondays from 4–5:30, in a room that he will post weekly.

#### Grading

There will be 6 homeworks which will represent 40% of the grade and an in-class final with is worth 60% of the grade.

<b>Class</b>	<b>Fall 2017</b>	<b>Topic</b>	<b>Assign</b>	<b>Due Date</b>
1	Fri Sep 08	Introduction: CAPM, SDF, empirical evidence	1	Fri Sep 22
2	Fri Sep 15	Law of one price and the stochastic discount factor		
3	Fri Sep 22	Consumption asset pricing	2	Fri Oct 06
4	Fri Sep 29	Empirical evidence on standard model and recursive preferences		
5	Fri Oct 06	Recursive preferences and long-run risks	3	Fri Oct 27
6	Fri Oct 13	Habit formation and continuous time basics		
7	Fri Oct 27	Applications: Euler errors and equity dividend strips	4	Fri Nov 10
8	Fri Nov 03	Frictions, transaction costs, and incomplete markets		
9	Fri Nov 10	Disaster risk; Model dynamics and conditional betas	5	Fri Nov 17
10	Fri Nov 17	Fixed income and currencies; Student presentations	6	Fri Dec 01
11	Fri Dec 01	Student presentations		
12	Fri Dec 08	In class final exam		

Table 1: Class schedule.

## Class schedule

Classes are held Fridays from 2:15-5:30pm in 329 Uris, with a 15 minute break in the middle. NOTE: The first class will run from 1:30-4:45pm. Table 1 shows the class dates, the anticipated class topics, and the assignment due dates.

## Assignments

There will be 6 homeworks, roughly one every two weeks. There will be a handout with many questions (and solutions) that I will give out at the end of the semester. This will be good practice for the final exam. The following are the topics of the homework assignments:

1. Stochastic discount factor
2. Dynamic programming
3. Bonds and generalized preferences
4. Habits and long-run risks
5. Frictions and other issues
6. Student presentations, or fixed income and currencies