# THE VALUATION OF NONMARKET ACTIVITIES IN INCOME ACCOUNTING

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Expanding a conventional national accounting framework in order to include activities that are not produced or consumed via ordinary markets requires the accountant to adopt some procedure for assigning unit values to these activities. Often, as is the case with governmental services, unit values are equated with unit costs of production.

This paper argues that the appropriate valuation generally differs depending on whether the activity is viewed from the perspective of the producer, the consumer, or society. The theoretical justification for this position is developed first for the case of nonmarketed environmental services and then for in-kind governmental transfers.

Rather than choosing a single unit value, the paper argues for and outlines an accounting system that will permit the simultaneous adoption of more than one valuation. Techniques for implementing the system for the environment and for in-kind transfers are discussed.

Finally, drawing on the experience of the authors, the paper argues for the importance of developing data sets with more than one valuation. The authors claim that the effort to implement the system has generated valuable ancillary data sets even though data limitations and unresolved methodological questions have precluded complete implementation.

## INTRODUCTION

One frequently heard criticism of the National Accounts is that they ignore those goods and services that are consumed outside of recognized, legal markets. This criticism is something of a half-truth. It is true that the conventional accounts ignore such nonmarketed items as the services of housewives or such marketed but illegal activities as the sale of heroin. Yet, one could hardly say that the accounts have ignored another large class of nonmarketed activities, namely the provision of goods and services by governments.[1] However, whether the treatment of these activities is satisfactory is another matter.

This paper discusses a general framework for entering the flow of nonmarketed activities in a national accounting system—a framework that would be applicable equally to those nonmarketed activities that presently are ignored as well as those that presently enter into accounting systems in some manner. The theoretical and empirical ramifications of this framework are discussed with respect to two types of nonmarketed activities that are assuming increasing significance: the services of the environment and the provision of in-kind subsidies by governments.

At the outset, it is important to realize that the renewed interest in accounting for nonmarketed activities has several different motivations. For example, there is the political and social interest in measuring the general welfare of a

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[1]Other nonmarket activities explicitly treated in the accounts are food consumed on farms, the services of owner-occupied houses, wages and salaries paid in-kind, and certain nonmonetary income and product flows associated with financial intermediaries.

nation over time. There is also a similar motivation to compare the welfare of individuals within a nation. The weaknesses of the conventional accounts and accounting aggregates for these purposes are well known. In addition, there is recognition of the vast increase in the numbers and size of in-kind governmental programs and the impact that growth and congestion are having on scarce environmental resources. Finally, there is the long-standing interest of the welfare economist who has been motivated by the theoretical aspects of the problem since the beginning of modern welfare economics.

Because of these different motivations, any particular solution for the problem of accounting for the flows of nonmarketed activities may appeal much more to one analyst than to another. Our particular approach to the problem is motivated by the recognition that information on these activities is demanded for a variety of reasons and that an important, if not most important, function of a national accounting system is its ability to organize and display information in a useful and consistent manner. We recognize, however, that our effort to serve many potential users may mean that none is served as completely as he may have wished.

The plan of this paper is first to discuss a major premise underlying our accounting system: that a nonmarketed activity does not possess a single value or price weight. The theoretical underpinning for this premise is presented, in general terms and with respect to two nonmarketed activities: environmental assets and in-kind governmental transfers. Next our accounting framework is presented and is compared with conventional frameworks. The paper then focuses on methods of empirical implementation, drawing heavily from the experience of the authors. A few estimates are presented in this section. In concluding, the paper discusses the usefulness of the data development activities that accompany the implementation of an accounting system that includes nonmarketed activities in a comprehensive and acceptable manner.

## The Foundation for More Than One Valuation

The possibility that the measurement of the goods and services in any social accounting system may require the use of more than a single set of value weights was raised some time ago by Hicks [7]. In considering the problem of the proper valuation of goods whose prices are affected by excise taxes, he wrote:

> Thus it is only possible to achieve a final solution of this particular problem if we are prepared to go back to the general issue and inquire into the whole *rationale* of valuation in National Income calculations. When we do this it seems to transpire that the right system of weights to be used for valuing the National Income depends upon the purpose for which the calculation is to be used. As National Income calculations are used for all sorts of purposes, we may have to be prepared to use more than one system of weights. It is not at all obvious without examination that the same system of weights which is appropriate for comparing real income over time is also appropriate for studying questions of distribution. There may be more than one *Money Value of the Social Income*, each corresponding to a different purpose of calculation. [7, p. 106]

With respect to two uses of National Income calculations, measuring social welfare and factor productivity (that is, factor income), Hicks argued that only under very restrictive assumptions would a single set of output-price weights serve both purposes. The existence of imperfect markets and governmental activities financed with excise taxes assure a divergence between the marginal utility of an item (measured by the item's market price) and the item's marginal factor cost. While Hicks felt that little could be done about the distortions due to market imperfections, he argued that use of aggregate factor income at least required the subtraction of excise taxes, a procedure that is followed in the conventional distinction between National Product and National Income.[2]

Hicks' definition of market output, as well as current procedures, includes the output of governmental activities measured at the cost to the government.[3] Hicks was careful to point out, however, that his advocacy of this procedure did not mean that he believed that the welfare value of governmental services equaled their cost but only that their cost was a probable lower bound to their true social value. In other words, Hicks felt that governmental services in the aggregate are worth *at least* what they cost and thus their cost could be used as a "rough estimate" of their social value.

Clearly Hicks felt this less-than-totally-satisfactory procedure was dictated by practical considerations. His unease was revealed when he wrote ". . . I do not see that we have any choice but to accept the actual choices of the government, even if they are expressed through a Nero or a Robespierre, as representing the actual wants of society. (To those who cannot stomach this I have indicated a way to escape.)" [7, p. 116]

Since national accountants are not normally at the forefront of revolutionary movements, the Hicksian position that cost can serve as a proxy for value has become fairly well entrenched in the official treatment of governmental services. Indeed, even with respect to proposed accounting treatment of nonmarketed, environmental services, it has been suggested that pollution control costs could serve as a rough proxy for the environmental damage caused by the pollution. As with governmental services, this procedure has been put forth as a fall-back position made necessary by the difficulty of obtaining direct measures of environmental damages and environmental services.[4]

The question remains, however, of the validity of these approximations for national accounting purposes. With respect to governmental services, we might ask several related, yet distinct, questions: How well does the cost of a good provided by the government reflect its social value? How well does the government cost reflect the value of the good as perceived by the direct recipient? Are governmental costs necessarily a lower bound of either the social valuation or the recipient's valuation of governmental services? And will the social and recipient values be equal?

[2]Kuznets [14] felt such an adjustment was unnecessary on the grounds that the governmental services financed by the excise taxes could be viewed as a return to factors of production.

[3]Hicks' position on this was modified in response to criticism by Kuznets to exclude certain governmental services that were clearly intermediate in nature (see [8]).

[4]See the Juster and Herfindahl–Kneese chapters in [10].

With respect to environmental services, we might also ask: Are environmental control costs reasonable approximations of the social damage caused by environmental pollution? To what extent are these costs and the social value of the environment as a valuable asset approximately the same? To discuss these questions qualitatively, we shall put forth two models, one pertaining to the nonmarket waste disposal services of the environment and one pertaining to the value of in-kind governmental subsidies as perceived by recipients.

## The Value of The Environment's Waste Disposal Services

That the use of the environment as a dumping ground has both socially positive and negative aspects is a well-accepted tenet of the theory of efficient management of environmental resources.[5] As a "polluter" dumps residuals, the marginal social benefit can be described by curve"A" in Figure 1. This marginal benefit equals the marginal cost to society were the polluter denied access to successive units of the environment.[6] Presumably, the socially valuable output of the rational polluter's activity is greater than would be the case were he not to utilize the "free" disposal services of the environment. Curve "A" is downward sloping to reflect the fact that, like any other input, the returns from environmental services diminish as more of this service is utilized.

Nevertheless this "free" disposal service has its social cost in terms of the disbenefits or "damage" engendered by the pollution. The marginal damage function is drawn as curve "B" in Figure 1. In fact, the "negative" of this function is shown so that the absolute values of pollution benefit and damage can be more easily compared. This curve is shown to have an upward slope to reflect the fact that the damage from pollution most likely increases more than proportionally to the physical amount of pollution. The curve is also drawn to have a "threshold" point, H, such that there is no damage with pollution less than this amount. The existence of such thresholds, however, is a matter of dispute.

Clearly, for any level of pollution other than OE the marginal value of a unit of pollution differs for society taking, on the one hand, the view of the polluter and, on the other hand, the view of any damaged parties. (In practice, the polluter and the damaged party can be the same individual.) Thus, at level OD the marginal benefit is rather low (DG) while the absolute value of the marginal damage is rather high (DF). If, as in fact we shall see in our accounting system, some significance is attached to the *difference* between marginal benefit and damage, *three* possible pollution (or environmental asset) valuations emerge from the model: DG, DF, and GF.

Since there is interest in collecting data on pollution-control expenditures, even at the official level in the United States, we shall consider the relevance of such data for these three valuations. Consider the valuation of the services of the

[5]A clear discussion of this theory may be found in Kneese and Bower [12].

[6]Figure 1 blurs the distinction between the emission of residuals and the total use of environmental assets as measured by ambient concentrations. Using "emissions" and "ambient concentrations" interchangeably does not affect the analysis as long as there is a "transformation" function relating the two concepts. See [18].

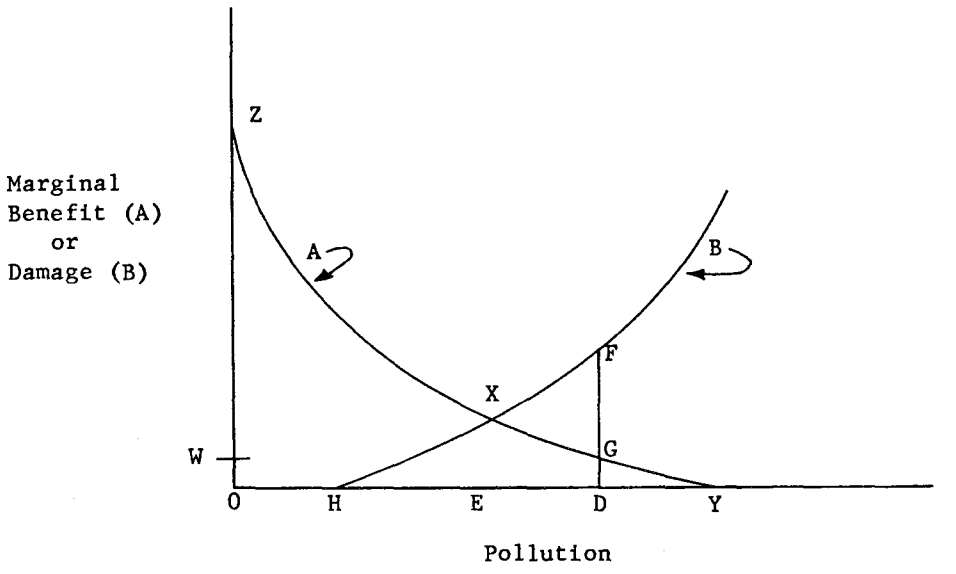


Figure 1. Marginal Pollution Benefit and Damage

environment. According to Figure 1, the total value of these services at pollution level OD is the area OZGD.[7] Is there any observable cost or expenditure number that approximates this area? The answer is "yes" if the question is interpreted to refer to costs that *might be incurred* were the polluter forced to forego entire use of the environment. The area OZGD is, by definition, the social opportunity cost attributed to the polluter were he denied access to the environment. If a law were passed forcing total denial, this area might also approximate his private costs. However, the polluter's already-incurred costs of pollution reduction, approximately equal to the area DGY, would not necessarily give the accountant a clue to the hypothetical costs he might incur. Thus, data on pollution control expenditures, such as those being assembled by the U.S. Bureau of Economic Analysis, while useful for certain purposes, yield no direct information on the value of environmental services.[8]

Consider now the value of environmental damage—the area HFD in Figure 1. It has been suggested that so-called "defensive" expenditures (assuming they could be measured) could be used as a proxy for the value of this damage. Certainly, if it is known that all damages due to the pollution at level D are being offset by expenditures on health care, air conditioners, extra paint, etc., then the sum of such expenditures would be a good estimate of pollution damage. However, parties may choose to simply suffer the damages without defensive

[7]An alternative valuation is also possible. The *marginal* value of the service is DG. Valuing all units at this marginal value yields the smaller number, OWGD, which is analogous to the price-times-quantity valuation used for ordinary marketed goods—a valuation that excludes "consumer surplus."

[8]It should be noted, however, that actual expenditure information combined with other data on actual pollution reduction and technology can be useful for estimating likely values of the costs that might be incurred with further pollution reduction.

purchases. Or they may choose to offset only part of the damage. Or they may be unable to defend against many damages. As before, while the assembly of data on defensive outlays may be useful for analytical purposes and may greatly contribute to efforts to find an estimate of pollution damage, there is no reason to believe that such data even partially approximate the true value of environmental damage.

In short, while pollution-related cost and expenditure information have their uses, such data are not sufficient to provide measures of the *value* of environmental services or damages. As we shall see, the failure of cost data to serve as a proxy for value data also holds with respect to the valuation of certain in-kind governmental transfers.

## The Value of In-kind Governmental Transfers

In the United States, governmental transfers in-kind have grown rapidly during the past decade. Among in-kind transfers meeting basic consumption needs are programs subsidizing food (Food Stamps at a cost of $5 billion; School Lunches at $2 billion), health care (Medicare for the aged at $17 billion; Medicaid for low-income families at $14 billion), and housing (around $2 billion). For many low-income families, such transfers provide a major share of the total family resources.

These programs are usually designed in ways that induce or constrain recipients to spend more on the subsidized goods than they would spend if given an equivalent dollar cash transfer.[9] Indeed, since in-kind transfer programs are more costly to administer than cash transfers, it is presumably society's intent that consumption patterns of recipients be distorted in this manner. To induce added consumption of the goods in question, in-kind programs lower prices to recipients and/or set amounts of the goods that recipients must consume. In constraining a recipient's choice, the value of the in-kind transfer to the recipient will often be less than if the transfer had been in cash. That is, its value will be less than the cost of the in-kind transfer to the government.[10]

This outcome can be depicted with reference to the standard utility diagram for an individual. For illustrative purposes we show a somewhat simplified Food Stamp program. This program is available to all households deemed eligible on the basis of income and assets. Food coupons that can be used to purchase any food items at most stores are purchased by eligible households at a price below the face (market) value of the coupons,[11] giving rise to the transfer. The amount of food coupons that may be purchased rises with the number of household members (currently, monthly coupons for a family of four have a market or food-purchase value of $166) and the price paid for the coupons rises with a

[9]In the low-rent public housing program, however, where a fixed amount of housing services are offered on a take-it or leave-it basis, empirical estimates have found a reduction in spending on housing relative to preferred levels for many households.

[10]The value of in-kind transfers to recipients may, however, be equal to the cost to the government, as we later show, and may even be greater than cost as when market imperfections are reduced.

[11]The face or market value of a coupon is defined as the market value of the amount of food that can be purchased with the coupon.

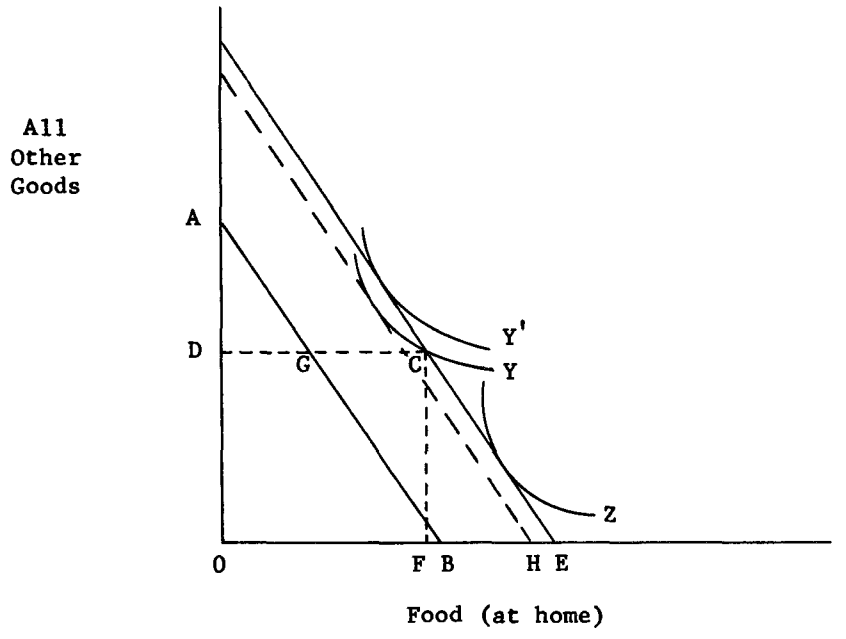


Figure 2. Utility Diagram—Food Stamp Program

household's net monthly income. In the diagram, the recipient's pre-program budget constraint is AB. The purchase value in units of food of the recipient's food coupons is shown by the distance OF. The purchase price is AD, or DG in units of food. Thus the amount of the transfer (in food units) is shown by the distance GC or BE.

Under the Food Stamp program, the new budget constraint becomes the kinked line AGCE. Were our hypothetical recipient to have preferences for food and all other goods represented by the indifference curve Z, he would supplement the food purchased with food coupons with additional purchases of food at market prices. For such a recipient, the Food Stamp transfer, in terms of the utility generated, is equivalent to a cash transfer equal to the government's cost. A sufficient condition for asserting that the recipient's valuation of Food Stamps is equal to the government's cost is the observation that the recipient purchases more food for home consumption than his food coupons alone permit.

However, for a recipient with a preference function shown by indifference curve Y, the Food Stamp transfer is worth less than an equivalent cash transfer equal to government cost. A cash transfer would have allowed the recipient to reach a higher indifference curve, shown as Y'. With cash, the recipient would have spent less on food and more on other goods than would be allowed within the confines of the Food Stamp program. Similarly, a smaller cash transfer—equal to BH—would have provided the same utility as the in-kind transfer.

The value of the in-kind transfer, in this latter case, is worth less to the recipient than an equivalent dollar cash transfer equal to government cost. However, non-recipients may derive some value from giving the transfer

in-kind, over and above whatever value they derive from giving a cash transfer.[12] There is no reason to presume that the sum of recipient values and nonrecipient (donor) values just equal the cost of the in-kind transfer to the government. Values, even in the aggregate, may exceed, or fall short of, government cost.[13]

## Accounting Framework

In illustrating how more than one valuation for an account entry can be handled in the context of the national accounts, we concentrate on the consolidated Income and Product account and its deconsolidated sector components. In order to simplify the presentation, many other possible modifications to the accounts will be ignored.[14] Furthermore, while our suggested modifications could pertain to the possible inclusion of *any* nonmarketed good or service, we shall focus only on environmental services and governmental in-kind transfers.[15]

At the outset, it will be necessary to introduce a convention necessitated by the fact that there can be two classes of governmental in-kind subsidy programs. With the first class of programs, the government purchases goods and merely transfers them to recipient households or individuals.[16] With the second class—the more typical class in the United States—the recipient purchases the goods in the market, but at a subsidized price. The government then compensates the producer or seller.[17] In certain cases, the subsidized price can be zero. While under the second class of programs the recipient appears to deal directly with the private sector, to show direct private sector-to-recipient deliveries in our accounting structure will make it appear that the private sector, and not the government, is providing the subsidy.[18] Therefore, we shall treat all governmental in-kind subsidies as if they were under the first class of programs. Production for governmentally-subsidized consumption will be shown as governmental purchases destined for transfer to recipients even though recipients may actually purchase the items directly.

[12]Whether these nonrecipient benefits flow from interdependence of utility functions (Hochman and Rodgers [9]) or societal preferences or perceptions (Thurow [24]) is unimportant for our purposes.

[13]However, in our accounting framework (discussed in the following section) the balancing entry "Net governmental benefit" is defined such that when added to "In-kind governmental transfers (recipient valuation)" it equals government costs. Some may wish to interpret "Net governmental benefit" as donor value but that interpretation is not intended in this paper.

[14]For example, the suggestions of Ruggles and Ruggles [20], Kendrick [11], Eisner [3], and others associated with the NBER Social Measurement Project.

[15]Also in the interests of simplification, we shall neglect certain classes of in-kind governmental transfers, namely those whose major costs are not observable on current account. The prime example is the provision of public housing services. Except for operating and maintenance outlays, the principal current account costs to the government are implicit annual capital charges, which are neglected in the standard accounting framework. A procedure for handling this type of in-kind transfer has been outlined by Smolensky *et al.* [23]. This procedure can easily be incorporated into our framework. However, if the reader wishes to assume that the government purchases its public housing in private rental markets, the simplified presentation below again becomes entirely valid.

[16]Examples are the food commodities program and, in part, the school lunch program.

[17]The Food Stamp, Medicare and Medicaid programs are examples.

[18]It also would not distinguish between governmental subsidies and those that are, in fact, directly provided by the private sector. Providing an employee with a car is an example. Our exposition neglects these private in-kind subsidies but our accounting framework could easily handle them as no new principles are involved.

Our modified consolidated income and product account can be deconsolidated into four major sectors: industries, governments, households, and the environment (nature). Each of these sectors will be discussed in turn.

1. *Industries*

The industrial income and product account has the general appearance of an industry input–output account except for the addition of three new entries: one measuring the input value of environmental services, one measuring the output or damage value as a result of employing these services, and a balancing entry equal to their difference. This entry will be termed "Net environmental effect."[19] Because we assume that industries are not recipients of in-kind governmental subsidies, the only entry pertaining to these subsidies appearing in this account is "Sales to government for in-kind transfer." For a typical industrial sector the account has the following appearance, as shown in Figure 3.[20]

I. Industry Product Account (Typical Sector)

| INPUT | OUTPUT |
|---|---|
| 1. Purchases from other industrial sectors | 11. Sales to private sector (current account)<br>a. To other industries<br>b. To households<br>c. Exports |
| 2. Compensation of employees and proprietors (incl. rental income) | 12. Sales to government<br>a. For government's own use<br>b. For in-kind transfer |
| 3. Indirect taxes | 13. Sales for gross investment |
| 4. Imports | |
| 5. Capital consumption allowances and net interest | |
| 6. Profits and surplus<br>a. Profits tax<br>b. Retained profits | |
| 7. Transfer payments | |
| 8. Subsidies received (−) | |
| GROSS INDUSTRY SECTOR INPUT | GROSS INDUSTRY SECTOR OUTPUT |
| 9. Environmental asset services (−)<br>a. Air<br>b. Water<br>c. Land | 14. Environmental damages (−)<br>a. Air<br>b. Water<br>c. Land |
| 10. Net environmental effect (I.14–I.9) | |
| MODIFIED GROSS INDUSTRY SECTOR INPUT | MODIFIED GROSS INDUSTRY SECTOR OUTPUT |

*I.9 means item 9, account I.

Figure 3.

[19]This term can be positive or negative in value but its sign has no welfare implications. In particular, a negative value does not imply any social or private disutility. However, the theory behind Figure 1 suggests that a zero value is desirable in the sense that it implies a Pareto optimal allocation of environmental assets.

[20]The form of the account layout follows Ruggles [21]. The item designated by the capitalized heading is the sum of items included in headings listed above it.

The environmental asset services (I.9) are signed negatively as a matter of convention since the gratis cost of these services makes them analogous to a subsidy. The environmental damages (I.14) are also signed negatively to reflect the fact that their marginal benefit and, hence, their "price" is negative.

2. *Governments*

In conventional national accounting, governmental "production" is defined to equal current outlays for labor and materials. With our modification, that amount of outlay for goods that are destined for in-kind transfer is deducted from the usual production total. In its place are added two new output terms: one measuring the recipient value of these transferred items and another termed "Net governmental benefit"—the difference between the cost to the government of the transferred items and the recipients' valuation. In effect we are following Hicks' convention that utilizes government cost as a "rough estimate" of social value. In actuality, social value is likely to be more than cost, as Hicks asserts, but it may be less. At some point in the future, we may be able to estimate social value more satisfactorily. In the meantime, however, it is important to accurately portray distributional implications of the in-kind transfers: namely, that the direct recipient may not benefit by the full government cost of the in-kind transfer.

As with the industrial sectors, a negative output, measuring the government's contribution to environmental damage, is also appended to the list of outputs; the environmental balancing item "Net environmental effect" is appended to the inputs. In addition, since the conventional output of government is defined to equal outlays for labor and materials, no surplus, deficit or tax

II. Governmental Product Account

| INPUT | OUTPUT |
|---|---|
| 1. Purchases from industry<br>a. Own use (I.12.a.)<br>b. For in-kind transfer (I.12.b) | 6. Governmental goods and services (II.1.a.+II.2.+II.3.)<br>a. Federal<br>b. State and local |
| 2. Compensation of employees | |
| 3. Imports | (7. Adjustment: Add purchases for in-kind transfer (II.1.b.)) |
| GOVERNMENTAL INPUT | GOVERNMENTAL OUTPUT |
| 4. Environmental asset services (−)<br>a. Air<br>b. Water<br>c. Land | (8. Adjustment: Subtract purchases for in-kind transfer (II.1.b)) |
| | 9. In-kind transfers (recipient valuation) |
| 5. Net environmental effect (II.11–II.4) | 10. Net governmental benefit (II.1.b–II.9) |
| | 11. Environmental damages (−)<br>a. Air<br>b. Water<br>c. Land |
| MODIFIED GOVERNMENTAL INPUT | MODIFIED GOVERNMENTAL OUTPUT |

Figure 4.

item appears. Financial transfers are not shown. This account is thus far different from the conventional governmental receipts and expenditure account.

The governmental product account takes the form as shown in Figure 4. The adjustment items II.7 and II.8 are included to make it easier to compare conventional governmental output with our modified version. It should be noted that were the environmental entries absent, the modified governmental output would equal the conventional output, since in-kind transfers plus net governmental benefit equals purchases for in-kind transfer.

3. *Households*

In the U.S. accounts, the only productive activity that is assumed to take place in the household sector is the production of the services of certain non-profit institutions and of domestics. Thus, in the conventional consolidated income and product accounts, the household sector plays a relatively minor role. However, the importance of households as a productive sector is far greater in our modified accounts. Primarily because of the automobile, households "produce" a substantial portion of air pollution damage and, at the same time, employ the atmosphere as a dumping ground for automobile exhausts.[21]

It should be noted that the only reason for displaying the household production account separately is to call attention to its role in the environment. This account is *not* a substitute for the conventional personal income and outlay account. Thus, it does not indicate total household income and expenditures but only that portion arising from household productive activity.

This account has the structure as shown in Figure 5.

III. Household Product Account

| INPUT | OUTPUT |
|---|---|
| 1. Purchases of intermediate goods from industry | 8. Services to households<br>a. Non-profit institutions<br>b. Domestics |
| 2. Compensation of employees and proprietors | |
| 3. Imports | |
| 4. Capital consumption allowances | |
| 5. Surplus of non-profit institutions | |
| GROSS HOUSEHOLD INPUT | GROSS HOUSEHOLD OUTPUT |
| 6. Environmental asset services (−)<br>a. Air<br>b. Water<br>c. Land | 9. Environmental damages (−)<br>a. Air<br>b. Water<br>c. Land |
| 7. Net environmental effect | |
| MODIFIED GROSS HOUSEHOLD INPUT | MODIFIED GROSS HOUSEHOLD OUTPUT |

Figure 5.

[21]Households also produce a substantial portion of water pollutants. However, sewered households do not. In our accounts, discharges from municipal sewage treatment works are credited to an industrial sector (SIC49).

4. *Nature*

Nature as a productive sector is introduced into our accounting framework for two reasons. First, it is the producing sector for all environmental asset services and net environmental effects. Secondly, nature is a significant source of environmental damage. The account shows this damage as a negative output of nature offset by a net-environmental-effect term on the input side. This term is identically equal to natural environmental damage (that is, it is *not* equal to the difference between environmental damage and asset services) since nature is not viewed as a consumer of environmental asset services.

Some might object to the concept of nature as a generator of environmental damage. This concept, however, is dictated more by practical than philosophical considerations. For the most part, statistical estimates of the damages due to environmental pollutants do not distinguish between those pollutants having a natural rather than a man-made source. To attribute these damage estimates solely to man-made sources clearly is erroneous.[22] In our empirical estimates we have thus prorated damages between nature and conventionally-defined economic sectors.

The product account for nature appears as in Figure 6.

IV. Natural Sector Product Account

| INPUT | OUTPUT |
|---|---|
| 1. Total environmental damages (−) (I.14.+II.11.+III.9.+IV.5.) | 3. Total environmental asset services (−) (I.9.+II.4.+III.6.) |
| 2. Net environmental effect, nature (= IV.5.) | 4. Total net environmental effect (I.10.+II.5.+III.7.+IV.2.) |
| | 5. Environmental damages, nature (−)<br>a. Air<br>b. Water<br>c. Land |
| NATURAL SECTOR INPUT | NATURAL SECTOR OUTPUT |

Figure 6.

5. *Consolidated gross product account*

The government, household, and natural product accounts can be consolidated with the industrial product accounts to generate a modified national gross product account. In this account imports have been shifted to the output side to conform with U.S. practice.

The account appears as in Figure 7. As was the case with the governmental product account, the adjustment items, V.14. and V.15., are included in order that conventional gross national product can be more easily compared with our modified version.

[22]Perhaps half of dissolved solids in water have a natural origin. Naturally-generated particulates and nitrogen oxides in the air greatly exceed those with man-made origins.

V. Consolidated National Income and Product Account

| INPUT | OUTPUT |
|---|---|
| 1. Compensation of employees and proprietors (incl. rental income) (I.2.+II.2.+III.2.) | 9. Personal consumption (I.11.b.+III.8.) |
| | 10. Gross private domestic investment (I.13.) |
| 2. Profits (I.6.+III.5.) | 11. Exports (I.11.c.) |
| a. Profits tax | 12. Imports (−) (I.4.+II.3.+III.3.) |
| b. Retained profits | 13. Governmental goods and services (II.6.) |
| NATIONAL INCOME | |
| 3. Indirect taxes (I.3.) | (14. Adjustment: Add governmental purchases for in-kind transfer (II.7)) |
| 4. Capital consumption allowances and net interest (I.5.+III.4.) | |
| 5. Transfer payments (I.7.) | |
| 6. Subsidies received (−) (I.8.) | |
| CHARGES AGAINST GROSS NATIONAL PRODUCT | GROSS NATIONAL PRODUCT |
| 7. Environmental asset services (−) (IV.3.) | (15. Adjustment: Subtract governmental purchases for in-kind transfer (II.8)) |
| 8. Net environmental effect (IV.4.) | 16. Environmental damages (−) (IV.1.) |
| | 17. In-kind governmental transfers (recipient valuation (II.9.) |
| | 18. Net governmental benefit (II.10.) |
| MODIFIED CHARGES AGAINST GROSS NATIONAL PRODUCT | MODIFIED GROSS NATIONAL PRODUCT |

Figure 7.

## Implementation Issues

Can this accounting system be implemented? It has sometimes been argued that the measurement of welfare is impossible. It is certainly true that to measure perfectly the dollar value of environmental damage or the recipient's valuation of an in-kind transfer requires, as we shall see, such things as implicit measures of areas under hypothetical demand curves or the ability to "observe" theoretically unobservable utility functions. However, if we are willing to lower our ambitions, to live with approximations, and, most importantly, to clearly understand exactly what we are and are not measuring, the task becomes more "possible."

## The Environmental Entries

Approximating the two environmental entries—the service value of the environment and the value of damage due to use of the environment—requires techniques that are now becoming familiar to those who must undertake benefit-cost analyses of projects with environmental prospects.[23] The techniques relevant to the benefit side of such analyses are applicable to the measurement of

[23]Such analyses are mandatory for projects undertaken by the Federal Government under the National Environmental Policy Act.

damages and the techniques relevant to the cost side are used in the calculation of environmental service values.

The methods of estimating environmental damages fall under three classes: alternative cost estimates, opportunity cost estimates, and willingness to pay estimates.[24] The first method attempts to estimate the direct costs of environmental damage assuming no substitution behavior on the part of damaged parties and the second attempts to estimate the costs of damage assuming substitution. The willingness to pay estimate, which is theoretically the most valid approach, attempts to estimate how much the damaged parties would be willing to pay to avoid the environmental damage. Each of these classes of techniques can be further broken down into a number of more specific approaches. For example, willingness to pay estimates can be based on market studies, travel cost studies, personal interviews, etc.

However, this cataloging is a bit deceptive. In practice, most of the available estimates are alternative cost estimates that attempt to measure the dollar cost of direct health and property damages. The number of available opportunity cost and willingness to pay estimates lag far behind, probably because these approaches make greater demands for data and sophisticated statistical techniques.

In principle, the very same techniques can be used to estimate the value of environmental services. The value of these services can be viewed in terms of the "damage" that would result were the polluter denied the services. Of course, the "damages" in question are not usually health or property damages but rather the cost to the polluter and society of the human and physical resources that must be substituted for the services that were being provided gratis by the environment. In practice, however, the only available estimates of environmental services are of the alternative cost variety. The value of environmental services have been proxied by estimates of the cost of pollution control. Not only does this proxy assume that the reported control costs are optimally calculated to be just equal to the social value of the environmental services foregone, but also that the only valuable services to the polluter are those that provide a medium for the disposal of his wastes.[25] These are, of course, very strong assumptions.

One feature of both the estimates of damages and asset services is that they cover the *full* value of these damages and services—not the value as would be perceived by the marginal consumer, that is, the consumer of the last available unit. Ordinary marketed goods and services, however, are valued in the National Accounts in terms of the last unit consumed. Any "consumer surplus" enjoyed by non-marginal consumers is neglected. Therefore, there is an inconsistency between the valuations of our new entries and the existing account entries, the magnitude of which depends on how much average values differ from marginal ones.[26]

[24]More detailed discussions of the techniques may be found in [6] and [19].

[25]Thus, the oxidation service provided by the air for combustion processes is neglected. It should be noted, however, that, given the vast quantity of air available for this purpose, the value of this service *at the margin* is nearly zero, although the total alternative cost value is very high.

[26]We have developed an approximation procedure for extracting consumer surplus which is exactly valid if the marginal curves in Figure 1 are straight lines.

Estimates of environmental asset services and damages have been developed with respect to the use of air for waste disposal. The estimates, for 1968 by SIC, are shown in Table 1. Similar estimates for water services and

TABLE 1

ANNUAL AIR POLLUTION DAMAGES AND ANNUAL COSTS TO ELIMINATE DAMAGE (1968)[a]
(millions of 1970 dollars)

| | Sector | Damages[b] | % of Total Damages | Industry Cost to Meet EPA Standards[c] | % of Total Control Cost |
|---|---|---|---|---|---|
| 01 | Agriculture | 201 | 1.0 | 1,137[d] | 5.1 |
| 07 | Agricultural services | 214 | 1.1 | 107 | 0.5 |
| 08 | Forestry | 864 | 4.3 | 160[d] | 0.7 |
| 10 | Metal mining | 14 | 0.1 | 19[d] | 0.1 |
| 11–12 | Coal mining | 72 | 0.4 | 161 | 0.7 |
| 13 | Oil and gas drilling | 27 | 0.1 | 8 | — |
| 14 | Nonmetal mining | 13 | 0.1 | 7 | — |
| 15–17 | Construction | 98 | 0.5 | 169[e] | 0.8 |
| 19 | Ordnance | 4 | —[f] | 3 | — |
| 20 | Food products | 138 | 0.7 | 55 | 0.3 |
| 21 | Tobacco products | 4 | — | 2 | — |
| 22 | Textiles | 49 | 0.2 | 19 | 0.1 |
| 23 | Apparel | 10 | — | 2 | — |
| 24 | Wood products | 36 | 0.2 | 63 | 0.3 |
| 25 | Furniture | 11 | — | 3 | — |
| 26 | Pulp and paper | 265 | 1.3 | 90 | 0.4 |
| 27 | Printing, publishing | 8 | — | 2 | — |
| 28 | Chemicals | 865 | 4.3 | 199 | 0.9 |
| 29 | Petroleum products | 1,316 | 6.5 | 207 | 0.9 |
| 30 | Rubber products | 97 | 0.5 | 11 | 0.1 |
| 31 | Leather products | 14 | 0.1 | 6 | — |
| 32 | Stone, clay, glass | 1,164 | 5.8 | 254 | 1.1 |
| 33 | Primary metals | 2,712 | 13.4 | 858 | 3.8 |
| 34 | Fabricated metals | 69 | 0.3 | 32 | 0.1 |
| 35 | Machinery except electrical | 63 | 0.3 | 16 | 0.1 |
| 36 | Electrical machinery | 48 | 0.2 | 10 | — |
| 37 | Transportation equipment | 117 | 0.6 | 27 | 0.1 |
| 38 | Instruments | 17 | 0.1 | 3 | — |
| 39 | Miscellaneous manufacturing | 23 | 0.1 | 3 | — |
| 40 | Railroads | 156 | 0.8 | 66[d] | 0.3 |
| 41 | Local and suburban transit | 139 | 0.7 | 165[d] | 0.7 |
| 42 | Motor freight | 120 | 0.6 | 133[e] | 0.6 |
| 44 | Water transportation | 180 | 0.9 | 49[d] | 0.2 |
| 45 | Air transportation | 46 | 0.2 | 274[d] | 1.2 |
| 46 | Pipelines | 15 | 0.1 | 34 | 0.2 |
| 49 | Utilities | 4,760 | 23.6 | 1,634 | 7.3 |
| 55 | Gas stations | 87 | 0.4 | 540[d] | 2.4 |
| 50–81 | Trades and services | 942 | 4.7 | 1,405[e] | 6.3 |
| 82 | Education | 18 | 0.1 | 67[e] | 0.3 |
| 88 | Households | 3,981 | 19.8 | 12,157[g] | 54.1 |
| 91–93 | Governments | 153 | 0.8 | 2,303[e] | 10.3 |
| Natural | | 1,019 | 5.1 | N.A. | N.A. |
| Total | | 20,149 | 100.0 | 22,460 | 100.0 |

[a]Estimates revised May 15, 1976.

[b]National total is based on extrapolation of EPA estimates. See [5]. The procedure for the breakdown by SIC is discussed in [17, Appendix]. [Footnotes continued on next page]

[c]The primary data source was *The Economics of Clean Air*, Annual Report of the Administrator of the Environmental Protection Agency, March 1972. Many EPA cost numbers have since been revised upward. Many other sources (e.g., journal articles, contractors' reports, industry studies, etc.) were used to obtain the two-digit SIC breakdowns. Complete documentation on these sources and estimating methods is available from the project investigators.

EPA does not provide estimates of the costs to meet standards for fuel combustion from stationary sources broken down by sector. Therefore, aggregate EPA cost estimates are distributed by estimated fuel usage. EPA cost estimates, reflecting emission levels in 1977–1978, were adjusted to the 1968 base year by assuming a fixed proportion between a sector's activity level and its emissions.

[d]EPA standards not established. Cost estimates are based on industry estimates of clean-up costs and EPA contractors' reports.

[e]Estimate assumes all gasoline vehicles are fitted with pollution control equipment necessary to meet 1977 standards.

[f]Less than 0.1 percent.

[g]Estimate based on 1970 automobile pollution.

*Note*: N.A. = not applicable.

damages have yet to be completed.[27] Total air damages, about $20 billion per year, approximate the value of the asset services, estimated at $22 billion.[28] Thus the relative value of total net environmental effect is rather small, about $2 billion. However, for individual sectors, such as primary metals or agriculture, the net environmental effect can be very significant.

While the asset services estimates are of the alternative cost variety, characterizing the damage estimates is more difficult. As discussed in [6], these estimates are an aggregation of extrapolated estimates drawn from a variety of studies which used several different techniques. The majority of these studies, however, appeared to have used the alternative cost approach. The estimates usually approximated the cost of offsetting any physical damage to health, materials, agriculture, and property caused by air pollutants and assumed no substitution behavior by the damaged party. However, certain estimates were based on residential property value studies. Properly conducted, such estimates can approach the ideal willingness-to-pay value.

## The In-kind Governmental Entries

A number of estimates of the value of selected governmental in-kind transfers to recipients have recently appeared in the literature.[29] Generally, they are attempts to estimate directly the cash equivalent of the increase in utility resulting from the in-kind transfer. That is, they are estimates of BH in Figure 2. These so-called Hicksian equivalent variation measures can be derived following the choice of a particular utility function, specification of the necessary utility function parameters, and definition of the operational characteristics of the in-kind transfer program.[30]

[27]This estimating activity has been undertaken by Leonard Gianessi and Henry Peskin as part of the National Bureau of Economic Research Social Measurement Program.

[28]As noted above, since environmental asset services are estimated by the alternative cost approach, these services are assumed equal to the costs shown in Table 1.

[29]See Clarkson [1], Kraft and Olsen [13], Murray [15], Smeeding [22], and Smolensky [23].

[30]The derivations follow from maximization of the indirect utility function. See DeSalvo [2] and Murray [15].

For several utility functions, such as the Cobb–Douglas or Stone–Geary, precise analytic forms for the cash equivalent are derivable; for other utility functions, approximations are necessary utilizing iterative computer operations. As an example, we show the cash equivalent measure for the Food Stamp program, as previously described, using a Cobb–Douglas utility function:

$$C = \left(\frac{F}{\alpha}\right)^{\alpha}\left(\frac{Y-P}{1-\alpha}\right)^{1-\alpha} - Y$$

where $C$ is the cash equivalent of the Food Stamp transfer, $F$ is the dollar amount of food coupons received by households, $P$ is the purchase price of the coupons, $Y$ is income, and $\alpha$ is the proportion of income spent on food (in the absence of the program).

The estimates of cash equivalent values available in the literature utilize a number of different utility functions and assumed or estimated parameters. They often cover different years, spanning the 1968 to 1972 period. Nevertheless, these estimates are remarkably similar. As can be seen in Table 2, housing subsidies and Medicaid are on average valued at only one-half to three-quarters of government cost. Food Stamps and Medicare are worth higher proportions of cost. Not only are the average values well below government cost, but there are sizeable distributional consequences as well. Values to the lowest-income recipients are considerably below those shown and values often rise to equal government cost for the higher income families eligible for program benefits.

TABLE 2

CASH EQUIVALENT VALUES TO RECIPIENTS AS A PROPORTION OF GOVERNMENT COST

| | |
|---|---|
| Food Stamps | 80–90% |
| Housing Subsidies | 55–65% |
| Medicare | 90% |
| Medicaid | 65–70% |

These are synthetic estimates for groups of households. As such they rely on assumptions concerning consumer preferences, drawn from data and studies on household expenditures. Greater utilization of household surveys will permit direct questions concerning value for individual households, such as: "How much cash would you accept in lieu of your Food Stamps?" Or, bounds might be placed on the cash equivalent values for individual households receiving certain in-kind benefits. For example, on a recent survey of the Department of Health, Education, and Welfare, households receiving Food Stamps were asked if they bought more food in a month than could be paid for with Food Stamps. Some 63 percent of these households responded that they had purchased significantly more food. For these households, the Food Stamps are valued at government cost.[31]

[31]These households are along the segment CE in Figure 2.

As with the environmental entries discussed earlier, these estimates include consumer surplus. Therefore, if the in-kind recipient could sell marginal units of the in-kind item on the market, the item's valuation by the market would be still farther below government cost.[32]

Moreover, current practices with respect to governmental in-kind transfers are not without arbitrary elements. This arbitrariness arises precisely because the issue of valuation is not addressed explicitly. In the conventional personal income and outlay accounts, certain in-kind transfers are entered, including Medicare and Food Stamps. Medicaid, however, does not appear. Perhaps the Bureau of Economic Analysis had difficulty determining the value of the program to recipients, given restrictions on its use. Unable to address the valuation issue directly, which would have permitted inclusion of Medicaid but at less than full cost, the choice became one of excluding Medicaid benefits entirely or including them at full cost. This arbitrary choice was an unnecessary one.

## Conclusion

We have presented a framework for including nonmarket activities in a national accounting system. The keystone of this framework is the recognition that a nonmarketed activity does not possess a single value or price weight. Explicit recognition of multiple values for nonmarket activities enables the expansion of the accounts to include currently-ignored items, such as environmental entries, as well as a more appropriate valuation of others, as in the case of governmental in-kind transfers.

To be given serious consideration, multiple valuation must be capable of implementation. We have shown that implementation is not only possible but that empirical estimates are, in some cases, currently available. While these estimates often involve approximations to the theoretically-desired value, they are closer to realistic and appropriate values than are arbitrarily-assumed government or employer or industry costs.

It is incumbent upon us to not only demonstrate that there are methods for approximating the values of the new entries in our expanded accounting framework, but to show that the data developed have the potential for being useful. In a number of areas, we believe these data are not only useful but crucial to an understanding of economic events. It is obvious that measures of social and individual welfare, temporally and at a point in time, require information on environmental damages and services and require a valuation of all nonmarket items that reflects the benefits derived (rather than the items' cost). It may not be so obvious that an understanding of aggregate economic activity, including prices, and of the distribution of that activity across sectors requires this information. How can one explain the rapid inflation in health care prices without understanding that governmental Medicare and Medicaid outlays are not identical to cash transfers?

To ignore these data is also to seriously misunderstand the distribution of income and of societal benefits. The distribution of environmental services and

[32]For example, in an alleged black market in Food Stamps, a price of $0.50 for a $1.00 coupon has been reported.

damages is extremely uneven, by region and by income class.[33] To exclude certain governmental in-kind transfers from personal income—as does BEA, for example, with Medicaid—biases comparisons across households. In addition, to assume equal well-offness from the receipt of cash and in-kind benefits, whether governmental or private, is a distortion of reality, particularly for low-income households where in-kind transfers loom so large in total income. It was also noted earlier that the recipient value of in-kind transfers, relative to government cost, varies sharply by income status.

Finally, when considering the usefulness of these efforts to expand the accounts into areas of nonmarketed activities, it should be remembered that while, in the words of Ruggles and Ruggles [20], the objective of national accounts is to provide an "information framework", this framework embodies more than the final set of accounts. To exclude from the definition of "framework" those ancillary data sets that must be developed as input to the entries that appear in the final accounts is to ignore a useful—some might say the most useful—feature of the national accounting exercise.

It is true that all the ancillary data could have been developed without the accounting structure. However, developing these data with the national accounting structure in mind can serve to strengthen these data in two respects:

- It helps assure completeness in coverage;
- It helps assure definitional consistency with other economic data.

Both desirable features have been borne out in the development of the environmental data. For example, to develop the entries on environmental asset services required the assembly of data on the emissions of residuals to the environment and the costs of reducing these emissions to various specified levels. Because of the comprehensiveness demanded by the national accounting framework, these data sets are far more complete than those that had been available within official U.S. environmental control agencies.[34]

In addition, while the primary data sources employed a variety of industrial sector definitions, the accounting framework necessitated a reclassification of all data into the definitions of the Standard Industrial Classification. A side benefit of this effort at reclassification has been the ability to integrate these data sets with official U.S. Census statistics for the purpose of undertaking special investigations. An example is the study of the distribution of the costs and benefits of the U.S. Clean Air Act noted in footnote 33. The existence of the ancillary accounting data in standard definitional form and with complete coverage made it possible to undertake this investigation at a much lower cost than would be the case were the study initiated independently of the national accounting activity.

In the same vein, estimation of recipient values of in-kind transfers allows improved income concepts and coverage in micro-data sets, such as the decennial census and Current Population Surveys of the Bureau of the Census. It

[33]This has been shown in a study of the distributional consequences of the Clean Air Act of 1970. See [4].

[34]Indeed, for this reason the U.S. Environmental Protection Agency has partially supported these data development efforts even though they have no direct interest in the ultimate accounting entries.

permits as well the evaluation of in-kind programs, particularly with respect to the effectiveness of the program in inducing added consumption of the good in question. In short, this proposed framework not only improves the coverage and accuracy of the national accounts but permits an understanding of economic forces and governmental policy options that would not otherwise be possible.

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