

School of Economics, University of Surrey

September 7th - September 15th, 2021

Online Summer School on Macroeconomics and
The Science and Art of DSGE Modelling

Two Parallel Four-Days Courses

Eight One-Day Stand-Alone Options

Followed by a One-Day Conference



TAMON ASONUMA

IMF

tasonuma@imf.org

CRISTIANO CANTORE

BANK OF ENGLAND AND U. SURREY

c.cantore@surrey.ac.uk

SZABOLCS DEAK

UNIVERSITY OF EXETER

s.deak@exeter.ac.uk

VASCO GABRIEL

UNIVERSITY OF SURREY

v.gabriel@surrey.ac.uk

ESTEBAN JAIMOVICH

UNIVERSITY OF SURREY

e.jaimovich@surrey.ac.uk

MARTIN KAAE JENSEN

U. NOTTINGHAM AND U. SURREY

m.k.jensen@surrey.ac.uk

HYUNGSEOK JOO

UNIVERSITY OF SURREY

h.joo@surrey.ac.uk

SILVIA MIRANDA-AGRIPPINO

BANK OF ENGLAND

silvia.miranda-agrippino@bankofengland.co.uk

MARYAM MIRFATAH

UNIVERSITY OF SURREY

maryam.mirfatah@surrey.ac.uk

RICARDO NUNES

UNIVERSITY OF SURREY

ricardo.nunes@surrey.ac.uk

RIGAS OIKONOMOU

U. CATHOLIQUE LOUVAIN AND U. SURREY

rigas.oikonomou@gmail.com

MARIO PASCOA

UNIVERSITY OF SURREY

m.pascoa@surrey.ac.uk

LUCIANO RISPOLI

UNIVERSITY OF SURREY

l.rispoli@surrey.ac.uk

KIRILL SHAKHNOV

UNIVERSITY OF SURREY

k.shakhnov@surrey.ac.uk

KJETIL STORESLETTEN

U. OF MINESOTA AND U. SURREY

kjetil.storesletten@gmail.com

ALESSIO VOLPICELLA

UNIVERSITY OF SURREY

a.volpicella@surrey.ac.uk

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1 Introduction

The Centre for International Macroeconomic Studies (CIMS) in the School of Economics, University of Surrey will hold an online summer course, September 7th - September 14th 2021, followed by a one-day Conference.

The first four days will consist of two parallel courses: one will be a *foundations course* aimed at early researchers with some knowledge of Real Business Cycle (RBC) or Dynamic Stochastic General Equilibrium (DSGE) macroeconomic models, but little or no experience of Dynare. This course assumes a basic knowledge of Matlab and will begin with the basics of Dynare and proceed to the construction, in stages, of a closed economy NK DSGE model. It will then progress to the estimation of the model by Bayesian methods and finish by showing how the model can be used to study optimal monetary policy.

The *advanced course* is aimed at researchers who are already fluent in Dynare and DSGE modelling or who wish to learn directly more advanced techniques. This course will be useful both for advanced PhD students, academic researchers, and central bank researchers engaged in macroeconomic modelling work. The advanced course covers models that are either computationally expensive to simulate, nonlinear, require additional recursive assumptions, or have infinite dimensional state-spaces thanks to heterogeneous agents. The basic and advanced courses will run in parallel for four days from September 7th - September 10th.

Then on day five and sixth, 13th and 14th September, we run several one-day course options. These are independent from the first week foundations and advanced parallel courses but all participants from both streams will be able to attend the options free of charge. Participants not attending the parallel courses on the first week will be able to register for the options. The *one-day courses* will cover credit market imperfections, DSGE-VAR models and forecasting, financial frictions, financial markets and the 2008 crisis, robust qualitative methods for macro, tractable heterogeneous agents models (TANK and HANK), fiscal policy, and sovereign default. All these courses are of interest to macroeconomists. Notes and model codes will be distributed to participants.

Finally, on Wednesday 15th September we will hold a *one-day Conference*. All participants on the Courses are invited to submit a paper on some aspect of Macroeconomics or DSGE modelling to be presented in the Conference.

Given the spread of the Coronavirus and the difficulty in air travel we have decided to deliver the Summer school in an online format. This decision has been made to ensure the safety of our participants, our colleagues, and all those involved with the Summer School. The Summer School 2020 was also held online and it was very successful and enabled many participants to attend from all over the world without the need to travel. The course will be conducted using Zoom platform. The university and the lecturers have extensive experience with online teaching and have state-of-the-art systems to do so as well as being able to deliver highly interactive lectures. Though we will do our best to record all the sessions, we are expecting participants to attend them live to enable them to interact with lectures and ask questions. Participants will be sent computer codes, lecture notes, and slides ahead of time. Participants will also receive direct assistance before the Summer school starts in order to set up all the systems ahead of the online events.

2 Instructors

Tamon Asonuma is an Economist in the Strategy Policy and Review Department of the IMF. Since joining the IMF in September 2010, he has spent most of times in Research Department and Strategy Policy and Review Department. During his time in the Strategy Review and Policy Department, he has contributed to series of the IMF Policy Papers on sovereign debt restructurings and IMF lending and involving in many debt restructuring cases as an expert. In Research Department, he has worked on research papers on costs of sovereign debt restructurings, fiscal policy, sovereign debt overhang and maturity and haircut structure of sovereign debt. He was a visiting researcher at Federal Reserve Bank of Chicago, Minneapolis, and Richmond, Boston University, and University of Munich. He holds a PhD in Economics from Boston University and his research interests are in macroeconomics, international finance, and public finance. He is particularly interested in sovereign debt and financial crises, and exchange rate regime. He has published in several academic journals including the Journal of the European Economic Association. For further details of publications see <https://sites.google.com/site/tamonasonuma/>

Cristiano Cantore is a Senior Research Economist at the Bank of England and a Reader in the School of Economics at the University of Surrey. He graduated from the Bocconi University (Milan, Italy) in 2004. He then completed his MSc degree in

Economics at Pompeu Fabra University (Barcelona, Spain). In 2010 he completed the PhD in Economics at University of Kent. Cristiano has also worked at the OECD and at the ECB as a trainee, visited the Bank of Spain in 2012 as a research fellow and the University of California at San Diego as visiting professor in 2014. Cristiano's research interests include monetary and fiscal policies, with particular focus on macro labour issues. He has published in these areas in the Journal of Monetary Economics, Journal of European Economic Association, Journal of Economic Dynamics and Control, The Scandinavian Journal of Economics, Macroeconomic Dynamics and Economics Letters. For further details of publications see <http://www.cristianocantore.com/>

Szabolcs Deak is a Lecturer at the University of Exeter since 2019. He was previously a full-time Research Fellow in the School of Economics at the University of Surrey. He joined the School in September 2013 to support the research activities of the ESRC funded project "Agent-Based and DSGE Macroeconomic Models: A Comparative Study". He received his Masters degree in Economics from the University of Szeged (Hungary) in 1999 and worked there as a full-time Lecturer from 1999 to 2005. He went on to study Economics at post-graduate level from 2006 at Bocconi University (Milan, Italy), receiving his PhD in 2011. He previously worked at the Monetary Policy Research Division of the European Central Bank (Frankfurt am Main, Germany) and held a Jean Monnet Postgraduate Fellowship at the European University Institute (Florence, Italy). For further details of publications see IDEAS-RePEc.

Vasco Gabriel is a former Head of the School of Economics and Director of Learning and Teaching at the University of Surrey. He graduated in Economics from the Technical University of Lisbon in 1995, where he was awarded the ICEP prize. He received a masters degree in Econometrics in 1998 from the same institution. In 2002, he completed his PhD in Economics at Birkbeck College, University of London. He taught at the University of Minho, Portugal, before being appointed as a Lecturer at the University of Surrey in 2004 and Senior Lecturer in 2010. Vasco's main field of specialization is Macroeconometrics, focusing on the application of non-linear methods, as well as general inference issues in macro models. He has published extensively in these areas including publications in Economic Letters, the Journal of Macroeconomics, the Journal of Money, Credit and Banking and the Oxford Handbook of the Indian Economy. For further details

of publications see IDEAS-RePEc.

Esteban Jaimovich is a Reader in the School of Economics at the University of Surrey. He completed his PhD in Economics at University College London in 2007. He was previously Assistant Professor in Economics at the Collegio Carlo Alberto in Turin, during 2007-2012, and next joined the University of Surrey as Senior Lecturer in Economics in 2012. Esteban's research mainly focuses on poverty persistence, lack of sustained long-run growth and international trade. He has published various articles covering those topics in the Journal of the European Economic Association, the Journal of International Economics, the Journal of Development Economics, the European Economic Review, and other journals. For further details of publications see IDEAS-RePEc.

Martin Kaae Jensen is a Professor in the School of Economics at the University of Surrey. His PhD is from the University of Copenhagen (1999-2002) and he was a post-doctoral scholar at Brown University between 2002 and 2004. He was previously a professor at University of Birmingham and University of Leicester. Martin works on various topics in theoretical macroeconomics, game theory and economic history, and his research has been published in journals such as Journal of Political Economy, Review of Economic Studies, Journal of Economic Theory, and Journal of Economic Dynamics and Control. For further details of publications see <https://sites.google.com/site/mkaaejensen/>

Hyungseok Joo is a Lecturer in the School of Economics at the University of Surrey. He graduated from the Yonsei University (Seoul, South Korea) in 2004. He then completed masters degree in Economics at University of Wisconsin in 2007, then he worked as a research analyst in tax and public finance area in a research institution in Korea. In 2015, he completed his PhD in Economics at Boston University, USA. He taught at the Wayne State University, USA, before being appointed as a Lecturer at the University of Surrey in 2019. His research fields are macroeconomics, international macro/finance, fiscal policy, and money and banking. For further details of publications see <https://sites.google.com/site/hsjoo214>

Silvia Miranda-Agrippino is a Senior Research Economist in Monetary Analysis at the Bank of England and a Research Affiliate in the Monetary Economics and Fluctuations (MEF) programme of CEPR. She was a Visiting Post-Doctoral Scholar at Northwestern University and a Post-Doctoral Researcher at London Business School, and holds a Ph.D.

in Economics from Bocconi University. Her research interests are Monetary Economics, Empirical Macroeconomics, International Macro-Finance, Macroeconometrics. For further details of publications see www.silviamirandaagrippino.com

Maryam Mirfatah is a Postdoctoral Research Fellow in Economics at the School of Economics, University of Surrey. She joined the Centre for International Macroeconomic Studies (CIMS) in 2018 on the project of "Macroeconomic Modelling and Policy Analysis for Emerging Economies". Currently, she is working on optimized simple monetary policy rules for open economies. Her research interests are in Macroeconomics, in particular the construction and estimation of DSGE models for the purpose of macroeconomic policy analysis. Maryam obtained her BSc in Statistics from Isfahan University of Technology, MSc in Economics from Azad University and a PhD in Economics (2019) from Yazd University, focusing on Money Growth Rules in Emerging Economies.

Ricardo Nunes is a professor and co-Director of the Centre of International Macroeconomic Studies at the University of Surrey. He obtained a PhD from Universitat Pompeu Fabra in 2007. He joined the Board of Governors of the Federal Reserve System in 2007, where he worked as an economist and senior economist. In 2014 he moved to the Federal Reserve Bank of Boston working as a senior economist and policy advisor. He was also a visiting researcher at the Bank of Portugal and the IMF. In 2018 and 2019 he worked at the Council of Economic Advisers to the Chancellor of the Exchequer. His main research is on monetary and fiscal policy. He has published in these areas in journals such as the Quarterly Journal of Economics, Journal of Political Economy, Journal of Monetary Economics, Journal of Economic Theory, Journal of European Economic Association, among others. For further details of publications see <https://sites.google.com/view/ricardonunes/home>

Rigas Oikonomou is professor of economics at the University of Louvain and faculty member at the University of Surrey. He completed his PhD at the London School of Economics in 2010. Prior to joining Louvain and Surrey he worked at the London Business School, the HEC Montreal and the Universitat Autònoma Barcelona. Rigas works on various topics in theoretical and applied Macroeconomics. His research has been published in journals such as the Review of Economic Studies, the Economic Journal and the Journal of Economic Dynamics and Control. For further details see: <https://sites.google.com/site/rigasoikonomou/research>

Mario Pascoa got his Ph.D. from UCLA in 1986, was assistant professor at the University of Pennsylvania from 1986 to 1992 and was at Universidade Nova de Lisboa prior to coming to Surrey in 2012. Having worked on monopolistic competition, large games and demand theory, his research over the last twenty five years has focused on collateral, repo markets and security pricing, both in finite horizon models and in economies with infinite lived agents. His published work includes contributions to Ponzi schemes and collateral (*Econometrica* 2002), lack of impatience and bubbles (*JET* 2011), re-hypothecation in repo (*JET* 2012), endogenous discounting and bubbles (*JET* 2019) and recourse loans (*ET* 2019). Has supervised ten doctoral students, placed in the U.S. (at Wisconsin-Madison), in Spain (at ESCP), in Brazil (at several business schools and economics departments) and in Portugal (at Nova).

Luciano Rispoli received his undergraduate degree in Economics in 2009 from Bocconi University. During his undergraduate degree he spent 6 months as an exchange student at the Australian National University. He then obtained a MSc in International Economics and Finance with distinction from the University of Sheffield in 2011. He then pursued his doctoral studies at Birkbeck College - University of London where he also worked as a Teaching Assistant and sessional Associate Lecturer. In 2016 he joined the University of Warwick as a Teaching Fellow where he taught Monetary Economics (MSc) and undergraduate micro and macroeconomics. In 2019 he joined the School of Economics at Surrey University where he currently teaches Quantitative methods (BSc), Corporate finance (BSc) and Financial Econometrics (MSc). His research fields are macroeconomics and monetary policy.

Kirill Shakhnov is a Lecturer in the School of Economics at the University of Surrey. In 2015, he completed his Ph.D. in Economics at European University Institute, Italy. He then held the Foscolo Europe Fellowship position at the Einaudi Institute for Economics and Finance and taught at LUISS University, before being appointed as a Lecturer at the University of Surrey in 2019. Kirill's primary research interests lie in the fields of international macroeconomics with a focus on sovereign bond markets and cryptocurrencies. The research is organized around three related topics: asset pricing of internationally traded assets, public finance, and the sources of macroeconomic fluctuations. For further details, please see <https://sites.google.com/site/kshakhnov>.

Kjetil Storesletten is a professor of macroeconomics at University of Oslo. He obtained a PhD in economics at Carnegie Mellon University in 1995. He has been a Monetary Advisor at Minneapolis Fed and associate professor at Stockholm University (IIES). He has served as managing editor of the Review of Economic Studies and as chairman of the same journal. He has also been a member of the Norwegian Executive Monetary Policy Committee. He has held an Advanced Grant from the European Research Council and in 2012 he received the Sun Yefang Award. Storesletten's work has appeared in all top journals in economics and he is a Fellow of Econometric Society.

Alessio Volpicella is a Lecturer in the School of Economics at the University of Surrey. He earned his BSc and MSc in Economics from Bocconi University (Milan, Italy). In 2020 he received a PhD in Economics from Queen Mary University of London. He joined the University of Surrey in August 2020. He has also collaborated with the European Central Bank (ECB), the Bank of England, and BNP Paribas. His main research is on macroeconometrics, identification in time series, and Bayesian econometrics.

3 Time-Table For all Courses (BST)

Registration will take place on day 1 at 9.00-9.30am (BST). Then for each day (for both Courses and Options) the time-table is as follows:

09.30 am - 11.00 am: Session 1

11.00 am - 11.30 am: Coffee and Tea

11.30 am - 01.00 pm: Session 2

01.00 pm - 02.15 pm: Lunch

02.15 pm - 03.45 pm: Session 3

03.45 pm - 04.15 pm: Coffee and Tea

04.15 pm - 05.45pm : Session 4

4 Foundations DSGE Macro-Modelling Course

This Course is aimed at those with some knowledge of RBC and NK models but little or no experience of setting them up in Dynare. The contents of lectures given by Gabriel,

Nunes, Rispoli, Shakhnov, and Volpicella over the four days are as follows:

- **Day 1 (7th Sep): Dynare Basics and the RBC Model**
 - Instructors: Deak, Shakhnov
 - Introduction to the 4-Day Course
 - Dynare Basics
 - RBC Model
 - Calibration and Use of an External Steady State
 - Linearisation
 - Exercises in Lab (all day)

- **Day 2 (8th Sep): The New Keynesian Model, Stability and Global Sensitivity Analysis**
 - Instructors: Cantore, Nunes
 - The New Keynesian (NK) Model
 - Stability-Indeterminacy
 - Introduction to the Global Sensitivity Analysis toolbox in Dynare
 - Exercises in Lab (all day)

- **Day 3 (9th Sep): Bayesian Estimation of the NK Model**
 - Instructors: Rispoli, Volpicella
 - Preparing the Data including use of various filters
 - An Introduction to Bayesian Methodology
 - Identification and Pre-estimation Checks
 - Direct Linear Estimation of the Non-Linear NK Model
 - Exercises in Lab (all day)

- **Day 4 (10th Sep): More on Estimation and Optimal Monetary Policy**
 - Instructors: Gabriel, Mirfatah

- Model Comparisons by Likelihood Races
- Comparison of Second Moments of Model with Data
- Optimal Monetary Policy for Linear-Quadratic Problems
 - * The Ramsey Problem
 - * Optimal Time-Consistent Policy
 - * Optimized Simple Rules
- Concluding Remarks
- Exercises in Lab (all day)

5 Advanced Macro-Modelling Course

The advanced course is aimed at people who are already fluent in Dynare and Matlab, but are finding that their ambition currently exceeds what they are able to do with these tools. We aim to distribute some of the numerical and computational tricks we have picked up over the course of our careers to enable people to tackle non-standard models. This course will be useful to anyone who is engaged in practical macroeconomic modelling work, especially if they are interested in working with models that are either computationally expensive to simulate, nonlinear, or infinite dimensional thanks to heterogeneous agents. Contents of the course to be given by Deak, Joo, Nunes, Shakhnov, and Storesletten are as follows:

- **Day 1 (7th Sep): Applied Dynamic Programming and Global Solution Algorithms**
 - Instructors: Joo, Nunes
 - The basic theory of dynamic programming
 - Numerical Integration
 - Function Approximation
 - Value Function Iteration
 - Policy Function Iteration
 - Projection Methods

- Exercises in Lab (all day)
- **Day 2 (8th Sep): Introduction to Heterogeneous Agents and Risk Sharing**
 - Instructor: Storesletten
 - Introduction to Models with Heterogeneous Agents
 - An analytical Aiyagari model with labor supply
 - Measuring risk sharing
 - Self insurance in terms of savings and labor supply
 - Dynamics of inequality
 - Welfare cost of inequality
- **Day 3 (9th Sep): Classical Heterogeneous Agents Models and Occasionally Binding Constraints**
 - Instructors: Deak, Shakhnov
 - Computational Issues in Models with Heterogeneous Agents
 - Solving Heterogenous-Agent Models without Aggregate Uncertainty: the Model of Aiyagari
 - Solving Heterogenous-Agent Models with Aggregate Uncertainty: the Krusell-Smith Algorithm
 - Alternative Algorithms
 - Exercises in Lab (all day)
- **Day 4 (10th Sep): Central Bank Communication, Imperfect Credibility, and Optimal Monetary Policy Applications**
 - Instructors: Nunes
 - Policy communication and central bank design
 - Price level targeting and alternative objectives
 - Credibility and imperfect commitment
 - Time-Inconsistency and Recursive Contracts

- Zero lower bound, exit strategies, and normalization policy
- Applications to medium and large scale models
- Exercises in Lab (all day)
- Concluding Remarks

6 One-day Options

On days 5 and 6, 13-14 September we run several one-day course options. Participants will be able to choose one option per day of the standalone courses. All options are *standalone* and can be chosen by all participants from both the foundations and advanced courses free of charge. Participants not attending the parallel courses on the first week will be able to register for the options. The instructors of the options are Cantore, Gabriel, Jaimovich, Jensen, Joo, Mirza, Pascoa, and Tamon.

6.1 Options first day (13th Sep)

6.1.1 Credit Market Imperfections and Poverty Traps

- Instructors: Jaimovich
- Technological Non-convexities and Poverty Traps
- Occupational Choice Models under Imperfect Credit Markets
- Misallocation of Talent and Market Failures
- Group Lending and Microcredit
- Risk and Insurance Motives in Economic Growth and the Village Economy Paradigm

6.1.2 DSGE-VAR Models and Forecasting

- Instructors: Gabriel
- Finite VAR approximation to solutions of DSGE models
- DSGE-VAR estimation

- DSGE forecasts in a Bayesian framework
- Estimation and out-of-Sample Forecasting
- Exercises in Lab (all day)

6.1.3 Topics in Sovereign Debt and Default

- Instructors: Joo, Shakhnov, and Asonuma
- Traditional sovereign debt model
- An introduction to quantitative sovereign default model
- Long term duration bond model
- Self-fulfilling debt model
- Quantitative properties of sovereign default models
- Sovereign debt restructurings
- Sovereign debt and fiscal policy
- Exercises in Lab (all day)

6.1.4 Tractable Heterogeneous Agents Models (TANK/HANK)

- Instructors: Cantore

The course is aimed at those who are familiar with representative-agent DSGE models, but no prior knowledge of heterogeneous-agents models is required.

- Summary of the key insights from the TANK/HANK literature
- TANK and THANK models as in Bilbiie (2019)
 - Inverted Aggregate Demand Logic
 - Cyclical Inequality and iMPCs
 - Forward Guidance
- Zero-Liquidity HANK

- Analytical Solution
 - Comparison with RANK
 - Taylor-principle
 - Forward Guidance
 - Endogenous uncertainty
 - Quantitative Easing
 - Distributional Consequence of Monetary Policy
- Exercises in Lab (all day)

6.2 Options second day (14th Sep)

6.2.1 Financial Markets: Collateral, Repo, and Credit Default Swaps

- Instructors: Pascoa
- Recourse and non-recourse loans; credit secured by durable goods; the impact of collateral margins on the price of the collateral.
- Short term loans backed by securities; over-the-counter versus centrally cleared repo markets; leverage and short-sales; repo specialness.
- The impact of repo margins on security prices; evidence from the European sovereign debt crisis; credit default swaps and the impact of their margins on security prices.
- The cross-currency-basis and repo: deviations from covered interest rate parity and secured funding frictions; the basis and the unsecured-secured interest rate spread; evidence from the 2008 crisis; central bank interventions.

6.2.2 Robust Qualitative Methods for Macro

- Instructors: Jensen
This topic goes to the research frontier of qualitative tools for both static and dynamic equilibrium models. Specific topics that will be covered are:
- Fixed Point Comparative Statics

- Distributional Comparative Statics
- Monotone Methods
- Examples and Illustrations from Behavioral Growth Models and Heterogeneous Agents Models

6.2.3 Modern Topics on Heterogeneous Agents and Wealth Accumulation

- Instructor: Oikonomou
- Models with Aggregate Uncertainty and Endogenous Labour Supply
 - Theory
 - Numerical Solutions.
 - Exercises in Lab
- Heterogeneous Agents New Keynesian Models
 - Theory
 - Numerical Solutions
 - Exercises in Lab

6.2.4 Empirical Identification of Macroeconomic Shocks

- Instructor: Miranda-Agrippino
- Overview of the Identification Problem and Classic Solutions
- Identification and Empirical Methods: VAR vs LP
- Identification with External Instruments
- Narrative-sign-restrictions