

PHYSICAL AND MONETARY ENVIRONMENTAL ACCOUNTING

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Summary

Use of only monetary data is not sufficient to obtain the information required for sustainable development, though they are effective to explain the value relations of the elements between the economy and natural assets. Physical data are complementary to them. So, physical data were introduced into the System of Environmental and Economic Accounting (SEEA). Moreover, human comprehension of the environment is expanded by the linkage between physical and monetary data through introduction of imputed valuation for physical data. The linkage also means the one between the SEEA and the System of National Accounts (SNA). The physical data system of the SEEA is based on the concept of material/energy balance. The concept is very effective to

explain the flows of materials necessary or unnecessary for humans between the economy and the environment, and, if related to the input-output table, is further useful as a tool for the analysis of material flows between them. On the other hand, the concept is based on the law of conservation of mass and the law of conservation of energy, or the first law of thermodynamics and the second law of thermodynamics in physics.

Some problems about stock and its changes are explained as far as they relate to flows or material/energy balance. Produced assets and natural assets are related to each other through the flows between the environment and the economy, and connected to each other in the SEEA. Incidentally, the concept of natural resource accounts also constitutes an important basis for the physical accounts of the SEEA, as well as that of material/energy balance.

1. Treatment of Environmental Elements in the System of National Accounts and the System of Integrated Environmental and Economic Accounting

The System of National Accounts (SNA) was revised in 1993, and its implementation has been recommended to every country. With that as a momentum, the System of integrated Environmental and Economic Accounting (SEEA) was proposed as one of satellite accountings to the SNA. It complements the core of the SNA with the data of the relations between economic activities and the natural environment. The SEEA went through five editions, and has been expanding its field of data and system with each edition. The first and second versions of the SEEA, based on the conventional SNA, contain only monetary data, and moreover the monetary data are based on market prices. Indeed monetary data are effective to explain the value relations of the elements between the economy and natural resources, but they are not sufficient independently to gain the information required for the attainment of sustainable development. As a matter of course, physical data are necessary for that as well. Physical data themselves are useful, and moreover can be linked with monetary data through inferring imputed value or prices. Multiplied or geometric effects will be expected with the linkage of the two kinds of data. Physical data were for the first time introduced into the SEEA, version III, and so linked with monetary data.

Into the SEEA, version III, physical accounting has been introduced on the concept of material/energy balance and natural assets accounts, and its data are linked with the SNA data. More concretely, material/energy balance means the input into the economy from the environment including natural assets, the changes in the economic process, and

the output from the economy into the environment. The natural assets accounts record or enter only the elements related to the economy, and this does not mean whole environment.

In version IV, the degradation and the depletion of natural assets are described on the concept of environmental imputed costs, adding to the conventional concept of "expenditures" or "actual costs." Version IV includes versions IV.1, IV.2, and IV.3 and introduces several concepts of costs. In the SEEA, environmental costs are fundamentally classified from two points of view. From one viewpoint, environmental costs are classified into two kinds: the costs called "actual costs" or "expenditures," and the costs called "imputed costs," just mentioned. From the other viewpoint, environmental costs are also classified into two kinds. One is the costs called "caused costs" or "costs caused," and the other is the costs called "borne costs" or "costs borne." The intersection of the two viewpoints, each of which brings two kinds of costs, constitutes a matrix consisting of four elements.

2. Environmental Costs Caused, Costs Borne, Actual Costs, and Imputed Costs

Environmental costs are explained in brief here. First, caused costs are those for which the actual offender is identified; they are related to the actual offender and are usually evaluated by applying the concept of maintenance costs valuation. The elucidation of maintenance costs is necessary to prevent or reduce the depletion or degradation of the environment. This concept is the necessary condition for sustainable economic development, that is to say, development sustained without quantitative or qualitative decrease in volume, that is to say, without depletion or degradation of the environment. As to caused costs and maintenance costs, there are actual costs and imputed costs. Imputed maintenance costs are additional costs of economic activities or decrease in value of natural and other assets.

Borne costs are those that someone bears, whether he is an actual offender or not. Of course, they are first evaluated in actual costs if possible, then in imputed costs. Some borne costs as imputed costs are evaluated in reference to market prices of relevant goods, for instance, using hedonic pricing method. With economic activities, borne costs are estimated in the SEEA only if they reflect actual costs or market valuation. It is proposed to adopt the contingent valuation as imputed costs when market valuation is not available in inference of borne costs. This concept of contingent valuation is expanded to the borne costs of households. That valuation is determined by the answer

to the question how much the income or consumption level of the people in question can be lowered so that the environment may not be damaged by their economic activities. That is based on the idea that the households or individuals share and bear the appropriate burden for the protection of the environment.

Eventually, in the concept of caused costs the point is the origin of the costs and the individuals or enterprises that caused the costs or that are liable for the accrual of the costs. On the contrary, with the concept of borne costs the point is the result or destination of the costs and who actually bears the costs, no matter whether they are liable for the accrual of the costs or not, or who have caused the costs. The borne costs are thought to be often borne as emergency measures for the removal of imminent danger from the damaged environment. The borne costs sometimes appear as repercussion on the environment. As mentioned before, both actual costs and imputed costs appear in caused costs and borne costs. In other words, actual costs mean actual payment in market price, and imputed costs mean indirect and inferred costs instead of market price, which is difficult to obtain.

3. Importance of Introducing Environmental Physical Data into Accounting

Physical data are often more appropriate than monetary ones, especially to describe generally the mutual relations between the economy and the environment, as already mentioned. The physical data system of the SEEA is based on the concept of material/energy balance. The concept is very effective to explain the flows of materials necessary or unnecessary for human beings within the environment, the flows from the environment into the economy, that is, the input to the economy, the flows or changes process within the economy, and the re-flows or return as residuals, that is to say, undesirable by-products from the economy to the environment, or the output from the economy. If related to the input-output table, this concept is also useful as a tool for the analysis of material flows between the economy and the environment. The concept and method of material/energy balance were developed around 1970.

Incidentally, the flows of materials within the environment should not be neglected since polluted materials, for instance, can be transferred and proliferated by rivers, ocean currents, winds, air currents, air mass currents, etc. from one place to another, sometimes bringing about more detrimental material, or reactions through the new combination of several materials and natural, chemical, or physical actions. One example is the combination of ultraviolet rays and chlorofluorocarbon, which produces

active chlorine. The active chlorine, in its turn, destroys the ozone layer, and the ultraviolet rays that consequently reach the earth's surface increase in volume to do more harm to human health.

The environment does not always resolve polluted materials into harmless ones, though the origin of pollution and proper responsibility for that belongs, of course, to human beings. In the end the change of, or a new addition to, global circumstances or the environment requires costs, for the social systems have been coordinated so far according to the actual circumstances of the environment in the development and evolution of society. The change requires the costs of systems restructuring. So, it is necessary to compare the gains and the costs by the change from the long-term point of view, so as to attain sustainable and everlasting development. This explains the necessity for general access to and acquisition of physical and monetary data. Actually physical data are more available and possibly better cover the range of relations between the environment and economic activities.

However, the present SEEA does not sufficiently describe flows and transformations just within the environment. The SEEA has not yet included proposals for comprehensive natural resource account. For instance, the regional components of the environment, which are significant for a comprehensive description of the global and whole natural environment and its changes within the accounting period, are out of the core accounts of the SEEA. The accounts for those should be setup and linked with the SEEA. A further limitation of the SEEA is its focus on the use of the environment by economic activities. Hence there is no description of flows and transformations within the environment. Extension of the SEEA to such a field is expected. In the end is necessary the property revaluation, for instance, of the environmental productivity of the Amazon rainforest, ecosystem of a certain sea area, etc. (See also "*Environmental Economics and Ecobusiness*" section 13: *an example of mathematical method.*)

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Biographical Sketch

Emeritus Professor Dr. Ichiro Kaneda, born February 22, 1934, in Tokyo, Japan, gained his bachelor's degree in Tokyo University in 1962 and his doctorate in Tokyo University in 1982. He is an Emeritus professor at Niigata Sangyo University and ex-president of the same university, having served as president from 1988 to 1996. His fields of specialization are environmental and food economics, mathematical economics, and regional economics. His main recent scientific publications are Economic, technical and political aspects of LNG carriers in comparison with NG pipelines (based on the paper he was invited to present at the U.N. Symposium on Natural Gas Transport and Utilization in Northeast Asia, Beijing, December 2000), Bulletin of Niigata Sangyo University (Faculty of Economics), 23, June 2001; NHK-Books: The Japan Sea Economic Rim (The Economic Region Surrounding the Sea of Japan) [in Japanese] (Tokyo: NHK Publishing, 1997); Economics and Philosophy of Organic Production by Global Nature (ecological and agricultural economics) [in Japanese] (Tokyo: Chuo-keizai-sha Publishing, 1996); and The change of the viewpoint on the Japan sea rim, DBI Economic Review [in Korean] (Daegu Korea: Daegu Banking Institute, 1995).