Open Source Economics

A platform for transdisciplinary research and education
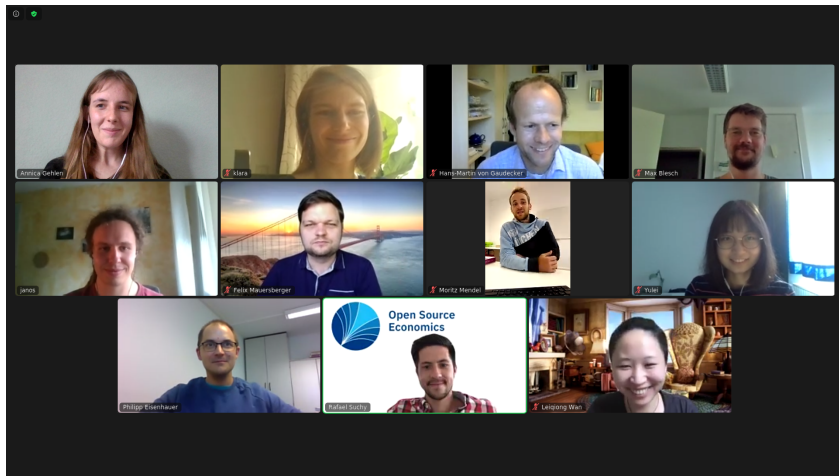
The OSE team

September 26, 2020

Open Source Economics

Sampling the core team

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 academic rigor

- Study mechanisms

- Predict public policies

Computational modeling in economics

Motivation

- Facilitate academic rigor

- Study mechanisms

- Predict public policies

Transdisciplinary in nature

- Economic model

- Mathematical framework

- Computational implementation

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

DIW BERLIN

LiMES
Life & Medical Sciences Institute

Statistisk sentralbyrå
Statistics Norway

UNIL | Université de Lausanne

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

What we are doing

Analysis pipeline

- estimagic

- econsa

- robupy

$\Rightarrow$ Intellectual arbitrage from work in applied mathematics

What we are doing

Analysis pipeline

- estimagic

- econsa

- robupy

$\Rightarrow$ Intellectual arbitrage from work in applied mathematics

$\Rightarrow$ Adapted to the needs of economists

Development

Workflow

- GitHub organization

- Code reviews

- Testing harness

- Continuous integration

Development

Workflow

- GitHub organization

- Code reviews

- Testing harness

- Continuous integration

Support

- Documentation

- Chatroom

- Hackathon

- Conferences

OSE Research

Eckstein–Keane–Wolpin models

Understanding individual decisions

- Human capital investment

- Consumption–savings decision

Eckstein–Keane–Wolpin models

Understanding individual decisions

- Human capital investment

- Consumption–savings decision

Predicting effects of policies

- Welfare programs

- Tax schedules

Eckstein–Keane–Wolpin models

Understanding individual decisions

- Human capital investment

- Consumption–savings decision

Predicting effects of policies

- Welfare programs

- Tax schedules

Mathematical framework and implementation

- Finite-horizon discrete Markov decision problem

- Backward induction algorithm

Eckstein–Keane–Wolpin models

Understanding individual decisions

- Human capital investment

- Consumption–savings decision

Predicting effects of policies

- Welfare programs

- Tax schedules

Mathematical framework and implementation

- Finite-horizon discrete Markov decision problem

- Backward induction algorithm

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

Eckstein–Keane–Wolpin models

Understanding individual decisions

- Human capital investment

- Consumption–savings decision

Predicting effects of policies

- Welfare programs

- Tax schedules

Mathematical framework and implementation

- Finite-horizon discrete Markov decision problem

- Backward induction algorithm

⇒ Transdisciplinary research on their economics, **data**, and computation

Eckstein–Keane–Wolpin models

Understanding individual decisions

- Human capital investment

- Consumption–savings decision

Predicting effects of policies

- Welfare programs

- Tax schedules

Mathematical framework and implementation

- Finite-horizon discrete Markov decision problem

- Backward induction algorithm

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

Research projects

Economics and data

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

Incorporate subjective expectations
Collaboration with DIW for SOEP-IS data collection
Facilitating development of **soepy** and **respy**

Economics and data

- Biased expectations

- **Robust decisions**   Account for ubiquitous uncertainties
  Robust decision in light of model misspecification
- Option value   Building on **respy** and **robupy**

Research projects

Economics and data

- Biased expectations

- Robust decisions

- **Option value**   Schooling reform for identification and validation
  Collaboration with Statistics Norway
  Extension of **respy** to capture schooling system

Research projects

Computation

- **Uncertainty quantification**   Capture parametric uncertainty
                                       Assess competing policy implications
- Global optimization   Need to adapt **econsa** to challenges in economic models

- HPC implementation

Computation

- Uncertainty quantification

- **Global optimization**

- HPC implementation

Explore estimation uncertainty
Acknowledge multiplicity of local minima
Show use-case for **estimagic** features
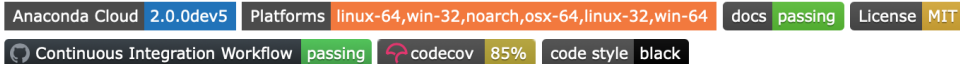
Research projects

Computation

- Uncertainty quantification

- Global optimization

- **HPC implementation**   Enable increased realism and auditing of economic models
  Exploit large-scale parallelism on supercomputers
  Refactor **respy** to meet needs

Community code

respy

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

| Anaconda Cloud | 2.0.0dev5 | | Platforms | linux-64,win-32,noarch,osx-64,linux-32,win-64 | | docs | passing | | License | MIT |

| Continuous Integration Workflow | passing | | codecov | 85% | | code style | black |

Core devs   Tobias Raabe, Janos Gabler
Docs   respy.readthedocs.io

Code as research

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

Components

Economics

- Motivation

- Interpretation

- Application

$\Rightarrow$ Level of difficulty easily adjusted

Programming

- Simulation

- Exploration

- Visualization

Components

Economics

- Motivation

- Interpretation

- Application

$\Rightarrow$ Level of difficulty easily adjusted

$\Rightarrow$ 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

- Guest lectures

- Contributors

Docs ose-scientific-computing.readthedocs.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.readthedocs.io

Integrated teaching and research platform

NUVOLOS

- Complete environments

- Identical configurations

- Browser-based

- Cloud-hosted

- Scalable workflows

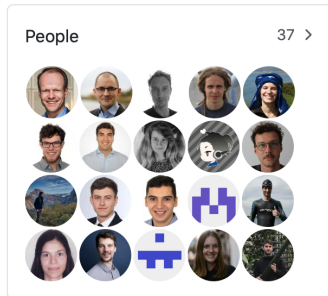# Conclusion

Let's make it a success!

Visit us at `https://open-econ.org`

Appendix

Contributors

- Professors

- Postdoctoral researchers

- Ph.D. students

- Master students

- Bachelor students

Join us!

http://bit.ly/ose-github

http://bit.ly/ose-zulip

https://twitter.com/open_econ

https://open-econ.org