PROBLEMS OF RECORDING ENVIRONMENTAL PHENOMENA IN NATIONAL ACCOUNTING AGGREGATES

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Is it expedient or possible to modify the content of the national accounting aggregates like GDP so that they reflect also the effect of environmental changes like pollution and noise—this is the question the author tries to answer. He points to some analogies with other national accounting problems, where the basic question is also how far should we go in modifying our measuring scale, the market price, in order to get closer to the measurement of some kind of economic welfare.

Reviewing the various possibilities for modifications of the national accounting concepts, the author does not propose any substantial changes. The harm done to the environment as such cannot be measured in monetary terms. The cost of prevention is not a good approximation of the harm done to the environment, since the correlation between these two variables is not strong enough. Nor is the cost of restoration a good measure of the disfunction. Some damages, like noise, lung cancer caused by air pollution, cannot be restored. If—as proposed by some authors—the compensation for the disfunction (e.g. a swimming pool built to compensate for the water pollution) were deducted from GDP, this would not provide a good solution either, since the trouble is the disfunction itself and not the remedying action. (If no swimming pool is built, there is nothing to be deducted?) On the whole, there is no sufficiently sound basis for evaluating the monetary value of environmental damages.

The author attaches great importance to getting more information on environmental phenomena. However, he prefers to supplement the national accounting information by a series of physical, chemical, biological, etc., indicators, instead of changing the national accounting concepts themselves.

In recent years a great deal of dissatisfaction has been expressed in respect of the national accounting aggregates, like the gross domestic product and national income. Many of these critics came from the "environmental" side, arguing that the main economic indicators do not reflect certain environmental phenomena appropriately. Indeed, the problems of the treatment of some flows affecting environment are serious ones and deserve careful examination.

The basic problem stems from the fact that the national accounting indicators reflect only the quantities of goods and services produced. They are insensible to what happened at the same time to the environment. The production of a given amount of goods and services always results in the same national income or product and this result is invariant to whether or not some substantial harm was done to the environment, e.g. by pollution or noise.

Thus, harm caused to the environment is not negative production and does not decrease the national income. However, repairing this harm, the restoration of the environment, is generally considered as production and does increase the national income. From this it follows that national income will be higher when harm is caused (e.g. rivers are polluted) and then the environment is restored than when *ceteris paribus* some preventive action is taken and the disfunction is avoided (e.g. by using antipollution devices). In reality, however, preventive action is in most cases preferable, not only because, in general, prevention costs less than cures, but also because the restoration cannot make good all the harm caused by the disfunction.

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To solve this problem it would be necessary to treat the harm caused to the environment as negative output. Is this possible? This is one of the main questions considered in this paper.

The second deficiency of present national accounting practice, as criticized by a number of authors, is connected with the treatment of environment-protective expenditure. How the aggregate results are affected by this expenditure depends on the types of unit which incur this expenditure. The same activity, e.g. the use of the same purifying materials for the same purposes, if done by enterprises, decreases the national income because the use of these materials is considered as intermediate consumption; however, if it is done by government or by households, it does not decrease national income, since in this case the use of these materials is considered final consumption.

It is worth noting that the two problems, though connected, are to some extent independent of each other. One can solve the first one, let us call it the output anomaly, by treating harm done to environment as negative output, but the second one, let us call it the input asymmetry, remains. And though one can solve this latter, e.g. by treating environment protective expenditure by enterprises as final and not as intermediate consumption, harm caused to the environment may still cause some output measurement anomalies.

Nobody seems to deny the existence of these problems, and most authors consider that they are regrettable properties of national accounting. However, the conclusion drawn is quite different from one author to another. Some of them would like to have drastic changes in the content of GDP or other similar indicator, both in the output and input measurement. Others would prefer to continue the GDP, GNP, etc., series with their present content, but they would like to have also some additional series where flows affecting environment as well as the production of goods and services are reflected. Still others, while recognizing that the present content of the national accounting indicators has serious limits, consider that there are no appropriate ways to improve them and suggest recording environmental phenomena outside the national accounting aggregates, as separate social-environmental indicators. In other words, they would like to leave the content of GDP, GNP, etc., as they are now, but accompany these aggregates with a number of indicators expressed generally in physical terms reflecting the state of the environment and the changes therein. Finally, a number of authors who do not see any possibility of eliminating the "output anomaly" still think that the "input asymmetry" problem can be solved and therefore suggest some limited modifications in the content of the GDP or similar other indicators.

This is not the first time anomalies and asymmetries of national accounting aggregates are discussed. Behind the concrete problems of the environment there is the ever basic question: what is the role of the national accounting aggregates, and what is their relationship to the measurement of welfare?

The present paper tries to contribute to these discussions by pointing out some analogies between these environmental problems and some other national accounting problems. It considers that the problems of the treatment of environmental phenomena are nothing other than a special manifestation of a general problem of the measurement of economic performance, of the conflict between

our aims and means. To be able to judge these questions better, we first have to become more familiar with the general nature of these problems. This is why I shall dwell relatively at length on the general aspects of these problems; in the second half of the paper, we will be back again to the environment.

Listening to the discussions, sometimes one gets the impression that the supporters and opponents of major alterations to the national accounting concepts are on different wave-lengths. On the one hand, it is pointed out how important it would be to get closer to a welfare or economic welfare measurement. On the other hand, it is emphasized how important it is to have an objective yardstick for measuring the national accounting flows and how dangerous it would be to adventure into arbitrary subjective valuations.

I am in full agreement with both of these arguments. I do not think it right to consider that national accounting aggregates have nothing to do with welfare. Even if welfare cannot be measured, some references to welfare are very important. Without these references we would lose our compass in the jungle of national accounting problems. In explaining why we are measuring what we are measuring, we have to say something about our aims. As to these aims, but only as aims, I would be willing to accept the view that we try to get as close as possible to the measurement of some kind of economic welfare.

However, in order to be able to measure something, we have to get our means also. We cannot find a yardstick which enables us to measure welfare, but we can sufficiently well measure market values and, by this, approximate the contribution of economic activities to welfare.

The history of national accounting demonstrates quite plainly that there is a conflict between our aims and our means. One can cite many national accounting problems which are manifestations of this conflict: in order to get closer to our aims, we try to adapt, to improve our means. In fact, there are some possibilities for improving our means. We do not need to use the market prices as in nature, e.g. to include only those goods and services in our measurement which effectively have market prices; we can make some imputations for which we still have a sufficiently objective basis. However, there are some limits to these improvements. Sooner or later we arrive at a point beyond which there is no longer a sound basis for imputation and where the risks of uncertainty are greater than the advantages of the conceptual improvements. Thus, what we are looking for is, in a general sense, a compromise, an optimal point, where we get reasonably close to measuring the contribution of economic activities to welfare, but where our yardstick is still sufficiently sound and the measurement sufficiently objective.

The most common example of the "improvement of the means" is the inclusion in the national accounting aggregates of non-marketed goods and services like consumption from own production, owner occupied dwellings, and goods and services provided free of charge by the government. These problems are dealt with abundantly in the literature and therefore there is no need to go into details. There is one aspect, however, that I should like to emphasize in the context of what I have just said. The scope of the non-marketed goods and services included in the national product, i.e. the scope of the various imputations made, varies. In a way it can be said that the point of reconciliation in the conflict between aims and means is not always the same. Even now there are some

services, namely, household activities, the welfare content of which is recognized, but which are excluded from the national accounting aggregates, since the "yardstick" on the basis of which this imputation could be made is considered by the official statisticians as not sufficiently sound.

That our means are not in complete accordance with our aims often escapes the attention of the statistician. In our routine work it is easy to forget that the market values we are working with are means only. However, here and there, we encounter some signs which warn us that not everything goes smoothly. Whenever the market does not provide us the appropriate yardstick, whenever some goods and services do not have market values, or we feel that their market values do not express the relative welfare-importance of the given goods or services, we get into trouble. In all these cases we feel clearly that the solution we apply is not perfect; and we may add now, it is not perfect because our means do not permit us to follow our aims entirely. Let us have a closer look at some of these warnings.

Consumption from our own production has been mentioned already. Though there is a general agreement that this item is to be included in measuring output or consumption, views and practices differ as to its valuation. SNA[1] proposes valuation at producers' prices, while in countries using MPS[2] in measuring consumption or the income of the households this item is valued at consumer prices. Consumer price valuation is used also in the United Nations-Pennsylvania University International Comparison Project. It is not that I would like to rewarm this old debate; the only thing I want to say here is that our trouble in this case stems from the fact that we have to adapt our means to our aims, and there is no perfect way of doing this. One cannot find a price for the potato consumed by the producer, which, from the point of view of its economic welfare importance is proportional to both the potato sold by the producer, valued at producers' prices, and the potato bought by the consumer, valued at consumer prices.

Goods and services accruing free of charge or at a reduced rate to households, financed entirely or partially by the government, also cause many headaches for national accountants. The market value of medical services or medicines, provided free of charge, in the strict sense is nil; nevertheless they play an important role in welfare, and many national accountants are of the opinion that they should be also included when measuring household consumption. This in the present context can be interpreted as being also a case where we can adjust our means in order to get closer to our aims. In fact, the concept Total Consumption of the Population, approved by the Statistical Commission of the United Nations, includes the goods and services provided free of charge and also the subsidies of some commodities like medicines and housing, which are not completely free of charge, but which are sold to the population at a substantially reduced rate.

Again, all does not go smoothly. The usual procedure is to value these goods and services at cost. However, our mind, which is very well accustomed to the formal rules of our means, accepts only with a certain reluctance the idea that

[1] *A System of National Accounts*, United Nations, 1968, Sales No. E. 69 XVII. 3.

[2] Basic Principles of the System of Balances of the National Economy (Material Product System), United Nations, 1971, Sales No. E. 71 XVII. 10.

within the same aggregate some items are valued at market prices and others at factor cost. One can argue that the indirect tax on tobacco, which is valued at market prices, may finance the subsidy of medicine, valued at factor cost, i.e. including subsidy; thus, by this mixed valuation some double counting may arise. Nevertheless, this mixed valuation is widely used in practice,[3] and this demonstrates clearly that we are not obliged to keep strictly to the formal rules of our means. There is some room to get closer to our aims. From the point of view of these aims this is, perhaps, the best we can do. One can find hardly any set of prices which would approximate better the relative welfare importance of the various consumer goods and services; pure market prices, where the value of the free medicine would be nil, or pure factor costs, where all commodities would be valued at cost would certainly not do better. However, from the point of view of our means we had to accept an unnatural solution and one can understand well that many statisticians do not like this mixture in valuation which, indeed, may cause certain disadvantages in other national accounting contexts, e.g. in the relationship between output and consumption aggregates. This is one of the reasons why "total consumption of the population" is part only of the United Nations Complementary System of Statistics on the Distribution of Income, Consumption and Wealth, but not a part of the System of National Accounts itself.

Wages in kind give us also certain warnings. Let us consider here a small but from the point of view of the present context a characteristic item, the free ticket of railway employees. In many countries railway employees and their family members get tickets valid for travelling in the whole country, in certain cases even abroad, in an unlimited quantity, free of charge or for a small nominal fee only.

No question, these railway tickets are wages in kind, they have to be included in the income and consumption of households, and any national accounting theory agrees with this. However, how can this item be valued? At market price? At a price of an identical ticket for non-railway employees who would have to buy it at the booking office? This would certainly overestimate the income of the railway employees who may enjoy travelling but only in a limited quantity. At cost? Apart from the fact that it is difficult to determine the cost of a free ticket, this again would overestimate the benefit of the railway employees. National accounting systems pay little attention to this problem, and, indeed, since this item is small, for macro-economic aggregates it does not matter much whatever valuation is applied. However, as soon as we start to accompany our macro-data with micro-series this problem becomes serious. Let us assume that we have to answer the question: is the income of railway employees higher or lower than the income of say metallurgy employees? Here the valuation of these free tickets may have a crucial importance.

In this case again, the market does not provide us the appropriate means and we get into some trouble. We have to value these tickets somehow; their entire omission would be even worse, but there is no perfect solution to do it.

The most instructive manifestation of the aims–means conflict is perhaps the series of problems connected with the treatment of new products and quality

[3]A great number of countries compile regularly the "total consumption of the population" and this concept is often used also in inter-country comparisons of household consumption.

changes in compiling quantity and price indexes. According to traditional theory price indexes can take into account only price changes of comparable products, and new products entering the market or old products leaving the market do not involve price changes. In the early 1950s, however, a number of economists suggested that the concept of price changes should be broadened and price indexes should also reflect the effect of some "concealed" price changes.

There are numerous variants which are referred to in the literature as "concealed price changes" or as "new products and quality changes". It is not possible now to give an exhaustive account of these problems, but it is worthwhile to distinguish between some typical cases. Let us start with those "new product" cases which in a sense come nearest to the concept of the traditional price changes and then move to more distant ones.

a. In a country where government prohibits price increases, but where there is still a strong tendency to push prices upwards, the producers withdraw a commodity from the market and introduce a "new" one which, however, in its main quality characteristics does not differ from the old commodity; only its name is different and its price is higher.

b. A similar case to "a" but here the quality of the new product differs in respect of one characteristic from that of the old product. Let us assume that we can determine with relatively great reliability that this quality difference would justify a 10 percent price difference in favour of the new product. However, the price of the new product is not 10 percent but 20 percent higher than that of the old one.

c. This example is only to indicate that there might be not only concealed price increases but also concealed price decreases. Let us assume that with a new procedure a new type of electric bulb is introduced in the market which provides exactly the same services as the old bulbs, only its life-time is twice as long as that of the old type and it costs, say, 60 percent more.

d. In economic conditions similar to cases "a" and "b" above, the new product which replaces the old product which has disappeared differs from its predecessor in respect of additional quality characteristics, most of them being better, some of them being worse. It is not possible to determine what would be the price increase justified by the quality change; however, there is a feeling that the actual price difference between the new and old products is greater than what would be justified by the quality differences.

e. A completely new product appears on the market which satisfies a new need; e.g. until now there was no television and now there are television sets on the market.

In all these cases the statistician has to answer the question: was there a price change? *Ceteris paribus*, should the price index be different from 1.00?

The replies in the particular cases are not the same and they may differ also from country to country. This illustrates again the conflict between aims and means, the fact that there are some possibilities of improving our means, of adapting them to the aims, but that there is a limit to this.

Most statisticians would probably say that in case "a" there is a price change and the price index has to show an increase. In this case the adaption of our means

is relatively easy; it does not raise any technical difficulties; and it is very clear that the phenomenon in question is the same, from the point of view of its welfare effect, as that which we consider traditionally as price change.

It is likely also that many statisticians would consider cases "b" and "c" as constituting price changes which are to be reflected in the price indexes. Here, the improvement of our means is somewhat more difficult, but this adjustment still seems to be sufficiently sound.

I do not think that there are many statisticians who would insist that in case "d" also the price index should reflect a change. Here, for the adjustment of our means, i.e. for the quantification of the quality differences, we no longer have a sufficiently reliable yardstick. Perhaps some statisticians will suggest that a rough estimation of the quality differences is still better than no estimation at all; however, my feeling is that most statisticians would prefer not to reflect this type of phenomena in the price indexes.

While for case "d" there might be some doubt, for case "e" I am sure no statistician would suggest measuring price changes here. In the case of completely new products, there is no way to improve our means; there is no basis for determining whether the introduction of a new product at a given price increases or decreases the general price level.

This last case is very instructive in illustrating the limits to what statisticians can do. It is worth while to take a closer look at this problem.

Let us take another example and assume that during the next year an anti-cancer medicament will be discovered and introduced on the market, which will reduce cancer mortality substantially. It is impossible to determine whether the introduction of this product at a given price increases or decreases the general price level, since we are unable to compare the welfare importance of this medicine to anything else. In such circumstances the statistician cannot do better than to assume that the new product does not have any influence on the general price index, irrespective of what its market price is. Of course, the statistician does know that from the point of view of welfare it is not irrelevant at what price the new product enters the market. If its price were 1 currency unit, this would be much better for the population than if its price were 100 currency units, since in the former case more remains from a given income, after the purchase of this medicament, for the consumption of other goods and services. Nevertheless, it is not possible to reflect this difference in the indices. Supposing there is no change in the nominal incomes of the population and there are no price changes in respect of the other goods and services, the statistician's real income index will be 1.00, irrespective of the entrance price of the anti-cancer medicament, whether it is 1, 10, 100 or 1,000 currency units.

To continue this example in order to demonstrate to what anomalies this may lead, let us add one more year to the comparison. Comparing this new year with the original base year via the intermediate year (chaining), our statistician cannot do better than say that according to his indexes, it would be better for the population if the medicament entered the market at 100 currency units and then its price fell to 95 currency units, than if it had entered the market at 1 currency unit and then remained unchanged.

It is somewhat sad to admit that even within the traditional field of quantity and price indices, there are such limitations to what statisticians can do, but this is how it is. Fortunately, there are not so many completely new products that they disturb the analytical value of our indices very much, but one should be aware of these limitations.

From a general point of view the problem we encountered here is similar to the previous ones. In the case of new products and quality changes the market does not provide us the appropriate means to measure the effect of these phenomena on the price level. We can supplement what the market has provided us with some imputations, with some judgements on the basis of quality characteristics. However, with these imputations we are no longer on the same solid ground as in the traditional field of index computations. And what is the most important in the present context: there is some limit for these imputations, beyond which our calculations would become too uncertain and subjective.

After this relatively long detour, let us come back to environment. The question we have to answer here is: do our means allow us to include the effect of environmental phenomena in national accounting aggregates? Do we find an acceptable basis which enables us to attach monetary values to pollution, noise and other environmental disfunctions?

Two years ago in a paper presented at the 13th General Conference of the IARIW[4] asking the same question I was of the opinion that it would be too early to try to get a definite answer. Countries were just beginning to organize their basic statistics of environment and as I said then "... until we see the details of environmental statistics later, we cannot tell to what extent it would be possible to attach monetary values to particular environmental phenomena."

Now, two years later we are still in the initial stage of the development of environmental statistics. As it turns out, environment is a very complex field, where only slow progress can be expected in organizing our statistics. Nevertheless, I would be inclined to go somewhat further in my conclusions. On the basis of experience I would say that there are only very limited possibilities of attaching monetary values to environmental phenomena, and, therefore I do not recommend any major alterations of the national accounting aggregates.

Environmental disfunctions like pollution do not have market values. This, of course, is not a new finding. What is to be emphasized in this context, however, is that there does not seem to be any sound basis for estimating the monetary value of the harm done to the environment.

Harm done by the disfunctions is a multi-dimensional concept. Pollution may destroy goods, e.g. fish in the lake. Even here serious valuation problems may be encountered, but let us assume that this can be solved somehow. However, the same pollution causes other types of damage, e.g. aesthetic damages (the lake smells, the town is dirty), or health damages (morbidity and mortality increase owing to air pollution), and in all these cases, indeed, there is no objective yardstick to evaluate the monetary value of these losses.

[4]In 1973 I was unable to circulate this paper before the session and, as with the other contributed papers, there was not sufficient time to discuss it. This is why I find it expedient to come back to some of the questions considered in my earlier paper.

Some economists try to estimate the monetary value of the disfunctions by questioning the subjects suffering from them. "How much would you be willing to pay for the reduction of the noise of the nearby airport?" is an example of this type of question, but this again cannot provide satisfactory results. One cannot expect realistic answers on questions "how much is your health or your life worth for you?"

The problems are manyfold. First, we have some difficulties in measuring the environmental phenomena themselves, e.g. the pollution in the air. There are many pollutants, present in different concentrations, caused not only by economic activities but also by natural factors. Second, it is very difficult to determine the effect of the environmental phenomenon, say SO_2 air pollution, on the economy or society, e.g. on human health. Finally, even if we solved these problems, and we were able to tell what the effect of the disfunctions is on human health, we still would face the very difficult task of valuing health and human life.

An additional difficulty is also worth mentioning: quite often there is a considerable time-gap between the disfunction itself and its effect on human health. Mercury pollution of waters affects first only the algae, then the fish consuming the algae, and only then the humans consuming the fish; thus the worst effect on human health may not occur for several years after the emission of the mercury.

Most authors seem to agree that it is not possible to measure the negative output of environmental disfunctions. Even those who are most critical in respect of the present content of the national accounting aggregates, e.g. Juster [10], Hueting [7] do not think it feasible to attach monetary values to the harm caused by the disfunction. The Herfindahl–Kneese study [4] also considers this type of measurement hopeless. The only attempt I found to do this exercise is by Peskin [16] who tried to evaluate the national damage caused in the United States by air pollution. Unfortunately, this study does not describe the method of the valuation step by step; nevertheless from the many reservations the author expresses himself, and from the conservatism in its attitude in respect of the national accounting aggregates, one may conclude that this is an experiment to provide some additional information with limited accuracy rather than an attempt to modify the basic national accounting concepts.

The fact that the "output" (harm caused) of the environmental disfunction cannot be measured as such does not necessarily mean that we have to neglect this flow entirely in the national accounting aggregates. There are a number of activities the output of which cannot be measured as output that are nevertheless included in the national accounting aggregates on the basis of some assumption. For example, GDP includes the services of public administration on the basis of the assumption that the more is spent on these services, the higher is their output. Would it not be possible to use a similar assumption in respect of environmental flows? Would it not be possible to measure environmental output by environmental input?

First, the reader should be reminded that even in the traditional fields where this input/output assumption is applied serious difficulties are encountered. In public administration, one either has to assume that productivity did not change, or to make some arbitrary estimate of productivity change, e.g. to assume that

productivity in public administration changed at the same rate as productivity in industry. There are many signs of dissatisfaction in the literature with the present method of output measurement of non-commodity type services.

With the environment the problems are even more difficult. Environmental disfunctions have no cost in the same sense as goods and services. What could be measured is the cost of avoiding the disfunction, that is, the cost of prevention. On the basis of the assumption that the more that is spent on prevention the smaller is the harm caused, the solution which offers itself might be that if no harm is caused nothing should be deducted from the aggregate national output; if, however, some harm is caused then the cost of avoiding this harm is to be subtracted.

At first sight this solution might seem quite attractive, since it is more or less analogous to what is done in national accounting in respect of non-commodity type services. The trouble is, however, that the assumption that the greater the cost, the greater the benefit or the smaller the harm, does not work sufficiently well for environmental phenomena. This assumption seems to be far less justified in the environment than even in the field of public administration.

Ideally, the greater the harm caused by a particular disfunction, the greater should be the negative production which we deduct from gross domestic product or national income as computed now. However, the harm done is often not proportional to the cost of avoiding it. There are some pollutants which would do great harm if not eliminated but where the treatment requires only relatively low cost. This is the case, for example, with most organic pollutants of water in sewage treatment in rural areas. On the other hand, nitrate in water below a certain concentration does not do great harm. However, its elimination at the stage of emission would be a very costly procedure.

The same type of problem may be encountered even when considering only one particular pollutant. In municipal sewage treatments, only 90 percent of organic matters are generally eliminated. This requires a certain cost; the elimination of the last 10 percent would require a cost 3–4 times higher, which would certainly not be in proportion to the benefit obtained from it.

One encounters almost everywhere in connexion with environment a basic difficulty to which Denison [2] has already drawn attention, namely that a linear relationship does not work here well. In economic statistics we are used to linear relationships. Ten eggs we consider always ten times as much as one egg, and this linearity works quite well in the field of goods and services. But in the field of environmental phenomena this is not so. A small carbon monoxide content in the air does not matter at all; somewhat more is a nuisance; and somewhat more still might be lethal.

We assumed tacitly that one is able to determine the cost of prevention without major difficulties. Looking more closely however, it turns out that even this assumption is not fully justified. Let us take the following example: an airport is built in a town where there was no airport before. The planes are noisy, and even with the best location of this airport one cannot avoid disturbing one part of the population by this noise. What should be considered the cost of prevention in this case? I cannot answer this question, and I have the feeling that any possible solution would be highly debatable.

The cost of restoration, instead of the cost of prevention, could be another solution. With this method the amount to be deducted from aggregate output is the cost of remedying the results of the disfunction. For example, in the case of air pollution we would need to determine how much it would cost to make good all the harm done, and subtract this from GDP or similar other indicator.

The assumption involved with this solution is perhaps somewhat better then with the cost of prevention, since it is likely that restoration cost is more closely correlated with the harm done than prevention cost. On the other hand, however, the cost of restoration is a relatively vague concept, and in many cases it is not clear how it can be measured. One can restore the quality of a river, but what is the restoration cost of the noise caused by a factory or an airport? And what is the restoration cost of lung cancer caused by air pollution? Thus, the restoration cost concept does not solve the problem of measuring environmental phenomena in the national aggregates.

Mention should be made of another approach. According to some views the question is not how much the prevention of damage or restoration of the environment would cost, but how much was spent on these purposes.[5] In these views, output, as defined now, should be netted by all items which serve the prevention of damage to and restoration of environment, the remedy of the harm done by the disfunctions. According to this opinion it is not only government and household expenditure on environment protection that should be deducted from the GDP, but also certain investments which serve as a remedy for the deterioration of the environment, e.g. a swimming pool built because, owing to pollution, the river or lake is no longer suitable for bathing purposes.

The weakness of this solution is that its criterion is not the disfunction itself, but the remedying action. Thus, if a river is polluted but no remedying action is taken nothing should be deducted from GDP as computed now. If, however, a swimming pool is constructed, the value of this investment should be deducted from GDP, since it only offsets the effect of the river pollution. Consequently if we now compare two cases, where in both instances the river becomes polluted, but in the first case no remedying action is taken at all, while in the second a swimming pool is built to provide new bathing facilities, according to this solution the modified GDP will be the same in the two cases. This, of course, is not a very attractive property for measuring economic performance. Another weakness of this solution is the fact that in many cases it is difficult to determine to what extent a given investment serves to remedy the environmental deterioration, and to what extent other purposes. For example, swimming pools are also built when there is little river pollution. In these cases, of course, nothing should be deducted from the GDP. But where is the critical point in the degree of pollution beyond which the value of the swimming pool is to be deducted from GDP?

If radical changes cannot be made in the national accounting concepts, i.e. if environmental disfunctions cannot be treated in general as negative production, there might be still some possibilities for limited modifications.

As pointed out in the introductory part, expenditures on the protection of the environment have a different impact on the gross domestic product or national

[5]Such views were expressed at a meeting on environmental statistics of the Conference of European Statisticians.

income depending on what type of unit is making these expenditures. Expenditures by government or by households on purifying materials do not decrease gross domestic product; the same expenditures by enterprises, since they are treated as intermediate and not final consumption, do decrease it.

There are two ways to eliminate this asymmetry: either to add to the present national accounting concepts the environmental-protecting expenditures by enterprises, or to deduct from the present concepts the environment-protecting expenditures by government and households.

It seems that most authors would like to get rid of this asymmetry; views are, however, divided as to which of the two ways is preferred. Juster [10] favours the deduction of government and household expenditure, while Jaszi [9] prefers the other solution, to add to the present GDP or GNP the environment-protecting expenditure by enterprises.

Personally I would give preference to the second solution. Juster's suggestion would fit into a national accounting system where all defensive expenditures (regrettable necessities) are excluded from the aggregate output. As pointed out, however, by Jaszi in [9] this solution is beset with serious drawbacks. There is perhaps no need in the present paper to go into the details of these problems. I note only that I found many of Jaszi's arguments convincing.

Even with the second solution, however, we have to reckon with a number of serious conceptual and practical problems. Environment-protecting expenditures cannot be defined without an operational definition of the environment. For the time being we do not have this. We have to define also a "base-line", i.e. we have to determine a point from which a particular expenditure can be considered as environment-protecting expenditure.[6] In other words, we have to define what zero expenditure is for environmental protection. This is not a simple matter, *inter alia*, because very often the same expenditure serves not only for the protection of environment, but also for other purposes. Walls of a factory protect the workers from rain, wind and cold and in this way they provide better conditions for production; at the same time, however, the same walls protect the environment from noise. Thus, we have to face here also the problem of the allocation of expenditures which serve many purposes.

I do not want to say that these problems are insolvable; the difficulties, however, seem to be very serious. I raise therefore the question: is it really worth while to undertake this modification? By doing so we can eliminate one asymmetry, but the major anomaly of the reflection of the environmental phenomena in the national accounting aggregates would still remain. Even if environment-protecting expenditures by enterprises were added, the basic problem, that harm done to the environment is not appropriately reflected in the GDP and similar other indicators, would not be solved. At the same time, this modification would cause new tensions; the gap between output as conceived by enterprises and as conceived by the national accountants would become wider.

As to these problems, I think that here, indeed, it is too early to take a final standpoint. We have to see first how the work on the elaboration of the operative definitions of environment, environment protecting expenditures etc. progresses.

[6]See in this connexion Jaszi [8].

Last, but not least, mention should be made here of another possible limited modification of the national accounting aggregates. The idea of this modification is based on the consideration that more and more countries are beginning to apply the "polluter should pay" principle, and to introduce environmental fines to be paid by polluting enterprises or other units. If such fines are further generalized and if it may be assumed that they are broadly proportional to the harm done, then they might become a suitable basis for imputing monetary values to environmental disfunctions.

Such fines are, of course, recorded also in the present national accounting systems, both in the United Nations System of National Accounts [17] and in the Balance of National Economy used in centrally planned economies [18]. However, as these fines are treated at present, they do not affect either national income or gross domestic product. They are treated as transfer-type payments, or redistributions. Thus, whatever the amount of the environmental fines, and behind this, whatever the harm caused to the environment, gross domestic product and the national income remain invariant.

The modification would consist of simply changing the treatment of the environmental fines in national accounting. Instead of treating them as transfer-type payments, they could be treated as intermediate consumption. In this case national income and gross domestic product would depend upon the disfunctions, and would be reduced by the total amount of the fees paid. The applicability of this method will depend on whether national legislation develops in the direction indicated and to what extent the fines are indeed fixed at a level which corresponds to the assumed harm done by the environmental disfunctions.

Although I have left some questions open, it is presumably quite clear to the reader that my attitude in respect of the desirability of the modification of the national accounting aggregates is fairly conservative. This does not mean, however, that I do not attach great importance to the development of our information system on the environment.

My preference is for an approach similar to that described in the Herfindahl–Kneese study [4]. It seems to me better to leave the content of the national accounting aggregates broadly as they are now, and let us supplement this national accounting information by a series of physical, chemical, biological etc. indicators of the state of environment.

This would be more or less analogous to what we are doing at present in a number of other fields. There are several welfare components which are not reflected in the national accounting aggregates, but for which we have a set of other information. For instance, distributional aspects of income are undoubtedly important welfare factors; nevertheless no appropriate way has been found to reflect this aspect in the GDP or GNP itself, and therefore income distribution statistics are to some extent separated from national accounting in the strict sense. Similarly, working conditions, e.g. the length of the working week, are also an important factor in welfare; again this is considered in a separate set of indicators and not in the national accounting aggregates.

I think we have to reconcile ourselves to the idea that in characterizing welfare we cannot do better than to have a few summary indicators obtained from the national accounts, like GDP or total consumption of the population, and a

number of supplementary indicators, characterizing particular components of welfare which are generally not reflected in the summary indicators. Among these supplementary indicators we shall have also the various environmental indicators.

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