Interactive comment on "Earth System Economics: a bio-physical approach to the human component of the Earth System" *by* Eric Galbraith

Anonymous Referee #1

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Dear Author,

Thank you very much for your accurate and comprehensive reply.

Let me refer to some of the issues raised by you. I will also try to make some points in my initial reply more precise. I really missed the detailed and comprehensive discussion of the framework design principles. When building interdisciplinary models (which normally are based on the already existing theories and approaches and the focus is set on selecting the optimal combination) there is a possibility of many alternative model frameworks. The central question is which theories are selected from relevant scientific discipline and why. Alternatively, which theories have been considered but finally not selected and why?. My impression was that you focused more on justifying single theories (building blocks of your model), whereas, in my opinion, it is their

selection process, guidelines and the additional features of the model resulting from their simultaneous application of these theories that are crucial. Please also discuss potential application areas of you model and its limitations. I still think that specifying these application areas where you expect that your model may deliver additional, new insights comparing to the existing approaches would be beneficial for your paper. One specific issue that remains crucial. Namely human behaviour modelling. As you correctly notice there is some "wall" between natural and social sciences. On one hand there is a critique that the social sciences are too abstract. On the other natural sciences are precise but not really able to explain more complex aspects of human behaviour other than satisfying basic needs as e.g. food consumption. Let me share some personal views from the perspective of social scientist. There is nothing wrong with being abstract, different levels of abstraction are commonly used for example in computer science. They are also used in natural sciences. For example mechanics behind pendulum movements have abstract description. The fact of actual physical shape of pendulum is ignored, so as the fact that it consists of particles, particles consists of atoms and so forth. The problem with connectome, neurons, synapses is not that they are abstract per se but that we cannot (at least at the current scientific level) connect it with observed human behaviour. These mechanism are abstract, rather guessed. For me using explicitly abstract social norms provide much better explanation of human behaviour than having the physical connectome in the model and then assuming/guessing some abstract mechanisms how it may influence our behaviour (I read and tried to understand the physiology of hunger and satiety and it is far away from the mechanism used in your model) . The first one can at least be examined using survey, interviewed etc. Now my impression is that a connectome is kind of hidden variable in your model with all disadvantages of such an approach. Some variable sin IAM are abstract as labour, capital, damage function,... but these variables can be easily operationalized labour – workers, capital – machinery, buildings and so forth. Also Cobb-Douglas (or CES) production function is abstract but one can easily image the production processes it represents and also estimate the necessary parameters

based on the real empirical data. So that eventually it can be used for modelling, forecasting the real phenomena. Using your (non abstract) approach one would need to explicitly model all existing machines, map all the production processes and so forth. Not realistic.

In my opinion the role of social sciences in your model should be described more clearly and justified in a more comprehensive way. Secondly, why do you think that modelling connectome and using it for explaining the human behaviour makes sense. It is really not clear for me. The argument that it is exists (is physical) is not convincing for me. We do not model the movements of each particle in the pendulum to understand its behaviour. Thirdly why do you think that somatic variables are that important. Of course age, gender yes but these are already used in economic modelling. On the other hand physical strength, muscle mass are mostly irrelevant due to machines applied in the production process.

I still think that you should provide more convincing example. Now in natural science there is a whole family of predator-pray model that could easily provide simple and elegant explanation to the same problem as in your example by just using constrained resources, energy, metabolism rate etc. Similarly analogous also simple model are used in economics.

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