

# Heterogeneity in Macroeconomics

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## 1. Heterogeneity in the Neoclassical Growth Model with Complete Markets (LS, 8.5.3)

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 quickly (since you have already seen it with Tom) 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.

- Chatterjee, Satyajit (1994) "Transitional dynamics and the distribution of wealth in a neoclassical growth model", *Journal of Public Economics*
- Constantinides George (1982) "Intertemporal asset pricing with heterogeneous consumers and without demand aggregation" *Journal of Business*
- 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*

## 2. The Income Fluctuation Problem I (LS, 16.1-16.4, 17.13)

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*
- Hall, Robert (1978); "Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence", *Journal of Political Economy*

- Leland, Haynes (1968); "Saving and Uncertainty: the Precautionary Demand for Saving", *Quarterly Journal of Economics*
- Sibley, David (1975); "Permanent and Transitory Income Effects in a Model of Optimal Consumption with Wage Income Uncertainty", *Journal of Economic Theory* (only section VI)
- Blundell, Richard and Ian Preston (1998); "Consumption Inequality and Income Uncertainty," *Quarterly Journal of Economics*

### 3. **The Income Fluctuation Problem II** (LS, 16.5-16.8, 17.3-17.5)

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.

### 4. **Numerical Techniques to Solve the Income Fluctuation Problem**

We present a set of simple numerical techniques to solve for the 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 new 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*
- Aruoba B., Fernandez-Villaverde Jesus, and Rubio-Ramirez, Juan (2006); "Comparing Solution Methods for Dynamic Equilibrium Economies", *Journal of Economic Dynamics and Control*
- Carroll, Chris (2006). “The Method of Endogenous Gridpoints for Solving Dynamic Stochastic Optimization Problems,” *Economics Letters*
- Barillas, Francisco and Fernandez-Villaverde Jesus (2007). “A Generalization of the Endogenous Grid Method,” *Journal of Economic Dynamics and Control*
- Judd, Ken (1998); *Numerical Methods in Economics*, MIT Press, chapters 6-10
- Marimon, Ramon and Scott, Andrew (1999); "Computational Methods for the Study of Dynamic Economies", Oxford University Press
- Heer, Burkhard and Alfred Maubner (2005); "DGE Modelling, Computational Methods and Applications," Springer

### 5. **The Neoclassical Growth Model with Incomplete Markets (“Bewley Models”)** (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.

- Imrohorglu, 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*

## 6. Some 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.

- Budria Santiago, Javier Diaz-Gimenez, Vincenzo Quadrini, Victor Rios-Rull (2002); Updated Facts on the US Distributions of Earnings, Income and Wealth, *Minneapolis Fed Quarterly Review*
- 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 Mc Grattan (1998); The Optimum Quantity of Debt, *Journal of Monetary Economics*

## 7. Constrained efficiency in the Aiyagari model

We discuss the difference between the first-best allocations and the constrained efficient allocations in the Aiyagari model with self-insurance. We argue that the planner, through saving decisions, will manipulate prices in order to raise wages (if the income of the poor is labor intensive), hence redistributing from the lucky-rich to the unlucky-poor. We also debate whether macroeconomists should refine the neoclassical growth model with incomplete markets by adding *observed* channels of insurance (family, bankruptcy laws, public insurance), or whether they should think about the fundamental reasons that limit full insurance (moral hazard, adverse selection, imperfect enforcement).

- Hong, Jay, Julio Davila, Per Krusell, and Jose-Victor Rios-Rull (2006), Constrained efficiency in the neoclassical growth model with uninsurable idiosyncratic shocks.

## 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.

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

#### 9. **Adding Aggregate Risk: A Near-Aggregation Result** (LS 17.14.2)

We extend the model to add aggregate fluctuations in productivity. We explain how to solve this model and present the near-aggregation finding of Krusell-Smith.

- Krusell, Per and Tony Smith (1998), Income and Wealth Heterogeneity in the Macroeconomy, *Journal of Political Economy*
- Heathcote, Jonathan (2004), Fiscal Policy with Heterogeneous Agents and Incomplete Markets, *Review of Economic Studies*

#### 10. **Economies with Default**

We first study an incomplete-market economy where agents face borrowing constraints that are tight enough so that they never have the incentive to default in the equilibrium. Then, we formalize a model where agents can default and the financial sector takes into account the default probability and increases the prices of loans accordingly.

- Zhang Harold (1997), Endogenous Borrowing Constraints with Incomplete Markets, *Journal of Finance*
- Livshits Igor, Jim McGee and Michele Tertilt (2006), Consumer Bankruptcy: A Fresh Start, *American Economic Review*

#### 11. **Life-Cycle Economies with Incomplete Markets**

We study a life-cycle version of the standard incomplete-markets model with overlapping generations, and an application to optimal Ramsey-style taxation.

- Imrohoroglu Ayse, Imrohoroglu Selo, Joines, Douglas (1995), “A life cycle analysis of social security,” *Economic Theory*
- Huggett, Mark (1996), “Wealth distribution in life-cycle economies.” *Journal of Monetary Economics*
- Rios-Rull Jose-Victor (1995), “Models with heterogeneous agents”. In *Frontiers of Business Cycle Research*, edited by Cooley TF. Princeton, NJ: Princeton University Press.
- Conesa Juan-Carlos, and Dirk Krueger (2006), “On the optimal progressivity of the income tax code,” *Journal of Monetary Economics*
- Conesa Juan-Carlos, Kitao Sagiri, and Dirk Krueger (2008), “Taxing Capital? Not a Bad Idea After All!” *American Economic Review*

## 12. Industry Equilibrium

We use what we have learned about heterogeneous agents economies to study the equilibrium of an industry with firms facing shocks to their productivity level, and with endogenous firm entry and exit. We analyze the impact of firing costs on the average productivity of the industry.

- Hopenhayn, Hugo (1992), Entry, Exit and Industry Dynamics in Long-Run Equilibrium, *Econometrica*
- Hopenhayn, Hugo and Richard Rogerson (1993), Job Turnover and Policy Evaluation: A General Equilibrium Analysis, *Journal of Political Economy*

## 13. Industry Equilibrium with International Trade

We extend Hopenhayan's model to an economy with monopolistic competition which is open to trade. Firms must pay a fixed cost of exporting to access a foreign market. We examine the impact of trade openness on firm selection and aggregate productivity.

- Melitz, Marc (2003). "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity", *Econometrica*