

Quantitative Macroeconomics

(with heterogeneous agents)

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Schedule. Monday 9:30-11:00, Monday 11:30-13:00, and Wednesday 15:30-17:00

Objective. This course introduces the techniques of modern quantitative macroeconomics to study economies with household heterogeneity, with a special focus on the life cycle dimension. One important aspect of the course is the emphasis on learning how to solve these economies in the computer. To this end, there is sequence of problem sets that will guide you to solve the canonical models of Aiyagari (1994) and Huggett (1996). In addition, the course devotes a substantial amount of time to study economies with firm heterogeneity and the problem of optimal allocation of factors across production units.

Requirements. Before taking the course you need to understand three things: (1) dynamic programming, (2) a little bit of measure theory and (3) Markov chains. There are several references to refresh the basics of dynamic programming: a simple one is (Ljungqvist and Sargent, 2004, chapter 3). Obviously, the most complete source is Stokey et al. (1989). Its first chapter is a very easy help. All the measure theory you need to know for this course is contained in some short notes I will provide to you. But if you want more you can check (Stokey et al., 1989, chapter 7) or even better Royden (1988). For Markov chains, a good reference is (Ljungqvist and Sargent, 2004, chapter 2) and I will also give you some notes. A very comprehensive treatment can be found in (Stokey et al., 1989, chapter 8).

Homework. The biggest part of homework will be computer based. It is strongly recommended that you do the computer-based problem sets in pairs. Please, submit just one copy per group.

Computer languages. During the course you will have to do a substantial amount of programming. I do not care which language you use, it is your choice and your responsibility. Students taking a course like this at CEMFI and elsewhere tend to choose Matlab or Julia; but this might as well be a good moment to invest in learning Fortran.

Student workshops. Students will be asked to present a paper related to the topics covered during the course. Presentations will last for 45 minutes, and everybody in the class is expected to read the paper in advance. The idea is that these workshops are like a reading group.

Structure. A typical course at CEMFI consists of 30 ninety-minute sessions. My initial plan is to use 19 sessions for theory, 1 session for an introduction to programming in Matlab, 5 sessions to discuss your homework, and 5 sessions for the student workshops. But this plan depends on

student enrolment, so we may need to fine tune it.

Books and references. There is no basic textbook for this course and most of the material comes from papers and chapters of different books. I list the basic references for each part in the next pages. Regarding numerical methods, easy introductions can be found in (Adda and Cooper, 2003, chapter 3) and (Ljungqvist and Sargent, 2004, chapter 4). In depth coverage of some very useful methods for economists can be found in Marimon and Scott (1999). Judd (1998) is very comprehensive (encyclopedic) and is a very good reference. Finally, Heer and Maussner (2009) is a recent textbook also worth looking at.

Evaluation. The final mark will be an average of the final exam (70%) and the homework (30%), provided that the student passes the final exam. Student presentations will also be used as an evaluation tool.

More information. This syllabus, exercise lists, and any other supporting material can be found in the new intranet (<https://master.cemfi.es/>). I will update its contents throughout the course.

Part I. The Neoclassical Growth Model with Heterogeneous Households.

Estimated duration: 4 theory sessions

1. The neoclassical stochastic growth model: recursive formulation.
Brock and Mirman (1972) and (Stokey et al., 1989, chapter 1).
2. Stylized facts on inequality.
Díaz-Giménez et al. (2011), Krueger et al. (2010) and Heathcote et al. (2010a).
3. The heterogeneous agents model in steady state.
Huggett (1993), Aiyagari (1994) and Dávila et al. (2007). For a textbook exposition see (Ljungqvist and Sargent, 2004, chapters 16 and 17).
4. Complete markets.
(Ljungqvist and Sargent, 2004, chapter 8).

Part II. Numerical Methods Applied to Heterogeneous Agents Economies.

Estimated duration: 4 theory sessions

1. Solving the household problem
 - Projection methods.
Judd (1992), (Judd, 1998, chapter 11) and McGrattan (1998)
 - An easy and useful application
2. Finding the steady state equilibrium.
Aiyagari (1994) and Ríos-Rull (1998)
3. Accuracy.
Judd (1992)
4. Solving non-linear equations
(Judd, 1998, chapter 5) or (Heer and Maussner, 2009, section 11.5)
5. Classical calibration, modern calibration and estimation.
Cooley and Prescott (1995) and Castañeda et al. (2003)

Part III. Some Extensions of the Heterogeneous Households Model.

Estimated duration: 4 theory sessions

1. Life Cycle

Huggett (1996)

2. Endogenous Labor

Pijoan-Mas (2006), Heathcote et al. (2010b)

3. Outside the Steady State

Krusell and Smith (1998), Ríos-Rull (1998). Textbook exposition: Krusell and Smith (2006).

4. Data:

- The importance of uninsurable idiosyncratic shocks and precautionary savings
Storesletten et al. (2004), Storesletten et al. (2001) and Kaplan and Violante (2010).
- Accounting for the wealth distribution.
Hubbard et al. (1995), Castañeda et al. (2003), De Nardi (2004) and Cagetti and De Nardi (2006).

Part IV. Endogenous Market Incompleteness.

Estimated duration: 2 theory sessions

1. Dynamic contracts and partial insurance.

A textbook exposition (which I will not follow) can be found in (Ljungqvist and Sargent, 2004, chapter 20)

- Public insurance may crowd-out private insurance.
Attanasio and Ríos-Rull (2000)
- Some empirical evidence in developing economies.
Attanasio and Albarran (2002)

2. Models with default.

- Accounting for default in consumer credit in the U.S.:
Chatterjee et al. (2007)
- Accounting for default in sovereign debt:
Arellano (2008)

3. The diverging trends of income and consumption inequality.

Krueger and Perri (2006), Athreya et al. (2009) and Heathcote et al. (2010b)

Part V. Firm Heterogeneity.

Estimated duration: 5 theory sessions

A good survey on the topic can be found in Hopenhayn (2014b)

1. Some data

2. Entrepreneurship

Lucas (1978), Guner et al. (2008)

3. Firm dynamics

Hopenhayn (1992), Hopenhayn and Rogerson (1993), Restuccia and Rogerson (2008)

4. Misallocation

Hopenhayn (2014a), Hsieh and Klenow (2009), Bartelsman et al. (2013)

5. Financial frictions

Moll (2014)

Part VI. Student Workshops.

Estimated duration: 5 sessions

1. Labor Market Uncertainty, Consumption Responses, and Welfare

(Week 6, Monday)

- F. Guvenen and A. Smith. Inferring labor income risk and partial insurance from economic choices. *Econometrica*, 6(82):2085–2129, 2014, presented by EMRE YAVUZ
- G. Kaplan and G. Violante. A model of the consumption response to fiscal stimulus payments. *Econometrica*, 4(82):1199–1239, 2014, presented by LUIS FERNÁNDEZ

2. Health Risks, Social Security, and the Savings of the Old

(Week 7, Monday)

- M. De Nardi, E. French, and J. Jones. Why do the elderly save? the role of medical expenses. *Journal of Political Economy*, 118(1):39–75, 2010, presented by ALEJANDRO REDONDO

- S. Kitao. Sustainable social security: Four options. *Review of Economic Dynamics*, 17(4):756–779, 2014, presented by CÉSAR GARRO

3. Human Capital Accumulation and Earnings Inequality

(week 7, Wednesday)

- M. Huggett, G. Ventura, and A. Yaron. Sources of lifetime inequality. *American Economic Review*, 101(7):2923–2954, 2011, presented by MOLIN LI
- F. Guvenen, B. Kuruşçu, and S. Ozkan. Taxation of human capital and wage inequality: A cross-country analysis. *Review of Economic Studies*, 81:818–850, 2014, presented by JUAN MANUEL CASTRO

4. Public Finance: Taxing Top Incomes

(Week 9, Monday)

- A. Badel and M. Huggett. Taxing top earners: A human capital perspective. St Louis FED Working Paper 2014-017B, 2014, presented by SIQI WEI
- N. Guner, M. Lopez-Daneri, and G. Ventura. Heterogeneity and government revenues: Higher taxes at the top? *Journal of Monetary Economics*, 80:69–85, 2016, presented by FEDERICA TROIANO

5. Entrepreneurship, Financial Frictions, and Inequality:

(Week 10, Wednesday)

- M. Cagetti and M. De Nardi. Entrepreneurship, frictions, and wealth. *Journal of Political Economy*, 114(5):835–869, 2006, presented by JOSÉ GUTIÉRREZ
- L. Allub and A. Erosa. Financial frictions, occupational choice and economic inequality. Mimeo, 2014, presented by JUAN PEDRO RONCONI

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- O. Attanasio and J.-V. Ríos-Rull. Consumption smoothing in island economies: can public insurance reduce welfare ? *European Economic Review*, 44:1225–58, 2000.
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