Asset Pricing I: Theory and Evidence

SUBJECT TO CHANGE

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1 Course objectives

In this course, we derive the workhorse models of modern asset pricing, and discuss their empirical validity. Most of the models are set in discrete-time models, though some are in continuous-time. The topics covered include: the law of one price and the stochastic discount factor, optimal portfolio decisions and consumption asset pricing, recursive preferences, habit formation, measuring cash flow and discount rate news, imperfect risk sharing, disaster risk models, reduced form stock valuation models, and issues in fixed income and currency pricing.

Most homeworks require working with data to elucidate theoretical concepts. You will also do numerical analysis of some models from class.[1] The homeworks are roughly 60% derivations and 40% coding.

The course is designed for second year doctoral and masters students. Doctoral students will find this course valuable because they will learn the important models of modern asset pricing. Masters students will find this course valuable because it will provide a foundation for rigorous financial decision making, something that we highlight throughout the semester.

2 Logistics

Prerequisites

Students may take this course if they have previously taken at least one PhD-level finance course that covers asset pricing and one PhD-level course on statistics or econometrics.

[1] I recommend either Python or R. Matlab is okay, but is not open source.

CLASS SCHEDULE

Classes are held Fridays 2:20-5:35pm in Kravis 680, with a 15 minute break in the middle. What better way to kick off the weekend than with 3 hours spent pondering asset pricing? Table 1 shows the class dates, the anticipated class topics, and the assignment due dates.

OFFICE HOURS AND TA

My office hours (in Kravis 1153) are by appointment. Please email me first to set up a time (*hm2646@columbia.edu*). Our TA will be Neel Shah *NShah27@gsb.columbia.edu*. He will have office hours on TBD in TBD.

GRADING

There will be 6 homeworks (the last homework may be replaced with an in-class presentation) which will represent 50% of the grade and an in-class final with is worth 50% of the grade. Homeworks will be handed out every two weeks (or so). Tentative homework topics are in Table 2.

STUDENT PRESENTATIONS

We will devote most of the final two or three classes to students presentations of recent (or classic) research papers that build on concepts we will have covered in class. Presentations will be done in groups of three people. Those presenting will not have to hand in homework 6, but will still be responsible for understanding the material homework 6 covers. In years when we can accommodate presentations by all students, presentations will be required.

FINAL EXAM

We will have a three-hour final during exam week. 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 final exam will be during exam week, on TBD at TBD in TBD.

3 MATERIALS

The course is self-contained and not based on any one book. The one that comes closest:

- John Campbell's excellent book called *Financial Decisions and Markets* (FDM).

If you buy only one book for the course, buy FDM. The following books are directly relevant in parts. Cochrane's book is very close to the early part of the course flow.

- John Cochrane's book *Asset Pricing* deals with many of the theoretical underpinnings of the course – SDF's, Hansen-Jagannathan bounds, Euler equations – but spends less time on the newer extensions of the standard model, like habits, recursive preferences, and so on. If you get only two books, get this one and Campbell's.

- Ljungqvist and Sargent, *Recursive Macroeconomic Theory* for coverage of dynamic programming, as well as two excellent chapters on asset pricing.

The following books are useful references:

- Back, *Asset Pricing and Portfolio Choice Theory* as a backup reference for the Cochrane book (with slightly more technical details).

- Campbell, Lo, MacKinlay, *The Econometrics of Financial Markets* for empirical topics.

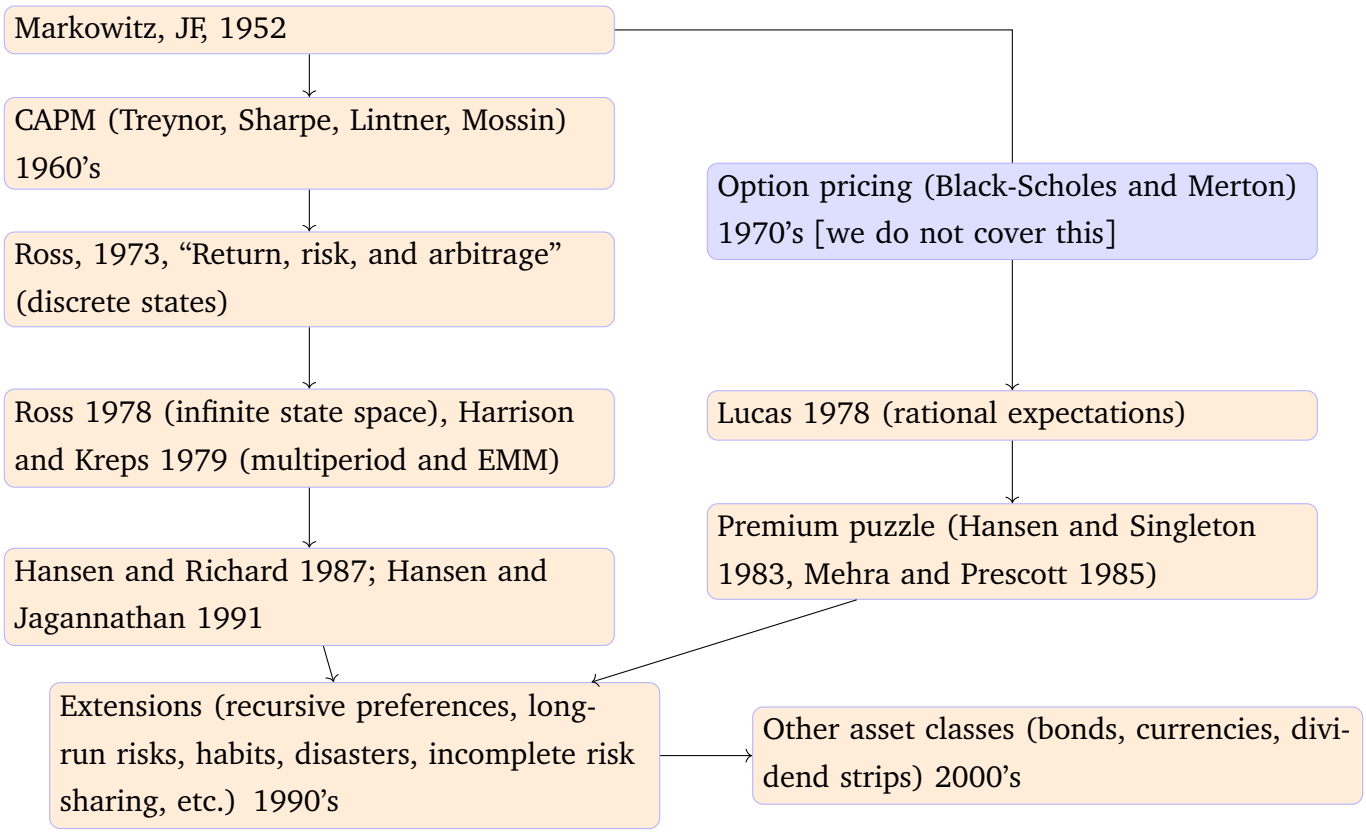
- Duffie, *Dynamic Asset Pricing* for continuous time methods.

- Harrison, *Brownian Motion and Stochastic Flow Systems* for an excellent introduction to stochastic calculus.

- LeRoy and Werner, *Principles of Financial Economics* for coverage of the CAPM and aspects of the stochastic discount factor.

- Stokey and Lucas with Prescott, *Recursive Methods in Economic Dynamics* is the classic book on dynamic programming in economics. The presentation in Ljungqvist and Sargent is much more readable, but L&S simply refer the reader here for most of the techincal details.

4 Logical evolution



5 TOPICS

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 rare 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.

*Cochrane, J., 2017, "Macro-finance," *Review of Finance*, 945–985. (I recommend you read this fantastic paper *at the end of the semester*. It will provide great context for many of the models we will have worked on over the next few months.)

Constantinides, G., 1982, "Intertemporal asset pricing with heterogeneous consumers and without demand aggregation,"*Journal of Business*, 55 (2), 253–267.

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

*Brunnermeier, M., E. Farhi, R. Koijen, A. Krishnamurthy, S. Ludvigson, H. Lustig, S. Nagel, M. Piazzesi, 2021, "Review article: Perspectives on the future of asset pricing," *Review of Financial Studies*, 34 (4), 2126–2160.

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

   - Kernel representation in general case: $P(X) = E[MX]$
   - Observing M empirically
   - Hansen-Jagannathan bounds
   - Application of risk-neutral pricing
   - 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.

Harrison, J.M. and D. Kreps, 1979, "Martingales and arbitrage in multiperiod securities markets," *Journal of Economic Theory*, 20, 381–408. (Among many other contributions, they show that with infinite state space, no-arbitrage implies the existence of an equivalent martingale measure (EMM), which through the Radon-Nikodym theorem implies the existence of a non-negative stochastic discount factor.)

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

*Martin, I., 2017, "What is the expected return on the market?" *Quarterly Journal of Economics*, 132 (1), 367–433.

Ross, S.A., 1973, "Return, risk and arbitrage," Wharton Discussion Paper, published in I. Friend and J. Bicksler, eds., *Risk and Return in Finance*, (Cambridge: Ballinger), 1976, 189–217.

Ross, S.A., 1976, "The arbitrage theory of capital asset pricing," *Journal of Economic Theory*, 13, 341–360.

Ross, S.A., 1978, "A simple approach to the valuation of risky streams," *Journal of Business*, 51, 453–475.

3. Consumption asset pricing

   - Dynamic programming
   - $M \sim U'(C)$
   - The consumption Euler equation
   - The equity premium puzzle
   - Bond pricing introduction
   - Empirical failure of the standard model

   References

Breeden, D., 1979, "An intertemporal asset pricing model with stochastic consumption and investment opportunities," *Journal of Financial Economics*, 7 (3), 265–296.

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.

(Explores implications of joint lognormality of consumption and asset returns.)

Ljungqvist and Sargent, 2012, *Recursive Macroeconomic Theory*, chapters 3-4.

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

Kydland, F. and E. Prescott, 1977, "Rules rather than discretion: The inconsistency of optimal plans," *Journal of Political Economy*, 85 (3), 473–492.

*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.

Rubinstein, M., 1976, "The strong case for the generalized logarithmic utility model as the premier model of financial markets," *Journal of Finance*, 31 (2), 551–571.

Rubinstein, M., 1978, "An aggregation theorem for securities markets," *Journal of Financial Economics*, 1 (3), 225–244.

Technical references

Blume, L., 2008, "Convex programming," in Durlauf, S.N. and L.E. Blume (eds) *The New Palgrave Dictionary of Economics*, Palgrave Macmillan, London.

Rust, John, 2008, "Dynamic programming," in Durlauf, S.N. and L.E. Blume (eds) *The New Palgrave Dictionary of Economics*, Palgrave Macmillan, London. (Discusses, among many other things, when time invariant controls are optimal.)

4. Recursive preferences

- Separating risk aversion and intertermporal substitution
- Epstein-Zin preferences
- Empirical evidence on the intertemporal elasticity of substitution (IES)
- Campbell's version of the ICAPM

References

Borovička, J. and J. Stachurski, 2020, "Necessary and sufficient conditions for existence and uniqueness of recursive utilities," *Journal of Finance*, 75 (3), 1457–1493.

Epstein and Zoin (1989) prove sufficient conditions for existence and uniqueness of recursive utilities, but these assume bounded consumption growth (for some upper bound B_c) with probability 1 (i.e., a bound on *all* paths). Here they also establish necessary conditions, and these do not require probability 1 boundedness, but only restrict *average* outcomes across all paths.

*Campbell, J., 1993, "Intertemporal asset pricing without consumption data," *American Economic Review*, 83 (3), 487–512.

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.

Weill, P., 1990, "Nonexpected utility in macroeconomics," *Quarterly Journal of Economics*, 105 (1), 29–42.

Contemporaneous with EZ (1991) and largely the same results.

Evidence on IES

Attanasio, O., J. Banks, and S. Tanner, 2002, "Asset holding and consumption volatility," *Journal of Political Economy*, 110 (4), 771–792.

Use expenditure survey data in UK to show IES values around 1 for shareholders, but much lower for nonshareholders.

Beaudry, P. and E. van Wincoop, 1996, "The intertemporal elasticity of substitution: An exploration using a US panel of state data," *Economica*, 63, 495–512.

"we provide evidence indicating that the IES is significantly different from zero and probably close to one."

Hall, R., 1988, "Intertemporal substitution in consumption," *Journal of Political Economy*, 96 (2), 339–357.

This and the Yogo (2004) paper argue the IES is close to zero (or 0.2) in the US. The value of the IES plays a large role in the Bansal-Yaron long run risks model.

Vissing-Jørgensen, A., 2002, "Limited asset market participation and the elasticity of intertemporal substitution," *Journal of Political Economy*, 110 (4),

825–853.

"I find estimates of the EIS around 0.3-0.4 for stockholders and around 0.8-1 for bondholders."

Yogo, M., 2004, "Estimating the elasticity of intertemporal substitution when instruments are weak," *The Review of Economics and Statistics*, 86 (3), 797–810.

5. Long-run risks

   - Bansal-Yaron paper
   - Log-linear approximation of the pricing kernel
   - Empirical evidence and applications
   - Validity of approximation

   References

   *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.

   Kreps, D. and E. Porteus, 1978, "Temporal resolution of uncertainty and dynamic choice theory," *Econometrica*, 46 (1), 185–200.

   Pohl, W., K. Schmedders, and O. Wilms, 2018, "Higher order effects in asset pricing models with long-run risks," *Journal of Finance*, 73 (3), 1061–1111.

   Restoy, F. and P. Weil, 2011, "Approximate equilibrium asset prices," *Review of Finance*, 15, 1–28.

6. Habit formation

   - External habit model of Campbell and Cochrane
   - Introduction to continuous time methods (the Kerry Back book is a good reference for the finance stuff, and the Harrison *Brownian Motion* book for the math stuff)

- External habit model of Menzly, Santos and Veronesi

References

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

Bekaert, G., E. Engstrom, and Y. Zing, 2009, "Risk, uncertainty, and asset prices," *Journal of Financial Economics*, 91, 59–82. (add a shock to the surplus process so it's not mechanically driven by consumption shocks)

*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.

Guiso, L., P. Sapienza, and L. Zingales, 2018, "Time varying risk aversion," *Journal of Financial Economics*, 128, 403–421.

Harrison, J.M. and S. Pliska, 1981, "Martingales and stochastic calculus in the theory of continuous trading," *Stochastic Processes and their Applications*, 11, 215–260.

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

Wachter, 2005, "Solving models with external habit," *Finance Research Letters*, 2, 210–226.

7. Market frictions

- Disaster risk

References

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

*Barro, R., 2009, "Rare disasters, asset prices, and welfare costs," 99 (1), 243–264.

Gabaix, X., 2012, "Variable rare disasters: An exactly solved framework for ten puzzles in macro-finance," *Quarterly Journal of Economics*, 127, 645–700.

Martin, I., 2013, "Consumption-based asset pricing with higher cumulants," *Review of Economic Studies*, 80, 745–773.

Nakamura, E., J. Steinsson, R. Barro, and J. Ursua, 2013, "Crises and recoveries in an empirical model of consumption disasters," *American Economic Journal: Macroeconomics*, 5 (3), 35–74.

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

Tsai, J. and J. Wachter, 2015, "Disaster risk and its implications for asset pricing," *Annual Review of Financial Economics*, 7, 219–252.

Wachter, J., 2013, "Can time-varying risk of rare disasters explain aggregate stock market volatility?" *Journal of Finance*, 68 (3), 987–1035.

- Incomplete markets, uninsurable income heterogeneity, and empirical evidence

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. (This is a classic paper about the effect of transaction costs in asset pricing. We will not get to it this semester.)

Scheinkman, J., 1989, "Market incompleteness and the equilibrium valuation of assets," in S. Bhattacharya and G. Constantinides (Eds.) *Theory of Valuation*, 45–51.

8. Discount rate and cash flow innovations

- Log-linearization of the returns R_{t+1} equation
- Value and growth firms: a reduced form SDF approach
- Dividend strips

References

Bansal, R., S. Miller, D. Song, and A. Yaron, "The term structure of equity risk premia," *NBER Working Paper No. 25690*. (This is a counterpoint to the dividend-strip anomaly literature.)

*Campbell, J., 1991, "A variance decomposition for stock returns," *The Economic Journal*, 101 (405), 157–179.

Campbell, J. and R. Shiller, 1988, "The dividend-price ratio and expectations of future dividends and discount factors," *Review of Financial Studies*, 1 (3), 195–228. (First to introduce the first-order approximation to the dividend yield in terms of future returns and future log dividend growth.)

Giglio, S., B. Kelly, and S. Kozak, 2019, "Equity term structures without dividend strips data," working paper.

*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.

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

9. 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 M. Piazzesi, 2005, "Bond risk premia," *The American Economic Review*, 95 (1), 138–160.

Cochrane, J. and M. Piazzesi, 2008, "Decomposing the yield curve," *working paper*.

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.

Ludvigson, S. and S. Ng, 2009, "Macro factors in bond risk premia," *Review of Financial Studies*, 22 (12), 5027–5067.

Piazzesi, M. and M. Schneider, 2007, "Equilibrium exchance rates," *NBER Macroeconomics Annual 2006*, Volume 21.

Thornton, D. and G. Valente, 2012, "Out-of-sample predictions of bond excess returns and forward rates: An asset allocation perspective," *Review of Financial Studies*, 25 (10), 3141–3168.

Wachter, J., 2006, "A consumption-based model of the term structure of interest rates," *Journal of Financial Economics*, 79, 365–399.

- 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.

Brandt, M., J. Cochrane and P. Santa-Clara, 2006, "International risk sharing is better than you think, or exchange rates are too smooth," *Journal of Monetary Economics*, 53, 671–698.

Dornbusch, R., 1985, "Purchasing power parity," *NBER working paper no. 1591*.

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.

10. Aspirational topics [unlikely we'll have time]

- Factorization of the SDF

References

Alvarez, F. and U. Jermann, 2005, "Using asset prices to measure the persistence of the marginal utility of wealth," *Econometrica*, 73 (6), 1977–2016.

Bakshi, G., F. Chabi-Yo, X. Guo, 2017, "A recovery we can trust? Deducing and testing the restrictions of the recovery theorem," *Review of Financial Studies*, 31 (2), 532–555.

Campbell, *FDM*, Chaper 8.

Hansen, L. and J. Scheinkman, 2009, "Long-term risk: An operational approach," *Econometrica*, 77 (1), 177-234.

Hansen, L., H. Heaton, and N. Lie, 2008, "Consumption strikes back? Measuring long-run risk," *Journal of Political Economy*, 116 (2), 260–302.

Jensen, C., D. Lando and L. Pedersen, 2019, "Generalized recovery," *Journal of Financial Economics*, 133 (1), 154–174.

Ross, S., 2015, "The Recovery Theorem," *Journal of Finance*, 70 (2), 615–648.

Schneider, P. and F. Trojani, 2019, "(Almost) model-free recovery," *Journal of Finance*, 74 (1), 323–370.

- Production

References

Cochrane, J.H., 1991, "Production-based asset pricing and the link between stock returns and economic fluctuations," *Journal of Finance*, 46, 209–237.

Zhang, L., 2017, "The Investment CAPM," *European Financial Management*, 23 (4), 545–603.

6 STUDENT PRESENTATIONS

- Students form groups and submit a ranked list of 3 papers that they would like to present. I will assign papers to groups from their lists.
- In the presentation, you should focus on the paper's modeling contribution and any empirical tests related to this. Make sure to go over the important derivations in the paper (try not to skip steps so your classmates will understand the material). Some papers have sections dealing with continuous time models – you can skip over these (or discuss them if you feel comfortable).
- Each group will have 1 hour to present. People are strongly encouraged to ask questions during the presentations.

- You can select papers from the list below, or from any paper we did not cover from the readings lists for the lectures (above), or another *relevant* paper of your choosing.
- The few paper marked with * strike me as particularly interesting.

Consumption-based pricing models

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

> Deviate from REE by allowing investors to learn about state dynamics from past prices. Even with time separable preferences, this model matches return volatilities, persistence of P/D ratios, and predictability of long-horizon returns.

Ai, H. and R. Bansal, 2018, "Risk preferences and the macroeconomic announcement premium," *Econometrica*, 86 (4), 1383–1430.

Albuquerque, R., M. Eichenbaum, V. Luo, and S. Rebelo, 2016, "Valuation risk and asset pricing," *Journal of Finance*, 71 (6), 2861–2903.

Bai, H., K. Hou, H. Kung, E. Li, and L. Zhang, 2019, "The CAPM strikes back? An equilibrium model with disasters," *Journal of Financial Economics*, 131 (2), 269–298.

Drew-Becker, I., S. Giglio, and B. Kelly, 2019, "Hedging macroeconomic and financial uncertainty and volatility," *NBER Working Paper No. 26323*.

Bekaert, G., E. Engstrom, and Y. Zing, 2009, "Risk, uncertainty, and asset prices," *Journal of Financial Economics*, 91, 59–82.

> A habit model with exogenous shocks, i.e., variation in habit unrelated to consumption growth.

Collin-Dufresne, P., M. Johannes, and L. Lochstoer, 2016, "Parameter learning in general equilibrium: The asset pricing implications," *American Economic Review*, 106 (3), 664–698.

Constantinides, G. and A. Ghosh, 2016, "Asset pricing with countercyclical household consumption risk," *Journal of Finance*, 72 (1), 415–460.

> Combines Constantinides and Duffie (1996) with recursive preferences.

Gabaix, X., 2009, "Linearity-generating processes: A modelling tool yielding closed forms for asset prices," working paper.

Gabaix, X., 2012, "Variable rare disasters: An exactly solved framework for ten puzzles in macro-finance," *Quarterly Journal of Economics*, 127, 645–700.

If you present the Gabaix paper, you can focus on the part that deals with power utility. The part on Epstein-Zin preferences (in Section V) can be skipped.

Kaltenbrunner, G. and L. Lochstoer, 2010, "Long-run risk through consumption smoothing," *Review of Financial Studies*, 23 (8), 3190–3224.

Investment-based asset pricing

Cochrane, J., 1991, "Production-based asset pricing and the link between stock returns and economic fluctuations," *Journal of Finance* 46, 209–237.

Hou, K., C. Xue, and L. Zhang, 2015, "Digesting anomalies: An investment approach," *Review of Financial Studies*, 28 (3), 650–705.

Characteristics of SDF

Cochrane, J. and J. Saa-Requejo, 2000, "Beyond arbitrage: Good-deal asset price bounds in incomplete markets," *Journal of Policitical Economy*, 108 (1), 79–119.

Haddad, V., S. Kozak, and S. Santosh, 2020, "Factor timing," *Review of Financial Studies*, 33 (5), 1980–2018.

Kozak, S., S. Nagel, and S. Santosh, 2018, "Interpreting factor models," *Journal of Finance*, 73 (3), 1183–1223.

Martin, I., 2013, "Consumption-based asset pricing with higher cumulants," *Review of Economic Studies*, 80, 745–773.

Martin, I. and C. Wagner, 2019, "What is the expected return on a stock," *Journal of Finance*, 74 (4), 1887–1930.

Intermediary asset pricing and other institutional frictions

Brunnermeier, M. and Y. Sannikov, 2014, "A macroeconomic model with a financial sector," *American Economic Review*, 104, 379–421.

*Brunnermeier, M. and Y. Sannikov, 2016, "Macro, money and finance: A continuous-time approach," *Handbook of Macroeconomics*, 2, 1497–1545.

*Gabaix, X. and R. Koijen, 2021, "In Search of the Origins of Financial Fluctuations: The Inelastic Markets Hypothesis," working paper.

He, Z. and A. Krishnamurthy, 2013, "Intermediary asset pricing," *American Economic Review*, 103 (2), 732–770.

Applications to non-equity or to international asset classes

Bansal, R. and I. Shaliastovich, 2013, "A long-run risks explanation of predictability puzzles in bond and currency markets," *The Review of Financial Studies*, 26 (1), 1–33.

Backus, D., N. Boyarchenko and M. Chernov, 2018, "Term structure of asset prices and returns," *Journal of Financial Economics*, 129, 1–23.

Brusa, Ramadorai, and Verdelhan, 2017, "International CAPM redux," working paper.

Gormsen, N. and R. Koijen, 2020, "Coronavirus: Impact on stock prices and growth expectations," *Review of Asset Pricing Studies*, 10 (4), 574–597.

*Jorda, O., M. Schularick, and A. Taylor, 2019, "The total risk premium puzzle," *NBER Working Paper No. 25653*.

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

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

Insights from log-linearization

Ang, A. and G. Bekaert, 2006, "Stock return predictability: Is it there?" *Review of Financial Studies*, 20 (3), 651–707.

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

Lettau, M. and S. Ludvigson, 2001, "Resurrecting the (C)CAPM: A cross-sectional test when risk premia are time-varying," *Journal of Political Economy*, 109 (6), 1238–1287.

Cross-sectional and other empirical tests

Bansal, R., D. Kiku, and A. Yaron, 2016, "Risks for the long run: Estimation with time aggregation," *Journal of Monetary Economics*, 82, 52–69.

Campbell, J. and T. Vuolteenaho, 2004, "Bad beta, good beta," *American Economic Review*, 94 (5), 1249–1275.

Campbell, J., S. Giglio, C. Polk, and R. Turley, 2018, "An intertemporal CAPM with stochastic volatility," *Journal of Financial Economics*, 128, 207–233.

Giglio, S., M. Maggiori, J. Stroebel, and S. Utkus, 2019, "Five facts about beliefs and portfolios," working paper.

Nakamura, E., J. Steinsson, R. Barro, and J. Ursua, 2013, "Crises and recoveries in an empirical model of consumption disasters," *American Economic Journal: Macroeconomics*, 5 (3), 35–74.

Consumption-based cross-sectional tests

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)

Malloy, C., T. Moskowitz, and A. Vissing-Jorgensen, 2009, "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., 2003, "Consumption risk and expected stock returns," *American Economic Review*, 93 (2), 376–382. (measure consumption over a longer time horizon that one quarter)

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)

Table 1: **Schedule.**

Class	Fall 2023	Topic	HW	Due Date
01	Fri Sep 8	Introduction: CAPM, Arrow-Debreu, SDF[†]	1	Fri Sep 22
02	Fri Sep 15	Law of one price, SDF, Hansen-Jagannathan bounds		
03	Fri Sep 22	Properties of SDF; Dynamic programming	2	Fri Oct 6
04	Fri Sep 29	Consumption asset pricing and its empirical flaws		
05	Fri Oct 6	Recursive preferences and ICAPM	3	Fri Oct 27
06	Fri Oct 13	ICAPM conclude and long-run risks		
	Fri Oct 20	– no class –		
07	Fri Oct 27	Habit formation and continuous time preliminaries	4	Fri Nov 10
08	Fri Nov 3	Continuous time habit and disaster risk		
09	Fri Nov 10	Incomplete markets and variance decomposition	5	Fri Dec 1
10	Fri Nov 17	Reduced form SDF & divd. strips; Fixed income intro		
	Fri Nov 24	– no class –		
11	Fri Dec 1	Fixed income models	6	Mon Dec 11
12	Fri Dec 8	Fixed income models (finish); Currency models		
	TBD	Final exam held in TBD at TBD		

[†]SDF $\equiv$ stochastic discount factor

Table 2: **Homework topics.**

1. Stochastic discount factor
2. Dynamic programming
3. Bonds and generalized preferences
4. Habits and long-run risks
5. Disaster risk, var. decomp., divd. strips
6. Fixed income and currencies