Hanno Kase

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OFFICE CONTACT INFORMATION

Forecasting and Policy Modelling Division
ECB Tower, Sonnemannstraße 20,
60314 Frankfurt am Main, Germany

RESEARCH INTERESTS

Quantitative Macroeconomics, Monetary Policy, Macroprudential Policy, Machine Learning

EDUCATION

2016 - 2021 **PhD in Economics**, European University Institute
Supervised by Prof. David Levine and Prof. Jesús Bueren
2016 - 2017 **MRes in Economics**, European University Institute
2011 - 2013 **MA in Finance**, Tallinn University of Technology
2008 - 2011 **BA in Economics**, Tallinn University of Technology

RESEARCH EXPERIENCE AND OTHER EMPLOYMENT

2023 - **Senior Economist**, Forecasting and Policy Modelling Division, ECB
2021 - 2023 **Postdoctoral Associate**, Department of Economics, University of Minnesota
2020 - 2021 **Research Associate**, European University Institute
COVID-19 Social Sciences and Humanities Data Portal
2020 **Research Assistant to Aldo Rustichini and Andrea Ichino**, European University Institute
2019 - 2021 **High Performance Computing Tutor**, European University Institute
2019 **Visiting Researcher**, Bank of Estonia, Research Department
2018 - 2019 **Research Assistant to Andrea Mattozzi**, European University Institute
2012 - 2016 **Economist**, Bank of Estonia, Financial Stability Department

PROFESSIONAL ACTIVITIES

Seminars and Conferences

2022 The Society for Nonlinear Dynamics and Econometrics (SNDE) Symposium, The Society for Economic Measurement (SEM) Annual Conference, The European Economic Association (EEA) and European meeting of the Econometric Society (ESEM) Conference, Conference on Non-traditional Data, Machine Learning and Natural Language Processing in Macroeconomics at Sveriges Riksbank, Midwest Macro Meeting
2023 ASSA, SEM, CEF, NBER Summer Institute, DSE
2024 CEF 2024, SED, SEM 2024, ECB, Goethe University Frankfurt, Numerical Methods in Macroeconomic

Refereeing

Baltic Journal of Economics, Journal of Applied Econometrics

HONOURS, SCHOLARSHIPS, AND FELLOWSHIPS

2019 - 2020	PhD Completion Grant, European University Institute
2016 - 2020	PhD Grant, Archimedes
2014	5th Lindau Meeting on Economic Sciences

SKILLS

Research software:	Python, R, Matlab, Julia, Stata
Machine learning software	PyTorch, JAX
Computer skills:	LaTeX, Git
Language skills:	English, Estonian

WORKING PAPERS

Estimating Nonlinear Heterogeneous Agent Models with Neural Networks

with Leonardo Melosi and Matthias Rottner

We leverage recent advancements in machine learning to develop an integrated method to solve globally and estimate models featuring agent heterogeneity, nonlinear constraints, and aggregate uncertainty. Using simulated data, we show that the proposed method accurately estimates the parameters of a nonlinear Heterogeneous Agent New Keynesian (HANK) model with a zero lower bound (ZLB) constraint. We further apply our method to estimate this HANK model using U.S. data. In the estimated model, the interaction between the ZLB constraint and idiosyncratic income risks emerges as a key source of aggregate output volatility.

WORK IN PROGRESS

Nonlinear Phillips Curve and Inflation Risk

with Leonardo Melosi, Sebastian Rast and Matthias Rottner

How does a nonlinear Phillips curve affect inflation risk? Using a strategic surveys approach and micro price data, we establish that the price setting behaviour of firms depends nonlinearly on the inflation environment. In a high inflation environment, the share of firms that adjust their prices in response to expected inflation increases. We rationalize these dynamics using a quantitative macroeconomic model with a nonlinear Phillips curve. The model features a tractable heterogeneous firm setup with endogenous varying degrees of price flexibility. Solving the model with a machine learning approach, we demonstrate that, in this setting, contractionary supply shocks lead to higher inflation, which provides a new motive for the monetary policy to act preemptively.

Sequence-Space Jacobian meets Deep Learning: Exploiting the Random Walk for HANK

with Rodolfo Rigato and Matthias Rottner

This paper introduces an innovative approach integrating deep learning techniques with sequence-space Jacobian methods to enhance Bayesian estimation in heterogeneous agent New-Keynesian (HANK) models. By employing a deep neural network as a surrogate for the posterior, we aim to accelerate the Bayesian estimation process significantly. This network is trained on a dataset comprising true model likelihoods generated through a parallel Metropolis-Hastings algorithm. Our method uniquely leverages all generated draws, including both accepted and rejected ones, thereby ensuring a thorough exploration of the parameter space. This strategy not only alleviates the computational burden traditionally associated with Bayesian estimation but also demonstrates remarkable efficiency in estimating parameters that necessitate the resolution of the model's steady state and the recalculation of Jacobians. Our work stands at the frontier of integrating advanced computational techniques with economic

modeling, promising substantial advancements in estimating and understanding complex heterogeneous agent models.

Backpropagating Through Heterogeneous Agent Models

This paper explores applications of the backpropagation algorithm on heterogeneous agent models. In addition, I clarify the connection between deep learning and dynamic structural models by showing how a standard value function iteration algorithm can be viewed as a recurrent convolutional neural network. As a result, many advances in the field of machine learning can carry over to economics. This in turn makes the solution and estimation of more complex models feasible.

Limits on Mortgage Lending

This paper aims to study the impact of macroprudential limits on mortgage lending in a heterogeneous agent life-cycle model with incomplete markets, long-term mortgages, and defaults. Using data from the Household Finance and Consumption Survey, the model is calibrated for the German economy. I consider the effects of four policy instruments: loan-to-value limit, debt-to-income limit, payment-to-income limit, and maximum maturity. I find that their effect on the homeownership rate is fairly modest. Only the loan-to-value limit significantly reduces the homeownership rate among young households. At the same time, it has the most significant positive welfare effect