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Can We Put a Price on Nature's Services?

In 1962, the Drifters, a popular rock 'n' roll group, sang:

*At night the stars put on a show for free,
And darling, you can share it all with me ...
Up on the roof ...*

Nature provides many goods and services which we, like the Drifters, enjoy "for free." But, as Thomas Paine said about liberty, "What we obtain too cheap, we esteem too lightly." Recently, a group of ecological economists led by Robert Costanza of the University of Maryland has argued that if the importance of nature's free benefits could be adequately quantified in economic terms, policy decisions could "better reflect the

value of ecosystem services and natural capital." Drawing upon earlier studies that have "aimed at estimating the value of a wide variety" of ecosystem goods and services—from waste assimilation and the renewal of soil fertility to climate stabilization and the tempering of floods and droughts—the research team has estimated the "current economic value" of the entire biosphere at between 16 and 54 trillion dollars per year. Its "average" value, according to Costanza and colleagues, is about \$33 trillion per year.

So tremendous an estimate—especially when presented in a lead article in the British science journal *Nature*—was bound to attract public attention. In feature stories with titles like, "How Much Is Nature Worth? For You, \$33 Trillion" and "What Has Mother



Despite dwindling harvests, skipjacks still dredge for oysters in the waters of the Chesapeake Bay.

Photograph by Michael W. Fincham.

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Nature Done for You Lately?" dozens of newspapers and magazines, including the *New York Times*, *Newsweek*, and *U.S. News and World Report*, covered the Costanza study. "What is the natural environment worth in cold cash?" asked a story in the *San Francisco Chronicle*. "No one knows for sure, but a team of economists and scientists figures \$33 trillion, more or less, for such 'free' goods and services as water, air, crop pollination, fish, pollution control and splendid scenery. . . . For comparison, the gross national product of all the world's countries put together is around \$18 trillion."

Costanza and colleagues acknowledge that their estimates are fraught with uncertainties; their study, they say, provides only "a first approximation of the relative magnitude of global ecosystem services." Their caution is understandable. No one can doubt that "ecological systems . . . contribute to human welfare, both directly and indirectly," or that the world's economies depend on the "ecological life-support systems" that nature provides. "Once explained, the importance of ecosystem services is typically quickly appreciated," writes Gretchen Daily, an ecologist at Stanford University who has edited a collection of papers on this theme. And yet, as Daily goes on to say, "the actual assigning of value to ecosystem services may arouse great suspicion." This is because "valuation involves resolving fundamental philosophical issues"—about the role of economic values in the policy process, and about the

relation between economic value and human welfare. Methodological problems also haunt any attempt to impute prices to the services of nature.

Even so, Daily concludes that "nothing could matter more" than attaching economic values to ecological services. "The way our decisions are made today is based almost entirely on economic values," she told the *Chronicle*. "We have to completely rethink how we deal with the environment, and we should put a price on it." This essay will review critically the attempt to set prices for the benefits that nature provides "for free."

Calculating Values

Environmentalists have long noted that many of nature's gifts, such as the show the stars put on at night, are "public goods"; in other words, they are not traded in commercial markets, no one can be excluded from using them, and one person's use does not limit another's, at least up to some congestion point. "Because ecosystem services are not fully 'captured' in commercial markets or adequately quantified in terms comparable with economic services and manufactured capital, they are often given too little weight in policy decisions," Costanza and colleagues argue. Public goods notoriously have no market prices. If prices could be imputed to ecosystem services, wouldn't these prices help us better to appreciate their worth?

The many studies which Costanza and colleagues have assembled use a great variety of methods by which to impute economic value to ecosystem services. Some employ experimental techniques, including "contingent valuation," to estimate the aesthetic or "nonuse" value of natural settings. The large majority of studies, however, estimate either the value of ecosystem *outputs*, such as fish, fiber, and food, or the costs of *replicating* ecosystem services. Costanza and colleagues use estimates of these two kinds—output values and replacement costs—to account for most of the \$33 trillion price tag they impute to ecosystem services. As we will see, however, neither kind of estimate can serve as a basis for measuring the economic value of ecosystem services, even though those services are essential to human well-being.

Costanza and colleagues gathered data reporting the market value of the outputs of the world's fisheries, forests, and farms. To calculate the contribution of ecosystem services to the oceans' fisheries, for example, the Costanza team multiplied the world's fish catch in kilograms by an average market price per

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kilogram. In other words, they used "price times quantity as a proxy for the economic value of the service." They apparently reasoned that since there would be no fish harvests if not for ecosystem services, the economic value of these services should be commensurate with the value of those harvests. They then used data about the value of the total harvest to calculate what they identify as "the 'incremental' or 'marginal' value of ecosystem services." To arrive at a "marginal" or "unit" price in fisheries, they divided the overall value of fish harvests by the number of hectares of ocean to reach an estimated ecosystem service contribution of \$15 per hectare.

The researchers used a slightly different approach to measure the value of ecosystem services in forestry and agriculture. Timber values "were estimated from global value of production, adjusted for average harvest cost... assumed to be 20% of revenues." In this instance, the researchers used "the net rent (or producer surplus)"—that is, proceeds to producers minus their costs—to estimate the overall value of ecosystem services. They used rents to farmers—that is, the value of crops less production costs—to compute the value of ecosystem services to agriculture. To obtain a "per unit" value for ecosystem services in forestry and agriculture, the researchers divided the resulting timber

values and crop values by the number of hectares of forests and farmland.

We can see one problem in reasoning from the value of an output to that of an input if we assume that several different ecosystem services, such as climate stabilization or nutrient cycling, are each essential to production in fisheries, forests, and farms. If so, each of these services would possess individually a value commensurate with the output of fishing, forestry, or agriculture. This same difficulty arises with respect to inputs other than ecosystem services that may also be essential to production. Ships are indispensable for fisheries, saws for forestry, and tractors for farming. If we were to use the Costanza team's approach to estimate the value of these inputs, we would infer a price for each of them by dividing the number used into the value of the proceeds or profits of the industry. In the aggregate, ships would be worth just as much as ecosystem services to fishing, saws to forestry, and tractors to farming. Labor, being essential, would also have the same price as ecosystem services collectively and individually in all of these industries.

It is understandable that Costanza and colleagues would want the economic value of ecosystem services to reflect the values of the industries to which they are essential. It is a mistake to assume, however, that if x is essential to the production of y , the price of x can be inferred from that of y . Rather, prices for inputs—or "factors"—of production are determined by market forces, that is, by supply and demand. The marginal economic value of a ship, for example, equals the amount it fetches in a market in which shipwrights compete for buyers on the basis of quality and price. Ships are essential to the fishing industry, to be sure, but this does not suggest that the price of ships can be inferred from the price of fish.

If the costs of providing ecosystem services are zero—if Mother Nature supplies them free—then the prices (and, in that sense, the economic value) of these services must approach zero as well. This is true because competition among suppliers for buyers tends to drive prices down to costs. If we fantasize that Mother Nature is a monopoly provider of ecosystem services, she may charge whatever the market will bear, gouging consumers for all they are willing to pay and extracting whatever profits producers might otherwise obtain. This seems to be the situation that Costanza and colleagues envision. Monopoly prices, however, do not represent fair marginal value. Prices, to be meaningful at all, must arise in competitive markets. If Nature sought to operate as a monopoly, the government would rightfully either set the price of an ecosystem service at a small percentage above costs (as it does with utilities) or break up Ma Nature into competing units (as it did Ma Bell).

Substitution and Replication

Costanza and colleagues also use the costs of creating technological substitutes for ecosystem services as a basis for inferring their incremental or marginal value. In an accompanying article in *Nature*, Stuart Pimm illustrates this process by explaining how the researchers determined that the nutrient-cycling services of the world's oceans are worth \$17 trillion:

If the oceans were not there, re-creating their nutrient cycling would require removing the nutrients from the land's runoff and returning them. The estimate of this service's \$17 trillion value is arrived at by multiplying the cost of removing phosphorus and nitrogen from a liter of waste water by the 40,000 cubic kilometers of water that flow from the land each year.

Similarly, Costanza and colleagues estimate what it would cost to re-create, with levees and other structures, natural flood control and storm protection (\$1.8 trillion); to replicate artificially the pollination of

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plants (\$1.8 trillion); to provide technological substitutes for natural waste treatment and breakdown of toxins (\$2.7 trillion); and to replace the outdoor recreation and "esthetic, artistic, educational, spiritual, and/or scientific" benefits people find in natural places (\$3.83 trillion).

When economists speak about substitution, they do not generally refer to alternative and sometimes more costly methods of providing some good or service. Rather, they refer to consumer indifference between alternatives at given prices. For example, the economic value of a beefsteak will be determined in part by the price at which consumers will switch to some other item on the menu instead. In the absence of cattle, it would be very expensive to produce beef. This fact suggests nothing, however, about the goods or services people would substitute for beef when beef prices increase.

Plainly, it would cost a great deal to replicate technologically the experience the Drifters enjoy up on the roof, where "it's peaceful as can be" and "the air is fresh and sweet." One cannot meaningfully impute an economic value to the rooftop experience, however, by determining how much it would cost to replicate it technologically—for example, by building an air-conditioned planetarium. Rather, to get at the economic value of the rooftop experience, one would ask the Drifters at what price they would choose a different activity—to venture under the boardwalk down by the sea, for example, or to spend Saturday night at the

movies. No matter how much it might cost to replicate an ecosystem service technologically, that amount does not tell us the economic value of the service.

To impute economic value, one would have to determine the price at which people would cease to demand that service and spend their money on some other source of satisfaction instead. A \$17 trillion dollar price tag on the oceans' work of "pure ablution round earth's human shores" (as the poet John Keats described it) would price these services out of the market. According to Pimm, people would not think these services are worth that kind of money: "In the short term, many would not notice (and perhaps not care) what happens to the elements as they flow into the ocean." New York City agreed to pay \$660 million over several years to enhance the Catskill area as an aquifer, but rather than pay \$4 billion for a technological alternative—a treatment plant—people might have moved from the city. Thus, the economic value of ecosystem services has no clear relation to the costs of replicating them technologically.

The Basis of Decision Making

The issue of determining economic prices for ecological services, Costanza and colleagues write, is inseparable from the choices and decisions we have to make about ecological systems. These authors continue:

Some argue that valuation of ecosystems is either impossible or unwise, that we cannot place a value on such "intangibles" as human life, environmental aesthetics, or long-term ecological benefits. But, in fact, we do so every day. When we set construction standards for highways, bridges and the like, we value human life (acknowledged or not) because spending more money on construction would save lives.

Many people share the suspicion that public policy is often based on implicit valuations that have never been articulated or defended. Part of the appeal of the Costanza study lies in its insistence that these matters of valuation be confronted directly.

Contrary to what Costanza and colleagues suggest, however, risk regulation does not necessarily imply an implicit economic valuation of "intangibles" such as human life. Decisions in this area more typically respond to public attitudes, statutory guidance, and relevant legal history. This is why our society protects human life and the environment much more stringently in some moral contexts than in others. We do not seek to save lives up to some predetermined economic value. Rather, we control risk more or less strictly on a number of moral grounds—for example, insofar as risks are involuntary or coerced, connected to dreaded events such as cancer, associated with industry and the workplace, unfamiliar, unnatural, and so on.

To be sure, one can infer an imputed or implicit economic value for human life from any of thousands of governmental regulations. Mandatory seat-belt laws

cost \$69 per year of life saved, while laws requiring uranium fuel-cycle facilities to purchase radionuclide emission-control technology cost an estimated \$34 billion for every year of life saved. Safety controls involving chloroform at paper mills weigh in at \$99 billion cost/life-year. For any number you pick between \$20 (motorcycle helmet requirements) and \$20 billion (benzene emission control at rubber-tire manufacturing plants), there is a governmental program from which that number can be inferred as the value of a statistical year of life.

Every situation—every regulatory decision—responds to different ethical, economic, political, historical, and other conditions. A national speed limit of 55 miles per hour on highways and interstates would save a statistical year of life at a cost of only \$6,600, but it is politically unpopular. Strict enforcement of such a speed limit, even more unpopular, would save an additional life/year at a cost of \$16,000. Still more unpopular are random motor-vehicle inspections—but these could save lives at even less expense. Can we infer that people value their lives at only a few thousand dollars? No; it is simply that people fear and resent some risks less than others, and least of all those risks they control themselves. These moral factors affect private and public decisions about risk. To impute a value-per-life/year to any regulation or policy, such as highway construction, is to create an epiphenomenon, a statistical abstraction, or descriptive convention, but not to identify a value judgment that necessarily affected that program.

Value in Exchange and Value in Use

The interest among academics and others in “green accounting,” of which the Costanza study is a model, seeks to serve an important political purpose, namely, to restrain the commercial juggernaut that is destroying the health, beauty, and integrity of the natural world. The *Nature* article urges us to recognize the benefits ecosystems provide “for free,” in the hope that this will prompt us to defend these systems from relentless exploitation and destruction.

Whatever the study’s political uses, however, it is difficult to see what it would mean for the researchers to “get the prices right.” In an actual market, budgetary constraints and consumers’ willingness to pay limit the number of dollars at which goods and services change hands. Prices represent bargains struck between willing buyers and sellers, for example, between Romeo and the honest apothecary. Prices do not represent the contribution a good or service makes to human welfare, if welfare is measured in any other way—or has any other sense—than market exchange.

Economists often describe their discipline as a positive rather than as a normative science. (This is the source of the maxim, quoted by Stuart Pimm, that

economists “know the price of everything and the value of nothing.”) As a positive science, economics concerns itself with value in exchange, which is to say, the prices at which goods and services change hands in competitive markets. Economic science does not traditionally claim that these prices indicate or reveal anything about the contribution goods or services make to human welfare in any substantive sense.

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Economic science uses the term “welfare” or “utility” in a purely formal way, to designate whatever it is that price is supposed to measure. This may have no relation to the true sources of human well-being or flourishing.

The classic articulation of this view is in Adam Smith’s *Wealth of Nations*:

The word VALUE, it is to be observed, has two different meanings, and sometimes expresses the utility of some particular object, and sometimes the power of purchasing other goods which the possession of that object conveys. The one may be called “value in use”; the other, “value in exchange.” The things which have the greatest value in use have frequently little or no value in exchange; and on the contrary, those which have the greatest value in exchange have frequently little or no value in use. Nothing is more useful than water: but it will purchase scarce any thing; scarce any thing can be had in exchange for it. A diamond, on the contrary, has scarce any value in use; but a very great quantity of other goods may frequently be had in exchange for it.

In order to investigate the principles which regulate the exchangeable value of commodities, I shall endeavor to shew . . . what is the real measure of this exchangeable value; or, wherein consists the real price of all commodities.

Cigarettes illustrate the difference between value in exchange and in use. The price of cigarettes reflects the costs of production, competition among suppliers, and levels of demand. The price has no relation to human well-being as society judges it. As a society, we have reached a judgment that cigarettes have a negative welfare value—a deleterious effect on actual human well-being. The more consumers are willing to pay to smoke, the worse off they are, according to doctors and other respected social authorities. Cigarettes, therefore, have a positive exchange value but a negative value in use.

Suppose a well-meaning team of economists, seeing that cigarettes are bad for health, wished to correct the price of cigarettes to make it better reflect their negative welfare effect. If these economists thought—as the Costanza team apparently does—that prices should rise with contribution to welfare, they would recom-

mend lowering the price of tobacco. In fact, society may set tobacco prices higher, not to reflect its great contribution to human welfare but to discourage its use.

To achieve social goals and values, including human well-being, we may adjust the prices of goods and services—for example, by taxing tobacco products. This kind of price-fixing, although often justifiable in terms of human welfare, does not reflect “true” or “correct”

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market value. To bring prices into line with societal goals, values, and judgments is not to embrace but to reject market exchange as a criterion or basis for social valuation. It is to recognize that market or exchange value bears no necessary connection to value in use.

Growth vs. Development

In important and insightful earlier essays, Robert Costanza and other ecological economists have criticized GNP as a measure of human welfare and economic growth as a goal of public policy. Improvements in the quality of human life, these analysts have argued, are not to be confused with increases in the size of the economy. Costanza has written elsewhere that economic growth “cannot be sustainable indefinitely on a finite planet.” Economic development, in contrast, “which is an improvement in the quality of life . . . may be sustainable.”

In these writings, Costanza and others insist on a distinction similar to the one that Adam Smith draws between “value in exchange” and “value in use.” Economic growth is measured in terms of value in exchange; it is the rate of increase of GNP, which is to say, the total market value of all goods and services produced or consumed as measured in current prices. Development has to do with value in use—true human flourishing, including happiness and contentment—and is measured in terms of indices of human welfare such as nutrition, education, and longevity. In these earlier writings, Costanza and other ecological economists did not try to “correct” the exchange or economic value of goods and services to make them better reflect their “true” contribution to human well-being. For example, they would not have imputed a higher exchange value to water and a lower one to diamonds to make the prices of these goods more commensurate with their importance to human survival.

The *Nature* article, in contrast, seeks to “correct” market prices “to better reflect the value of ecosystem

services and natural capital.” The article concludes that world “GNP would be very different in both magnitude and composition if it adequately incorporated ecosystem services.” In seeking to “get the prices right,” however, Costanza and colleagues discard the earlier insight that measures of economic value, which arise from the play of market forces, have no clear relation to human welfare or well-being in any substantive sense. The effort to “correct” the prices of ecological services and natural capital confuses value in exchange with value in use, or, in contemporary terms, measures of economic growth with indices of human development.

The Drifters recognized the importance of nature to their well-being even though its services are free. Like the Drifters, Costanza and colleagues understand the abiding importance of nature’s services to the quality of our lives. Our dependence on ecosystem services cannot be overstated, and our efforts to sustain them can never be too great. To try to “get the prices right” as a way to protect nature, however, is to lend support to economic measures of welfare, such as economic growth and GNP, ecological economists rightly reject. The effort Costanza and colleagues undertake to “estimate the ‘incremental’ or ‘marginal’ value of ecosystem services” should be seen as an aberration within the program of ecological economics. It can succeed only in lowering the credibility of that discipline while increasing the legitimacy of the standard cost-benefit policy framework most likely to defeat attempts to protect the natural environment.

—Mark Sagoff

Sources: Robert Costanza et al., “The Value of the World’s Ecosystem Services and Natural Capital,” *Nature*, vol. 387, no. 6230 (May 15, 1997); William K. Stevens, “How Much Is Nature Worth? For You, \$33 Trillion,” *New York Times* (May 20, 1997); Charles Petit, “Natural Environment Gets a Price Tag—\$33 Trillion,” *San Francisco Chronicle* (May 15, 1997); Gretchen C. Daily, ed., *Nature’s Services: Societal Dependence on Natural Ecosystems* (Island Press, 1997); Stuart L. Pimm, “The Value of Everything,” *Nature*, vol. 387, no. 6230 (May 15, 1997); Robert Costanza, Herman E. Daly, and Joy A. Bartholomew, “Goals, Agenda and Policy Recommendations for Ecological Economics,” in Robert Costanza, ed., *Ecological Economics: The Science and Management of Sustainability* (Columbia University Press, 1991).