EMERGY SYNTHESIS 5: Theory and Applications of the Emery Methodology

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Is Emergy Best Suited for Ecological Economics, Environmental Economics, or with an Economic Context of Its Own?

Erik Grönlund, Daniel Hedin and Per-Olof Eriksson

ABSTRACT

Emergy accounting is sometimes referred to as ecological economics, and H.T. Odum one of the founders of the field. The definition of ecological economics is very wide, and emergy accounting can fit in readily with the definition given. However, the emergy concept is rarely recognized in the bulk of ecological economics text, and ecological economics students have often never heard of the concept. Emergy can not fit into the theoretical neoclassical context of environmental economics, which views environmental questions as a subfield of economy. As an estimator for externalities where markets are nonpresent it can, however, be used by not so “hard core” environmental economists. On the other hand economic flows produced in a neoclassical context are often used by emergy accountants.

In this paper emergy is also discussed as a third category of economics and from that position compared to neoclassical environmental economics and ecological economics. Similarities and differences are expressed, and some economic subfield etiquettes other than ecological economics are suggested for emergy accounting.

INTRODUCTION

Emergy accounting is sometimes referred to as ecological economics, and H.T. Odum as one of the founders of the field (Hall 1996, Brown and Hall 2004, Wikipedia, 2007). However, the emergy concept is rarely recognized in the bulk of ecological economics texts, and often the ecological economics students have never heard of the concept.

The objective of this paper is to discuss if emergy accounting should be viewed as ecological economics or environmental economics, or if it is another type of economic branch. The structure of the paper is: environmental economics is briefly presented with special focus on its relation to natural science. Then, ecological economics is introduced, and next is described how economic flows are used in emergy accounting. Then we discuss how emergy calculations fits into the frames of environmental economics and ecological economics, and further, emergy is discussed as a possible economic subfield of its own rather than part of the fields of environmental and ecological economics.

ENVIRONMENTAL ECONOMICS

The theoretical foundation of environmental economics is neoclassical economy and the so called Wealth theory (see e.g. Söderqvist and Soutukorva, 2006). The core of the theory is market choices made by individuals. Where real markets do not exist, which is often the case in environmental economics, methodological options still based on choices by individuals has been developed. Since many environmental issues are described mainly in natural science based terms, it is a problem that the
gap between neoclassical economics and natural science is of fundamental character (Snow 1959). Environmental economists try to fill this theoretical gap with different methods based on a neoclassical theoretical foundation, with low connection to natural science theory. The situation can be described with a picture from football: In the neoclassical view natural science can be seen as the arena where the game of the market mechanisms is performed. The rules of the game do not have to explicitly include or consider natural science aspects as the given climate or the growth pattern of the grass. These effects will be indirectly considered by each player’s individual choice during the play.

Neoclassical economic theory is thoroughly and extensively described in a vast flood of textbooks. Here will only be mentioned one of the cornerstones that will be addressed later in this paper. The market information criteria says that the market, need to have full information about the options to chose between to function well.

ECOLOGICAL ECONOMICS

Ecological economists have another view than the (neoclassical) environmental economists. They want to include natural laws, and the connection to the resource base, more explicit. This is done by using a variety of “ad hoc” approaches standing on many different theoretical foundations. Often there is no conversion of other values to monetary terms. If used at all, point systems is used to compare the “apples and pears” of the analysis on the same measuring scale.

Costanza, (1989) opens the first issue of the Journal of Ecological Economics with the following statement:

“Environmental and resource economics, as it is currently practiced, covers only the application of neo-classical economics to environmental and resource problems. Ecology, as it is currently practiced, sometimes deals with human impacts on ecosystems, but the more common tendency is to stick to 'natural' systems. Ecological Economics aims to extend these modest areas of overlap. It will include neoclassical environmental economics and ecological impact studies as subsets, but will also encourage new ways of thinking about the linkages between ecological and economic systems.”

The institutional economist Peter Söderbaum (2000) introduces the field in his textbook of ecological economics the following way:

“Ecological economics can be described as a transdisciplinary field of study rather than a single discipline. Scholars from economics can contribute, but so too can those who have their main background in other disciplines. --- Ecological sustainability is the vision (although there are different interpretations of this term) and the idea is to develop theories and means that will bring us closer to the ideal of a sustainable society. --- It should be made clear, however, that pluralism do not mean that 'anything goes'. Each scholar may have strong preferences in terms of theoretical perspectives and methods. Pluralism in our sense therefore means that such preferences are combined with a willingness to listen and learn. This open-minded attitude implies that even a neo-classical environmental economist can refer to her- or himself as an ecological economist if she or he so prefers.--- The preferences of the present author tend to be in the direction of institutional economics and the argument of this book can be described as 'an institutional version of ecological economics'.”

These two authors represent the field of ecological economics. Costanza as a leading person in the society and journal of Ecological Economics, Söderbaum as an institutional economist, the most common type of economist in the field. However, economists are not dominating the member stock of the Society of Ecological economics (Pers. comm. Manfred Max-Neef 2007).
ECONOMY IN EMERGY ACCOUNTING

In emergy evaluations the economic flows are considered, that are present in the system window put up for the actual evaluation, regardless of the theoretical foundation of the economic flows. In this way emergy accountings do not care about the theoretical economic debate, but rather consider economic flows as phenomenological, and possible to bring into the accountings as they are. In emergy two views have been used, the first rare today and the second the dominating:

- Odum (1984) focused on the observation that money also seemed to self-organize in hierarchical patterns. An assumption was made that the hierarchies of energy and money were proportional. Assuming proportionality, a translation factor could easily be obtained, translating economic numbers to emergy or vice versa: emergy to emdollars.
- The dominating view today (e.g. in Odum 1996) is that economic flows are considered as an emergent property at a certain level in the energy hierarchy. The theoretical interpretation is that economic flows are a result of underlying resource flows measurable in emergy terms, and expressed in terms of how much emergy it takes to circulate one unit of money in the studied economy.

Some emergy authors appear to believe that money are used only as rough estimators in emergy calculations. A more proper theoretical approach is instead suggested to be using human metabolism as calculation base, and then use pure transformity values (seJ/J, not seJ/$ or seJ/kg) to correct for the qualitative aspect in the energy hierarchy. However, very few transformities for different human professions have so far been assessed, and the use of this approach has so far been limited. In opposition of this view one may argue that the metabolism method of assessing the self-organizing systems hierarchy of human societies, will never reach the same refinement as the main pattern of the self-organization of money. This, since money is a property of the system, and the metabolism approach is a resource demanding meta assessment of the same system.

FITNESS OF EMERGY IN ENVIRONMENTAL AND ECOLOGICAL ECONOMICS

In Table 1 environmental economics, ecological economics and emergy are compared from a theoretical view.

Emergy fits into ecological economics easily, in the same way as environmental economics does. Emergy accounting and numbers achieved based on neoclassical methods are just options among others to set up the best set of information to manage scarce resources. Ecological economists are used

<table>
<thead>
<tr>
<th>Theory type</th>
<th>Environmental Economics</th>
<th>Ecological economics</th>
<th>Emergy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory type</td>
<td>Unified</td>
<td>Multiapproach</td>
<td>Unified</td>
</tr>
<tr>
<td>Theoretical base</td>
<td>Neoclassical economy</td>
<td>Institutional economy</td>
<td>Systems theory</td>
</tr>
<tr>
<td></td>
<td>Wealth theory</td>
<td>Natural science explicit</td>
<td>Thermodynamics</td>
</tr>
<tr>
<td></td>
<td>Individual choices</td>
<td>Many theoretical keystones</td>
<td></td>
</tr>
<tr>
<td>Counting unit</td>
<td>Convert all to $</td>
<td>Everything keeps its integrity</td>
<td>Convert all to seJ or Em$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Possibly point systems</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Foundations of environmental economics, ecological economics and emergy.
Figure 1. a) the neoclassic view with the economy separated from “nature”, b) the ecological economic view of the economy as a subsystem of “nature”, c) the emergy view—“the wedding cake economy”—with the economy as an emergent property relying on “nature”, d) the emergy view—“the tilted wedding cake”—with the energy hierarchy pictured from left to right.

 Emergy theory sees the economy as the general ecological economist: the economy is a subsystem of “nature”, or an emerging system from the resource base (figure 1). On the other hand the emergy figures are not obtained from “true” economic questions, i.e. focus on the “household of scarce resources” questions. But the ecological economist is used to handle such problems.

 The largest problem for an ecological economist is probably that the theoretical foundation for emergy – i.e. the view on different qualities of energy – is not yet to a large extent recognized by the dominating part of the scientific community.

The hard core neoclassic environmental economists probably have problems accepting the ecocentric view of emergy, since they separate the economy from nature (figure 1a), and all valuation should stem from individuals choices. On the other hand the methods currently used by environmental economists give problematic answers. It may be assumed that the main systematic problem is the low fulfillness of the information criteria. The market actors used in environmental economics methods generally have too little knowledge about the environmental question they are supposed to value. The not so hard core environmental economist may accept emergy values as “ad hoc” values, patching a problematic area in current application of neoclassic economy. However anthropocentric the neoclassic economy is, there is a special case connected to the information criteria, when it coincides with the ecocentric view, see table 2.

EMERGY AS ENERGY HIERARCHY ECONOMICS – A SEPARATE SUBFIELD?

As described above emergy fits readily into the multiapproach frame of ecological economics. However, as seen in table 1, it is also similar to environmental economics in the way that it stands on a unified theoretical base and use one single measure (expressed as seJ or Em$) to model the system studied.
Table 2. The coincidence of the anthropocentric and ecocentric views, in the special case of high knowledge of dependence on the environmental services.

<table>
<thead>
<tr>
<th>Knowledge of dependence on environmental services</th>
<th>Anthropocentric</th>
<th>Ecocentric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low knowledge</td>
<td>Low value given to environmental services</td>
<td>Respect for nature.</td>
</tr>
<tr>
<td>Medium knowledge</td>
<td>Medium value given to environmental services</td>
<td>Respect for nature, and reinforcing actions to strengthen environmental services, some of them contra productive.</td>
</tr>
<tr>
<td>High knowledge</td>
<td>High value given to environmental services. An ecocentric position on anthropocentric reasons.</td>
<td>Respect for nature, and strong reinforcing actions to strengthen environmental services.</td>
</tr>
</tbody>
</table>

Emergy is not “true” economics with focus on the “household of scarce resources”. At least not in the sense of value to humans – an anthropocentric focus. However, with an ecocentric focus emergy accounting has a lot to say about the economy of the system. And as shown in table 2 this may coincide with the anthropocentric focus in the special case of high knowledge of the dependence on the environmental services. Of course this implies that there is in fact a strong dependence on the environmental services. In the ecocentric view the emergy measure may be seen as a “component value” of the systems total function.

It may in this sense be relevant to view emergy accounting and theory as an economic subfield of its own. Some authors would probably then group it together with what is called “energy economics”. However, there is a quite large difference regarding the view and use of the energy concept in emergy thinking. Better suggestions of label may be:

- “Energy hierarchy economics”? Focus on most fundamental concept.
- “System theory economics”? Emergy is systems science although it’s most common application so far has been ecology.
- “Quality thermodynamics economics”? Focus on the theoretical home of energy hierarchy theory and maximum empower theory.

CONCLUSIONS

Even though most ecological economists do not use emergy calculations (by choice or by not knowing about the emergy methodology), in theory they should have no problem using emergy calculation as part of their evaluation. This since their theoretical foundation is a multiapproach. They are used to gather information from different fields standing on different theoretical foundations, and then compare the information qualitatively rather than quantitatively.

“Hard core” neoclassical environmental economists will never use emergy calculations, since it is not compatible with their theoretical foundation, which is based on market choices by individuals. The not so “hard core” environmental economist may, however, accept emergy values as “ad hoc” values, patching a problematic area where there is no current “pure” neoclassical theory application available.

Emergy evaluations can be viewed as ecological economics, as mentioned above as one option among a wider set of ecological economics approaches, however, one with little general acceptance today. But emergy may rather be viewed as an economic branch of its own, since it has a distinct theoretical foundation; “energy hierarchy economics” may be a proper label for this branch of economy.
REFERENCES