ECON-GA 2021 — Financial Economics I Professor: Jaroslav Borovička TA: Fall 2022

ECON-GA 2021 — Financial Economics I

NYU, Fall 2019 — Asset Pricing Theory

Jaroslav Borovička

Syllabus

Lecture:19 W 4th Street, room 736Mon 2 – 5 pmOffice hours:19 W 4th Street, room 714open door / by appointment

1 Course description

The purpose of this course to provide an introduction to the frontier of research in asset pricing theory. We will cover technical tools and modeling strategies that will help us understand the empirical predictions of various modern asset pricing models.

2 Course requirements and grading

This course is intended for PhD students who are interested in more advanced modeling in asset pricing and macroeconomics. I will put more weight on topics which you are less likely to encounter in more 'standard' asset pricing courses. Sydney Ludvigson's course and/or courses at Stern finance are recommended complements that will introduce you to the broader literature, although I do not require these courses as a pre-requisite.

There will be a take-home exam at the end of the course. I will also ask you to replicate the results of a recent paper that fits the topics and the level of the material covered in the course.

3 Reading and other material

This section is ongoing work in progress. Main texts:

- Duffie (2001) *Dynamic Asset Pricing Theory*. Highly recommended for the first part of the course.
- Øksendal (2007) *Stochastic Differential Equations*. Covers a lot of technical detail, including well beyond the scope of this course. A mainly mathematical text with some finance applications.
- Ljungqvist and Sargent (2018) *Recursive Macroeconomic Theory*. Selected chapters on asset pricing in complete and incomplete market setups from the macroeconomic perspective in an accessible and familiar format.

Other major texts providing additional background:

- Cochrane (2005) *Asset Pricing*. A standard text frequently used in introductory courses, less technical with more focus on economic substance.
- Hansen and Sargent (2008) *Robustness*. A comprehensive treatment of decision-making under uncertainty.
- Campbell (2018) *Financial Decisions and Markets*. A more recent asset pricing textbook that also treats new research trends.
- Karatzas and Shreve (1991) *Brownian Motion and Stochastic Calculus*. There are many books that deal with continuous-time stochastic calculus. This is one of the standard references. Other textbooks include Karatzas and Shreve (1998) or Revuz and Yor (1999).
- Karlin and Taylor (1981) *A Second Course in Stochastic Processes*. A transparent treatment of special topics including Kolmogorov equations.

4 Course outline

This section is ongoing work in progress.

4.1 Mathematical preliminaries

- Foundations of asset pricing (Duffie (2001), chapters 1–4). Arbitrage-free pricing in static models; risk-neutral probabilities; equilibrium asset pricing; dynamic programming; stochastic discount factors.
- Introduction to continuous-time calculus (Duffie (2001), chapter 5 and appendix, Øksendal (2007), chapters 1–4; Karlin and Taylor (1981), chapter 15). Construction of the Brownian motion; diffusions; Ito's lemma; boundary behavior; Kolmogorov equation; Feynman-Kac formula, change of measure.
- Arbitrage pricing in continuous time (Duffie (2001), chapter 6). Decentralization, arbitrage, Black-Scholes formula.

- primary: Harrison and Kreps (1979), Black and Scholes (1973), Merton (1973b)
- secondary: Harrison and Pliska (1981), Dybvig and Huang (1988), Cox and Ross (1976), Ross (1978), Merton (1977), Heston (1993)

4.2 Introduction to numerical methods

• Finite difference methods and other approaches (Judd (1998), Holmes (2007), Candler (2001), Cox et al. (1979))

4.3 Portfolio allocation and equilibrium with complete markets

- **Porfolio allocation and consumption choice** (Duffie (2001), chapter 9). Merton's problem, martingale approach.
 - Merton (1971), Cox and Huang (1989)
- **Equilibrium economies** (Duffie (2001), chapter 10). Endowment economy model; consumption CAPM; the role of state variables and predictability.
 - Merton (1973a), Breeden (1979), Hansen and Jagannathan (1991)

4.4 Recursive preferences, ambiguity and robustness

- **Recursive preferences and preference for timing of uncertainty**. Nonseparabilities in preferences and
 - Kreps and Porteus (1978), Epstein and Zin (1989), Duffie and Epstein (1992)
- Robust preferences (Hansen and Sargent (2008))
- Ambiguity aversion
- 4.5 Learning
 - Filtering problems in continuous-time
 - Robust learning

4.6 Rational inattention, costly information, and information aggregation

- Rational inattention in asset pricing
- Information aggregation models

4.7 Constraints, frictions, and heterogeneous agents

- Consumption allocations with multiple classes of agents
 - Chan and Kogan (2002), Dumas (1989), Dumas et al. (2000), Yan (2008), Borovička (2013)
- Financial markets with constraints
 - Luttmer (1996)
- Macroeconomic models with financial frictions
 - Brunnermeier and Sannikov (2014), He and Krishnamurthy (2012), He and Krishnamurthy (2012c), Di Tella (2012)

4.8 New methods in asset pricing theory

- Valuation decompositions
 - Alvarez and Jermann (2005), Hansen and Scheinkman (2009), Hansen (2012), Backus et al. (2013), Borovička et al. (2014a)
- Shock elasticities, nonlinear impulse response functions
 - Borovička et al. (2011), Borovička et al. (2014b)
- Large deviation methods
 - Varadhan (1967), Fournié et al. (1997), Stutzer (2003), E et al. (2004), Borovička et al. (2013)

References

- Alvarez, Fernando and Urban J. Jermann (2005) "Using Asset Prices to Measure the Persistence of the Marginal Utility of Wealth," *Econometrica*, 73 (6), 1977–2016.
- Backus, David K., Mikhail Chernov, and Stanley E. Zin (2013) "Sources of Entropy in Representative Agent Models," Forthcoming in Journal of Finance.
- Black, Fischer and Myron Scholes (1973) "The Pricing of Options and Corporate Liabilities," *Journal of Political Economy*, 81 (3), 637–654.
- Borovička, Jaroslav (2013) "Survival and Long-Run Dynamics with Heterogeneous Beliefs under Recursive Preferences."
- Borovička, Jaroslav, Lars Peter Hansen, Mark Hendricks, and José A. Scheinkman (2011) "Risk-Price Dynamics," *Journal of Financial Econometrics*, 9 (1), 3–65.

- Borovička, Jaroslav, Lars Peter Hansen, and José A. Scheinkman (2013) "Pricing Rare Events," Mimeo.
- (2014a) "Misspecified Recovery," Mimeo.

— (2014b) "Shock Elasticities and Impulse Responses," *Mathematics and Financial Economics*, 8 (4), 333–354.

- Breeden, Douglas T. (1979) "An Intertemporal Asset Pricing Model with Stochastic Consumption and Investment Opportunities," *Journal of Financial Economics*, 7 (3), 265–296.
- Brunnermeier, Markus K. and Yuliy Sannikov (2014) "A Macroeconomic Model with a Financial Sector," *American Economic Review*, 104 (2), 379–421.
- Campbell, John Y. (2018) *Financial Decisions and Markets: A Course in Asset Pricing*: Princeton University Press.
- Candler, Graham V. (2001) "Finite-Difference Methods for Continuous-Time Dynamic Programming," in *Computational Methods for the Study of Dynamic Economies*, Chap. 8, 172– 194: Oxford University Press.
- Chan, Yeung Lewis and Leonid Kogan (2002) "Catching Up with the Joneses: Heterogeneous Preferences and the Dynamics of Asset Prices," *Journal of Political Economy*, 100 (6), 1255–1285.
- Cochrane, John H. (2005) Asset Pricing: Princeton University Press, Revised Edition.
- Cox, John C. and Chi-fu Huang (1989) "Optimal Consumption and Portfolio Policies when Asset Prices Follow a Diffusion Process," *Journal of Economic Theory*, 49 (1), 33–83.
- Cox, John C. and Stephen A. Ross (1976) "The Valuation of Options for Alternative Stochastic Processes," *Journal of Financial Economics*, 3 (1–2), 145–166.
- Cox, John C., Stephen A. Ross, and Mark Rubinstein (1979) "Option Pricing: A Simplified Approach," *Journal of Financial Economics*, 7 (3), 229–263.
- Di Tella, Sebastian (2012) "Uncertainty Shocks and Balance Sheet Recessions."
- Duffie, Darrell (2001) Dynamic Asset Pricing Theory: Princeton University Press, 3rd edition.
- Duffie, Darrell and Larry G. Epstein (1992) "Asset Pricing with Stochastic Differential Utility," *Review of Financial Studies*, 5 (3), 411–436.
- Dumas, Bernard (1989) "Two-Person Dynamic Equilibrium in the Capital Market," *The Review of Financial Studies*, 2 (2), 157–188.
- Dumas, Bernard, Raman Uppal, and Tan Wang (2000) "Efficient Intertemporal Allocations with Recursive Utility," *Journal of Economic Theory*, 93 (2), 240–259.
- Dybvig, Philip H. and Chi-fu Huang (1988) "Nonnegative Wealth, Absence of Arbitrage, and Feasible Consumption Plans," *Review of Economic Studies*, 1 (4), 377–401.

- E, Weinan, Weiqing Ren, and Eric Vanden-Eijnden (2004) "Minimum Action Method for the Study of Rare Events," *Communications in Pure Applied Mathematics*, 57 (5), 637–656.
- Epstein, Larry G. and Stanley E. Zin (1989) "Substitution, Risk Aversion, and the Temporal Behavior of Consumption and Asset Returns: A Theoretical Framework," *Econometrica*, 57 (4), 937–969.
- Fournié, Eric, Jean-Michel Lasry, and Pierre-Louis Lions (1997) "Some Nonlinear Methods for Studying Far-from-the-money Contingent Claims," in *Numerical Methods in Finance*, 115–145: XX.
- Hansen, Lars Peter (2012) "Dynamic Valuation Decomposition within Stochastic Economies," *Econometrica*, 80 (3), 911–967.
- Hansen, Lars Peter and Ravi Jagannathan (1991) "Implications of Security Market Data for Models of Dynamic Economies," *Journal of Political Economy*, 99 (2), 225–262.
- Hansen, Lars Peter and Thomas J. Sargent (2008) *Robustness*: Princeton University Press, Princeton, New Jersey.
- Hansen, Lars Peter and José A. Scheinkman (2009) "Long Term Risk: An Operator Approach," *Econometrica*, 77 (1), 177–234.
- Harrison, J. Michael and David M. Kreps (1979) "Martingales and Arbitrage in Multiperiod Securities Markets," *Journal of Economic Theory*, 20 (3), 381–408.
- Harrison, J. Michael and Stanley R. Pliska (1981) "Martingales and Stochastic Integrals in the Theory of Continuous Trading," *Stochastic Processes and their Applications*, 11 (3), 215–260.
- He, Zhiguo and Arvind Krishnamurthy (2012) "A Model of Capital and Crises," *Review of Economic Studies*, 79 (2), 735–777.
- (2012c) "A Macroeconomic Framework for Quantifying Systemic Risk."
- Heston, Steven L. (1993) "A Closed-Form Solution for Options with Stochastic Volatility with Applications to Bond and Currency Options," *Review of Financial Studies*, 6 (2), 327–343.
- Holmes, Mark H. (2007) Introduction to Numerical Methods in Differential Equations: Springer.
- Judd, Kenneth L. (1998) Numerical Methods in Economics: The MIT Press, Cambridge, MA.
- Karatzas, Ioannis and Steven E. Shreve (1991) *Brownian Motion and Stochastic Calculus*: Springer, 2nd edition.
- (1998) *Methods of Mathematical Finance*: Springer.
- Karlin, Samuel and Howard M. Taylor (1981) A Second Course in Stochastic Processes: Academic Press.

- Kreps, David M. and Evan L. Porteus (1978) "Temporal Resolution of Uncertainty and Dynamic Choice Theory," *Econometrica*, 46 (1), 185–200.
- Ljungqvist, Lars and Thomas J. Sargent (2018) *Recursive Macroeconomic Theory*: The MIT Press, 4th edition.
- Luttmer, Erzo G. J. (1996) "Asset Pricing in Economies with Frictions," *Econometrica*, 64 (6), 1439–1467.
- Merton, Robert C. (1971) "Optimum Consumption and Portfolio Rules in a Continuoustime Model," *Journal of Economic Theory*, 3 (4), 373–413.
- (1973a) "An Intertemporal Capital Asset Pricing Model," *Econometrica*, 41 (5), 867–887.
- (1973b) "Theory of Rational Option Pricing," *Bell Journal of Economics and Management Science*, 4 (1), 141–183.
- (1977) "Option Pricing When Underlying Stock Returns Are Discontinuous," *Journal of Financial Economics*, 3 (1–2), 125–144.
- Øksendal, Bernt (2007) Stochastic Differential Equations: Springer Verlag, 6th edition.
- Revuz, Daniel and Marc Yor (1999) *Continuous Martingales and Brownian Motion*: Springer-Verlag, 3rd edition.
- Ross, Stephen A. (1978) "A Simple Approach to the Valuation of Risky Streams," *Journal of Business*, 51 (3), 453–475.
- Stutzer, Michael (2003) "Portfolio Choice with Endogenous Utility: A Large Deviation Approach," *Journal of Econometrics*, 116 (1–2), 265–386.
- Varadhan, S. R. Srinavasa (1967) "Diffusion Processes in a Small Time Interval," Communications on Pure and Applied Mathematics, 20 (4), 659–685.
- Yan, Hongjun (2008) "Natural Selection in Financial Markets: Does It Work?" *Management Science*, 54 (11), 1935–1950.