

## ***Interactive comment on “Resource acquisition, distribution and end-use efficiencies and the growth of industrial society” by A. Jarvis et al.***

### **Anonymous Referee #3**

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This paper presents an interesting although perhaps provocative view. The authors interpret global economic growth through the perspective of physical network theory.

I have some major difficulties with the paper. The authors adopt the conceptual model of a space-filling network that expands over time. They use analogies from biology describing the structure of organisms. However, they don't provide any real argument that this has any relevance to the global economy. Resources are extracted at the point where they exist (influenced by economic and practical constraints which have changed over time) and usage is wherever the largest energy demands happen to be (which in large part depends on historical contingencies and energy availability, and therefore may bear little relationship to modern energy production). The spaces in between are not necessarily filled, and the economic organisation has not grown larger in any way

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analogous to a biological organism. There is little economic activity in the vast bulk of the oceans, polar and mountainous regions. Moreover, transport distances are surely bounded by half the circumference of the planet, with an average of half that value. Australia exports large quantities of coal, OPEC exports oil (and has been doing so for many decades). Where is the network expanding physically, recently and in the future? More directly, what is the authors' estimate of the relevant length scale and how it has changed? Surely this must be a primary parameter of the analysis, and it might be interesting in its own right.

The transport network is nowhere close to space filling. The ocean is basically empty with a handful of ships, the skies are clear, even road networks are far more space than road (this becomes a little dubious when one considers only urban areas, but this is a small part of the energy transport network). Electric cables are not packed into space, and neither are oil and gas pipelines limited by space. I simply don't see why the authors think that the space-filling network theory ought to apply even approximately in this situation. I think the authors need to work harder on explaining to the readership why this theory might be expected to be relevant. To a good approximation, I would expect the transport distance to simply be the great circle distance between resource extraction and use. Can the authors refute this naive assumption, either by theory or data?

The dimension argument seems implausible and forced. In order for the network theory to apply, I believe it is the case that the expansion in all three dimensions must be at the same (at least, similar) proportional rate. Do the authors think this has happened? What are the quantitative implications, in relation to the horizontal length scale.

So in summary, I do think there might be an interesting story here and I certainly don't want to reject their ideas out of hand, but I do think the authors need to justify the conceptual basis of their analysis rather better than they have done so far.

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Interactive comment on Earth Syst. Dynam. Discuss., 6, 133, 2015.

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