

# Model Trustworthiness and Modeler Responsibility in Economic Agent-Based Modeling practices: a Meta-Analytical approach

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## Abstract

Economic Agent-Based Modeling (ABM) has emerged as a valuable technique in various fields due to its ability to incorporate heterogeneity and flexibility into the modeling process (e.g., Chattoe, 1996, Dosi and Roventini, 2019). However, the inherent flexibility of ABMs necessitates a careful consideration of the modeling workflow (e.g., Graebner, 2018, Edmonds et al., 2019) in order to assure model trustworthiness. In point of fact, modeling an ABM requires constant iteration and adaptation of assumptions and model structure to accommodate the interim output of the model, ultimately aiming to achieve a satisfactory level of model behavior (Edmonds, 2010). Evaluation of models typically involves, either a general approach through the identification of specific patterns (stylized facts) and the conduction of sensitivity analyses to determine suitable parameter settings (e.g., Casini and Manzo, 2016), or more tailored but challenging forms of validation and calibration (e.g., Guerini and Moneta, 2017, Fagiolo et al., 2019, Platt, 2020). Moreover, since the model can be in principle modified in any of its components, the workflow that leads to the final model often deviates from traditional nomological-deductive and inductive practices, potentially resulting in overfitting it onto the available data. In this context, the interpretability, the translability, and the consistency of both the conceptual model and the labeling process of the computational model become crucial in assuring the alignment between the intended purpose of the model, the chosen modeling strategy and the model output. Unfortunately, this crucial aspect is often overlooked in practice.

The scope of this paper is two-fold. Firstly, it defines model trustworthiness as the alignment among modeling purpose, modeling strategy and model structure, thus it endorses and deepens a notion of reliability as representational fidelity (Weisberg, 2013). Then, it defines the modeler responsibility as the commitment by the modeler in enabling third parties in checking such alignment. To reach these goals, this paper conceptualizes ABMs as iterated analogies and presents an overarching pipeline for ABM development. Building upon prior research in the field, ABMs are decomposed into three ontologically distinct models: conceptual, discretized, and computational

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(e.g., Weisberg, 2013, Graebner, 2018). Furthermore, these models are analyzed in terms of their substructures and the meta-analytical processes that allow the interpretation of the computational model within the conceptual framework. We argue that a comprehensive understanding of the computational model, its conceptual counterpart, and the overall research goals can only be achieved by considering the meta-analytical subprocesses. Such analysis is enabled by contextualizing the existent work on scientific and cognitive analogical reasoning (e.g., Bartha, 2010, Holyoak et al., 2010, Boge, 2020) into the ABMs modeling framework. By carefully examining the schemas and meta-analogues that drive model creation, it becomes possible to contextualize the information and enhance the understanding provided by the model and its objectives. The paper proceeds as follows. In the first chapter, the notion of trustworthiness and responsibility within the modeling process is framed by emphasizing scientific responsiveness and adherence to good practices in scientific research. The second chapter presents specific challenges related to Economic ABMs, highlighting the need for a meta-analytical framework to assess the coherence among different modeling components. Then, the third part introduces an analogical framework and discusses its relevance in addressing the raised questions. The last and concluding chapter compares the normative results sketched in the work with the current best practices in the field, with specific reference to the ODD protocol (e.g., Railsback and Grimm, 2019). In summary, this paper emphasizes the importance of responsible modeling in Economic ABMs and proposes a meta-analytical perspective to enhance the alignment between different modeling components. By adopting this approach, researchers can ensure scientific responsiveness, comply with good research practices, and achieve a deeper contextualization and understanding of the model and its objectives.

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