Econ 606: Graduate Macroeconomics (II)

Georgetown University
Jinhui Bai
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Instructor: Jinhui Bai, ICC 557, 202-687-0935, jb543@georgetown.edu.

Teaching Assistant: Kai Du (kd225@georgetown.edu).

Time and Location: T, Th 4:15 - 5:30pm, ICC 116.

Instructor Office Hours: Wednesday 1:30pm - 3:30pm or by appointment, ICC 557.

TA Office Hours: Thursday 2pm - 4pm, Science Library, 3rd Fl. Reiss building.

TA Recitation Session: Monday 7:40-8:55pm, ICC 119. Kai will go over the answers to the homework assignment. The first TA recitation meeting is on Monday, January 22.

Course Description:

The goal of the course is to introduce students to the dynamic stochastic general equilibrium (DSGE) models. The course will teach students the key aspects of dynamic programming and the formulation and solution of *Sequential Competitive Equilibrium* and *Recursive Competitive Equilibrium* (or sometimes called *Stationary Markov Equilibrium*). We will apply these techniques and equilibrium concepts to a variety of topics, including growth, business cycles, labor market, asset pricing, wealth distribution, fiscal policy and monetary policy.

There will be relatively little emphasis on empirical macroeconomics. But we will emphasize basic computational methods of dynamic programming and competitive equilibrium. Several homework will involve using the standard programming languages (e.g., MATLAB or GAUSS) to compute solutions to dynamic programming problems and the recursive competitive equilibrium. An introduction to MATLAB will be given at an appropriate time. Although I will write and distribute the (MATLAB) code to solve these problems, you should at least know enough about one of these languages to play around with my code.

After completing the course, students should be able to understand the basic language of the mainstream literature of modern dynamic macroeconomics.

Recommended Textbooks:

(a) Ljungqvist, L., Sargent, T., 2004. *Recursive Macroeconomic Theory*, Second Edition, MIT Press. The solution to the problems in the *LS* book is freely available on the internet (http://pages.stern.nyu.edu/~svnieuwe/pdfs/masterex.pdf). The MATLAB programs for selected models in the *LS* book is freely available on the link "ftp://zia.stanford.edu/pub/sargent/webdocs/mitbook".

(b) Stokey, N., Lucas, R.E., Jr., with E. Prescott, 1989. *Recursive Methods in Economic Dynamics*, Harvard University Press.

These two books will be referred to as *LS* and *SLP,* respectively.

Other Useful References:

[1] Blanchard, O., Fischer, S., 1989. Lectures on Macroeconomics. MIT Press.

[2] Chow, Gregory, 1997. Dynamic Economics: Optimization by the Lagrange Method. New York: Oxford University Press.

[3] Cooley, Thomas F., 1995. Frontiers of Business Cycle Research. Princeton, NJ: Princeton University Press.

[4] Romer, D., 2006. Advanced Macroeconomics. Third Edition, McGraw-Hill.

[5] Sargent, T., 1987, Dynamic Macroeconomic Theory. Harvard University Press.

[6] Sargent, T., 1987, Macroeconomic Theory. Second Edition, Academic Press.

Course Website: Georgetown University Blackboard (http://campus.georgetown.edu). I will post class announcement, lecture notes (slides), problem sets, answers to problem sets, and additional readings to the website.

Grading and Exams: There will be weekly assignments, a midterm exam and a final. They will count toward the grade as follows.

Assignments	Midterm	Final
20%	30%	50%

There will be around 10 Problem sets for the course. The assignments are due in class before the lecture at the announced date (typically Thursday). Homework assignments will be graded according to the following scale: $\checkmark+$, $\checkmark$, $\checkmark-$, 0. Late problem sets will receive a grade of **zero**. To allow for the possibility of unexpected emergency, I will drop one lowest homework score in calculating your final grade. Group discussion in solving the homework assignments is strongly encouraged, but each student is expected to write his/her own answers and in his/her own words.

The midterm exam is currently scheduled to be in class on **March 1, 2007** (Thursday). The final exam will take place at 4:00pm-6:00pm on **May 7, 2007** (Monday). The final exam is cumulative. Both exams will be open-book and open-notes.

Additional Readings: In addition to readings from the textbook, readings from academic publications will occasionally be posted to the course web site whenever necessary. Because the lectures cover only the key points of each topic, reading and studying the textbook and the assigned papers in a timely fashion is an essential part of the course.

Course Outline

The lecture is planned to cover Parts I - V below. Parts VI - VIII are optional. The schedule is subject to change.

I. Introduction (1 lecture)

1. Continuous time versus discrete time
2. Set up of the discrete time neoclassical growth model

II. Stochastic Growth Model and Discrete-time (Stochastic) Optimization Methods

1. Finite-Period Deterministic Problem

(a) Sequential method (Lagrange): Kuhn-Tucker and Shooting Algorithm
(b) Principle of Optimality and recursive method (dynamic programming)

2. Infinite-Period Deterministic Problem

(a) Sequential method (Lagrange)
(b) Principle of Optimality and recursive method (dynamic programming)
(c) Contraction Mapping theorem and Blackwell's sufficient condition
(d) Solution methods for dynamic programming
(e) Relationship between Infinite-period and Finite-Period problem

3. Approximation Methods

(a) Two Euler-equation-based methods: Shooting Algorithm and (log) linearization
(b) A simple value-function based method: Discrete state value function iteration

4. Markov process and stochastic dynamic programming

(a) Representation of uncertainty: event tree and probability space
(b) Markov process
(c) Sequential versus recursive methods

5. Approximation Methods again

(a) A simple Euler-equation-based method: linearization around steady state
(b) A simple value-function based method: Discrete state value function iteration

6. Solution and Simulation of Real Business Cycles (RBC) model

7. (Optional) Continuous-time dynamic programming versus optimal control

Readings: *LS* Chapter 2, 3, 4, 6; *SLP* Chapter 2, 3, 4.

III. Labor Search Model

1. Basic model
2. Computational method

Readings: *LS* Chapter 6

IV. Dynamic Stochastic General Equilibrium (DSGE) with Complete Markets

1. Two-Period pure exchange economy: formulation

(a) DSGE with complete commodity markets: Date-zero trading
(b) DSGE with complete asset markets: sequential competitive equilibrium
(c) (Consumption) equivalence of two equilibrium results
(d) Equivalence of competitive equilibrium and planning problem

2. Two-Period pure exchange economy: Characterization

(a) Consumption correlation
(b) Asset pricing

3. Infinite-Horizon pure exchange economy: formulation

(a) DSGE with complete commodity markets: Date-zero trading
(b) DSGE with complete asset markets: sequential competitive equilibrium
(c) DSGE with complete asset markets: "recursive" competitive equilibrium
(d) Equivalence of equilibrium and planning problem

4. Infinite-Horizon pure exchange economy: Characterization

(a) Consumption correlation
(b) Asset Pricing for one-period security
(c) Asset pricing for long-lived security: Lucas (1978) asset pricing model
(d) Quantitative evaluation: Mehra-Prescott (1985) equity premium puzzle

5. Two-period and Infinite-Horizon Production economy: Formulation

(a) DSGE with complete commodity markets: Date-zero trading
(b) DSGE with complete asset markets: sequential competitive equilibrium
(c) DSGE with complete asset markets: recursive competitive equilibrium
(d) Welfare properties

Readings: *LS* Chapter 8, 12, 13.

V. DSGE with Incomplete Asset Markets

1. Two-Period models

(a) Exchange Economy: sequential versus recursive equilibrium
(b) Production economy with a representative neoclassical firm
(c) Welfare properties of incomplete market equilibrium
(d) Two-Period incomplete market economy with Malinvaud (1973) idiosyncratic risk
(e) Arrow Securities versus mutual insurance contracts with idiosyncratic risk

2. Infinite-Horizon model with Idiosyncratic Labor Income Risk: Bewley Economies

(a) Storage economy: Imrohoroglu (1989)
(b) Pure exchange economy: Huggett (1993)

(c) Neoclassical growth model: Aiyagari (1994), Huggett (1997), Krusell and Smith (1998)

Readings: *LS* Chapter 16, 17.

The following topics will be covered only if we have time.

VI. Overlapping-Generations (OLG) Models

1. Samuelson (1958) pure-exchange economy

2. Diamond (1965) growth model

Readings: *LS* Chapter 9.

VII. Monetary competitive equilibrium model

1. Hahn problem in a finite-period economy

2. Bewley-Townsend Model

3. Sidrauski Money-in-the-Utility and Shopping Time Model

4. Lucas-Stokey (1987) Cash-Credit Goods model

5. Monetary Growth model: Cooley-Hansen (1989)

Readings: *LS* Chapter 24, 25; Nakajima and Polemarchakis (2005)

VIII. Optimal Fiscal Policy with Commitment

1. Ricardian equivalence with lump-sum and history-dependent distortionary taxation

2. Chamley-Judd optimal taxation result

3. Brief introduction to optimal taxation in the Bewley models: Aiyagari and McGrattan (1998), Heathcote (2005)

Readings: *LS* Chapter 10, 11, 15.

References

[1] Aiyagari, R., 1994. Uninsured idiosyncratic risk and aggregate saving. Quarterly Journal of Economics 109, 659-684.

[2] Aiyagari, R., McGrattan, E., 1998. The optimum quantity of debt. Journal of Monetary Economics 42, 447-469.

[3] Bassetto, M., Kocherlakota, N., 2004. On the irrelevance of government debt when taxes are distortionary. Journal of Monetary Economics 51, 299-304.

[4] Bewley, T., 1977. The permanent income hypothesis: A theoretical formulation. Journal of Economic Theory 16, 252-292.

[5] Bewley, T., 1980. The optimum quantity of money, in Models of Monetary Economics, ed. by John Kareken, Neil Wallace, Minneapolis, Minnesota.

[6] Bewley, T., 1983. A difficulty with the optimum quantity of money, Econometrica, 51, 1485-1504.

[7] Bewley, T., 1986. Stationary monetary equilibrium with a continuum of independently fluctuating consumers, in: Hildenbrand, W., Mas-Colell, A. (Eds.), Contributions to Mathematical Economics in Honor of Gerard Debreu. North-Holland, pp. 79-102.

[8] Cooley, T.F., Hansen, G., 1989. The inflation tax in a real business cycle model. American Economic Review 79, 733-748.

[9] Deaton, A., 1991. Saving and liquidity constraints. Econometrica 59, 1221-1248.

[10] Duffie, D., J. Geanakoplos, A. Mas-Collel, A. McLennan, 1994, "Stationary Markov Equilibrium," Econometrica, 62, pp.745-781.

[11] Geanakoplos, J. and H. Polemarchakis, 1986, Existence, regularity, and constrained suboptimality of competitive allocations when the asset market is incomplete, in: W.P. Heller, R.M. Ross and D.A. Starrett, eds., Uncertainty, information and communication, essays in honor of Kenneth J. Arrow, Vol. III (Cambridge University Press, Cambridge).

[12] Geanakoplos, J., M. Magill, M. Quinzii, and J. Dreze, 1990, "Generic inefficiency of stock market equilibrium when markets are incomplete," Journal of Mathematical Economics 19, 113-151.

[13] Hansen, Gary D., 1985. Indivisible labor and the business cycles. Journal of Monetary Economics 16, 309-327.

[14] Heathcote, J., 2005. Fiscal Policy with Heterogeneous Agents and Incomplete Markets. Review of Economic Studies 72, 161-188.

[15] Huggett, M., 1993. The risk-free rate in heterogeneous-agent incomplete-insurance economies. Journal of Economic Dynamics and Control 17, 953-969.

[16] Huggett, M., 1997. The One-Sector Growth Model with Idiosyncratic Shocks: Steady States and Dynamics. Journal of Monetary Economics 39, 385- 403.

[17] Imrohoroglu, A., 1989. Cost of business cycles with indivisibilities and liquidity constraints. Journal of Political Economy 97, 1364-1383.

[18] Imrohoroglu, A., 1992. The welfare cost of inflation under imperfect insurance. Journal of Economic Dynamics and Control 16, 79-91.

[19] Krusell, P., Smith, A.A., Jr., 1998. Income and wealth heterogeneity in the macroeconomy. Journal of Political Economy 106, 867-896.

[20] Lucas, R.E., Jr., 1978, Asset prices in an exchange economy, Econometrica 46, 1429-1445.

[21] Lucas, R.E., Jr., Stokey, N.L., 1987. Money and interest in a cash-in-advance economy. Econometrica 55, 491-513.

[22] Malinvaud, E., 1973. Markets for an exchange economy with individual risks. Econometrica 41, 383-410.

[23] Mehra, R., Prescott, E., 1985. The equity premium: A puzzle. Journal of Monetary Economics 15, 145-161.

[24] Nakajima, T. and H. M. Polemarchakis, 2005. Money and Price under uncertainty. Review of Economic Studies 72, 223-246.

[25] Townsend, R., 1980, Models of money with spatially separated agents, in Models of Monetary Economics, ed. by John Kareken, Neil Wallace, Minneapolis, Minnesota.

[26] Woodford, M., 1994. Monetary policy and price level determinacy in a cash-in-advance economy. Economic Theory 4, 345-380.