

Syllabus Macroeconomics I

CEMFI – Fall 2023

Federico Kochen

Schedule. Mondays 9:30h-11:00h. Thursdays 9:30h-11:00h, and 11:30h-13:00h.

Course Description. This course is the first section of the macroeconomics sequence at CEMFI. The course aims to learn about some seminal theoretical works in macroeconomics and confront them with the data. The material will be presented primarily from a theoretical point of view, with a secondary focus on empirical topics. As an introduction, we will devote the first three lectures to reviewing optimization methods in continuous time, which will provide you with the tools necessary to solve the models we will see later in the course.

Topics. (see detailed contents below)

1. Dynamic Optimization in Continuous Time
2. Neoclassical Growth
3. Multi-Sector Growth
4. Endogenous Growth
5. Overlapping Generations
6. Investment

Calendar. The course is 10 weeks long, with three 90-minute sessions per week. Typically, two will be theory sessions with me, and one will be recitation with the T.A., where you will go through the weekly problem sets. [Table 1](#) presents the tentative calendar for the semester.

Homework. There will be seven problem sets for you to work on at home. Problem sets must be handed in electronically via *Moodle*. Students must submit their own solutions individually. Only the exercises marked with the word “Graded” will count toward your homework grade. The remaining questions are optional (intended as practice material for the final exam), and you may choose not to submit answers for the non-graded exercises.

Exam. There will be a 3-hour final exam on December 2023. Exact date TBA.

Grading. The final exam counts 85% of the final mark, homework grade counts 10%, and class participation counts 5%.

Contact. You contact me via email at: federico.kochen@cemfi.es. You can ask me unresolved questions after class. In-person meetings are only by appointment.

Teaching Assistant. The course TA is Marta Domínguez (marta.dominguez@cemfi.edu.es). Marta will teach the weekly recitations and grade the “Graded” exercises from the problem sets.

Recitations. Marta will hold weekly homework sessions where she will go over the solution of the problem sets. “Graded” exercises will be solved first, followed by other relevant exercises to help you prepare for the exam. You can also use this session to ask her questions from the theory lectures. Attendance to the recitations is voluntary.

Table 1: Course Tentative Calendar

	Date	Time	Type	Topic
Week 1	Sep-26 (Tu)*	15.00-16.30	Theory	Cont.-time Optimization 1
	Sep-28 (Th)	09.30-11.00	Theory	Cont.-time Optimization 2
		11.30-13.00	Theory	Cont.-time Optimization 3
Week 2	Oct-2 (Mo)	09.30-11.00	Theory	Neoclassical Growth 1
	Oct-5 (Th)	09.30-11.00	Theory	Neoclassical Growth 2
		11.30-13.00	Theory	Neoclassical Growth 3
Week 3	Oct-9 (Mo)	09.30-11.00	Theory	Neoclassical Growth 4
	Oct-9 (Mo)*	11.30-13.00	Theory	Neoclassical Growth 5
	Oct-11 (We)*	15.00-16.30	Recitation	Problem Set #1
Week 4	Oct-16 (Mo)	09.30-11.00	Theory	Multi-Sector Growth 1
	Oct-19 (Th)	09.30-11.00	Theory	Multi-Sector Growth 2
		11.30-13.00	Recitation	Problem Set #2
Week 5	Oct-23 (Mo)	09.30-11.00	Theory	Multi-Sector Growth 3
	Oct-26 (Th)	09.30-11.00	Theory	Endogenous Growth 1
		11.30-13.00	Recitation	Problem Set #3
Week 6	Oct-30 (Mo)	09.30-11.00	Theory	Endogenous Growth 2
	Nov-2 (Th)	09.30-11.00	Theory	Endogenous Growth 3
		11.30-13.00	Recitation	Problem Set #4
Week 7	Nov-6 (Mo)	09.30-11.00	Theory	Endogenous Growth 4
	Nov-9 (Th)	09.30-11.00	Theory	Overlapping Generations 1
		11.30-13.00	Recitation	Problem Set #5
Week 8	Nov-13 (Mo)	09.30-11.00	Theory	Overlapping Generations 2
	Nov-16 (Th)	09.30-11.00	Theory	Overlapping Generations 3
		11.30-13.00	Recitation	Problem Set #6
Week 9	Nov-20 (Mo)	09.30-11.00	Theory	Overlapping Generations 4
	Nov-23 (Th)	09.30-11.00	Theory	Overlapping Generations 5
		11.30-13.00	Recitation	Problem Set #7
Week 10	Nov-27 (Mo)	09.30-11.00	Theory	Investment 1
	Nov-30 (Th)	09.30-11.00	Theory	Investment 2
		11.30-13.00	Theory	Investment 3

*Different from usual meeting day, or hour.

Contents of the Course

Part I. Dynamic Optimization in Continuous Time.

- **Duration:** 3 theory session.
- **Description:** In this part, we will introduce the mathematical tools necessary to solve dynamic optimization problems in continuous-time settings, which will be useful for the rest of the class.
- **Program:**
 1. Calculus of Variations
 2. Optimal Control Theory (Hamiltonians)
 3. Dynamic Programming (Hamilton-Jacobi-Bellman Equations)
 4. Brief Introduction to Stochastic Calculus
- **References:** This will be a math-intensive section with not a lot of economics. Chiang (1984) and Chiang (1992) are good help for the less initiated. The mathematical appendix in Barro and Sala-i-Martin (1999), as well as Acemoglu (2009, chapter 7 and Appendix B), are also good references.

Part II. Neoclassical Growth.

- **Duration:** 5 theory sessions.
- **Description:** In this section, we will look at foundational one-sector, exogenous growth models based on capital accumulation, and we will assess their empirical performance.
- **Program:**
 1. Stylized Facts of Economic Growth
 2. The Solow Model
 3. The Ramsey Model
 4. Growth and Development Accounting
- **References:** The class notes for the Solow and the Ramsey models will follow Barro and Sala-i-Martin (1999, chapters 1 and 2) quite closely. For the Solow model, additional references are Romer (1996, chapter 1) and Acemoglu (2009, chapter 2). For the Ramsey model, additional references are Blanchard and Fischer (1991, chapter 2), Romer (1996, chapter 2) and Acemoglu (2009, chapter 8). For growth accounting, you can have a look at Barro and Sala-i-Martin (1999, chapter 10), and for development accounting at Caselli (2005). The empirical performance of the Solow and Ramsey models is in Acemoglu (2009, chapter 3) and Barro and Sala-i-Martin (1999, chapters 11 and 12). Several empirical facts seen in class come from Jones (2015).

Part III. Multi-Sector Growth.

- **Duration:** 3 theory sessions.
- **Description:** In this section, we will extend the Neoclassical framework to a multi-sector setting, and will study questions related to structural change.
- **Program:**
 1. The Multi-Sector Ramsey Model
 2. Different Productivity Growth across Sectors
 3. Non-Homothetic Preferences
- **References:** The class lectures do not follow any specific textbook, but you can find a good survey of structural change with data and a review of models in Herrendorf, Rogerson, and Valentinyi (2014). The section “Different Productivity Growth across Sectors” follows Ngai and Pissarides (2007), and “Non-Homothetic Preferences” follows Kongsamut, Rebelo, and Xie (2001). This part can also be found in Acemoglu (2009, chapter 20).

Part IV. Endogenous Growth.

- **Duration:** 4 theory sessions.
- **Description:** In this part, we will study models in which growth stems not from capital accumulation, but from the generation of ideas as a by-product of firm-level decisions.
- **Program:**
 1. Growth from Knowledge Externalities
 2. Growth from Expanding Varieties
 3. Directed Technical Change
 4. Schumpeterian Growth Models
- **References:** This part will track the development of endogenous growth theory in roughly chronological order, covering the most seminal papers along the way. The exposition will follow Barro and Sala-i-Martin (1999, chapters 4, 6 and 7) and Acemoglu (2009, chapters 11 through 15) closely. The basic model of growth with knowledge externalities is due to Romer (1986), and the foundational expanding-varieties growth model is due to Romer (1990). The first neo-Schumpeterian growth model with quality-ladder innovation is due to Aghion and Howitt (1992), and further developed by Grossman and Helpman (1991).

Part V. Overlapping Generations (OLG) Models.

- **Duration:** 5 theory sessions.
- **Description:** In this part, we will study models in which households have finite horizons and are born at different points in time, to study questions related to government debt and valued fiat currency.
- **Program:**
 1. The Basic OLG Model
 2. Optimality
 3. Government Debt
 4. Valued Fiat Currency
- **References:** The class lectures will follow Ljungqvist and Sargent (2012, chapter 9). I strongly recommend you to read Samuelson (1958).

Part VI. Investment.

- **Duration:** 3 theory sessions.
- **Description:** In this section, we will study models of investment and firm behavior, as well as open-economy models.
- **Program:**
 1. The q Theory of Investment
 2. An Equilibrium Open Economy
- **References:** The basic model of the q *Theory* can be easily followed in Romer (1996, chapter 8), Acemoglu (2009, chapter 7) or in Adda and Cooper (2003, chapter 8). The *Open Economy* case follows Blanchard and Fischer (1991, chapter 2), although in the book they solve for the social planner problem. You can also look at Barro and Sala-i-Martin (1999, chapter 3).

References

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