

---

# Open Source Economics

A platform for transdisciplinary research and education

The OSE team

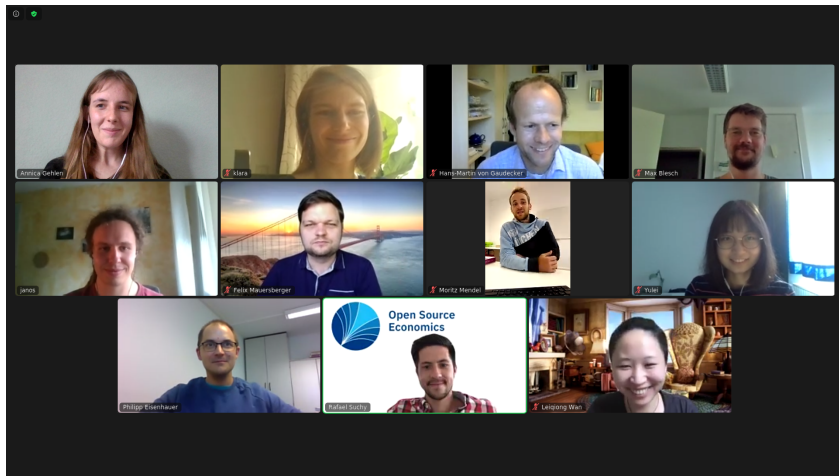
September 23, 2020



Open Source  
Economics

---

## Sampling the core team



*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.*

## Motivation

- Facilitate academic rigor
- Study mechanisms
- Predict public policies

## 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



Institute for  
Numerical Simulation



# What we are doing

---

## Economic models

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

⇒ Intellectual arbitrage from work in applied mathematics

# What we are doing

---

## Analysis pipeline

- estimagic
- econsa
- robupy

⇒ Intellectual arbitrage from work in applied mathematics

⇒ 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

---

## Understanding individual decisions

- Human capital investment
- Consumption–savings decision

## Understanding individual decisions

- Human capital investment
- Consumption–savings decision

## Predicting effects of policies

- Welfare programs
- Tax schedules

## 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

## 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

## 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

## 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**



### Economics and data

- **Biased expectations**      Incorporate subjective expectations  
Collaboration with DIW for SOEP-IS data collection
- Robust decisions      Facilitating development of **soepy** and **respy**
- Option value

### 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**

### 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  
Assess competing policy implications
- Global optimization    Need to adapt **econsa** to challenges in economic models
- HPC implementation

### Computation

- Uncertainty quantification
- **Global optimization**
  - Explore estimation uncertainty
  - Acknowledge multiplicity of local minima
  - Show use-case for **estimagic** features
- HPC implementation

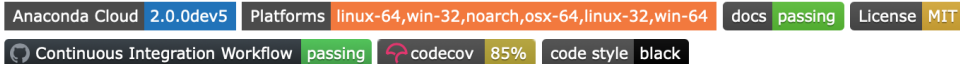
### Computation

- 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



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



**Core devs** Tobias Raabe, Janos Gabler

**Docs** [respy.readthedocs.io](https://respy.readthedocs.io)

## Ecosystem

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



## 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

⇒ Level of difficulty easily adjusted

## Programming

- Simulation
- Exploration
- Visualization

# Components

---

## Economics

- Motivation
- Interpretation
- Application

⇒ Level of difficulty easily adjusted

⇒ Skills transferable across domains

## Programming

- Simulation
- Exploration
- Visualization

### Scientific computing for economists

- Basic numerical methods
- Dynamic model of human capital application
- Software engineering
- Guest lectures
- Contributors

**Docs** [ose-scientific-computing.readthedocs.io](https://ose-scientific-computing.readthedocs.io)

### 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](https://ose-data-science.readthedocs.io)



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



---

## Conclusion

---

## Join us!

---



<http://bit.ly/ose-github>



<http://bit.ly/ose-zulip>



[https://twitter.com/open\\_econ](https://twitter.com/open_econ)



<https://open-econ.org>

Let's make it a success!

---



**Open Source  
Economics  
Bonn**

---

---

# Appendix

---

# Contributors

---

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

