Prof. Dr. Marten Hillebrand
Lukas Kuebek, B.Sc.

Winter semester 2022/23

Master's course

Germany's Next Climate Model - Dissecting Macroeconomic Models of Climate Change

Syllabus

- Summary:

The course provides a guided introduction to the theory and numerical simulation of macroeconomic models of climate change. Using state-of-the-art dynamic general equilibrium theory, each of the models to be discussed unifies an economic growth model with a model of the climate system. The growth model includes a description of the production process and its dependence on clean and dirty energy sources with the latter generating emissions of CO_2. The climate system describes how these emissions evolve in the atmosphere and feed back into the economic production process. The integrated modeling approach permits to incorporate the complete interactions between the climate system and the macroeconomy under alternative climate policies set by the government.
Based on this structure, the first part of the course focuses on global models of climate change as developed in Golosov et al. (2014). Their model incorporates various sources of clean and dirty energy and permits to derive a globally optimal climate policy in closed form.
Using the framework developed in Hillebrand & Hillebrand (2019, 2021), the second part extends these findings to a multi-region world permitting to incorporate regional heterogeneity and various clean and dirty energy sources. Assuming free trade between regions and a frictionless international capital market permits to determine an optimal climate tax policy and design a transfer scheme which redistributes tax revenue such that each region has an incentive to implement the optimal climate tax.
Using recent results from Hillebrand & Hillebrand (2022), the final part of the course uses a game-theoretic approach to study optimal climate policies under different assumptions about cooperation and non-cooperation between regions and the formation of coalitions.

All models are first explored at the theoretical level and then simulated with Python using calibrated parameter values. Calibration draws on various data sources of key macroeconomic variables as well as energy and climate variables. The tutorials provide an introduction to programming in Python and help participants write their own simulation scripts in order to explore alternative climate policies and political scenarios.

- Contents (tentative):

  1. The climate problem from an economic perspective
  2. Optimal climate policy in a basic model of climate change
  3. Calibration and simulation of the basic model
  4. Optimal climate policies in a multi-region model
  5. Calibration and simulation of the multi-region model
  6. Cooperation and non-cooperation in a multi-region model.
  7. Calibration and simulation under cooperation and non-cooperation.

- Literature:

  - Golosov, Hassler, Krusell & Tsyvinski (2014): *Optimal Taxes on Fossil Fuel in General Equilibrium*
  - Hillebrand & Hillebrand (2019): *Optimal Climate Policies in a Dynamic Multi-Country Equilibrium Model*
  - Hillebrand & Hillebrand (2021): *Who Pays the Bill? Climate Change, Taxes, and Transfers in a Multi-Region Growth Model*
  - Hillebrand & Hillebrand (2022): *Win as a Team or Fail as Individuals: Cooperation and Non-Cooperation in the Climate Tax Game.*

  Additional references will be given in class.

- Target audience:

  Master students enrolled in the M.Sc. programs "Economics" and "VWL" and related fields such as Mathematics or Computer Science.

- Area of study:

  Public Sector Economics

  International Taxation

  ...

- Credit points: 6 ECTS
- Prerequisites:

  Course participants should have attended at least one of the two courses *Advanced Macroeconomics 1* or *Advanced Macroeconomics 2*.

  Above all, we expect a strong interest in the topic of climate change and in macroeconomic model building and programming in Python.

- Course meeting times:

  Lectures take place weekly on *Tuesdays, 4-6 pm* in *HS 1221 (KG I)*

  Tutorials take place weekly on *Mondays, 4-6 pm* in *HS 1016 (KG I)*

  Lecture classes start on *Tuesday, October 18, 2022*

  Tutorial classes start on *Monday, October 24, 2022*.

- Teaching format:

  All classes take place in-person requiring your presence in Freiburg.

  Students unable to be in Freiburg can not participate in this course.

- Organization:

  The entire course material (slides, problem sets) will be provided electronically on the ILIAS platform (`ilias.uni-freiburg.de`).

  Students can directly sign up for the course and no password is required.

  The course material will be released gradually every week. Participants enrolled in the course will be notified about all updates.

  Same procedure applies for the tutorials and working Python simulation scripts.

- Examination:

  Course participants work on a (guided) extension of the models discussed in class on which they have to submit a write-up (about ten pages) and a Python simulation script.

  All participants present their simulation results as part of a 'mini-conference' at the end of the semester.

Bibliography

Golosov, M., J. Hassler, P. Krusell & A. Tsyvinski (2014): "Optimal Taxes on Fossil Fuel in General Equilibrium", *Econometrica*, 82(1), 41–88.

Hillebrand, E. & M. Hillebrand (2019): "Optimal Climate Policies in a Dynamic Multi-Country Equilibrium Model", *Journal of Economic Theory*, 179, 200–239.

——— (2021): "Who Pays the Bill? Climate Change, Taxes, and Transfers in a Multi-Region Growth Model", Working paper, University of Freiburg.

——— (2022): "Win as a Team or Fail as Individuals: Cooperation and Non-Cooperation in the Climate Tax Game", Working paper, University of Freiburg.