Heun et al Cpt2\_Second pass

You need Barry quote…

We’re now using the quote:

Essentially, all models are wrong, but some are useful. [1, p. 424] —George E. P. Box

who blame stagnation in the CONVENTIONAL factors of production

added “conventional”

(manufactured capital, labor, and technology –ALL INTRINSIC TO THE ECONOMY ) for the bleak situation.

Added “—all endogenous to the economy”

p.n27 bot Introduction (Chapter 1) contaied much CONTAINED

Fixed. Thanks!

2.2.1 by the Best-First Principle (Section 1.4.2) check to see if still appropriate

It is now correct. The section to which the reference points contains discussion of Best-First Principle.

Fig. 2.1 In the traditional ECONOMIC model, the economy is represented as a circular flow of goods and

Added “economic”

services between two sectors. Producers manufacture goods and services by taking in labor and

capital. Consumers exchange labor for wages which are used to purchase the goods and services

of the producers. THERE ARE NO CONNECTIONS TO THE BIOSPHERE. We use energy circuit diagrams to represent the flow of materials, energy and information.[7]

Added “There are no connections between the economy and the biosphere.”

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OK I AM HAVING A PROBLEM WITH THE FOLLOWING: NOT THAT ITS WRONG OR BAD, BUT THE “IN OUR OPINION” SEEMS TO IGNORE THAT IT WAS ALSO IN THE OPINION OF MANY OTHERS FOUR DECADES AGO: HOWARD Odum (1973) myself (1986) , Hemut Haberl and Maria Kowal---; others. Replace with “In our oponion, and that of others ( Odum ….).

2.2 The economy is society’s metabolism

In our opinion, an apt metaphor for the economy in the age of resource depletion

should provide for robust interaction and suggest tight coupling between the biosphere

and the economy. Specifically, it should account for the following facts about

real economies. Economies:

1. intake material and energy from the biosphere

2. exchange materials, energy, and information internally

3. discharge material and energy wastes to the biosphere

4. are a↵ected by energetic costs

5. are a↵ected non-linearly by scarcity in the face of low substitutibility

6. can change non-linearly or in discrete steps with the potential for structural

transformation

7. accumulate embodied energy in material stocks, and

8. maintain organizational structure despite changes in their environment.20

19 See England [31] for a starting point.

20 We note that several areas of the literature speak to the items in this list. Materials Flow

Analysis (MFA) and Economy-Wide Materials Flow Analys (EW-MFA) stress the importance

of material intake by the economy. (See Section 3.5.) The Input-Output (I-O) method highlights

the e↵ects of internal exchanges of material and information with economies. (See Chapter 7.)

Life-Cycle Assessment (LCA) techniques focus attention on otherwise-neglected wastes. (See

Section 7.6.) Net Energy Analysis (NEA) predicts that energy resource scarcity reduces Energy

Return on Investment (EROI) and increases energy prices. (See Sections 4.3 and 9.4.) The Energy

While I am at it there are a lot of issues in this chapter that I feel I was the originator (EROI – It was not my student Cleveland --although he contributed a lot) and felt that Hall et al. 2001 was a better and sometimes earlier critiquer of t he failure of conventional economics to be consistent with the laws of physics etc (not to mention Mirowski, and Georgescu Roegan and Herman Daly. I know there are many who have done this, but your list seems a bit strange or empty to me. You can fix this easily by adding in some of these others as a second reference of the ones you use.

You say this little later: 32–37], Although we’re not the first to suggest the metabolism metaphor for the economy we believe that the metabolism metaphor is underutilized on both practical and theoretical levels. Maybe just put this near the start of the section…

On a theoretical level, the metabolism metaphor is underutilized, because most researchers

(with the exception of Giampietro [33, 34]) (also Odum1973 etc. Hall et almm1986 metc

The above comments are very helpful. There are certainly many authors who could be included as either progenitors for and/or direct users of the metabolism metaphor. I decided to handle it this way:

The first sentence of the section entitled “The economy is society’s metabolism,” now reads:

In our opinion (and that of several others20) an apt metaphor for the economy…

Footnote 20 reads:

20 An incomplete list of authors who are either (a) progenitors for or (b) directly associated with

the metabolism metaphor includes Georgescu-Roegen [31], Odum [32], Daly [33], and Hall [34]. Heijman [35], Haberl [36], Fischer-Kowalski [37], Liu [38], and Giampietro [39].

Fig 2.3 is good, might add to legend see also figure 3 I think in Hall et all 2001 orm5.3 Hall and Klitgaard

highlight the important physical role of RESOURCE EXTRACTION AND manufactured capital stock

Added “resource extraction and”. The sentence now reads:

We think that a deeper understanding of the metabolic metaphor can serve to both highlight the important physical roles of both resource extraction and manufactured capital stock and provide the basis for a rigorous theoretical framework for comprehensive national accounting.

by considering anabolism (capital formation), catabolism (energy CONSUMPTION ), autophagy (recycling), and issues of scale. Thereafter, we summarize the benefits of the metabolism metaphor

for national accounting.

How can catabolism be production???

You raise a very important point about word choices here.

In reality, both catabolism and the energy conversion machines in the economy perform energy transformations. One form of stored energy is converted to another, more directly useful, form of energy. If you focus on the stored energy, the processes look like consumption. If you focus on the useful energy, the processes look like production.

The sentence in question above puts the economic version (as opposed to the cellular version) in parentheses. Because, we usually talk about energy PRODUCTION by the energy sector and energy CONSUMPTION by energy purchasers, I used the word “production” in the parentheses behind “catabolism.”

See an additional aspect of this response below.

The economic analog to biological anabolism is capital formation, net addition

to the stock of capital ( AND I NFRASTRUCTURE MORE GENERALLY) within a period of time.

Added “(infrastructure, more generally)” as suggested.

2.2.2 Catabolism (energy production???? CONSUMPION OR USE???)

Again, good points.

I decided to be more explicit about cellular catabolism being part of a chain of material and energy transformations. Same for energy “production” in the economy. I think this clarifies the parallels and strengthens the metaphor. The section on catabolism now reads:

Catabolic processes break down and destroy material stocks within an organism through an oxidation process. At the cellular level, catabolic oxidation releases chemical free energy, some of which synthesizes adenosine triphosphate (ATP), thereby providing fuel to cells. The remainder of the released energy is manifest as waste heat. One of the waste products of cellular catabolism is CO$\_2$. Catabolic processes are part of a chain of material and energy transformations wherein stored chemical energy is converted to useful energy with waste heat and CO$\_2$ as byproducts.

The analogy between catabolic processes and energy transformation processes within the economy is striking. Power plants (fired by coal, oil, natural gas, or refined liquid fuels) in either the energy sector or the final consumption sector break down fossil fuels in an oxidation process (combustion) to produce useful energy (typically, electricity or mechanical drive~\cite{Ayres:2010ug}), thereby providing energy to sectors of the economy. Both waste heat and CO$\_2$ are byproducts of combustion, and O$\_2$ is consumed in the process. Energy production in the economy is a chain of material and energy transformations wherein machines and engines convert stored chemical energy to useful energy with waste heat and CO$\_2$ as byproducts.

We focus on energy flows among sectors of the economy

in Chapter~\ref{chap:direct\_energy}.

2.2.4 Issues of scale

The metabolism metaphor brings to light issues of scale (size) for economies and

societies. First, scale is directly related to material flow rates. Larger organisms

consume food at higher rates (ALTHOUGH SMALLER RATES PER GRAM), in part to obtain essential nutrients to replenish cellular structures.

The “per-unit-mass” issue was already discussed beneath Equation 2.5, but it wasn’t particularly clear. To amplify the point, I added this footnote:

26 On a per-unit-mass basis, Kleiber’s Law becomes

Q ̇ /m = q0m−1/4 , (2.6)

from which it can be seen that smaller organisms (smaller m) consume more energy per unit mass (Q ̇/m).

Fig. 2.5 Kleiber’s law for metabolic rates (heat production) of di↵erent-sized animals [40, p.530].

Larger animals, as determined by mass, have a higher metabolic rate, but the relationship between

mass and metabolic rate is not linear.

\*\*\*\* Do we need to obtain permission to use this figure? \*\*\*\* It is so old I would think not

OK.

2.3 New national accounting

Society needs to respond to the material and energy shortages that we now face

(Chapter 1), and part of that response should involve more-comprehensive national

accounting guided by a deeper understanding of the real BIOPHYSICAL economy gained

Added “biophysical”

p. 39-40 good questions

Throughout the methodological chapters (3–7), our accounting framework is

developed through a series of increasingly-disaggregated models of the economy (Table

2.1), USING THE SME MODEL STRUCTURE AS MUCH AS POSSIBLE. We use the US auto industry as a running example for application and

discussion.

I split the sentence in two. It now reads:

Throughout the methodological chapters~(\ref{chap:materials}--\ref{chap:intensity}),

our accounting framework is developed

through a series of increasingly-disaggregated

models of the economy~(Table~\ref{tab:examplesABC})

using, as much as possible, the same model structure for each.

We use the US auto industry

as a running example for application and discussion.