

SUSTAINABLE DEVELOPMENT

Adding Environmental Services to an Economy's Scorecard

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From childhood people learn to “keep score.” Weight at birth as well as the times to walk and talk are among the many measures compared by new parents. Children have their own lexicon of important indexes, keeping track of their height, performance at sports, and even skill levels in computer games. Scores are pervasive in most aspects of life, and our economic lives are no different.

Real gross domestic product (GDP) is our conventional scorecard for the national economy. GDP simultaneously measures the total output of goods and services and the incomes generated in the process of producing them. “Real” means it is adjusted to take account of changes in nominal prices over time (i.e., inflation or deflation). Although not as exciting as some measures, it has its share of time in the sun, perhaps being followed especially closely when times are bad.

GDP, and the related family of national accounts, is the subject of this paper. Granted, GDP accounting is not normally a subject that can long hold a typical reader's attention, although it may provoke a passing gleam in the eye of the rapacious capitalist just as it does a smolder in that of the rabid environmentalist. But here we try to develop a more interesting perspective on the topic, claiming that trade-offs between economic well being and environmental quality are false. We shall argue that a broader “green GDP” changes any lingering perceptions of mutually exclusive options. Counting the beneficial services provided by the environment (or deducting the loss caused by pollution), green GDP provides a more fair set of scales for economic scoring. This position is far from radical. Indeed, it is part of the logic used to define national income and has been so for nearly a century. What may be more radical is the move from concept to reality and the associated claim that it is feasible to actually extend the GDP in this way. After discussing these conceptual issues, we discuss the precedents for such work and the ground that has already been covered, as well as that which remains to be explored.

The Concept of National Income

The purpose of measuring national income is to develop a gauge of material well being. National Income is defined as the *total consumption of all people in the nation during a given time period*. GDP sums all goods consumed in a given year, valued at their purchase price. (Because of the emphasis on consumption, goods produced but not consumed are not counted.) When literally summing apples and oranges, each good is weighted by its price because, with competitive markets, the price is a commodity's value “at the margin.” That is, it is the value to the last buyer of one more unit.

Labeling GDP as an aggregate income when reasoning from household consumption may seem confusing. However, in a closed economy where budgets ultimately balance, what is spent must be paid to someone, because one person's expenditures wind up in someone else's pocket.

All of this logic is fine when the things we use to produce these goods and services are “used up” each time we record that income. But of course, we know that this is not the case. Some things provide services that can be used for production (or consumption) over many time periods. In this case the expenditures for them today permit future production without future expenditures, so our balance between expenditures and income is no longer consistent. To try to meet this challenge economists have used adjustments, at least for what they have judged to be the most important types of lasting capital. These adjustments generally involve deducting the amount of capital as-

sets that are “used up” in any given year (known in technical terms as depreciation). The concept is known as net income, and its corresponding measure is Net GDP.

One interpretation of net income is the amount that may be consumed each year and still leave the nation as well off as it was before that consumption. In his 1939 classic *Value and Capital*, Sir John Hicks explained this concept by analogy to an individual's income. Suppose that all of a person's income comes from the returns on some financial asset (the interest on a bank savings account for example). If the face value of the asset is \$100, and the interest rate is 5%, then his income is \$5. This is the maximum amount that the person can consume in the period without changing his financial position. By spending anything less, he would be saving; by purchasing anything more, he would be eating into his capital. Thus, \$5 is a *sustainable* income. For an economy, net national income is national income less any changes in the stock of equipment and structures. As we discuss below, an important element in efforts to reform measures of national income is to recognize that a society has more assets that contribute to national well being than simply the fixed assets in its factories.

At a conceptual level, these issues can be defined in precise terms. Nonetheless, in practice what we measure has never been more than an approximation. Net GDP has a number of flaws that are well recognized. First, it neglects all man-made consumption goods that do not trade in markets at observed prices. For example, services and goods exchanged on black markets are omitted. Some might regard these activities as relatively small, but the extent of black market activity is likely to vary across nations, complicating comparisons between them. Another omission is “home production,” goods produced or services performed by a family for itself. In developing economies, home production can include subsistence farming and often comprises a large share of the over-all production and “income” generated through these activities. In the developed economies, home production can include cooking, cleaning, child-care, home improvements and so on. As many of these types of goods were traditionally “women’s work,” one branch of feminism has accordingly critiqued the conventional measure of national income as having a male bias. Once again this observation is not news. An earlier pioneer in the measurement of national income, A.C. Pigou, ironically observed, “If a man marries his housekeeper or his cook, the national [income] is diminished.”

Another set of non-market services is more relevant to our argument for expanding the economic scorecard: GDP also omits services provided by the environment. Clean lakes and fishing tackle are both required for angling; clean air and medicines both can prevent asthma attacks; but only the latter element in each pair is counted in GDP. As with home production, this omission was noted from the beginning. Pigou noted for example the benefits of public parks and natural beauty, and likewise the damages from factory smoke, which may hinder a number of services including visibility, clothes washing, and gardening.

The adjustments inherent in Net GDP have similar inconsistencies, in particular omitting the depreciation of natural capital. If the pump at an oil well wears out, its depreciation is deducted from GDP; if the oil runs out, it is not. If a disease destroys a herd of domestic cattle, the lost asset is deducted from GDP; if a commercial fishery becomes depleted, it is not. By the same token, *discoveries* of new natural resources are also not added to GDP. These examples are especially persuasive because the commodities involved (oil and fish) are important elements in national output. Nevertheless, the basic reasoning extends to the services of ecological assets that are not traded on markets.

Wetlands, for example, are natural assets that provide a stream of services (no pun intended), including supporting fish habitat, flood protection, and filtering nutrients from water to maintain quality. In the case of fossil fuels and minerals, the U.S. Bureau of Economic Analysis (BEA), the agency charged with maintaining data on the national accounts, recognized the inconsistency as far back as the 1940s. However, it omitted such deductions, not for theoretical reasons, but because of measurement problems with valuing or pricing the un-priced assets.

While proponents of green GDP have emphasized the inter-temporal issues of depreciating natural assets to ensure more credible measures of the extent of sustainable growth, the static issues of monetizing the economic value of the flow of environmental services are equally important. The problem is not one of theory but one of measurement. From the beginning, Pigou and others clearly preferred that public goods be included in the ideal measure, but omitted them for practical considerations. They argued (probably rightly in most cases) that an index of market goods was likely to be positively correlated with a Hicksian measure of sustainable income, so that it might serve as a proxy.

While current measures of net GDP have been important in focusing significant policy debates in the last half of the twentieth century, a new century offers the opportunity to consider additional steps. Moreover, there is evidence to suggest that the expansion is overdue. For example, research by Dora Costa (see Further Readings) has found that, between 1900 and 1997, expenditures on recreation goods as a percent of total personal expenditures nearly tripled from 3% to nearly 9%. Historically, patterns in such expenditures have also mirrored the use of the natural assets such as parks and forests that support such recreation. As the importance of these types of non-market services has grown over time, the bias of the proxy may have grown as well. This calls into question the value of a proxy if its definition may lead analysts to overlook practices that undermine public goods, thereby systematically eroding the correlation with a more reliable measure of sustainable income.

Measuring the Quantities and “Prices” of Non-Market Goods

As previously noted, the basic procedure for calculating Net GDP is to sum the value (as measured using market prices) of all goods and services consumed in a given year (Nominal GDP), next to subtract estimates of depreciation of capital equipment (Nominal Net GDP), and last to correct for inflation (Real Net GDP).

In principle, observing changes in the amounts of services provided by non-market resources need not be any more difficult than observing the quantities of market goods. Extensive data are already collected on reserves of natural resources, on air and water quality (to measure changes in these amenities), and on some aspects of the service provided by ecosystems. However, there are at least two challenges that would have to be overcome to incorporate the environment and natural resources into GDP. First, more data would need to be collected on a more systematic basis to represent the condition of the services being provided by diverse natural assets on a national scale. Even where government agencies and private parties are currently collecting data, they frequently target problem areas, rather than developing a sample that would adequately represent the country. Second, judgments would have to be made about the best way to describe the services these assets provide and thus to collect the relevant data. Market goods generally come to consumers in reasonably well-defined units, often-discrete packages. Even services available from

private markets typically have a unit of account that has been determined by the market. But what are the “units” we should use to measure changes in air quality? From one place to another and from one time period to another, air quality may be impaired by different pollutants, and furthermore each pollutant may be important to people for different reasons. Some pollutants may have cumulative impacts resulting from long-term exposure. Others may have serious effects following acute episodes. Moreover, these ambient concentrations can vary continuously over space and time, rather than being sold in discrete packages at discrete locations.

To address these difficulties, the most important aspects of environmental quality would have to be determined, and resources would have to be aggregated in some way, such as by affected population, or by natural area (e.g. an airshed or watershed). While they raise new roadblocks to be maneuvered, most have been recognized before and thus need not form an insurmountable barrier to progress. Indeed, a century ago, before GDP was constructed, similar problems probably seemed daunting. Prices and quantities had not been previously collected on a large scale; judgments had to be made about adjusting for quality changes across place and time; and even more fundamental questions about the theory and arithmetic of indexes were yet to be worked out.

A more difficult problem than measuring the quantity of environmental services is inferring the values to weight them. For market goods, these values are prices, but there are obviously no prices for goods that are not traded in markets. Moreover, even in those cases where it is not easy to distinguish the quantity of a market good from its price, economists have long recognized that we have an “ace in the ‘whole’ ”: we know how much was spent. These total expenditures provide a fundamental consistency condition. The product of price and quantity indices equals observed expenditures, so we can infer an implicit price from total expenditures, given an appropriate quantity index or vice versa.

We have put a number of measurement issues on the table. Once again, however, they are not entirely new, and economists have developed tools to address them. Consider first the case of depreciating natural capital, such as the depletion of fossil fuels and minerals, net of new discoveries. While we observe the price of extracted resources in markets, we cannot observe directly the value of natural resources in the ground. The value of the asset may be inferred from an estimate of the future stream of extracted resources, or appraised based on sales or leases of similar lands. Nonetheless, these are not airtight procedures. They must be based on informed judgment, and there is nothing wrong with admitting it. The perfect is the enemy of the good, a truism that has been recognized in depreciating man-made capital. We do not necessarily observe the change in market price of capital equipment as it wears out (blue-book guides may exist for automobiles, but not factory equipment). Rather, here too rules-of-thumb and professional appraisals must be adopted.

In fact, the U.S. BEA began a process of measurement with the depletion of stocks of natural resource in the early 1990s, before being expressly prohibited by the U.S. Congress. Interestingly, their preliminary estimates showed that, over the past 40 years, new discoveries have roughly offset depletions in the United States. The same has not been true in all countries, however. Robert Repetto and his colleagues at the World Resources Institute have estimated that much of Indonesia's tiger-like economic growth in the 1980s becomes more tabby-like when its declining forest resources are depreciated.

Accounting for the depreciation of these natural assets is facilitated because the raw materials they provide are traded in markets, even if the assets themselves are not. It should not be sur-

prising that more difficulty arises in valuing the non-market goods and services provided by natural assets. This same difficulty has arisen in another context, assessing the benefits and costs of a public project. A simple, historical example of benefit-cost analysis may help to crystallize the parallel. Consider a proposal to build a dam. The dam has clearly defined market-based costs. It also provides some market services, such as hydropower, whose benefits can be measured in dollars. But usually it also provides significant non-market services—recreation, watershed protection, and flood control—that partly motivate the project, as well as some non-market costs in the form of lost natural areas.

If the market benefits alone do not justify the costs, an economic appraisal of the project turns on whether the net economic benefits of the non-market services are “big enough.” To answer such questions, economists have developed techniques to infer these values. In fact, government agencies have been using them routinely in benefit-cost analysis for many years, and are even required to do so by legislation or by Executive Order for major regulations. As a result, there is an inconsistency between the way such goods are treated when “keeping score” of a single project or a regulatory program versus the collection of public and private activities that comprise the economy as a whole.

One common method for estimating values for non-market goods is to infer them from behavior in linked markets. For example, in the case of water quality that supports outdoor recreation, people do not pay for the water quality directly. Instead they pay by traveling further to a better quality lake, thereby revealing their value for the differential quality. Similarly, people may not pay directly for air quality. Yet in some cities like Los Angeles, households do pay more for homes in a community with cleaner air. Estimating the economic values for such environmental services becomes more challenging as they become more remote from markets. The enjoyment people derive from knowing that bald eagles exist can probably only be valued with survey questionnaires of people's willingness to pay for protecting them.

The context of GDP accounting requires a somewhat different perspective on these methods than a typical benefit-cost assessment. First, for benefit-cost analysis, economists have generally had the goal of estimating the total benefits for a proposed discrete change in some environmental resource, whereas for GDP accounting only the marginal value of a small change at the observed level of the resource is required. Second, in benefit-cost analysis a baseline is observed and new levels of environmental services are “guesstimates” of what a policy will deliver, while for GDP accounting the change in environmental services being evaluated is actually observed.

Finally, sampling economic values from various locations is complicated by the fact that there is no reason to believe that values are constant within regions. For market goods, competition forces prices to be roughly comparable within a given area and for comparable outlets. Without this competition, the value of environmental goods may differ by people's tastes in a community and by the background levels of the good. For example, people may be willing to pay more for an environmental improvement if they live in a highly polluted neighborhood than if they live in one that is already fairly clean.

An actual example for the value of wetlands illustrates the last point. The American Association of State Highway and Transportation Officials (AASHTO) periodically surveys states' costs in meeting requirements to preserve wetlands when constructing new highways. In 1993, the average per acre mitigation costs (often associated with purchasing wetland mitigation credits from established “wetland banks”) ranged from \$58,200 to about \$1.1 million—substantially more than

an order of magnitude difference in this crude proxy for a monetary measure of the costs to maintain these natural assets (i.e., the depreciation of wetland resources as natural assets). Similar differences can be found in measurements of household values for environmental services.

Despite differences with the benefit-cost context, economists have begun to accumulate experience in applying such valuation methods to the accounting context. For example, we have used information on changing levels of air quality (as well as other public goods such as crime and education) in the Los Angeles area to calculate green cost-of-living indexes, closely related to green GDP. Such cost-of-living indexes are an average of price changes weighted by quantities, rather than quantities weighted by prices. We found that when improvements in Los Angeles's air quality were accounted for, the estimated cost-of-living decreased by one-tenth of one percent. While this estimate may seem small, it is comparable to measures of the effect on the cost of living of the improving quality of market goods, and is large enough to have important economic implications. Thus, at least in this case, the environment has the potential to have a noticeable impact on our accounts.

Certainly, these are only beginnings, and questions remain. Accordingly, movement toward green accounts should take place incrementally. Even when a full accounting is realized, the green accounts would best be treated as "satellite" accounts, released together with the conventional accounts rather than in place of them. In so doing, we can begin preliminary work while gaining experience with them.

Conclusions

On the thirtieth anniversary of Earth Day, ABC aired a program with President Clinton and Leonardo de Caprio about the condition of the environment. The Nielsen ratings put ABC in last place among major networks and one of the other networks aired a re-run! Moreover, ABC lost viewers over the course of the hour. Analysts used this evidence, as well as other polls, to suggest that the environment was unlikely to be a major issue in the November 2000 Presidential election, and indeed it was not. Yet these same observers argued that the results did not imply public commitment to the environment was on the wane. Rather, people tend to view the environment as a collection of local issues. Inevitably, however, one confronts the adding up problem. That is, does the adage to "think globally but act locally" really compute? Without consistent green GDP we cannot know!

A union of national accounting and environmentalism is a marriage that can make both families proud. From the perspective of economic accounting, it moves our empirical measures closer to their theoretical goals. National accounts are increasingly used to keep score of how the economy is doing over time, and frequently to draw inferences about the effectiveness of public policies and political leaders. And yet, many goods and services that people value, including those furnished by the environment, are not included in the index. In some cases, such as the example of Indonesia, these omissions create a large difference in one's assessment of the economy and its leadership. In other cases, their importance may be less significant, but including them assures that we recognize unintended byproducts of policies that may cause harms in the future and would otherwise be overlooked by conventional indicators.

Environmentalists have strategic reasons to support green accounting. Simply put, to count in the policy arena, the environment must literally be counted. Rather than being associated merely

with abstract and usually forgettable benefit-cost ratios for specific policies or regulations that cannot be added up across policies or statutes, enhanced (or degraded) environmental services would be reflected directly in the national accounts. Thus, green accounting has the potential to sustain a seat for the environment in the policy table.

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