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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progress with scale economies. (Only pure scale economies can produce natural monopoly.) Further, in the realm of computer technology, the assumption of unlimited economies of scale may apply to the reproduction of software but not to other factors of production.

The final theory chapter develops a model of how consumer preferences and their interaction in the marketplace affect choices among technologies. The authors explore the consequences of alternative assumptions. Ultimately, they demonstrate that because the owner of a superior technology has an incentive to attract customers, the temporary dominance of a competing technology can be overcome.

Liebowitz and Margolis are overly polite is dealing with the fundamental problem of the path-dependence model: its reliance on a long chain of improbable assumptions to prove that markets can sustain bad choices. "The Fable of the Keys" was good enough for me, and the theory case was won there, on page 58 of Liebowitz and Margolis's book. Although the further theoretical discussion was interesting, my advice would be to quit when you are convinced. There is no help for those who are unwilling to accept so fully developed a case.

EMPIRICAL EVIDENCE TO BUTTRESS THE THEORY

CASE STUDIES COMPRISE THE BULK OF the book and make interesting reading. Liebowitz and Margolis start with previously reported work showing that neither the Sony beta format for video tape recorders nor the Apple operating system was markedly superior to its rivals as others had argued.

The Beta format, it turns out, had no advantage. VHS had the same performance and greater capacity.

The Macintosh operating system, when introduced, so strained available computer capacity that PCs using DOS were faster. As computers caught up, Microsoft went on to Windows, a reasonable approximation of the Macintosh operating system. Here the authors may be too kind to Apple. Its operating system always has been easier to use, but the Macintosh was not superior to PCs in every respect: Apple seemed to seek a price premium and the company was so badly adrift that its survival was in doubt.

The authors then treat the metric system, MITI, and FORTRAN. The metric system does not produce great advantages. MITI was fallible. FORTRAN was less durable than contended.

Liebowitz and Margolis also extensively examine the principal application programs used on desktop computers. Here, the same pattern emerges: leadership radically changes as better programs emerge, and the best program wins. The authors successively review Windows, office suites, spreadsheets, word processors, personal finance, desktop publishing, web browsers, and online services. They show the tendency of programs to lose market share when their performance lagged that of rivals; that is, market share tends to correspond to magazine review ratings.

CURRENT RELEVANCE

IN A CONCLUDING APPENDIX, LIEBOWITZ and Margolis draw on their analysis to argue that the case against Microsoft is unfounded and that Microsoft owes its success to technical superiority.

For example, Microsoft is strongest in the oldest (and largest) categories of programs: word processing and integrated spreadsheets. The originators of such programs disappeared long ago. Microsoft competed against other newcomers and won because it persisted in improving its products. ■

Superfund: The High Cost of Environmental Alarmism

Reviewed by Michael Gough

CALCULATING RISKS: The Spatial and Political Dimensions of Hazardous Waste Policy

by James T. Hamilton and W. Kip Viscusi

326 pp. Cambridge, Mass.
The MIT Press, 1999

THERE IS NO SHORTAGE OF PEOPLE willing to take credit for Superfund. Al Gore's election campaign website (*www.algore2000.com/agenda/issue_environ.html*) modestly cites "his leadership in the House to pass the original Superfund legislation." Lois Gibbs is less restrained and takes full credit as "the Mother of Superfund." (See the review of her book, *Dying from Dioxin*, in *Regulation* 19 [no. 2]: 78.)

Gibbs led the effort to blame chemicals that escaped from a waste dump at Love Canal as the cause of birth defects, poor health in children, and cancer and other terrible diseases in adults. The fact that no credible scientific study could validate Gibbs's claims did not keep Congress from enthusiastically embracing her story.

Congress passed Superfund—more formally, the Comprehensive Environmental Response, Compensation, and Recovery Act (CERCLA) in 1980—it made companies that had deposited wastes in waste dumps responsible for cleaning up those dumps if the dumps were judged to create a health hazard. And there seem to be hazards aplenty: more than 36,000 waste dumps appear on one or another list of concerns.

There is no question about the cost of Superfund. It cost $20 billion between 1981 and 1992, and another $7 billion is committed to continuing cleanup projects.

What has all that money bought? James T. Hamilton, an associate professor of public policy at Duke University, and W. Kip Viscusi, a professor of law and the director of the Empirical Legal Studies Program at Harvard University, provide some answers. The analytical centerpiece of their book *Calculating Risks* is an examination of the chemical risks, exposed popula-

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