

# Hanno Kase

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## OFFICE CONTACT INFORMATION

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

## RESEARCH INTERESTS

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Quantitative Macroeconomics, Monetary Policy, Macroprudential Policy, Machine Learning

## REFERENCES

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### Prof. David Levine

European University Institute  
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### Leonardo Melosi, Ph.D.

Federal Reserve Bank of Chicago  
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### Prof. Jesús Bueren

European University Institute  
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## EDUCATION

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- 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

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- 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

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### 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

## Refereeing

Baltic Journal of Economics

## HONOURS, SCHOLARSHIPS, AND FELLOWSHIPS

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

## SKILLS

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

## WORKING PAPERS

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### **Estimating Nonlinear Heterogeneous Agents Models with Neural Networks**

with Leonardo Melosi and Matthias Rottner

We leverage the recent advancements in machine learning to develop a solution and estimation method based on neural networks for complex economic models. We apply our method to a nonlinear Heterogeneous Agent New Keynesian (HANK) model with a zero lower bound constraint for the nominal interest rate. To begin with, we demonstrate with simulated data that our method is much more efficient than existing global solution methods and that likelihood estimation converges to the true parameter values. We then estimate the model with US aggregate data and evaluate the information content it provides about households' idiosyncratic risk. Our empirical application also sheds light on the efficacy of our method in simultaneously handling a large number of state variables and parameters, nonlinear dynamics, heterogeneity, and aggregate uncertainty.

## WORK IN PROGRESS

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### **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.

### **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