## **Open Source Economics**

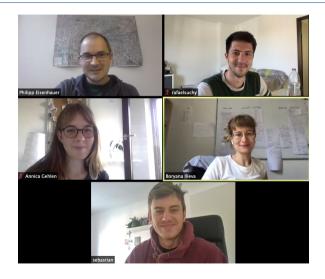
A platform for transdisciplinary research and education

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

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- Facilitate learning
- Study mechanisms
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#### 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











#### **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

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- robupy

⇒ Intellectual arbitrage from work in applied mathematics

#### **Analysis pipeline**

- estimagic
- 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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#### **Support**

- Documentation
- Chatroom
- Hackathon
- Conferences

## **OSE Research**

#### **Understanding individual decisions**

- · Human capital investment
- Consumption savings decision

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#### **Predicting effects of policies**

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- Tax schedules

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- $\Rightarrow$  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

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Account for ubiquitous uncertainties

Robust decision in light of model misspecification

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

#### **Economics and data**

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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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#### **Economics**

- Motivation
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- $\Rightarrow$  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

