CEMA 2009 Summer School

Economic Dynamics

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Course Overview This course introduces the theory and application of dynamic optimization and equilibrium analysis in discrete time. It aims at providing necessary techniques for graduate students to analyze economic dynamics. The topics focus on analyzing and solving discrete-time dynamic programming problems in economics and finance. We will put more emphasis on applications by solving many economic examples such as consumption/savings, investment, optimal growth, industry dynamics, job search, recursive utility, portfolio choice, and asset pricing. We will also study computational methods because they become important in economics and finance. We will focus on the log-linear and second-order approximation methods (Dynare), discrete state space method (value function iteration), and the projection method. The best way to learn computational methods is learning-by-doing. Thus, students are expected to complete a computation project.

Textbooks Teaching will be based mostly on the textbook and my lecture notes. I will produce lecture notes that will be made available on the course web site. The following textbook is required, which can be purchased from internet bookstores such as Amazon or Barnes&Nobel.

- Stokey, N. and R.E. Lucas with E. Prescott, 1989, Recursive Methods in Economic Dynamics, Harvard University Press. (SLP)

The following books are highly recommended. You may find them from internet bookstores.

- Adda, J. and R. Cooper, 2003, Dynamic Economics: Quantitative Methods and Applications, The MIT Press.
- Judd, K., 1998, Numerical Methods in Economics, Cambridge, MA: MIT Press
- Lundquist, Lars and Thomas J. Sargent, 2004, Recursive Macroeconomic Theory, 2nd edition, MIT Press.
- Miranda, M.J. and P.L. Fackler, 2002, Applied Computational Economics and Finance, MIT Press.

COURSE OUTLINE

1 Deterministic Models

SLP Chapters 3-6

1.1 Mathematical Preliminaries

- Metric spaces
- Contraction mapping theorem
- The theorem of the maximum

1.2 Dynamic Programming under Certainty

- Bellman equation
- Euler equation

1.3 Deterministic Dynamics

- Linear system and linear approximation

1.4 Applications

- Growth models
- Consumption-savings problem
- Investment with convex adjustment costs

2 Stochastic Models

SLP Chapters 7-13.

2.1 Mathematical Preliminaries

- Measure theory and integration
- Markov processes

2.2 Stochastic Dynamic Programming

- Bellman equation
- Euler equation
- Policy functions and transition functions

2.3 Convergence of Markov Processes

- Strong convergence
- Weak convergence

2.4 Applications

- Optimal growth (RBC)
- Consumption-savings problem
- Bewley model (Aiyagari (1994))
- Firm dynamics (Hopenhayn (1992), Hopenhayn and Rogerson (1994), Gourio and Miao (2008))
- Investment with convex/nonconvex adjustment costs (Cooper and Haltiwanger (2005))
- Recursive utility (Epstein and Zin (1989), Backus et al. (2004))
- Portfolio choice and asset pricing (Chen, Ju and Miao (2008), Ju and Miao (2008))

3 Numerical Methods

- (Log) linear and second-order approximation
- Value function iteration (interpolation)
- Projection method

References

S.R. Aiyagari, Uninsured Idiosyncratic Risk and Aggregate Saving, Quarterly Journal of Economics, 109 (1994) 659-684.

Ang, Andrew, Geert Bekaert, and Jun Liu, Why Stocks May Disappoint, Journal of Financial Economics, v76, n3, 471-508, June, 2005.

Backus, David, Bryan Routledge, and Stanley Zin, 2004, Exotic Preferences for Macroeconomists, NBER Macroeconomic Annual.

Bekaert, Geert, Robert J. Hodrick, and David A. Marshall, 2001, The implications of first-order risk aversion for asset market risk premiums, Journal of Monetary Economics 40, 3-39.

Blanchard, Olivier J. and Charles M. Kahn, 1980, The Solution of Linear Difference Models under Rational Expectations, Econometrica 48, 1305-1311.

Chen, Hui, Nengjiu Ju and Jianjun Miao, 2008, Dynamic Asset Allocation with Ambiguous Predictability, working paper, Boston University.

Cooper, Russell, and John Haltiwanger, 2006, On the nature of capital adjustment costs, *Review of Economic Studies* 73, 611-633.

Epstein, Larry G. and Stanley Zin, 1989, Substitution, Risk Aversion and the Temporal Behavior of Consumption and Asset Returns: A Theoretical Framework, *Econometrica* 57, 937-969.

Gourio, Francois and Jianjun Miao, 2008, Firm Heterogeneity and the Long-Run Effects of Dividend Tax Reform, forthcoming in American Economic Journal: Macroeconomics

Hopenhayn, Hugo A., 1992, Entry, exit, and firm dynamics in long run equilibrium, *Econometrica* 60, 1127-1150.

Hopenhayn, Hugo A., and Richard Rogerson, 1993, Job turnover and policy evaluation: A general equilibrium analysis, *Journal of Political Economy* 101, 915-938.

Ju, Nengjiu and Jianjun Miao, 2007, Learning, Ambiguity, and Asset Returns, working paper, Boston University.

King, Robert G. and Mark W. Watson, 1998, The Solution of Singular Linear Difference Systems Under Rational Expectations, International Economic Review 39, 1015-1026.

Klein, Paul, 2000, Using the Generalized Schur Form to Solve a Multivariate Linear Rational Expectations Model, Journal of Economic Dynamics and Control 24, 1405-1423.

Schmitt-Grohe S. and M. Uribe, 2004, Solving Dynamic General Equilibrium Models Using a Second-Order Approximation to the Policy Function, *Journal of Economic Dynamics and Control* 28, 645-858.