

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 in 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_environment.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

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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-

tions, and costs at 150 Superfund sites.

EPA'S ROLE AND METHODS

WHEN THE ENVIRONMENTAL PROTECTION Agency (EPA) completes its investigation of the risks at a site, it signs a Record of Decision (ROD) and decides on remediation actions. From 267 RODs signed in 1991-92, Hamilton and Viscusi selected 150 for which chemical analysis and risk assessment data were available in EPA's regional offices. (EPA's willing cooperation in providing those data stands in marked contrast to in blocking access to data about the supposed health effects from air pollution. See "The Case for Public Access to Federally Funded Research Data," *Cato Policy Analysis* 366.)

Using EPA's methods of estimating risks, Hamilton and Viscusi calculate that the 150 Superfund studies for which data were available will yield 731 cases of cancer in the next 30 years, in the absence of any cleanup. Hamilton and Viscusi also show that there is less than a 1-percent probability that anyone will ever be exposed to the concentrations that EPA routinely assumes in assessing cancer risks. When more realistic exposures are entered into the calculations, the number of expected cancer cases drops by two-thirds.

Even assuming EPA's exaggerated risks, only 10 of the 150 sites are expected to have one or more cancer cases in the next 30 years. In terms of cancer prevention, cleanup at the other 140 sites yields no benefits. Hamilton and Viscusi point out that current analyses at Superfund sites are inadequate to determine if there is cause for concern about threats to health or the environment.

Hamilton and Viscusi limit themselves to an analysis of EPA's exposure estimates and do not question EPA's judgments about toxicity, considering that beyond the scope of their work. Yet, 652 of the 731 cancer cases calculated by EPA's methods are expected at one California site contaminated by

polychlorinated biphenyls (PCBs). Given the results for the largest population of PCB-exposed workers ever studied, which show that PCBs have not caused cancer in humans, the 652 expected cancer cases may be overestimated by 652. (See "Mortality in Male and Female Capacitor Workers Exposed to Polychlorinated Biphenyls," by Renate D. Kimbrough, Martha L. Doemland, and Maurice E. LeVois, in *Journal of Occupational and Environmental Health* 41 [1999]: 161.)

SILLY ASSUMPTIONS AND "PERMANENT REMEDIES"

IN ANY CASE, THE PCBs AT THE CALIFORNIA site are under a paved parking lot. Only if people remove the asphalt and build houses or playgrounds on the site will there be any exposure at

In any event, Superfund cleanups are not cost-effective. According to Hamilton and Viscusi, it can cost as much as \$7.2 billion to avert a single case of cancer.

all. Such improbable scenarios are common in EPA's risk assessments. In half of all cases, for example, EPA assumes that people will build houses on Superfund sites—evidently cutting through fences, digging up contaminated soil, plunging into waste lagoons, and ignoring all kinds of warnings in the process.

Hamilton and Viscusi's scholarly credentials seem to prevent them from passing judgment on such assumptions. This reviewer feels no such constraint: EPA makes silly assumptions about peoples' behavior.

Congress shares the blame for wasting billions of dollars. In 1986, unhappy with what was perceived to be lax enforcement of CERCLA, Congress passed the Superfund Amendments and Reauthorization Act (SARA). SARA mandates that EPA select "permanent remedies."

Fencing off or paving over a con-

taminated area is not permanent; thus, the paved parking lot is not judged sufficient protection against buried PCBs. Digging up the contaminated soil and incinerating it is a preferred permanent remedy.

Hamilton and Viscusi note that governments don't necessarily adhere to permanent remedies when they bear the costs. The city of Boston is building a convention center over a former junkyard, heavily contaminated with PCBs, after capping it with soil and paving.

COST IS NO OBJECT?

CLEANING UP SUPERFUND SITES WILL not prevent many cases of cancer, but how much will it cost? Hamilton and Viscusi calculate that it would cost \$2.2 billion to clean up the 150 sites they studied, if done as mandated by

EPA. They suggest some changes that would reduce the cost without significantly increasing risks to health. (As I have discussed, there seems to be little risk to health, anyway.)

Congress requires that "applicable or relevant and appropriate requirements" (ARARS) from

other environmental laws be applied to cleanups. That increases costs by imposing stricter standards than required to reduce cancer risks to the levels acceptable under Superfund policies. The elimination of ARARS would reduce the total cost of the cleanup to \$2 billion. The simple expedient of fencing Superfund sites (largely precluded by SARA) would further reduce the cost to \$1.6 billion.

In any event, Superfund cleanups are not cost-effective. According to Hamilton and Viscusi, it can cost as much as \$7.2 billion to avert a single case of cancer. That is far in excess of the value of \$5 million or so placed by EPA (and most analyses) on a life saved. Hamilton and Viscusi, for example, analyze the effects on house prices of proximity to Superfund sites and other pollution sources in Grand Rapids, Michigan. They find that residents, when informed of the risks, place a

value of about \$5 million on a human life. (In contrast to the burgeoning literature about the inability of the public to respond appropriately to information about risks, the citizens of Grand Rapids came up with the same answer as the experts—indicating, again, that people are smarter than they are given credit for being.)

Hamilton and Viscusi advocate the use of cost-benefit analysis (CBA) in an effort to bring rationality to Superfund. They suggest proceeding with cleanups costing less than \$5 million. For more expensive cleanups they suggest two possible limits on expenditures: \$5 million for each cancer averted (to reflect the average value placed on a human life) or \$100 million for each cancer averted (because the Office of Management and Budget has never turned down a regulation that “saves” a life for \$100 million or less).

If cleanup costs were capped at \$5 million for each cancer averted, the 150 Superfund sites studied by Hamilton and Viscusi could be cleaned up for less than \$100 million, instead of \$2 billion. If cleanup costs were capped at \$100 million for each cancer averted, the 150 sites could be cleaned up for about \$500 million.

Recall that EPA would spend \$2 billion to prevent 731 cases of cancer. By contrast, capping expenditures at \$5 million for each cancer prevented would prevent between 670 and 705 cases; capping expenditures at \$100 million for each cancer prevented would prevent between 710 and 726 cases. Eliminating the last little bit of risk is very expensive. Hamilton and Viscusi calculate that 95 percent of Superfund expenditures are directed at the last 0.5 percent of the risk.

Remarkably, the use of CBA would increase protection for minorities. Currently, wealthier, better-educated, and more politically influential populations demand and get the more extensive cleanups. Poorer populations with higher percentages of minorities are not treated as well. They would be better off with the use of CBA because the sites that fall under the \$5 and \$100 million caps for each life saved have higher percentages of minorities.

SELECTIVE READING

THE READER WHO WANTS A FIRM grounding in the benefits and costs of Superfund can read the first and last (ninth) chapters of the book. Chapters 2 through 8 provide the underpinnings for the other chapters, and some redundancy runs through them. Although the redundancy is a minor annoyance to someone who reads the book straight through, it makes it possible to read just one chapter without reference to other chapters—a useful feature for professors and students.

Readers who want to slaver over partial differential equations of the type that pepper so much of the microeconomics literature will enjoy Chapter 6, the analysis of pollution sources on housing prices. Two appendices provide analytical details.

WHO BENEFITS?

I DOUBT THAT MR. GORE WILL PAY ANY heed to this book. Ms Gibbs will reject it out-of-hand. But citizens who are interested in understanding just how little has been bought by the expenditure of billions of dollars under the Superfund banner will find *Calculating Risks* to be informative and illuminating. Politicians with claims to regulatory reform should seize on the book's analysis to show just how much good can be done for a lot less money. Those who represent minority populations may be surprised to find how the authors' analysis can help their constituents.

Mr. Gore, Ms Gibbs, and their ilk can take all the credit they want for Superfund. But it is bothersome that the rest of us have to pay for it. ■