WHAT PROSPECTIVE MODELS FOR AN ECOLOGICAL TRANSITION?

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Overview

This article presents a conceptual analysis of the prospective modeling biases and possible development by tracing how models and their results are influenced by their underlying economic frameworks. It begins with a cross comparison of two archetypal economic schools of thought – neoclassical and ecological economics - highlighting the key conceptual differences between them.

The article then explores how these theoretical distinctions permeate the modeling process, shaping both model outputs and the associated policy responses, thereby constraining the space of possibilities accordingly. Models circumscribe the possibility tree in two interrelated ways. First, through their own structure, which often conceals ethical choices within the formalization process, despite these choices being critical to model results. Second, by their central role in constructing prospective scenarios, as modeling literature cristalizes research agendas on the ecological transition.

Finally, the paper proposes a classification of models depending on their suitability for representing both economic frameworks. It suggests a conceptual modeling agenda to enlarge economic perspective, make ethical considerations more explicit, and explore possible paradigmatic shifts for achieving a sustainable economy.

Methods

Building upon debates regarding the role of economic science and its inherently political and ethical dimensions (Sen, 1987; Daly, 1980; Polanyi, 1977), this article reviews the theoretical schism between neoclassical and ecological economics. It illustrates the dissensus in five key points: sustainability (Pearce, 2002), substitutability (Cohen and Harcourt, 2003), societal metabolism and reliance of the economy on the environment (Haberl et al., 2019), banking theories (Mercure et al., 2019), and, perhaps most importantly, the object of interest and the ethical purpose of the economy, illustrated by Daly's ends-means spectrum (see Figure 2). The article then proposes a classification of models based on three key characteristics: optimization or simulation; equilibrium or disequilibrium; top-down or bottom-up. It examines the implications of these structural differences for model scenarios and results. Ethical considerations embedded in model structures are explored through concrete examples, such as Negishi weighting (Stanton, 2011), discount rate (Guigourez, 2023) and damage function attribution rule (Dennig et al., 2015). From a broader perspective, the article also illustrates how models structure contribute to shaping academic and political agendas, using the example of the SSPs.

Results

Various modeling methods are identified and their convenience for both economic paradigms is discussed (figure 1).

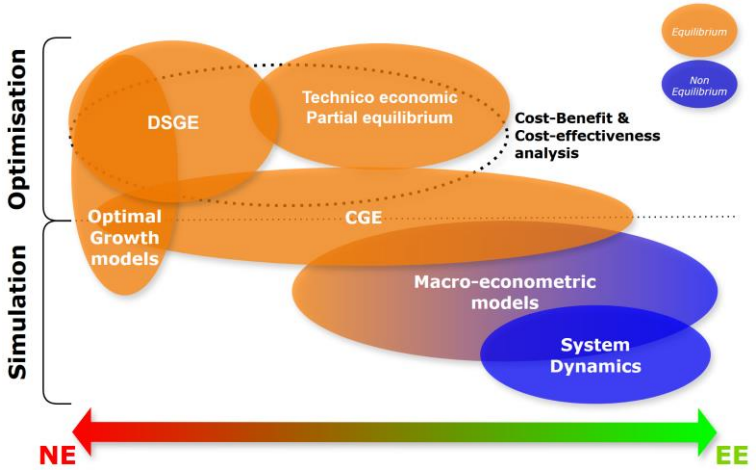

Figure 1 – Classification of different modeling methods according to their suitability to represent both neoclassical economics (NE) and ecological economics (EE) frameworks

Optimization models carry a significant normative charge, as their goal is to identify an 'optimal' path based on a predefined objective. In contrast, simulation models adopt a more positive approach, aiming to describe the behavior of a system. Given that ecological economics intend to expand the economic perspective on Daly's ends-means spectrum, simulation models seem better aligned with this objective. Three different modeling strategies are suggested to do so (Figure 2). The traditional policy-based modelling approach should be supplemented by a need-based approach to explicitly define economic purpose, and by biophysical modelling to integrate physical limits to the economy. Coupling these three approaches in an integrated manner would enlighten a comprehensive understanding of the relationship from ends to means.

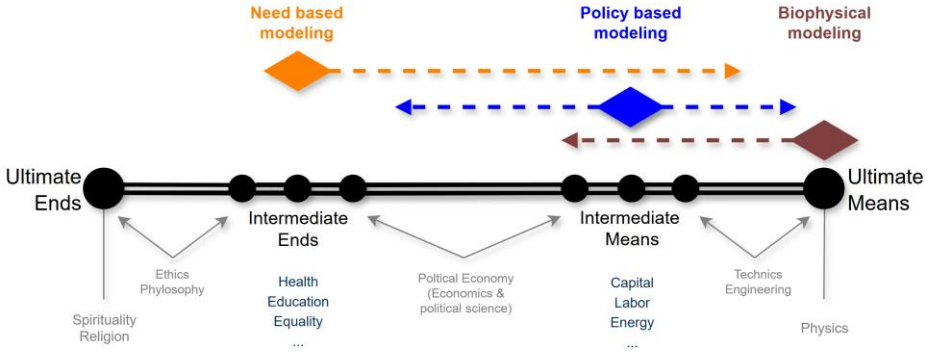

Figure 2 – Daly's ends-means spectrum (Daly, 1980) and suggested modeling strategies to cover it

Conclusions

Given their radically different conception of the economy, it is only logical that neoclassical and ecological economics propose opposing solutions to address present ecological and social issues. This paper first clarifies how these differences influence modelling methods and their outputs. Doing so, it highlights the deep normative charge of economics frameworks and modelling methods in political decisions.

To effectively address contemporary ecological and social challenges, economics must adopt a systemic perspective by critically interrogating its ends, and integrating physical means. Prospective modeling can actively contribute to this agenda by completing the end-mean spectrum in a formalised and integrated way, confronting explicitly enounced ends to physical constraints, and evaluating the effect of different socio-economic organizations and policy proposals in between.

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