Open Source Economics

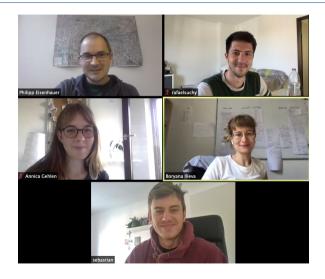
A platform for transdisciplinary research and education

The OSE team

September 18, 2020



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

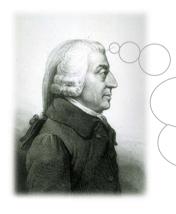
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Transdisciplinary in nature

- Economic model
- Mathematical framework
- Computational implementation

New tools 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











Economic models

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

Economic models

respy

• **ruspy** Infinite-horizon discrete Markov decision problem Industrial organization

pydsge

Economic models

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

Analysis pipeline

• estimagic Numerical optimization

Estimating structural econometric models

econsa

robupy

Analysis pipeline

estimagic

• econsa Sensitivity analysis

Assessing uncertainty of model implications

robupy

Analysis pipeline

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

Analysis pipeline

- estimagic
- econsa
- robupy

⇒ Intellectual arbitrage from work in applied mathematics

Analysis pipeline

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- econsa
- robupy

- \Rightarrow Intellectual arbitrage from work in applied mathematics
- ⇒ Adapted to the needs of economists

Development

Workflow

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

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- Code reviews
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Support

- Documentation
- Chatroom
- Hackathon
- Conferences

OSE Research

Understanding individual decisions

- · Human capital investment
- Consumption-savings decision

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Predicting effects of policies

- Welfare programs
- Tax schedules

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- Backward induction algorithm

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

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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

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Account for ubiquitous uncertainties

Robust decision in light of model misspecification

Building on **respy** and **robupy**

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

Computation

Uncertainty quantification

Capture parametric uncertainty

Global optimization

Assess competing policy implications

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

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



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



Docs respy.readthedocs.io

Code as research

Ecosystem

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

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Infrastructure

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

OSE Education

Components

Economics

- Motivation
- Interpretation
- Application

Programming

- Simulation
- Exploration
- Visualization

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- Application
- \Rightarrow Level of difficulty easily adjusted

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Components

Economics

- Motivation
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- Application
- \Rightarrow 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

