# Open Source Economics

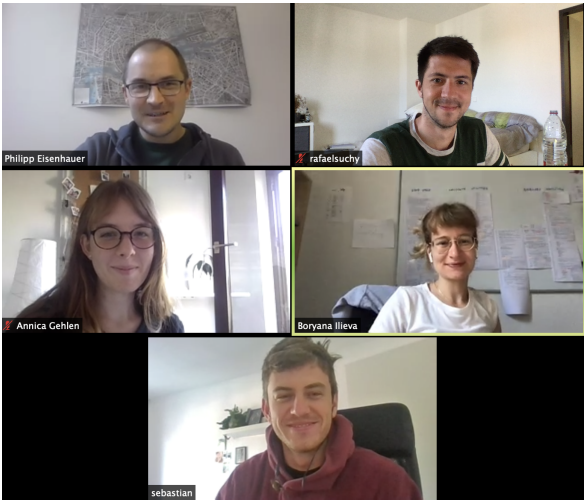
## A platform for transdisciplinary research and education

The OSE team

**September 17, 2020**

Open Source Economics

# Public outreach



# In a nutshell

*We provide a platform for economists, mathematicians, and computational scientists to facilitate the* ***transdisciplinary collaboration*** *in the development, analysis, and application of* ***computational economic models****.*

*Together, we* ***expand the set*** *of possible economic questions that we can address and* ***improve the quality*** *of our answers.*

# Computational modeling in economics

## Motivation

- Facilitate learning
- Study mechanisms
- Predict public policies

# Computational modeling in economics

## Motivation

- Facilitate learning
- Study mechanisms
- Predict public policies

## Transdisciplinary in nature

- Economic model
- Mathematical framework
- Computational implementation

# New tooling for an old idea

THE greatest improvement in the productive powers of labor, and the greater part of the skill, dexterity, and judgment with which it is anywhere directed, or applied, seem to have been the effects of the **division of labor**.

- Adam Smith, The Wealth of Nations

# Partners

Institute for
Numerical Simulation

SMART
DATA
ANALYTICS
FROM DATA TO KNOWLEDGE




# What we are doing

## Economic models

- **respy** — Finite-horizon discrete Markov decision problem; Labor economics
- ruspy
- pydsge

# What we are doing

## Economic models

- respy
- **ruspy** Infinite-horizon discrete Markov decision problem
  Industrial organization
- pydsge

# What we are doing

## Economic models

- respy
- ruspy
- **pydsge** Dynamic stochastic general equilibrium model
  Monetary economics

# What we are doing

## Analysis pipeline

- **estimagic** Numerical optimization
  Estimating structural econometric models
- econsa
- robupy

# What we are doing

## Analysis pipeline

- estimagic
- **econsa** Sensitivity analysis
  Assessing uncertainty of model implications
- robupy

# What we are doing

## Analysis pipeline

- estimagic
- econsa
- **robupy** Robust optimization
  Incorporating model ambiguity

# Development

## Workflow

- GitHub organization
- Code reviews
- Testing harness
- Continuous integration

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- Testing harness
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## Support

- Documentation
- Chatroom
- Hackathon
- Conferences

# OSE Research

# Eckstein–Keane–Wolpin models

## Understanding individual decisions

- Human capital investment
- Consumption – savings decision

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$\Rightarrow$ transdisciplinary research on their economics, data, and computation

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## Understanding individual decisions

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$\Rightarrow$ transdisciplinary research on their economics, data, and **computation**

# Research projects

## Economics and data

- **Biased expectations**
- Robust decisions
- Vocational training
- Option value

Incorporate subjective expectations
Collaboration with DIW for SOEP-IS data collection

# Research projects

## Economics and data

- Biased expectations
- **Robust decisions**
  Account for ubiquitous uncertainties
  Robust decision in light of model misspecification
- Vocational training
- Option value

# Research projects

## Economics and data

- Biased expectations
- Robust decisions
- **Vocational training**
  - Distinguish vocational and general education
  - Collaboration with IZA to study case of Germany
- Option value

# Research projects

## Economics and data

- Biased expectations
- Robust decisions
- Vocational training
- **Option value**

Schooling reform for identification and validation
Collaboration with Statistics Norway

# Research projects

## Computation

- **Uncertainty quantification**
  Capture parametric uncertainty
  Assess competing policy implications
- Global optimization
- HPC implementation

# Research projects

## Computation

- Uncertainty quantification
- **Global optimization**
- HPC implementation

Explore estimation uncertainty
Acknowledge multiplicity of local minima

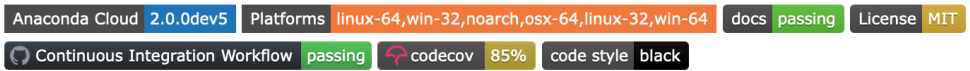
# Research projects

## Computation

- Uncertainty quantification
- Global optimization
- **HPC implementation** — Enable increased realism and auditing of economic models
  Exploit large-scale parallelism on supercomputers

# respy

A research code for the flexible specification, simulation, and estimation of Eckstein–Keane–Wolpin models.




**Docs** respy.readthedocs.io

## Ecosystem

- Permissive license
- Online documentation
- Benchmark data sets
- Retreat

# Code as research

## Ecosystem

- Permissive license
- Online documentation
- Benchmark data sets
- Retreat

## Infrastructure

- Research software engineer
- Pre-doc position
- Lectures
- Courses

# OSE Education

# Components

## Economics

- Motivation
- Interpretation
- Application

## Programming

- Simulation
- Exploration
- Visualization

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- Motivation
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- Application

$\Rightarrow$ Level of difficulty easily adjusted

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# Components

## Economics

- Motivation
- Interpretation
- Application

⇒ Level of difficulty easily adjusted

⇒ Skills transferable across domains

## Programming

- Simulation
- Exploration
- Visualization

# Exemplary course

## Scientific computing for economists

- Basic numerical methods
- Dynamic model of human capital application
- Software engineering
- High-performance computing
- Contributors

**Docs** ose-scientific-computing.rtfd.io

# Exemplary course

## Data science for economists

- Methods of causal analysis
- Applications in labor economics
- Python data science ecosystem
- Simulation experiments
- Reproducible workflow

**Docs** ose-data-science.rtfd.io

# Digital infrastructure


- Cloud-hosted
- Browser-based
- Identical configurations
- Complete environments
- Scalable workflows

# Conclusion

# Join us!

http://bit.ly/ose-github


http://bit.ly/ose-zulip

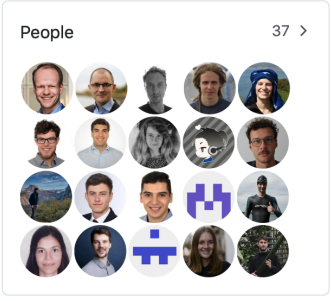
https://twitter.com/open_econ


https://open-econ.org

# Appendix

# Contributors

- Professors
- Postdoctoral researchers
- Ph.D. students
- Master students
- Bachelor students



Open Source
Economics
Berlin