

## ***Interactive comment on “Long-run evolution of the global economy: 2. Hindcasts of innovation and growth” by T. J. Garrett***

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Garrett’s earlier work on the thermodynamics of “civilization” has generated some pushback, illustrated for example in some of the references he quotes in his response to the comments of Jarvis. Perusing these criticisms suggests the great difficulty that many researchers have in accepting the view that the world economy is a physical phenomenon that is subject to physical laws, such as the laws of thermodynamics, and that taking the application of these laws seriously, as Garrett does in the present ESDD paper, is a valid, and in fact necessary, step in coming to a full appreciation of the problems humanity faces in the unfolding Anthropocene. These physical constraints and processes in some ways are most usefully examined at the global scale, where they are free of detailed fine-grained relationships too numerous and entangled for our full

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comprehension. The most striking and important consequence of this line of investigation is that there is much more at play in global economic/social dynamics than simply the application of human will and intention, which when considered alone, as is the case in the lion's share of economic and environmental research and practice, are insufficient for addressing, much less solving, current challenges to human well-being under global change. Although this theme, as a minority view, has a long history, there are several contemporary accounts that clearly articulate and develop the idea of human capture by a global dynamic. I would suggest that Garrett could add to the weight of his presentation by providing references to some of this work. He has already included a reference to my articulation of an autonomous “technosphere” (Haff 2014), but might also usefully refer to the work of Herrmann-Pillath, in press but referenceable as “Energy, growth, and evolution: Towards a naturalistic ontology of economics, Ecological Economics (2015), <http://dx.doi.org/10.1016/j.ecolecon.2014.11.014>”, and Gowdy and Krall, “The ultrasocial origin of the Anthropocene, Ecological Economics 95 (2013) 137–147”. By “naturalistic ontology” Herrmann-Pillath points to the fundamental physical basis from which economics must ultimately spring. Gowdy and Krall’s use of a bioeconomic approach that relies on arguments based on multi-level-selection/group-selection dynamics for the evolution of human ultrasociality (especially a high degree of cooperation) is in effect an explication of a particular mechanism by which the physical thermodynamic processes of Garrett actually emerge, a question not treated in the latter’s work. Both Herrmann-Pillath and Gowdy and Krall, like Garrett, underscore the importance of energy as a key variable, one that is not substitutable except locally by technology. The arguments of all these papers lead us to the same final position, to contemplate how to deal with a world system that is out of control even as it constrains and conditions our own behavior in a direction favorable to its continued functionality.

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Interactive comment on Earth Syst. Dynam. Discuss., 6, 655, 2015.

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