Macroeconomic Theory II (ECO-504) – Spring 2023

Heterogeneity and Market Incompleteness in Macroeconomics

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General Information

Lectures: Monday 10:40-12:10 and 2:40-4:10

Office Hours: By appointment, email me at `violante@princeton.edu`.

Preceptor: George Nikolakoudis, email: `gn3@princeton.edu`.

Homework: There will be weekly problem sets that are required for a passing grade. The problem sets are handed out on Monday and are due the next Monday. George will go over the solution on Wednesday during precept. You are allowed to cooperate with other students, but every student has to hand in his/her own uniquely written assignment.

Summary and Objectives

Summary: This last section of the core macro sequence is devoted to studying economies where agents are heterogeneous. These models are helpful to analyze a wide range of questions pertaining to business cycles, income distribution, asset pricing, consumption insurance, labor supply, the aggregate and redistributive effects of policies, etc. We will start with some "aggregation theorems" to show that in some cases (notably with complete markets) a representative agent still exists. Next, we will move towards economies with "incomplete markets" where agents can only borrow and save through a risk-free bond. We begin by characterizing in detail the individual problem. Next, we proceed to the description of the stationary equilibrium. Then, we study an incomplete-markets model with aggregate shocks. The last set of classes are devoted to defining economies where there is default in equilibrium, and economies with heterogeneous firms.

Objectives: The aim of this course is to learn: 1) this important class of macroeconomic models, and 2) how to solve numerically for the equilibrium of these economies, a necessary step to use these models for quantitative research.

Textbooks and Reading Material

In what follows $\star$ denote compulsory readings. All references to LS are compulsory.

Textbooks: The main textbook is *Recursive Macroeconomic Theory*, by Lars Ljungqvist and Tom Sargent (LS), MIT Press, latest edition. You will also use *Recursive Methods in Economic Dynamics*, by Stokey, Lucas, and Prescott (SLP), Harvard University Press, 1989.

Background readings: Three useful background readings for this course are:

- $\star$ Jonathan Heathcote, Kjetil Storesletten, and Gianluca Violante (2009). Quantitative Macroeconomics with Heterogeneous Households, *Annual Review of Economics*

- Guvenen, Fatih (2012). Macroeconomics with Heterogeneity: A Practical Guide, *Richmond Fed QR*
- Quadrini, Vincenzo and Jose-Victor Rios-Rull (2014). Inequality in Macroeconomics, *Handbook of Income Distribution*, chapter 14

Read them once at the beginning of the course, in that order. You'll probably find many of the sections hard to follow. Read them again at the end of the course, and you will see the light.

Course Outline

1. **A Brief History of Macroeconomics**
   A helicopter view of how the field of macroeconomics has evolved since its inception until today.

2. **Heterogeneity in the Neoclassical Growth Model with Complete Markets** (LS, 8)
   We discuss the assumptions on fundamentals under which, although households are heterogeneous in preferences and endowments, a representative agent exists. And we apply these results to the neoclassical growth model. We discuss the Negishi method. This methodology allows to calculate the competitive equilibrium prices and allocations of complete markets economies (in particular, economies for which the first welfare theorem holds) with heterogeneous households. This method proves to be particularly useful for those economies where aggregation does not hold, hence we cannot use the representative agent. We present one illustration of this method based on a paper by Maliar and Maliar.

   - ⋆ Gorman, W.M. (1953). Community preference fields. *Econometrica*
   - ⋆ Chatterjee, Satyajit (1994). Transitional dynamics and the distribution of wealth in a neoclassical growth model. *Journal of Public Economics*
   - Caselli Francesco, and Jaume Ventura (2000). A Representative Consumer Theory of Distribution. *American Economic Review*
   - Stiglitz, Joseph E. Distribution of Income and Wealth Among Individuals. *Econometrica*
   - Negishi, Takashi (1960). Welfare Economics and the Existence of Equilibrium for a Competitive Economy. *Metroeconomica*
   - ⋆ Constantinides George (1982). Intertemporal Asset Pricing with Heterogeneous Consumers and Without Demand Aggregation. *Journal of Business*
   - Ogaki, Masao (2003). Aggregation under Complete Markets. *Review of Economic Dynamics*
   - Maliar, Lilia and Serguei Maliar (2001). Heterogeneity in Capital and Skills in a Neoclassical Stochastic Growth Model. *Journal of Economic Dynamics and Control*

⋆ Maliar, Lilia and Serguei Maliar (2003). The Representative Consumer in the Neoclassical Growth Model with Idiosyncratic Shocks. *Review of Economic Dynamics*

3. **The Income Fluctuation Problem I** (LS, 18.14)
We discuss the empirical implications of full-insurance for consumption. We review the Permanent Income Hypothesis and we apply it to characterize the consumption-saving problem of a single-agent who faces a stochastic income stream and can trade only a risk-free bond. We introduce the notion of precautionary savings and relate it to the convexity of marginal utility (prudence).

   - Mace, Barbara (1991). Full Insurance in the Presence of Aggregate Uncertainty. *Journal of Political Economy*
   - ⋆ Cochrane, John (1991). A Simple Test of Consumption Insurance. *Journal of Political Economy*
   - Schulhofer-Wohl, Sam (2011). Heterogeneity and Tests of Risk Sharing. *Journal of Political Economy*
   - ⋆ Hall, Robert (1978). Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence. *Journal of Political Economy*
   - ⋆ Leland, H. (1968). Savings and Uncertainty: The Precautionary Demand for Saving. *Quarterly Journal of Economics*
   - ⋆ Sandmo Agnar (1970). The Effect of Uncertainty on Saving Decisions. *Review of Economic Studies*.
   - ⋆ Blundell, Richard and Ian Preston (1998). Consumption Inequality and Income Uncertainty. *Quarterly Journal of Economics*

4. **The Income Fluctuation Problem II** (LS, 17)
We introduce borrowing constraints and show that precautionary savings can arise even without prudence as long as borrowing constraints may bind in some state of the world. We then derive an important condition on the interest rate that guarantees that the optimal individual consumption sequence is bounded above, in presence of income uncertainty. If time permits, we will also see the continuous time formulation of the problem and show that its solution can be characterized more completely relative to the discrete time case.

   - Chamberlain, Gary and Charles Wilson (2000). Optimal Intertemporal Consumption under Uncertainty. *Review of Economic Dynamics*
   - ⋆ Kimball, Miles (1990). Precautionary Saving in the Small and in the Large, *Econometrica*
   - ⋆ Schechtman, J. (1976). An Income Fluctuation Problem. *Journal of Economic Theory*.

- ⋆ Schechtman J. and V. Escudero (1977). Some Results on An Income Fluctuation Problem. *Journal of Economic Theory*
- Sibley David (1975). Permanent and Transitory Income Effects in a Model of Optimal Consumption with Wage Income Uncertainty. *Journal of Economic Theory*
- Yaari, M. E. (1976). A Law of Large Numbers in the Theory of Consumer's Choice Under Uncertainty. *Journal of Economic Theory*
- Bewley, T. (1977). The Permanent Income Hypothesis: A Theoretical Formulation. *Journal of Economic Theory.*
- Achdou, Yves, Jiequn Han, Jean-Michel Lasry, Pierre-Louis Lions and Benjamin Moll (2017). Income and Wealth Distribution in Macroeconomics: A Continuous Time Approach.

5. **Numerical Techniques to Solve the Income Fluctuation Problem**
We present a set of simple numerical techniques to solve for the discrete-time consumption and saving policy functions in the recursive formulation of the income-fluctuation problem for the single-agent who self-insures by saving/borrowing through a risk-free bond. In particular, we study a very fast numerical method, called endogenous grid method.

   - ⋆ Tauchen, George (1986). Finite State Markov Chain Approximations to Univariate and Vector Autoregressions, *Economic Letters*
   - Suen, Richard and Kopecki, Karen (2010). Finite State Markov-Chain Approximations to Highly Persistent Processes. *Review of Economic Dynamics*
   - ⋆ Lkhagvasuren, Damba (2012). Key Moments in the Rowenhorst Method, Mimeo.
   - Lkhagvasuren, Damba and N. Gospodinov (2014). A Moment-Matching Method for Approximating VAR Processes by Finite-State Markov Chains. *Journal of Applied Econometrics*
   - ⋆ Carroll, Chris (2006). The Method of Endogenous Gridpoints for Solving Dynamic Stochastic Optimization Problems. *Economics Letters*
   - Judd, Ken (1998). Numerical Methods in Economics. MIT Press, chapter 6
   - Miranda Mario, and Paul Fackler (2002). Applied Computational Economics and Finance. MIT Press. Chapter 6.
   - Heer, Burkhard and Alfred Maubner (2005). DGE Modelling, Computational Methods and Applications, Springer. Chapter 6.

6. **The Neoclassical Growth Model with Incomplete Markets** (LS 17.1-17.2, 17.6-17.12)
We analyze the equilibrium of a neoclassical growth model populated by a continuum of agents who face idiosyncratic labor income risk and trade only a risk-free asset. We use the tools we learned to characterize (as much as possible...) the existence and uniqueness of the invariant distribution.

- ⋆ Imrohoroglu, Ayse (1989). The Costs of Business Cycles with Indivisibilities and Liquidity Constraints. *Journal of Political Economy*
- ⋆ Huggett, Mark (1993). The Risk-Free Rate in Heterogeneous-Agent Incomplete-Insurance Economies. *Journal of Economic Dynamics and Control*
- ⋆ Aiyagari, Rao (1994). Uninsured Idiosyncratic Risk and Aggregate Saving. *Quarterly Journal of Economics*
- ⋆ Hopenhayn H. and E. Prescott (1992). Stochastic Monotonicity and Stationary Distributions for Dynamic Economies. *Econometrica*
- Heer, Burkhard and Alfred Maubner (2005). DGE Modelling, Computational Methods and Applications, Springer. Chapter 7.
- ⋆ Uhlig, Harald (1996). A Law of Large Numbers for Large Economies. *Economic Theory.*
- Laitner, John (1992). Random Earnings Differences, Lifetime Liquidity Constraints, and Altruistic Intergenerational Transfers. *Journal of Economic Theory*

7. **Some Classical Applications of Bewley Models**
   We illustrate how to use this class of self-insurance models to analyze questions related to the wealth distribution and to fiscal policy.

   - ⋆ Moritz Kuhn and Victor Rios-Rull (2015). 2013 Update on the U.S. Earnings, Income, and Wealth Distributional Facts: A View from Macroeconomic Modelers, *Minneapolis Fed Quarterly Review*
   - Benhabib, Jess and Alberto Bisin. Skewed Wealth Distributions: Theory and Empirics. *Journal of Economic Literature*
   - ⋆ De Nardi, Mariacristina, and Giulio Fella (2017). Saving and Wealth Inequality. *Review of Economic Dynamics*
   - ⋆ Hubbard, Skinner and Zeldes (1995). Precautionary saving and social insurance, *Journal of Political Economy*
   - Krusell, Per and Tony Smith (1997). Income and wealth heterogeneity, portfolio choice, and equilibrium asset returns, *Macroeconomic Dynamics*
   - ⋆ Castaneda, Ana, Javier Diaz-Jimenez and Jose-Victor Rios-Rull (2003). Accounting for earnings and wealth inequality, *Journal of Political Economy*
   - Quadrini Vincenzo (2000). Entrepreneurship, Saving and Social Mobility, *Review of Economic Dynamics.*
   - ⋆ Floden Martin and Jesper Linde (2001). Idiosyncratic Risk in the U.S. and Sweden: Is there a Role for Government Insurance?, *Review of Economic Dynamics*
   - ⋆ Aiyagari, Rao and Ellen McGrattan (1998). The Optimum Quantity of Debt, *Journal of Monetary Economics*

- De Santis, Massimiliano (2007). Individual Consumption Risk and the Welfare Cost of Business Cycles. *American Economic Review*

8. **Transitional Dynamics in the Neoclassical Growth Model with Incomplete Markets**
   We study how to compute the transitional dynamics and how to measure correctly the welfare changes associated to a tax reform.

   ⋆ Domeij, David and Jonathan Heathcote (2003). On the Distributional Effects of Reducing Capital Taxes. *International Economic Review*

   ⋆ Benabou, R. (2003). Tax and Education Policy in a Heterogeneous-Agent Economy: What Levels of Redistribution Maximize Growth and Efficiency? *Econometrica* (only section 5 on welfare decomposition)

   ⋆ Floden, Martin (2001). The Effectiveness of Government Debt and Transfers as Insurance. *Journal of Monetary Economics* (only section 3 on welfare decomposition)

   - Bhandari, Anmol, David Evans, Mike Golosov and Tom Sargent (2022). Efficiency, Insurance, and Redistribution Effects of Government Policies
   - Davila, Eduardo and Andreas Schaab (2021). Welfare Assessments with Heterogeneous Individuals

9. **Adding Aggregate Risk: A Near-Aggregation Result** (LS 17.14.2)
   We extend the model to add aggregate fluctuations in productivity. We explain the original/standard way to solve this model and present the near-aggregation finding of Krusell-Smith.

   - Boppart, Timo, Per Krusell, and Kurt Mitman (2018). Exploiting MIT Shocks in Heterogeneous-Agent Economies: The Impulse Response as a Numerical Derivative. *Journal of Economic Dynamics and Control*

   ⋆ Krusell, Per and Tony Smith (1998). Income and Wealth Heterogeneity in the Macroeconomy, *Journal of Political Economy*

   ⋆ Krusell, Per and Tony Smith (2006). Quantitative Macroeconomic Models with Heterogeneous Agents, *Advances in Economics and Econometrics: Theory and Applications, Ninth World Congress*

   - Yaari, M. (1976). A Law of Large Numbers in the Theory of Consumer's Choice under Uncertainty. *Journal of Economic Theory*, 12, 202-217.
   - Levine, D., and W. Zame (2001). Does Market Incompleteness Matter? *Econometrica*, vol. 70(5), 1085-1839.
   - Heathcote, Jonathan (2004). Fiscal Policy with Heterogeneous Agents and Incomplete Markets, *Review of Economic Studies*

- Reiter, M. (2009). Solving Heterogeneous-agent Models by Projection and Perturbation. *Journal of Economic Dynamics and Control*

10. **Models of Firm Dynamics**
We apply the recursive equilibrium tools we studies to the notion of industry equilibrium with firm heterogeneity and firm dynamics.

   - ⋆ Hopenhayn, Hugo (1992). Entry, Exit and Firm Dynamics in Long Run Industry Equilibrium, *Econometrica*
   - ⋆ Hopenhayn, Hugo ad Richard Rogerson (1993); Job Turnover and Policy Evaluation: A General Equilibrium Analysis, *Journal of Political Economy*
   - Jovanovic, Boyan (1982); Selection and Evolution of Industry, *Econometrica*
   - Melitz, Marc (2003). The impact of trade on aggregate industry productivity and intra-industry reallocations, *Econometrica*