Theory development through agent-based modelling
Lessons from economics

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Purpose of the presentation

- What can we learn from (mainstream) economics when it comes to theory construction?
  - Positive practices to follow, negative practices to avoid

Outline:

1. Basic terminology
2. The situation in economics
3. The lessons from economics
4. My conclusions for theory development using ABM
1 Basic terminology
2 The situation in economics
3 The lessons from economics
4 My conclusions for theory development using ABM
Concept

Mental representations (or ‘ideas’) and basic building blocks of thinking, e.g. ‘shirt’, ‘love’, ‘GDP’, ‘money’, ...

▶ Concept ≠ symbolic representation of a concept
▶ Concepts as such located on the meaning structure
▶ For transfer among individuals, a symbolic representation needed (surface structure)
▶ Communication of concepts requires shared meanings as well as shared symbolic framework
Terminology II

Theory

A set of concepts, a set of propositions about relations among these concepts, and logical justifications of these propositions (including a clarification of scope).

- Theories also have a meaning and a surface structure
- Theory development is a social endeavor: requires communication
- Both *mental* and *surface* level must align
Terminology III

Model

Epistemic artifacts, usually used to represent a target system.

- Ontology of models highly disputed area of philosophy
- Best understood *functionally*
  - Representations of targets, used to facilitate cognitive processes such as understanding
- *How* models represents requires explicit epistemological framework (e.g. the DEKI account, see Frigg and Nguyen, 2016; Gräbner, 2018a)
- ABM are a particular **type** of model with particular *representational capacities* (Weisberg, 2013)

Main question

What can we learn from (mainstream) economics when it comes to theory construction?
1. Basic terminology
2. The situation in (mainstream) economics
3. The lessons from (mainstream) economics
4. My conclusions for theory development using ABM
On the situation in economics I

- Economics is divided, with a strong ‘mainstream’ and smaller ‘heterodoxies’
- In the ‘mainstream’, ABM increasingly present but still a rather peripheral method
  - Situation a bit different outside the ‘mainstream’

![Graph showing the number of articles retrieved in the EconLit database](source: Richiardi (2015), data from Econlit (2015)).

**Figure**: Source: Richiardi (2015), data from Econlit (2015).
‘Economics’ mainly defined ‘in terms of the economic method’

“economics is a way of doing social science, using particular tools. In this interpretation the discipline is associated with an apparatus of formal modeling and statistical analysis rather than particular hypotheses or theories about the economy.” (Rodrik, 2015, p. 7)

“There is a standing presumption in economics that, if an empirical statement is deduced from standard assumptions such as expected utility maximization and market-clearing, then that statement is reliable ” (Sugden, 2000, pp. 16-17)
The ‘economic model’ is characterized by...

- Utility maximizing individuals
- Systemic equilibrium

- Strong preference for analytical models over simulations (e.g. Lehtinen and Kuorikoski, 2007)

- This has important implications for communication within economics

Figure: Source: Aistleitner, Kapeller, and Steinerberger (2017), data from Thomson Scientific.

- Citation patterns show strong segregation in ‘research programs’
- Intense communication within mainstream, but absent communication with non-mainstream

▶ Hypothesis: Theoretical ‘lock-in’ in economics (e.g. Gräbner, 2018b)
1. Basic terminology
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Lessons from (mainstream) economics

Positive aspects

- Almost universally shared mapping between *meaning* and *surface* structure of theories
- Successful application of the TAPAS practice
- Close integration of theoretical and empirical work
  - Yet no fallibilism a la Popper

Negative aspects

- Alternative methods & inconsistent theories not considered
  - Theoretical ‘lock-in’ with ‘blind spots’
- Lack of self-reflection and excessive reliance on ‘standard’ approaches
- Extreme concentration on ‘Top five’ journals and their theoretical approaches

- Communication on the applied level works well
- Theory development of dominant approaches works - superficially - very efficiently
- There is an alarming lack of diversity
- Many parts of the ‘theory space’ are neglected
Best practice outside the ‘mainstream’

Already works *somehow well* in some non-mainstream areas of economics

**Agent based-stock flow consistent macroeconomics: Towards a benchmark model**

Alessandro Caiani a,*, Antoine Godin b, Eugenio Caverzasi a, Mauro Gallegati a, Stephen Kinsella c, Joseph E. Stiglitz d

▶ Follow very much Volker Grimm’s practice
▶ Theoretical core provided by an evolutionary approach to economics
Three lessons

First lesson

- Aligning the meaning and surface structures of researchers working on the same theories is essential
  - Shared standard, common meta-theoretical convictions,
  - Using both simple & complex formal models, and aligning them with each other, helps

Second lesson

- A certain theoretical and methodological diversity is important (for general assessment see Page, 2007)
  - Otherwise, theoretical lock-ins and blind spots will occur
  - Diversity must be actively protected against tendencies of monopolization
  - ABM alone cannot contribute to good theory development
    - Triangulation with other methods mandatory

Third lesson

- There is an inherent trade off between ...
  - successful communication and well aligned meaning and surface structures and...
  - a sane openness to theoretical and methodological innovations

- Good theory development requires an answer to this tension
1. Basic terminology
2. The situation in (mainstream) economics
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There are both short-run and medium-run conclusions that I draw from my experience in economics.

**Short-run conclusions**

- Other social theories must not be neglected: much valuable knowledge has been already accumulated
  - This applies to both ‘mainstream’ as well as ‘heterodox’ approaches
  - Citation statistics often not good to identify ‘useful’ theories
- Transform and extend existing theories & models in an agent-based framework is fruitful and important for ABM in several respects (see e.g. Gräbner et al., 2017)
  - Allows exploitation of existing theory
  - Allows aligning ABM to other methods and approaches
  - Might also increase acceptance of ABM
Medium-run conclusions

- Measures must be taken to level successful communication with theoretical diversity

**To ensure communication**
- Embed models into explicit explicit epistemological frameworks (Gräbner, 2018a, JASSS)
  - Consider PoS, e.g. debate on multiple-model hypothesis (Aydinonat, 2018)
  - Debates on pluralism in economics (e.g. Gräbner, 2018b)

**To ensure diversity**
- Sane mixture between theoretical and empirical ABM
  - Theoretical ABM extend the computational menu of “causal mechanism schemes” (Ylikoski and Aydinonat, 2014)
  - Use Empirical ABM to synthesize these causal mechanism schemes and explore their empirical validity
- Ensure the representation of diverse “schools of thought” and alternative methodologies in publication outlays
- Organize interdisciplinary symposia where the contributions of these schools and methods are related to each other to ensure sane communication among them
  - Examples include thematic special issues, e.g. on ‘Different perspectives on the sources for inequality’
Economics can teach us a lot - in the positive as well as in the negative

Good theory development requires good communication among researchers...

...as well as a well-aligned diversity of theoretical and methods

My more concrete suggestions have been:

1. Take existing theories, express and extend them via ABM
2. Embed this work into explicit meta-theoretical frameworks
3. Align & appreciate stylized, theoretical, complex, and empirical ABM
4. Actively embrace interdisciplinary and pluralist discourse
References I


Claudius Gräbner et al. “Getting the Best of Both Worlds? Developing Complementary Equation-Based and Agent-Based Models”. In: Computational Economics (2017).


