technical difficulties to be overcome, however. The idea of a green GDP suffers from deeper conceptual problems. The National Economic Accounts are a measure of economic activity, but they are not a measure of national wealth and welfare, even when one considers only purely market transactions.

When I rent a videotape for $3, for example, it creates a double entry: $3 of revenue for the shop and $3 of expenditure for me. The National Economic Accounts maintain an overall balance so that, when everything is totaled, National Product equals National Income. But if you view these numbers as a measure of national welfare, you get the impression that the whole economy is a wash—we might just as well not have bothered!

A benefit-cost analysis that is designed to measure welfare changes takes a very different view of the same transaction. If I got $10 worth of enjoyment from the video, what counts is the $7 difference between what I paid and what I might have been willing to pay. The $3 that appears in the National Economic Accounts is netted out of the benefit-cost analysis; only the $7 "consumer surplus" is of interest to the welfare economist. Yet, the consumer surplus does not appear at all in the GDP!

Thus, the omission of environmental and other nonmarket goods and services from the National Economic Accounts is not an example of inconsistency; indeed, it is perfectly consistent with the way the accounts treat marketed goods and services—consumer surplus is ignored, and only the monetary exchange is recorded.

This omission means that the National Economic Accounts are limited; they show only the marginal value of a subset of national consumption. They cannot be used as a measure of total wealth or welfare, nor can they be used as a reliable yardstick to judge the value of government policy decisions. On the other hand, the accounts are rigorously constructed, they deal with observable things, and they can be used for comparisons across time and geography. National Economic Accounts are useful in the same way that keeping tabs on the functioning of an automobile is useful. It is important to track gas consumption, mileage, maintenance, wear, and so forth. But none of this will tell you whether the vehicle is taking you where you really want to go.

Research into the value of environmental resources should certainly continue. But this research is best treated by the methods of welfare economics and benefit-cost analysis, and it should be kept quite apart from the collection of economic statistics on market exchange. Better yet, a systematic effort to privatize environmental resources would bring more of them within the scope of observable market transactions, which would have far more beneficial effects than can ever be achieved by tinkering with the National Economic Accounts. ■

How Much Do We Care about the Deep Future?

Reviewed by Brian Mannix

DISCOUNTING AND INTERGENERATIONAL EQUITY

by Paul R. Portney and John P. Weyant (editors)

186 pp. Washington, D.C.

Resources for the Future, 1999

BENEFIT-COST ANALYSIS, THE standard tool for evaluating government investments, is 100 years old this year. Its origins can be traced to the Rivers and Harbors Act of 1900, which required the Army Corps of Engineers to calculate the economic benefits of its harbor-dredging projects.

Over the years, a central point of controversy in benefit-cost analysis has been the choice of a discount rate—the effective rate of return that a government project is expected to earn to be considered worthwhile. Because the costs of a Corps project are front-loaded, while the benefits can last for many years (particularly in the case of a dam), the Corps favored using a low discount rate—sometimes 2 percent. That made the present value of a project with many years of benefits seem much larger than the project's costs.

Environmentalists, who often opposed new dams, were among those who objected to the low discount rate. They pointed out that private investments needed to pass a much higher threshold to attract funding.

Environmentalists took the opposite position when the government began proposing environmental projects—particularly expensive regulatory programs—with high up-front costs but long-term environmental benefits. Environmentalists then argued in favor of low, even zero, discount rates.

CONSENSUS...FOR A WHILE

A SUBSTANTIAL LITERATURE DEVELOPED on the economic theory of discounting, in an attempt to resolve the perennial disputes that arose. A milestone was reached in 1982 with the publication of a book that came out of a conference held in 1977 by Resources for the Future (RFF), a Washington think tank. That book—*Discounting for Time and Risk in Energy Policy* (Baltimore: Johns Hopkins University Press)—became known as the "Lind" book not only because of Robert Lind's editorship but also because of his contributions to the theory and his masterful summary chapter that laid out the consensus of participants.

Economists have believed since the publication of the Lind book that the right way to evaluate a government investment or regulation is to account separately for time, for risk, and for the effects of taxation. A relatively low, risk-free discount rate, say, 4 percent (although there is still plenty of room for argument about the precise number) accounts for the time value of deferred consumption. A separate calculation of expected values is the best way to account for risk and uncertainty about future benefits and costs. And benefits and costs that increase or decrease private capital should be weighted by, say, a

Brian Mannix's biography appears with the preceding review.

factor of 2 or 3 (although there is even more room for argument here), to reflect the fact that a dollar of capital in our economy is more valuable than a dollar of consumption. (This last adjustment factor is called the "shadow price of capital," and it is largely the result of a tax system that penalizes savings, thus making capital more scarce and ultimately more valuable than consumption.)

This three-step procedure resolved the thorniest theoretical issues and helped to explain the difference between market rates of interest and the lower rates generally used in benefit-cost analysis.

In recent years the economics profession's consensus about discounting government projects has been ruptured, and climate change is the reason. Advocates of the Kyoto accord argue that to protect future generations, we must take expensive actions now that will not have any discernible benefits for a century or two. But the case is weak because (among other reasons), at a 4 percent-discount rate, a thousand dollars in a century is not worth twenty dollars today—even without inflation and risk.

Many economists have expressed discomfort with the dramatic effect of discounting over such long time horizons. The problem arises not only with greenhouse gases but also with a range of other issues: the use of ozone-depleting chemicals, long term storage of radioactive waste, the extinction of species, and the depletion of mineral deposits.

AIMING FOR A NEW CONSENSUS

THE EROSION OF THE OLD CONSENSUS led RFF to organize another conference, this one in 1996. RFF invited the leading theoreticians—including several contributors to the earlier book—to address the discounting of government projects. Thus *Discounting and Intergenerational Equity*.

The central concern of the 1996 conference was not so much economic theory as it was moral philosophy. William Nordhaus describes the problem most succinctly: "When the implications of conventional benefit-cost tests are ethically unacceptable, how might they be modified?" (p. 145).

Economists who consider that problem divide roughly into two camps, which have been called "descriptive" and "prescriptive." The descriptive camp argues for estimating the discount rate by using economic theory combined with empirical data derived from behavior that reveals the value people place on the future. The prescriptive camp argues that, at least in the case of "intergenerational" time horizons (greater than 30 or 40 years), we should derive the discount rate from ethical principles. It may be that discounting purely for the passage of time is morally wrong. Contributors to this volume take both points of view seriously, and struggle to resolve them with only limited success.

> If government policy in 1900 had been designed to save oil for us today, can we imagine that such a policy would have made us better off?

MISPLACED MORALIZING

IN MY VIEW, IT IS A MISTAKE TO VEST THE discount rate with moral significance. It is simply a price, formed by the interaction of supply and demand and strongly influenced by the state of technology. It cannot be derived from first principles. Depending on the circumstances and available technology, even a solitary Robinson Crusoe may have a negative discount rate (say, if his fixed store of corn is spoiling at the rate of 10 percent per year) or a positive one (if he learns he can plant the corn).

What should we think about the "ethically unacceptable" results of discounting? Can we conclude that it is all right to destroy Earth just to save $3, if doomsday is delayed long enough? Well, if you invest the $3 in an index fund until doomsday, you will be able to buy three or four planets to replace this one!

Actually, that nonsensical punch line reveals the basic flaw in the question. There is no market for planets. The discount rate—and all the other observable prices in the economy—apply to marginal changes in quantities of goods and services. Selling a pint of blood for $50 does not mean you would part with 2 gallons for $400. Similarly, trading small amounts of money today for larger amounts tomorrow does not mean you would trade away the whole planet at some point. If we really are faced with a decision to save the planet, we cannot figure out what to do by observing market prices.

We rarely face such apocalyptic decisions, however. Any human influence on the climate, intentional or unintentional, is going to be marginal, not terminal. Even the irreversible loss of species may be viewed as a partial loss of genomic information, over which any particular public decision has only a small influence.

INTERGENERATIONAL TRANSFERS AS FOREIGN AID

MANY OF THE CONTRIBUTORS TO THIS volume consider ethics to be a primary consideration in determining the discount rate for any project that transfers wealth between the present generation and future generations, even if the "fate of the planet" is not at stake. Thomas Schelling, for example, argues that we should consider spending money to deal with threats to the climate in the same light as foreign aid. That is, through environmental programs we are altruistically paying money now to help people who are mostly unrelated to us and who are distant from us, in time as well as place. He concludes (as do others) that because future generations are going to be wealthier than we are, we can probably find better ways to spend our money on those who are now alive.

It is not clear, however, that there really are good examples of government policies that can reliably transfer wealth into the distant future. Consider the question of whether our ancestors of a century ago did us a disservice by consuming too much oil. They did indeed consume some amount that could have

been left for us. But that seems a petty complaint when the supply of proved reserves today is 15 times what it was in the middle of the twentieth century.

Even more significant is the intangible wealth that we have inherited from our ancestors: the knowledge of what oil is, how to find and extract and refine it, how to make an internal-combustion engine and a turbine, and how to make plastic. A large component of the wealth that each generation passes to the next is embodied in technology, and most of that is in the public domain (*not* the public sector).

If government policy in 1900 had been designed to save oil for us today, can we imagine that such a policy would have made us better off? Any such policy would almost certainly have caused collateral damage by delaying the development of technology—a far more valuable resource than a small increase in the physical stock of oil.

TIME TO THINK AGAIN

A SIMILAR ANALYSIS SURELY APPLIES TO governmental restraints on greenhouse gas emissions. Even if the hoped-for benefits materialize—a big "if"—there certainly will be a range of undesirable effects as well. Price and allocation controls on oil in the 1970s caused tremendous inefficiencies in the U.S. economy.

Government controls on greenhouse gases would yield similar inefficiencies. And the effects of government controls are likely to be far worse in other countries, where central planning and public corruption would be encouraged. Free-market and free-trade institutions would be compromised, and the cooler citizens of 100 years hence might find that they have much to regret.

Given the difficulty we have in reconciling policies that differentially affect the three or four generations now living (and voting), it seems awfully presumptuous to meddle patronizingly in the affairs of generations yet unborn.

Despite the current controversy over the moral import of discounting, the best policy is to continue to discount as we have been doing—but to stop and think hard if ever we are confronted with a policy issue that truly affects the fate of the planet. ■

Debunking Path Dependence

Reviewed by Richard L. Gordon

WINNERS, LOSERS & MICROSOFT: Competition and Antitrust in High Technology

by Stan J. Liebowitz and Stephen E. Margolis

288 pp. Oakland, Cal.

The Independent Institute, 1999

IN 1985, ECONOMIST PAUL A. DAVID argued that that an inventor named August Dvorak had devised a typewriter keyboard better than the standard QWERTY arrangement. Based on that example, he contended that products that maximize consumer benefits relative to costs do not necessarily dominate markets. David argued, instead, for "path dependence." According to that theory, the QWERTY keyboard is used not because it is objectively the best but because it was first.

A decade ago, the April issue of the *Journal of Law and Economics* arrived with a lead article intriguingly entitled "The Fable of the Keys" (reprinted as Chapter 2 of this book). Liebowitz and Margolis wrote "The Fable of the Keys" because they felt that the evidence cited by David in his attack on QWERTY was flimsy and wondered whether it would stand close scrutiny (p. 20).

The authors pursued the history of QWERTY and concluded that David was wrong about its inferiority. David relied on assertions that a U.S. Navy report—which he had not seen—proved the superiority of the Dvorak layout. The authors sought and found the original report. It proved to be methodologically unsound, and Dvorak wrote it. The authors found other studies that differed from the one written by Dvorak. They found, moreover, that QWERTY was the product of competition among rival typewriter manufacturers to provide better keyboard layouts.

As the authors point out (p. 20), the title "The Fable of the Keys" alludes to another myth of market failure that had been disproved by facts. The allusion is to "The Fable of the Bees," the title of Stephen Cheung's 1973 article. Cheung showed that private transactions did compensate for benefits to apple orchards from pollination by bees.

In "The Fable of the Keys," Liebowitz and Margolis argued that they had added to the contributions of Cheung and also of Ronald Coase who showed that contrary to a standard example private groups successfully built and operated lighthouses. Nevertheless, as with lighthouses and bees, the QWERTY myth lived on. It tacitly became the applications barrier to entry that is the heart of the government's case against Microsoft.

The authors therefore went on to examine more cases and to develop further the underlying theoretical case against path dependence. *Winners, Losers & Microsoft* is the fruit of their efforts.

THE THEORETICAL CASE AGAINST PATH DEPENDENCE

THE AUTHORS DEVOTE THREE CHAPTERS to theory. The first of those chapters argues that the necessary conditions for path dependence and its associated suboptimal outcomes are unlimited economies of scale and an absence of foresight by market participants (p. 57). (The spuriousness of those assumptions is self-evident.) As the authors argue (pp. 57-58), the economic definition of technical superiority—a higher payoff—creates an incentive for the owner of a superior technology to seek market superiority. There is foresight at work.

The second theory chapter deals with externalities. Liebowitz and Margolis show that where costs are increasing the owner of a technology can and will profit from promoting efficiency. The authors then turn to the flaws of Brian Arthur's assumption (in *Increasing Returns and Path Dependence in the Economy*) of unlimited economies of scale. Arthur seems to have committed the classic error of confusing technical

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