

Topics in Macroeconomics II: Heterogeneous Agents

**2023-24 Academic Year
Master of Research in Economics, Finance and Management**

Description of the subject

Topics in Macroeconomics II

Total credits: 3 ECTS

Type of subject: Optative

Department of Economics and Business

Teaching team: Edouard Schaal and Davide Debortoli

Code: 32707

Workload: 75 hours

Term: 1st

2. Teaching guide

- **Objective**

This course is an introduction to the topic of heterogeneous agents in macroeconomics. The first part, taught by Edouard Schaal, will cover key frameworks in the literature, such as the classic Bewley-Huggett-Aiyagari with incomplete markets and heterogeneous household, the life cycle model of Storesletten, Telmer and Yaron (2004), and time permitting the heterogeneous firms model in the family of Hopenhayn (1992). The second part of the course, taught by Davide Debortoli, will focus on the role of heterogeneity for aggregate fluctuations and the effects of macroeconomic policies. A strong emphasis will be put on the numerical aspects. We will review some of the state-of-the-art resolution methods that people use nowadays to solve and simulate this class of models.

- **Contents**

Part I: Edouard Schaal

1. **Heterogeneous Households: Bewley-Huggett-Aiyagari models.**
Model definition. Distribution invariants.
2. **Life-Cycle Economies.**
Storesletten, Telmer and Yaron (2004).
3. **Heterogeneous Firms (time permitting)**
Hopenhayn (1992). Kahn and Thomas (2008). Winberry (2018)

Part II: Davide Debortoli

4. **Aggregate Uncertainty in Heterogeneous-agent Economies.**
Krusell and Smith (1998), Boppart, T., Krusell, P., and Mitman, K. (2018). Auclert et al. (2021).
5. **Topics in Heterogeneous-agent Economies.**
Wealthy Hand-to-Mouth (Kaplan, Violante and Weidner, 2014). HANK (Kaplan, Moll and Violante, 2018), McKay, A., E. Nakamura, and J. Steinsson (2016/

- **Teaching methodology**

Approach and general organization of the subject

This course is a natural follow-up to the Macroeconomics module of the Research Seminar, which is a prerequisite. The core of the course revolves around the modelling and numerical challenges that typically arise in heterogeneous agent economies (e.g., modelling and simulating time-varying distributions, aggregate uncertainty, etc.). The course will open up to current open questions and debates in the literature.

Students will have to write computer programs to implement the techniques discussed in class. MATLAB will be the language used in class but students may use whichever language they like (Fortran, C, Python, Julia).

Training activities

Lectures, proposed readings, study and development of computer programs.

- **Assessment and Grading System**

The grade of the course will be determined on the following basis:

- (60%) 2 homeworks (one per part), requiring to write computer programs to solve standard problems and models. Homeworks could be performed in small groups (max. 2 people, one solution per group).
- (40%) A class presentation of a paper covering a recent topic in heterogeneous agent modeling towards the end of the course.

- **Textbook and References**

The slides are the main resource for this course. They will be regularly posted on Box.

Other references for **numerical methods for macroeconomic models** are

Algan Y., O. Allais, W. Den Haan and P. Randal (2014), “Solving and Simulating Models with Heterogeneous Agents and Aggregate Uncertainty”, *Handbook of Computational Economics*, Vol. 3, Ch. 6.

Auclert, A., Bardóczy, B., Rognlie, M., & Straub, L. (2021). Using the sequence-space Jacobian to solve and estimate heterogeneous-agent models. *Econometrica*, 89(5), 2375-2408.

Boppart, T., Krusell, P., & Mitman, K. (2018). Exploiting MIT shocks in heterogeneous-agent economies: the impulse response as a numerical derivative. *Journal of Economic Dynamics and Control*, 89, 68-92.

Reiter, M. (2009). Solving heterogeneous-agent models by projection and perturbation. *Journal of Economic Dynamics and Control*, 33(3), 649-665.

Winberry, T. (2018). A toolbox for solving and estimating heterogeneous agent macro models. *Quantitative Economics*, Vol. 9, Issue 3 Nov. 2018

References for specific **applications** are:

Aiyagari, S. R. (1994). Uninsured idiosyncratic risk and aggregate saving. *The Quarterly Journal of Economics*, 109(3), 659-684.

Cooper, R. W., & Haltiwanger, J. C. (2006). On the nature of capital adjustment costs. *The Review of Economic Studies*, 73(3), 611-633.

De Nardi, M., French, E., & Jones, J. B. (2010). Why do the elderly save? The role of medical expenses. *Journal of Political Economy*, 118(1), 39-75.

Domeij, D., & Heathcote, J. (2004). On the distributional effects of reducing capital taxes. *International economic review*, 45(2), 523-554.

Evans, D. S. (1987). Tests of alternative theories of firm growth. *Journal of political economy*, 95(4), 657-674.

Favilukis, J., Ludvigson, S. C., & Van Nieuwerburgh, S. (2017). The macroeconomic effects of housing wealth, housing finance, and limited risk sharing in general equilibrium. *Journal of Political Economy*, 125(1), 140-223.

Glover, A., Heathcote, J., Krueger, D., & Ríos-Rull, J. V. (2011). *Intergenerational*

redistribution in the great recession (No. w16924). National Bureau of Economic Research.

Hopenhayn, H. A. (1992). Entry, exit, and firm dynamics in long run equilibrium. *Econometrica: Journal of the Econometric Society*, 1127-1150.

Hopenhayn, H., & Rogerson, R. (1993). Job turnover and policy evaluation: A general equilibrium analysis. *Journal of political Economy*, 101(5), 915-938.

Huggett, M. (1993). The risk-free rate in heterogeneous-agent incomplete-insurance economies. *Journal of economic Dynamics and Control*, 17(5-6), 953-969.

Kaplan, G., Moll, B., & Violante, G. L. (2018). Monetary policy according to HANK. *American Economic Review*, 108(3), 697-743.

Kaplan, G., Violante, G. L., & Weidner, J. (2014). The Wealthy Hand-to- Mouth. *Brookings Papers on Economic Activity*, 2014(1), 77-138.

Khan, A., & Thomas, J. K. (2008). Idiosyncratic shocks and the role of nonconvexities in plant and aggregate investment dynamics. *Econometrica*, 76(2), 395-436.

Klette, T. J., & Kortum, S. (2004). Innovating firms and aggregate innovation. *Journal of political economy*, 112(5), 986-1018.

Krueger, D., and Kubler, F. (2004). Computing equilibrium in OLG models with stochastic production. *Journal of Economic Dynamics and Control*, 28.7: 1411-1436.

Kubler, F., & Schmedders, K. (2015). Life-cycle portfolio choice, the wealth distribution and asset prices. *Swiss Finance Institute Research Paper*, (10-21).

Krusell, P. and A. Smith (1998). Income and Wealth Heterogeneity in the Macroeconomy. *Journal of Political Economy*, 106, 867–896.

McKay, A., E. Nakamura, and J. Steinsson (2016). The Power of Forward Guidance Revisited. *American Economic Review*, 106(10): 3133-58.

Ríos-Rull, J. V. (1996). Life-cycle economies and aggregate fluctuations. *The Review of Economic Studies*, 63(3), 465-489.

Storesletten, Kjetil, Chris I. Telmer, and Amir Yaron (2001). How important are idiosyncratic shocks? Evidence from labor supply. *The American Economic Review*, 91.2 (2001): 413-417.

Storesletten, Kjetil, Christopher I. Telmer, and Amir Yaron (2004). Consumption and risk sharing over the life cycle. *Journal of Monetary Economics*, 51.3: 609-633.

Winberry, T. (2021). Lumpy investment, business cycles, and stimulus policy. *American Economic Review*, 111.1, 364-96.

Suggestions for presentations at the end of the course.

Acharya and Dogra (2020). Understanding HANK: Insights from a PRANK,” *Econometrica*.

Auclert, A. (2019). Monetary policy and the redistribution channel. *American Economic Review*, 109(6), 2333-67.

Auclert, A., M. Rognlie and L. Straub (2018). “The Intertemporal Keynesian Cross”, Working paper (R&R and the Journal of Political Economy).

Auclert, Rognlie and Straub (2020). “Micro Jumps, Macro Humps: Monetary Policy and Business Cycles in an Estimated HANK Model”, working paper (R&R at American

Economic Review).

Bayer, C., Born, B., & Luetticke, R. (2020). Shocks, frictions, and inequality in US business cycles, CEPR DP No. 14364.

Bayer, Luetticke, Pham-Dao and Tjaden (2019). "Precautionary savings, illiquid assets, and the aggregate consequences of shocks to household income risk", *Econometrica*.

Benhabib, J., Bisin, A., & Luo, M. (2019). Wealth distribution and social mobility in the US: A quantitative approach. *American Economic Review*, 109(5), 1623-47.

Berger, Bocola and Dovis (2022). Imperfect Risk Sharing and the Business Cycle, *Quarterly Journal of Economics*.

Bilal, A. (2023). Solving Heterogeneous Agent Models with the Master Equation, NBER working paper 31103.

Debortoli, D., & Galí, J. (2018). Monetary policy with heterogeneous agents: Insights from TANK models. working paper.

Fagereng, A., Guiso, L., Malacrino, D., & Pistaferri, L. (2020). Heterogeneity and persistence in returns to wealth. *Econometrica*.

Guerrieri and Lorenzoni (2017). "Credit Crises, Precautionary Savings and the Liquidity Trap", *The Quarterly Journal of Economics*.

Hubmer, J., Krusell, P., & Smith Jr, A. A. (2021). Sources of US wealth inequality: past, present, and future. *NBER Macroeconomics Annual*, 35(1), 391-455.

Kaplan and Violante (2014), "A Model of the Consumption Response to Fiscal Stimulus Payments." *Econometrica*, 82.4, 1199-1239.

Koby, Y. and Wolf, C. K. (2020). Aggregation in Heterogeneous-Firm Models: Theory and Measurement. *Manuscript Princeton University*.

Maliar, L., Maliar, S., & Winant, P. (2021). Deep learning for solving dynamic economic models. *Journal of Monetary Economics*, 122, 76-101.

McKay and Reis (2016), "The Role of Automatic Stabilizers in the US Business Cycle." *Econometrica*.

Ottonello, P., & Winberry, T. (2020). Financial heterogeneity and the investment channel of monetary policy. *Econometrica*, 88(6), 2473-2502.

Ravn, M., & V. Sterk (2012). Macroeconomic Fluctuations with HANK and SAM: An Analytical Approach," *Journal of the European Economic Association*.

Straub, L. (2019). "Consumption, Savings, and the Distribution of Permanent Income". Working Paper (R&R at Econometrica)

Werning, I. (2015). Incomplete markets and aggregate demand. National Bureau of Economic Research working paper, w21448.