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M.Sc./PhD Program

Summer Term 2016
University of Bonn

Dynamic Macroeconomics (Part I)

-Syllabus-

1 Aims and Purposes of the Course

This course introduces students to techniques that allow them to bring modern business cycle models to the data. This includes basic techniques for estimating *linearized* DSGE models, such as e.g. the Kalman filter and Bayesian estimation, but also *non-linear* solution and estimation techniques.

The course starts with a refresher on the basic RBC model and techniques to solve this model. We will then learn how to use the Kalman filter on the state-space representation of the RBC model to construct the likelihood function and how to estimate this model using ML and Bayesian methods. For the latter, we will make use of the Metropolis-Hastings algorithm. A particular focus will be on how to detect and remedy the typical problems arising in the estimation of linearized DSGE models. In particular, we will discuss convergence diagnostics and identification.

However, the global financial and economic crisis has thrown business cycle research into somewhat of a state of disarray and has shown the need to go beyond traditional business cycle explanations, such as, e.g., uncertainty shocks. Simulating and estimating many of these new models, however, requires the use of *non-linear* solution and estimation techniques. The last part of Part I of the course will thus introduce higher-order perturbation as an accurate and efficient model solution technique before then introducing Sequential Monte Carlo methods/Particle Filter and the Simulated Method of Moments as techniques for estimating non-linear models.

Importantly, this course is designed as a hands-on course that requires students to write their own Matlab/Dynare code to implement the concepts discussed in class!

2 Course Homepage

All relevant materials for the course can be found on Ecampus.

3 Matlab

You will need to bring your own laptop to all lectures. Matlab licenses will be made available in class. No previous knowledge of Matlab is required for the course, although some programming experience would be helpful. We will have a quick introduction to Matlab in the first week. A Matlab primer is available on Ecampus.

Please also download the Tools-folder from Ecampus and store it in a directory you will be working in during the course.

We will be using Dynare (Adjemian et al., 2011). The version to be used will be announced during the course.

4 Grading

100% of the grade will be based on an oral exam.

5 Organization of Lectures and Course Outline

This the first half of a full semester course with 4 hours of lectures each week (the second half will be taught by Christan Bayer). Tutorials/exercise sessions are integrated into the lectures. The class takes place on

- Thursdays and Fridays from 10:15 to 11:45, Kaiserplatz 7-9, seminar room (4th floor).

5.1 Background Reading

As the course sequence intends to bring students to the research frontier, there is no encompassing textbook yet. The course will thus move along a set of papers and textbook chapters. General textbooks covering (parts of) the material relevant in this course are:

- Dejong and Dave (2011)
- Hamilton (1994)
- Lütkepohl (2005)
- Ljungqvist and Sargent (2012)
- Durbin and Koopman (2012)
- Geweke (2005)
- Geweke, Koop, and Van Dijk (2011)

There will also be handouts covering the technical details of selected aspects of the course.

5.2 Selected Literature for the Covered Topics

1. The Basic RBC Model: Solution and Calibration
    - Blanchard and Kahn (1980)
    - Gomme and Klein (2011)
    - Fernández-Villaverde and Krüger (2012), Ch. 7.4/Krüger (2007), Ch. 8
2. The Kalman Filter and Maximum Likelihood Estimation of DSGE Models
    - Hamilton (1994), Ch. 13
    - Ljungqvist and Sargent (2012), Ch. 2
3. Bayesian Estimation of DSGE Models
    - An and Schorfheide (2007)
    - Koop (2003), Ch. 1
    - Chib and Greenberg (1995)
    - Pfeifer (2013)
4. Identification

- Iskrev (2010)
- Ratto and Iskrev (2011)

5. Higher-Order Perturbation
   - Gomme and Klein (2011)
   - Schmitt-Grohé and Uribe (2004)
   - Andreasen, Fernández-Villaverde, and Rubio-Ramírez (2013)
   - Kim, Kim, Schaumburg, and Sims (2008)
6. Particle Filtering
   - Arulampalam, Maskell, Gordon, and Clapp (2002)
   - Fernández-Villaverde and Rubio-Ramírez (2007)
7. Simulated Method of Moments
   - Ruge-Murcia (2012, 2013)

6 Assessment

To be determined.

References

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Arulampalam, M. S., S. Maskell, N. Gordon, and T. Clapp (2002). "A tutorial on particle filters for online nonlinear/non-Gaussian Bayesian tracking". *IEEE Transactions on Signal Processing 50*, 174–188.

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Chib, Siddhartha and Edward Greenberg (1995). "Understanding the Metropolis-Hastings algorithm". *The American Statistician 49* (4), 327–335.

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Durbin, J. and Siem J. Koopman (2012). *Time series analysis by state space methods*. Second Revised Edition. Oxford: Oxford University Press.

Fernández-Villaverde, Jesús and Dirk Krüger (2012). "Advanced macroeconomics - a text for undergraduates". Mimeo. University of Pennsylvania.

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Geweke, John (2005). *Contemporary Bayesian econometrics and statistics*. Hoboken, NJ: John Wiley & Sons.

Geweke, John, Gary Koop, and Hermann Van Dijk, eds. (2011). *The Oxford handbook of Bayesian econometrics*. Oxford: Oxford University Press.

Gomme, Paul and Paul Klein (2011). "Second-order approximation of dynamic models without the use of tensors". *Journal of Economic Dynamics and Control 35* (4), 604–615.

Hamilton, James D. (1994). *Time series analysis*. Princeton, NJ: Princeton University Press.

Iskrev, Nikolay (2010). "Local identification in DSGE models". *Journal of Monetary Economics 57*, 189–202.

Kim, Jinill, Sunghyun Kim, Ernst Schaumburg, and Christopher A. Sims (2008). "Calculating and using second order accurate solutions of discrete time dynamic equilibrium models". *Journal of Economic Dynamics and Control 32* (11), 3397 –3414.

Koop, Gary (2003). *Bayesian econometrics*. Chichester: John Wiley & Sons.

Krüger, Dirk (2007). "Quantitative macroeconomics: an introduction". Mimeo. University of Pennsylvania.

Ljungqvist, Lars and Thomas J. Sargent (2012). *Recursive macroeconomic theory*. 3rd ed. Cambridge, MA: MIT Press.

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Pfeifer, Johannes (2013). "A guide to specifying observation equations for the estimation of DSGE models". Mimeo. University of Mannheim.

Ratto, Marco and Nikolay Iskrev (2011). "Algorithms for identification analysis under the Dynare environment: final version of the software". Mimeo. Joint Research Centre, European Commission.

Ruge-Murcia, Francisco J. (2012). "Estimating nonlinear DSGE models by the simulated method of moments: with an application to business cycles". *Journal of Economic Dynamics and Control 36* (6), 914–938.

——— (2013). "Generalized Method of Moments estimation of DSGE models". *Handbook of Research Methods and Applications in Empirical Macroeconomics*. Edward Elgar Publishing. Chap. 20, 464–485.

Schmitt-Grohé, Stephanie and Martín Uribe (2004). "Solving dynamic general equilibrium models using a second-order approximation to the policy function". *Journal of Economic Dynamics and Control 28* (4), 755–775.