

# *Applied macroeconomic analysis and modelling in complex systems*

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*Epistemological Perspectives on Simulations  
in Macroeconomics*

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From an epistemological perspective, a macroeconomics involving simulations, agent-based modeling, heterogeneous expectations, and uncertainty employs an **open system approach** to macroeconomic modelling rather than the **closed system approach** of standard mainstream DSGE macroeconomics.

Open systems are complex systems

Following Simon's 'Architecture of Complexity' (1962) on the nature of a complex system:

open systems are complex systems that derive their openness from their dynamic, reflexive character

How are open systems dynamic and reflexive?

- (i) groups of different agents interact at the micro level
- (ii) this affects overall macro aggregate behavior
- (iii) this feeds back on and affects micro level interaction
- (iv) this again affects macro aggregate behavior

This continues as a **two-level, reflexive dynamic process**

Closed macro systems approaches employ rational behavior microfoundations to generate determinate aggregate level behavior in a one-way street manner by removing aggregate behavior feedback effects on the micro agent level

These **closed system** microfoundations are investigators' **exclusive entry points** for the system's one-level aggregate performance.

In **open systems** different possible views of agents allow investigators **multiple entry points** to examine different types of two-level dynamics.

Comparative analysis of different possible two-level open systems makes **simulations** a key method of investigation

Different simulation results can be evaluated for **realism** and **policy potential** in investigations of evolving macroeconomies

Two important implications of open system approaches:

- (i) agent **values** and behavioral motivations are multi-dimensional both within and across agents
- (ii) the concept of **time** is that what is true can change over time in an emergent, evolutionary way

In contrast, **closed system rational behavior** microfoundations are reductionist about agent values, logically regimenting them strictly only as ordinal preferences in order to:

- (i) produce behavioral determinacy
- (ii) ensure equilibrium solutions
- (iii) represent the macro economy ‘as if’ a single representative agent exists

With **open system heterogeneous behavioral foundations** agents have multiple kinds of values and different value structures

Feedback from macro aggregate level affects these value structures differently and this affects agents' interaction in a non-simple way

Agents are adjusting satisficers, not utility maximizers

No single 'representative' agent exists

Regarding time, **closed system rational behavior** assumes what is true is timelessly true

What maximizes utility cannot change when an economy adjusts to a new equilibrium since equilibrium outcomes presuppose rational behavior

This implies fatalism, or that what is true today must be true in the future

For time in an **uncertain open world** what maximizes utility and is true at  $t_1$  may not maximize utility and be true at  $t_2$  after the economy adjusts to a shock and agents adjust their behavior

What is true is not timeless and depends upon how the economy evolves

**Emergence** is a real phenomenon; fatalism is rejected

Summarizing, modelling in complex systems employs an **open system** approach in economics

Open systems are complex systems that model the economy as a **two-level, reflexive dynamic process**

This entails agents have **complex value structures** and a conception of **time** that allows for emergence and evolutionary change

Thank you!

Comments? Questions?