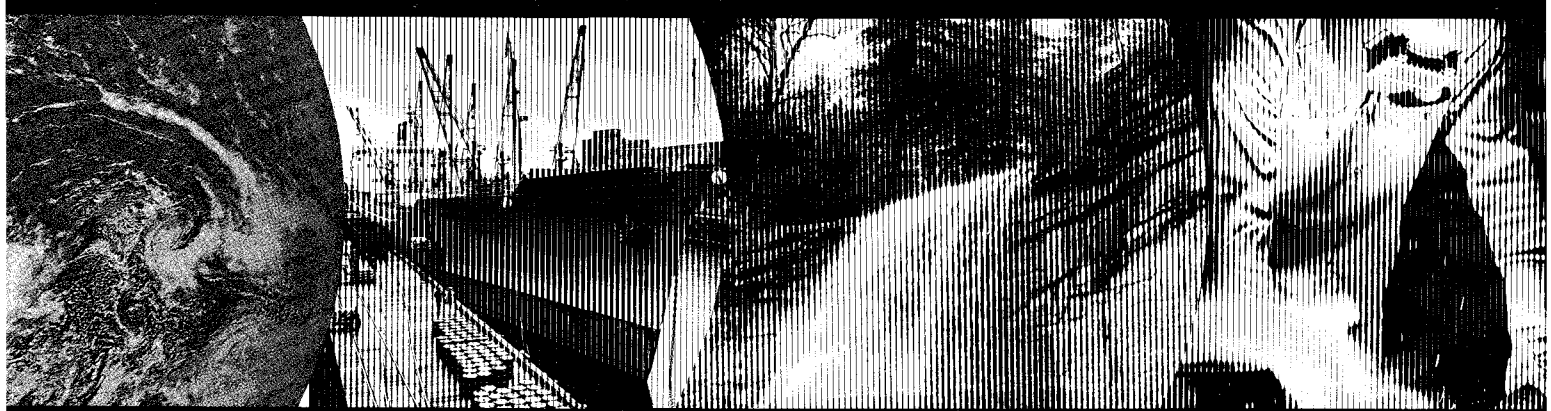

JOBS, COMPETITIVENESS, AND ENVIRONMENTAL REGULATION:

WHAT ARE THE REAL ISSUES?

Robert Repetto

WORLD RESOURCES INSTITUTE

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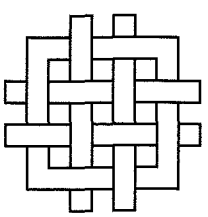

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R.R.

FOREWORD

Americans want a clean environment and have said that they are willing to pay for it, but the cost is high in terms of jobs and industrial competitiveness—right?

Wrong. Contrary to their own expectations, economists have found little evidence that the costs of environmental protection have affected the competitiveness or profitability of U.S. firms or reduced the number of jobs in the economy.

In *Jobs, Competitiveness, and Environmental Regulation: What are the Real Issues?*, WRI economist Robert Repetto summarizes the results of recent studies and examines important new data from thousands of U.S. industrial operations. He compares environmental performance with profitability and finds that plants with poor environmental records are generally not more profitable than cleaner ones in the same industry, even controlling for their age, size, and technology. This is true in "dirty" pollution-intensive industries as well as in clean ones.

Environmental protection is not free. We pay some $200 billion a year to avoid the ravages of pollution and the destruction of natural resources.

But the real question is not how to resolve the conflict between our economic goals and our environmental goals. Indeed, that conflict is largely imaginary. The real question is how to get more environmental protection for less money. How can we enhance the incentives and opportunities for technological and process changes that help the economy and the environment? The answer is that we must change the *way* we pursue our goals. Today's rigid, one-size-fits-all, command-and-control regulations block progress more than they spur it. They were designed to compel compliance by reluctant industries, but now they restrain the introduction of new environmental technologies.

Instead of throwing hurdles across the path, a rational regulatory system would set environmental goals and then allow regulated industries to meet them in the most efficient way, and it would offer industries economic incentives to continually improve their environmental performance. If the 104th Congress takes this tack, Americans across the political spectrum will support a large-scale regulatory reform effort.

In some cases, fees would be the most efficient way to deter environmental damages. Dr. Repetto suggests fee-based strategies to curb automotive air pollution, a growing problem as more and more drivers log more and more miles. Raising parking charges can discourage solo commuting. Pegging registration fees to tailpipe emissions can help get the dirtiest cars off the road. Charging higher tolls during rush-hour can reduce traffic congestion. As Dr. Repetto notes, fees are so much more efficient than current regulation that even some industries favor them.

Jobs, Competitiveness, and Environmental Regulation extends the policy analyses and recommendations set forth in such previous WRI studies as *Green Fees: How a Tax Shift Can Work for the Environment and the Economy, A New Generation of Environmental Leadership: Action for the Environment and the Economy,* and *Paying the Farm Bill: U.S. Agricultural Policy and the Transition to Sustainable Agriculture.* By detailing ways that the United States can improve environmental quality at less cost to consumers, businesses, and taxpayers, WRI's economists point the way toward an economically and environmentally sustainable future.

We would like to thank The Joyce Foundation and the American Conservation Association for their financial support of this study. To both, we are deeply grateful.

Jonathan Lash
President
World Resources Institute

I. WHAT ARE THE ISSUES?

A. DISLOCATION OF TRADE AND INVESTMENT

The U.S. economy has improved in the last several years: employment is up, and productivity has accelerated; the federal deficit is lower, and economic growth has been relatively strong. Nonetheless, progress in environmental protection is at a standstill. Almost all reauthorizations and new enactments of environmental legislation stalled in the recently ended 103rd session of Congress. The new majority in the 104th Congress proposes measures that would severely curtail environmental protection at the federal level. Many businessmen, labor unionists, politicians, and ordinary citizens fear that America can't afford the costs of stronger environmental protection, that regulatory burdens are undermining our competitive position internationally, destroying jobs at home, and dragging down productivity and growth.

The United States does spend more on environmental protection, absolutely and as a percentage of gross domestic product, than any other country.[1] In 1990, the percentage had already reached 2.1 and the trend is still upward. A complex web of environmental laws and regulations—thousands of pages of dense, obscure, and sometimes vague language—has grown up piecemeal over the past twenty-five years. Various state and federal courts and agencies interpret and enforce these requirements, sometimes inconsistently. Regulations limit industry's choice of technologies, product design and mix, plant location, and other important production decisions. Firms must allocate investment and operating funds to reduce environmental impacts, with scant hope of recovering all these expenditures through materials or energy savings or higher product prices. In addition to direct compliance costs, industries face delays and uncertainties in dealing with regulatory requirements.[2]

It is argued that environmental regulations impose costs and restrictions on industries in the United States that rivals in other countries do not face, and thus put American firms at a competitive disadvantage.[3] Especially in pollution-intensive sectors that have been heavily impacted by regulatory requirements, such as chemicals and petrochemicals, pulp and paper, metals and metal products, and transportation equipment, this competitive disadvantage has allegedly contributed to a loss of America's market share in world trade. Moreover, it is claimed, in order to escape the burdens of environmental regulation, U.S. and other multinational companies have located new plants in other countries where environmental costs are lower and regulations less stringent.

These concerns have spilled over into the policy arena. They have led to legislative proposals that would impose countervailing duties on imports from countries with weak environmental standards, in order to offset the putative cost disadvantages U.S. firms face.[4] Related proposals call for using antidumping provisions of U.S trade law against foreign producers who fail to incorporate environmental costs fully into their export prices.[5] Concerns about Mexico's relatively lax environmental regulations figured prominently in the NAFTA debate and resulted in elaborate safeguard mechanisms to ensure that differences in environmental standards would not distort trade flows.[6] The same worries have spawned a vigorous debate over whether GATT rules should be amended or reinterpreted to allow the United States to apply trade penalties based on the environmental effects of production processes and methods used in other countries—an idea that excites grave fears in other parts of the world of disguised protectionism or large-country pressures to adopt excessively strict environmental standards, or both.[7]

Concerns over competitive disadvantage manifest themselves also in strong pressures, especially among OECD countries, to harmonize their environmental standards—not only those that apply to the characteristics of traded commodities but also those that govern the methods used to produce such goods. Pressures for harmonization of environmental standards raise a host of issues: harmonization toward what

level? How can pressures to adopt the weakest standards be avoided? Must state and local governments relinquish their standard-setting prerogatives? How are various national interests to be represented in international standard-setting processes? These issues arise primarily because harmonization is thought necessary to "level the playing field" and avoid competitive disadvantage.

Is all this necessary? Must we pay a heavy price in international trade and investment for environmental protection, or can we have our cake and eat it too? The counter-argument, articulated first by business school professor Michael Porter, asserts that stringent environmental regulations may lead firms to develop new, less-polluting and more efficient products and manufacturing processes. Such innovations give firms that have responded creatively to regulation a competitive advantage over sluggardly rivals as environmental standards tighten worldwide.

> "Ultimately, nations succeed in particular industries because their home environment is the most forward-looking, dynamic, and challenging... Strict government regulations can promote competitive advantage by stimulating and upgrading domestic demand. Stringent standards for product performance, product safety, and environmental impact pressure companies to improve quality, upgrade technology, and provide features that respond to consumer and social demands. Easing standards, however tempting, is counterproductive."[8]

A somewhat different counterargument hinges on the rapid growth in markets for goods and services that "solve" environmental problems. According to recent surveys, these "green" industries, which sell pollution monitoring and abatement equipment, engineering and construction services, and a variety of products with environmentally superior characteristics, have already reached almost 200 billion dollars in sales annually in the industrialized countries alone, and are expected to expand even more rapidly in the newly industrialized countries where environmental conditions demand increased attention.[9] Countries with more stringent environmental standards in their home markets will allegedly develop a competitive advantage in these "green" industries, offsetting whatever disadvantage those standards impose on the "dirty" industries. Both counterarguments suggest that our relatively strict environmental standards are likely to confer benefits on American industry in the long-run.

B. JOB LOSS

A parallel debate revolves around the effect of environmental regulations on the employment rate. Business spokesmen frequently argue that stricter environmental standards will force them to close down factories or move them overseas. Restrictions on natural resource use, such as limits on timber harvesting on public lands, are attacked because they reduce employment along with production. Labor unionists also fear job losses if environmental regulations raise production costs or restrict supply. Many economists subscribe to a more sophisticated version of this argument, pointing out that diverting capital to invest in pollution-control equipment instead of capacity expansion or productivity improvement also limits the *growth* of output and employment over time.[10]

The usual riposte is that environmental protection actually creates more jobs than are lost: limits put on the extraction of natural resources may threaten jobs in extractive industries, but will save or create jobs in recreation industries and in footloose high-tech industries attracted to a high-quality environment. Environmental regulations that require pollution abatement or raise energy prices create jobs in industries supplying pollution-control or energy-conservation equipment and services. Since these industries are more labor-intensive than the heavily polluting industries (e.g., energy supply, basic metals, and chemicals) it is argued that greater expenditures on environmental protection will create jobs on balance, even if it's at the expense of employment in the polluting sectors.

II. ARE THESE ISSUES WORTH WORRYING ABOUT?

A. THE "COMPETITIVENESS" ISSUE IN PRINCIPLE

The proposition that differential environmental standards lead to loss of competitiveness and employment is so obvious to many businessmen, labor leaders, and politicians that it is regarded as axiomatic. Its validity needs no demonstration: if U.S firms are forced to incur costs that their international rivals are not and these costs are not matched by market benefits, then profitability or market share will suffer, so output and employment will be reduced.

Despite its plausibility, the proposition is flawed both in principle and in fact. In principle, competitiveness—manifested as an increase in net exports in a single industry or in all industries together—is not a valid economic objective. The quest for competitiveness rests on topsy-turvy mercantilist principles that equate exports with economic advantage and imports with economic harm. From this standpoint, if the United States became increasingly "competitive" in all sectors, we'd export a great deal and import little. But, there is no reason to export except to trade for things we want and cannot make as well or as cheaply at home. Exporting just to amass foreign currencies or other financial assets without eventually importing in return makes no sense. From an economic and an environmental perspective, the *less* production needed to support any standard of consumption, the better. If countries can acquire what they want at lower real cost through international trade, they're better off.

Preoccupation with "competitiveness" reflects the almost total dominance of producer interests over consumer interests in trade policy, which is therefore inveterately mercantilist. In the Uruguay Round and in previous trade negotiations under the General Agreement on Tariffs and Trade (GATT) or in other settings, when a country lowers its barriers to imports, it is viewed as a "concession" to foreign countries, although the main beneficiaries are consumers in the country that cuts its tariffs. If the United States is a net importer of a particular good, then the value of its consumption exceeds that of its domestic production, and the benefits of a lower price to consumers are typically much greater than the harm done to domestic producers.[11] Thus, the U.S. economy also gains overall. Yet, mercantilist trade policy holds that a country that lowers its import barriers in its own interests deserves to be "compensated" by its foreign trading partners by similar cuts in their import barriers.

The idea that extremely poor people can better afford to pay inflated prices for inferior quality merchandise would be laughable if not so tragic. By international agreement, the developing countries were given discretion to shoot themselves in the foot.

This way of looking at trade policy reflects producer interests completely. Still, since successive negotiating rounds have lowered trade barriers substantially, this perspective might be dismissed as a quaint but innocuous convention in the specialized jargon of multilateral trade policy—were it not for the enormous damage the underlying assumptions have done, especially in the developing world. For the GATT granted the developing countries—because they are poor—special dispensation to establish and maintain higher levels of protection for their producers than their richer trading partners do. What a diplomatic triumph that was! The idea that extremely poor people can better afford to pay inflated prices for inferior quality merchandise would be laughable if not so tragic. By international agreement, the

developing countries were given discretion to shoot themselves in the foot. Of course, most developing country governments jumped at the invitation to protect their domestic producers, and so created monopolistic, inefficient, and technologically backward industries. At the same time, they reduced their peoples' living standards. Only in recent years—and mostly through unilateral action rather than through multilateral negotiation—are developing countries lowering the barriers to international commerce that have lowered their real incomes and retarded their growth.

The dominance of producer interests in trade policy perhaps explains why such international trade organizations as the GATT have had so much more trouble incorporating environmental objectives into their operations than other inter-governmental organizations have. It has been the custom and privilege of producers everywhere, but especially in the developing and formerly socialist economies, to externalize some of their production costs by dumping virtually all their wastes—however toxic—outside the factory gate into the most convenient water body, air stream, or vacant lot. Few developing or transitional economies devote even one third of one percent of total income to environmental control. The resulting pollution exacts a heavy toll on people's health and welfare, as well as on surrounding enterprises dependent on increasingly degraded natural systems.[12] These real economic damages, which total 1 or 2 percent of GDP in the industrialized countries, can reach 4 percent of GDP or more in the newly industrializing and resource-dependent economies.[13] Overwhelmingly, these environmental damages are borne by domestic residents and firms in the form of ill health, reduced productivity and higher costs. Apart from the greenhouse gases and ozone-depleting CFCs, few pollutants cross international boundaries.

Yet, so dominant are producer interests in trade policy that developing countries complain that their economies would become less competitive if they enacted and enforced measures to reduce the injuries suffered by their own populations and natural systems. Simultaneously, producer interests in the developed countries complain of unfair competition from imports produced under weaker environmental standards in newly industrializing nations. In fact, by allowing their firms to externalize significant production costs by dumping their wastes indiscriminately, developing country governments are subsidizing consumers in rich countries at the expense of their own populations and national economies. Since firms don't have to incur the costs of pollution control, those costs are not reflected in the prices of exported commodities. Therefore, consumers in the importing countries don't have to pay any share of the environmental control costs. Nonetheless, rich country governments, reflecting producer interests, complain of damage from unfair competition, and developing country governments complain of "Northern over-consumption" but resist the measures that would make those consumers pay their way. If exporting countries sell their wares below cost by failing to internalize environmental damages into producers' costs and prices, then the importing country is the gainer and the exporting country is the loser.[14] But one would never guess that by listening to the trade policy debate.

If exporting countries sell their wares below cost by failing to internalize environmental damages into producers' costs and prices, then the importing country is the gainer and the exporting country is the loser. But one would never guess that by listening to the trade policy debate.

In any case, the effects of environmental regulations on trade shouldn't be judged at the level of the individual firm or even the individual industry. Businessmen care about the fortunes of their own firms, but public policy must be constructed on a broader frame. If one firm lacks the technological or managerial capability to meet an environmental standard efficiently, then another firm in the same industry may gain market share at its expense. Governments should not (but often do) tailor policy to the least capable of firms within an industry.

Moreover, many of the pollution control costs as well as the costs of environmental damage originating in a single industry are diffused throughout the economy over time. Even though in the short run the polluting firm may pay the costs of abatement, most of those costs are eventually passed along to customers. If the polluting firm produces capital goods or intermediates, these customers are other firms.[15] Analogously, most environmental damages from uncontrolled pollution are borne not by the offending firm but by other households and enterprises. Health damages lower productivity and raise health care costs throughout the economy. Chemical and oil spills drive up insurance rates for all firms, not just the careless ones. Air and water pollution from basic industries raise costs or reduce profits in such unrelated industries as agriculture, forestry, fishing, tourism and outdoor recreation. Consequently, the effects of environmental regulation must be evaluated at the level of the economy as a whole.

Unfortunately, the models and methodologies now used to do that are fatally flawed. Empirical macroeconomic models used by leading academic economists and economic consulting firms to estimate the economic effects of environmental regulations completely omit the damages that pollution and other environmental impacts impose on consumers and even on producers. They only include the costs of pollution abatement. Naturally, they conclude that environmental regulations impose an overall cost on the economy. President Truman, tired of economic advisors who always said "On the one hand, this... and on the other hand, that...." once beseeched his staff to find him a one-armed economist. Wishes are dangerous—there's always the chance they'll be granted. Now most macroeconomists look only at the costs of reducing environmental damages and ignore the costs of *not* reducing those damages.[16]

Several economists have also estimated the effects of environmental regulation on productivity growth at the industry level. In principle, such studies are more valid than those that focus merely on trade dislocations. Yet, estimates of productivity impacts also measure only the effects of regulation on industry costs, but don't account for the reductions in pollution damages attributable to those regulations.[17] For example, if an electric utility switches to low-sulphur coal in response to the Clean Air Act, its estimated productivity declines because low-sulphur coal costs more per BTU and generates no more electricity. Nowhere do the productivity estimates reflect the reduced damages from respiratory disease or from acid deposition on forests and materials. Productivity measurements that include both the costs and benefits of environmental regulations lead to dramatically different conclusions. Environmental regulations may well raise the rate of productivity growth, if their benefits exceed their costs.[18]

B. THE "COMPETITIVENESS" ISSUE IN FACT

Any significant change in a country's export costs would lead over time to an adjustment in the exchange rate or in real wage levels to maintain the balance of international payments, so efforts to look at the effects of environmental regulations have had to try, in principle, to hold these variables constant. In practice, economists have investigated the competitiveness issue by looking at

a) whether highly regulated industries suffer adverse trends in net exports relative to lightly regulated industries;
b) whether production of highly regulated industries moves abroad to less regulated countries;
c) whether U.S. firms in highly regulated industries invest overseas in less regulated countries;
d) whether such basic indicators as productivity are adversely affected in highly regulated industries.[19]

Economists who have reviewed the research on this subject, which includes a number of careful and ingenious studies, find scant evidence that environmental regulation has had adverse effects by any of these measures. The reason why most efforts to find adverse effects have come up empty is evident from the historical data. Consider exports from industries heavily impacted by environmental regulations in the industrialized countries, relative to other exports from those countries. The industries that spend most to comply with environmental regulations are pulp and paper, petroleum products, organic and inorganic chemicals, coalmining, fertilizer, cement, ferrous and

non-ferrous metals, metal manufactures, and wood manufactures such as veneers and plywood.[20] A recent World Bank report reviewed trends in world trade in these products from 1970 to 1990, a period in which most industrial countries put their environmental regulations into effect. The report found that "Contrary to common perceptions, higher environmental standards in developed countries have not tended to lower their international competitiveness. There has been little systematic relationship between higher environmental standards and competitiveness in environmentally sensitive goods (those that incurred the highest pollution abatement and control costs...)."[21]

In fact, as the data in Table 1 show, the countries with tight environmental standards have had more export success in these environmentally sensitive industries than in manufacturing industries as a whole or in their entire range of industrial and agricultural export products. Between 1970 and 1990, the industrial countries' overall share in world exports declined from 74.3 to 72.7 percent, mainly because the rest of the world experienced faster economic growth and now contributes a larger share of world output than before. The industrial countries' share of world

Contrary to widespread perceptions, the industries heavily affected by environmental regulations did relatively well in international trade.

exports of manufactured goods declined even more (from 91.3 to 81.3 percent), largely because the composition of expenditures and output in the rich countries shifted toward services while that of the countries in the early stages of industrialization shifted away from agriculture toward manufactures. However, *within* the category of manufactured exports, the share of the advanced countries in exports in industries that experience the highest pollution control costs has actually declined by very little (just from 81.3 to 81.1 percent). The sectors in which the industrial countries markedly lost their comparative advantage were not those heavily affected by environmental regulations but rather those in which labor costs are a large fraction of total costs, such as textiles,

Table 1. Share in Total World Exports of Manufactures and of Environmentally Sensitive Goods, Selected Industrial Countries, 1970–90.

Regions/Countries	Total Exports		All Manufactures		Environmentally Sensitive Industries	
	1970	1990	1970	1990	1970	1990
	(percent)					
Industrial Countries, of which,	74.3	72.7	91.3	81.3	81.3	81.1
Austria	1.0	1.3	1.3	1.6	1.3	2.0
Finland	0.8	0.8	0.9	0.9	2.1	2.4
Norway	0.8	1.0	0.8	0.5	1.9	1.7
Sweden	2.3	1.8	2.9	2.0	4.0	3.4
Germany	11.7	12.2	17.2	15.2	12.1	13.8
Japan	6.6	8.8	10.2	11.8	8.0	8.0
United States	14.5	11.4	16.9	12.3	11.6	10.1

Source: Piritta Sorsa, 1994, Table 2 and Annex Table 2.

apparel, footwear, and other light manufactures. Contrary to widespread perceptions, the industries heavily affected by environmental regulations did relatively well in international trade.

Among the industrial countries, the United States was no exception. As evident in Table 1, our share in world exports has declined along with our falling share in world output, and our share in manufactured exports has declined considerably faster. But, within the manufacturing sector, the decline in our share in exports of environmentally sensitive products has been much less than the average. In other words, the industries most affected by regulations have performed relatively well in international trade over a period in which regulatory compliance costs have been rising. Of course, these trends don't imply causality. They merely suggest that other, more powerful forces have been at work reshaping the world economy. They also show why statistical studies have not been able to show any consistent link between environmental regulation and trade performance.

The diversity in the experiences of industrialized countries reinforces the point. Germany, for example, which in many respects has tighter environmental standards than the United States does, actually increased its export share in environmentally sensitive goods while losing market share in manufactures as a whole. Japan, whose industries are typically less polluting than their U.S. counterparts, held its own in the sectors most affected by regulation. When the performance of individual industries *within* the environmentally sensitive group is examined, the diversity of experience increases further: the U.S., for example, seemed to strengthen its comparative advantage in 17 of 38 individual environmentally sensitive industries, and lose ground in the rest.[22] Clearly, important factors other than regulation are at work.

A broad look at the U.S. trade balance with other countries and regions also casts doubt on the trade impacts of differences in pollution control costs. Over the early 1990s, the U.S. had an overall trade deficit, which reflected our macroeconomic imbalance. The rest of the world was lending us money to finance the excess of our total consumption over our aggregate production, which meant that the United States had to have an import surplus. However, our trade deficit with Japan was relatively *large*, although Japan's environmental standards are stricter than our own in most respects.[23] The United States maintained a trade surplus with Mexico, even though Mexico's environmental standards were significantly weaker than ours. In general, as Table 2 illustrates, the pattern of U.S. trade deficits had no relation to the environmental standards of our trading partners relative to our own.

Table 2. United States' Exports and Imports. Aggregate Figures for 1990–92.

	Exports 1990–92	**Imports 1990–92**	**Exports ÷ Imports**
Canada	258,261	288,808	0.8942
Japan	144,496	287,561	0.5025
Germany	61,252	85,591	0.7156
Other Industrialized Countries	224,375	259,455	0.8648
Africa, total	18,589	46,064	0.4035
Asia, excl. Japan	202,458	338,923	0.5974
Mexico	102,249	98,549	1.0375
Other Western Hemisphere, total	90,921	106,247	0.8558
E. Europe & F.S.U.	10,845	3,295	3.2914

Source: Directory of Trade Statistics Yearbook, IMF, 1993.

Looking at investment flows to less developed countries doesn't change the picture. The data on direct foreign investment provide no support for the contention that multinational companies are relocating environmentally sensitive industries in countries with weak regulations. It is true that direct foreign investment in developing countries has increased sharply since the mid-1980s after collapsing during the debt crisis in the first half of the 1980s. For example, by 1992, the developing and transitional economies received nearly half—45 percent—of U.S. direct investment abroad (USDIA). But a much *smaller* proportion of that direct investment went into the environmentally sensitive industries (petroleum and gas, chemicals and related products, and primary or fabricated metals) than was the case for U.S. direct investment abroad in the already developed countries with relatively tight environmental standards. Table 3 shows that 24 percent of USDIA into the advanced countries went into pollution-intensive sectors, but only 5 percent of USDIA into the less developed economies went into those sectors. Of the total direct foreign investment in pollution-intensive industries, 84 percent went to other developed countries, compared to 49 percent of overseas investment in other industries. To the extent that the advanced countries seem to be exporting their "dirty" industries, they seem predominantly to be sending them to each other, not to the less developed economies.

"To the extent that the advanced countries seem to be exporting their "dirty" industries, they seem predominantly to be sending them to each other, not to the less developed economies."

This phenomenon is corroborated by trends in developing countries that are major recipients of direct foreign investment and keep statistics by sector of destination. In Nigeria, Hong Kong, Korea, Malaysia, Philippines, Singapore, Taiwan, Thailand, Argentina, Brazil, Colombia, and Venezuela together, and in each one individually except Venezuela, the stock of inward foreign direct investment in the pollution-intensive industries represents a *smaller* share of total foreign direct investment now than in the 1960s or early 1970s, despite the fact that environmental regulations have tightened in the countries making the foreign investments.[24] This implies that since 1970 foreign direct investment has increased much faster in other sectors than in the pollution-intensive industries. The multinational companies that have really been raising their stakes rapidly in the

Table 3. U.S. Direct Foreign Investment, by Region, 1992 ($ million).

	Sector						
Receiving Region	Petroleum & Gas (1)	Chemicals (2)	Metals (3)	Subtotal (4)	All other Sectors (5)	Total (6)	(4) ÷ (6)
Developed Countries	171	4,070	503	4,744	15,359	20,103	0.236
Developing Countries	-327	1,007	247	927	16,092	17,019	0.058
Total	-156	5,077	750	5,671	31,451	37,122	0.15
Developed Countries ÷ Total	n.a.	0.80	0.67	0.84	0.49	0.54	

Source: "U.S. Direct Investment Abroad," U.S. Department of Commerce, *Survey of Current Business,* July 1993; Table 12.4, p.104.

developing world include consumer products companies such as Coca-Cola, service companies such as Citicorp, and makers of apparel, appliances and other labor-intensive products or components.

To be sure, the share of the developing countries in world production and trade in the pollution-intensive sectors has grown, but this is not necessarily because of differences in environmental standards.[25] Demand for these products has grown faster in the rapidly industrializing countries of Asia and Latin America. Production has followed the growth of demand. The relocation of production in these basic industries to the newly industrializing countries can also be attributed to the well-known "product cycle" described decades ago by Raymond Vernon and others.[26] As industries mature with respect to product and process designs, their outputs become more like "commodities" subject primarily to price competition, which induces migration to low-cost producing countries. Cost advantages may stem from lower wages or materials costs. Advanced countries maintain comparative advantage in technologically sophisticated industries and in new products designed for high-income consumers. The product cycle can readily explain the modest gains the developing countries have made in basic chemicals, metals, pulp and paper, and other polluting industries.

In the face of these basic trends in international trade and investment, there's little wonder that econometric investigations find scant evidence that differences in environmental regulations affect patterns of trade, foreign investment or industrial location. Judith Dean, a professor at the School of Advanced International Studies at Johns Hopkins University, surveyed an extensive economics research literature dating mostly from the 1970s and 1980s. Her conclusion:

> "More stringent regulations in one country are thought to result in a loss of competitiveness, and perhaps in industrial flight and the development of pollution havens. The many empirical studies that have attempted to test these hypotheses have shown no evidence to support them."[27]

Other experts have gone over the same ground. A recent OECD volume summarizing a symposium on trade and environment concluded:

> "Empirical studies show that the costs of pollution control are a small part of total costs in most sectors and that nearly all the OECD countries have introduced similar environmental measures at roughly the same time. Environmental measures have not been the source of significant cost differentials among the major competitors and have had minimal effects on overall trade between OECD and non-OECD countries."[28]

A still more recent literature review by economists from Harvard University, the National Bureau of Economic Research, and Resources for the Future drew virtually the same conclusion:

> "We assess the evidence and find that there is little to document the view that environmental regulations have had a measurably adverse effect on competitiveness. Although the long-run social costs of environmental regulation may be significant, including adverse effects on productivity, studies attempting to measure the effect of environmental regulation on net exports, overall trade flows, and plant location decisions have produced estimates that are small, statistically insignificant, or not robust..."[29]

These economists also find little evidence to support Michael Porter's counter-hypothesis that stricter regulations actually improve international competitiveness.

A well-known environmental lawyer in a recent law review article has provided a somewhat more pessimistic reading of essentially the same body of evidence, but his conclusions were based mainly on the presumption of unmeasured costs of environmental regulation in addition to pollution control costs, such as legal expenses, regulatory delays and uncertainties. Such costs undoubtedly exist in the United States, largely as the result of our litigious, adversarial, command-and-control approach to regulation, but the author takes little account of the very significant overall regulatory delays and uncertainties facing private investors in less developed countries.[30]

Studies have also investigated whether differences in the stringency of environmental regulations

from state to state *within* the United States have had a measurable effect on the location of new industrial plants. The answer is generally no. Other factors dominate.[31] This is a more sensitive test of the impact of environmental factors on investment decisions. States do differ in the stringency of their emissions standards and in the resources they put into enforcement of environmental regulations. Other locational costs probably vary less among regions within the country than between the United States and foreign countries. So, if environmental factors don't affect locational decisions within the United States, they are unlikely to affect investment decisions internationally.

In summary, the many economists who have investigated the impact of environmental standards on trade and investment and those who have reviewed the research literature have consistently found that regulatory differences among jurisdictions have no significant impact on the direction or magnitude of trade and investment flows, even in industries whose compliance costs are relatively high. These findings are perfectly consistent with the basic facts presented above on trends in North-South trade and investment over the past twenty years, which give no indication that countries with more stringent standards have suffered a loss of international competitiveness.

III. HOW ENVIRONMENTAL PERFORMANCE AFFECTS COMMERCIAL SUCCESS

If "competitiveness"—the ability to sell in competition with foreign producers—is not a good indicator of commercial success, then what is? In a competitive economy, *profitability* is a much better measure. It encompasses success in the domestic as well as in the international market and reflects costs of production along with sales volume. Profitability, literally "the bottom line" in a market economy, captures all the factors influencing the success of the enterprise, while export sales measure only one aspect of success. For this reason, the "competitiveness" issue is better posed in a different form:

> Do establishments with superior environmental performance tend to be more or less profitable than establishments with inferior environmental performance within the same industry?

This question focuses on actual environmental performance rather than on regulatory "stringency," which can't be defined or measured. Comparing legal requirements won't do: strict regulatory standards aren't stringent if they're not enforced. Moreover, U.S. federal environmental regulations now fill 16 volumes, so finding a single summary measure of regulatory stringency is virtually impossible. Comparing the stringency of regulations in different countries is even more difficult, since regulations are multidimensional and countries' administrative approaches vary widely. One country may be tougher on certain forms of pollution and laxer on others. Furthermore, within any industry some firms will be operating well within their permitted emissions while others may be out of compliance. Using a firm's expenditures on pollution control as a surrogate indicator confuses the issue, because inefficient firms will probably spend more to comply with the same regulations than efficient ones will. What matters is their actual environmental performance. The right question is whether firms whose environmental performance is better than their competitors within the industry are more or less successful in the marketplace.

"The right question is whether firms whose environmental performance is better than their competitors within the industry are more or less successful in the marketplace."

Environmental performance is measured by emissions per unit of shipments. If industrial processes are viewed in thermodynamic terms as the *transformation* of materials and energy from crude into usable forms, then the ratio of waste products to useful, salable outputs is one measure of the efficiency of the process. Since all materials that enter an industrial process must come out again in some form as physical outputs, because matter is neither created nor destroyed, emissions per unit of shipments reflects the ratio of useful "good" outputs to useless "bad" outputs. Viewed in this way, it makes more sense to hypothesize that industrial processes that transform a larger fraction of the energy and materials they use into salable forms might be more profitable.[32]

The standard hypothesis, of course, is that better environmental performance comes at a cost, so firms that divert resources to reduce their emissions beyond the point at which waste recovery just pays for itself must sacrifice some profits. Under this hypothesis, environmental performance and profitability should be inversely related. The competing "Porter Hypothesis" holds that once firms are motivated to seek out solutions to environmental problems—by regulations or other pressures—they typically find previously overlooked cost-saving opportunities to improve processes, reduce wastes, or redesign products.

Economists view with enormous skepticism the hypothesis that firms typically overlook opportunities

to reduce costs or improve product quality.[33] One of the most important insights in economics is that market competition continually pressures firms to maximize profits by reducing their operating costs and improving their products. This explains why firms in a market economy are more efficient in providing goods and services than organizations not subject to market competition—the U.S. Congress, for example. However, in their formal analyses, economists take this insight a step further and stipulate that most firms throughout the economy have *already* optimized their operations, an assumption that absolutely dumfounds anybody who has actually worked inside a corporation for more than a week. This extraordinary assumption is analytically convenient: economists can say much more about some observed behavior if it reflects the maximum attainable value of some objective—such as profitability—than if it is just part of a general muddling along. However, if it were true that companies typically operate at maximum efficiency, it would be hard to understand exactly what the hordes of management consultants swarming around them are being paid to do. To take a specific example, it would be hard to understand how the Ford Motor Company, after watching their Japanese rivals at work, could achieve radical cost savings in producing new models—after almost a century in the business—by *starting* to have their designers talk with their manufacturing engineers and marketing experts while the designs are being worked out.[34]

Alternative models of organizational and managerial behavior featuring bounded rationality and adaptive decision-making, "satisficing" behavior, principal-agent problems and other incentive failures within the organization can help explain why firms don't operate as efficiently as possible. Economists have helped develop these models.[35] Such models have been applied to environmental issues to explain why firms that agreed to cooperate with EPA's voluntary "Green Lights" program by investing in cost-effective energy-saving investments have been able to find many projects that earn relatively high rates of return, projects that presumably were available before the companies joined the program.[36] But, in most analytical work, economists treat these inefficiencies as special cases. In this investigation, the Porter hypothesis is reflected in the possibility that firms with superior environmental performance also achieve superior profitability within their industries.

The empirical tests of these competing hypotheses make use of a relatively new database generated by the U.S. Census Bureau's Center for Economic Studies, the Longitudinal Research Database (LRD).[37] Taking advantage of new possibilities in data processing and retrieval, this database merges records on individual industrial establishments from six censuses of manufactures and twelve or more annual surveys of manufactures. Each census covers more than 200,000 large manufacturing establishments, and contains detailed information on each establishment's location and ownership, its inputs of materials, energy, labor, and capital and its outputs of products and services. The Annual Survey of Manufactures is a much smaller stratified sample designed to include most large establishments in surveys taken periodically in non-census years. It contains most of the same information collected in the censuses plus detailed information on assets, investments, depreciation, and other costs.

Parts of this large core database have been merged, establishment by establishment, with information from other sources, including databases on emissions and pollution control expenditures by manufacturing firms. For the 1987 census year, LRD has been combined with EPA's Toxic Release Inventory, which provides information on the releases and discharges of over 300 toxic substances,[38] the National Emissions Data Systems, which gives information on the discharge of non-toxic effluents into surface waters, and the Aerometric Information Retrieval System, which documents the atmospheric release of pollutants regulated under the Clean Air Act. LRD data have also been merged with information from the Commerce Department's Pollution Abatement and Control Expenditure surveys.[39] The result is a database encompassing thousands of manufacturing establishments (the exact number depending on which environmental data are being matched to the LRD data) and containing detailed information on emissions, production costs, sales, and revenues. Using this database, it was possible to investigate whether firms with superior environmental performance were more or less profitable than their competitors.

In measuring environmental performance, the toxic release data have been kept distinct from information on conventional pollutant releases into air and surface waters. Separate emissions-to-shipments ratios have been calculated for all three, in order to avoid reducing drastically the size of the sample of establishments that could be used in the analysis. Relatively few establishments could be matched from all four datasets. Also, looking at airborne, waterborne, and toxic emissions separately reduced the already difficult problems of aggregating emissions of various substances. The Toxic Release Inventory was aggregated into total pounds released into all media, including transfers to treatment works, ignoring the widely differing toxicities and characteristics of various substances. Water pollutants included BOD (biological oxygen demand) in kilograms per day, and TSS (total suspended solids) in kilograms per day. Separate ratios of effluents to shipments were computed for each measure, but the results reported later are based on a combined ratio that added BOD and TSS together, then divided the sum by the establishment's total shipments. Air pollution was measured by the ratio of particulate emissions to total shipments. Although the same firms are not represented in all comparisons, these measures give a fairly comprehensive picture of the environmental performance of manufacturing establishments.

Specialized (5-digit Standard Industrial Classification code) industrial sectors that produce a relatively narrow range of homogeneous products were selected for study. The SIC classifies industries even more narrowly (7-digit or 9-digit codes) but further disaggregation would have limited the sample sizes drastically. Even at the 5-digit level of classification, had industrial sectors that include firms producing a wide range of products ("miscellaneous inorganic chemicals," for example) been selected, comparisons of establishments making very different products with quite different materials and technologies would have been inevitable. Comparing the emissions per unit of shipment among such establishments would have been no more meaningful than comparing apples and oranges. Confining the investigation to specialized sectors with relatively homogeneous product lines reduced one possible source of spurious variation in the findings. Sectors with homogeneous product lines were chosen on the basis of several additional criteria: first, to represent a wide range of manufacturing industries; second, to include sectors that have significant environmental impacts and incur relatively large environmental control costs; and third, to include sectors with sufficient numbers of establishments in the matched database to allow meaningful comparisons across plants.

Environmental performance varies remarkably even among establishments in narrowly defined industrial lines, such as makers of printed circuitboards or ready-mix concrete. A common measure of variability is the coefficient of variation, which is the ratio of the standard deviation of a variable to its mean. Across all the industries examined in this study, the median value of this measure was 1.7: the standard deviation of environmental performance among establishments in the same industry was typically seventy percent larger than the average of the individual establishment's emissions-to-output ratios.

Two measures of profitability were constructed from the LRD data. The first is the gross operating margin, defined as the difference between the total value of shipments and total operating costs (including labor, materials, energy, rental, and contract costs), expressed as a fraction of the total value of shipments. The second is the net return as a fraction of the end-of-year book value of fixed capital. The net return is simply the difference between the total value of shipments and total operating costs, minus annual depreciation. Neither of the two is a perfect measure of profitability. Gross operating margin, which excludes capital costs, would be higher in capital-intensive firms than in less capital-intensive firms, even if the two were equally profitable. The net return on book value reflects a user charge on owned capital, but such factors as taxes and inflation would make this measure diverge from a true return on invested capital. However, comparing these measures only across establishments *within* narrowly defined industrial segments minimizes these distortions. Establishments within a single narrowly-defined industry are likely to be similar in capital-intensity and to face similar inflationary trends and tax regimes. Table 4 summarizes the various measures of environmental and economic performance used in this analysis.

Table 4. Measures of Environmental and Market Performance.

A. Measures of Environmental Performance	B. Measures of Profitability
1.a Total Toxic Releases per dollar of shipments	1.b Gross Operating Margin: (Total value of shipments less total operating costs) divided by total value of shipments
2.a Total Airborne Particulate Emissions per dollar of shipments	2.b Net Return on Book Value: (Total value of shipments less total operating costs less annual depreciation) divided by book value of invested capital
3.a Biological Oxygen Demand (BOD) plus Total Suspended Solids (TSS) per dollar of shipments	

What do the results of this exercise show? Correlations between environmental performance would be positive under the standard hypothesis, negative under the competing "Porter hypothesis." The detailed findings are laid out in Appendix Tables IA–IC but can be comprehended more readily by looking at Figures 1A–1C. In each of these graphs, the two measures of profitability are represented on the axes—gross margin on the horizontal and net return on the vertical axis. Each point represents the correlation coefficient between environmental performance and the two measures of profitability. Thus, if environmental performance in a particular industry is positively correlated with *both* measures of profitability, the industry will be represented by a point in the upper right quadrant of the graph. The further away from the origin of the graph in both dimensions, the closer the correlations. If the industry's environmental performance is negatively correlated with both measures of profitability, it will be represented by a point in the lower left quadrant. If the correlation with gross margin is positive, but that with net return on capital is negative, the point will fall in the lower right; if the correlations are reversed, the point will be in the upper left. In general, there is no tendency for superior profitability to be correlated with greater emissions per unit of output.

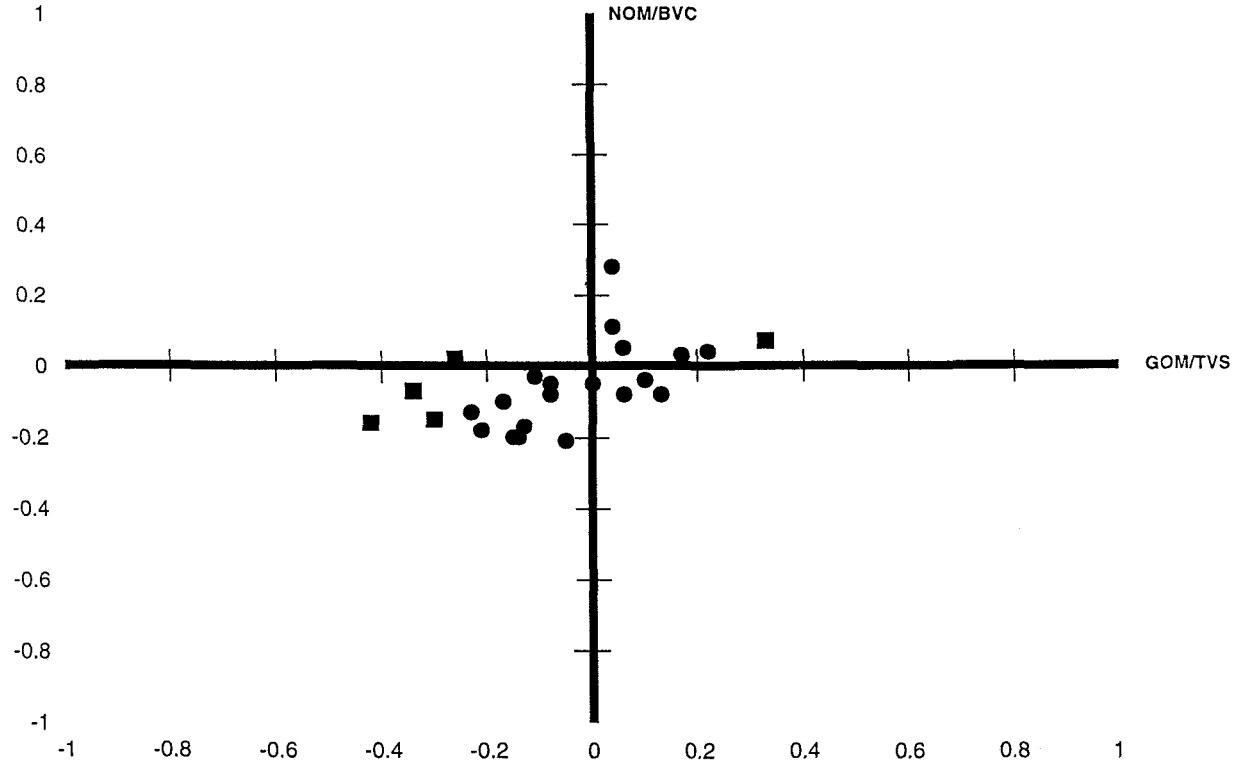
It should be emphasized that each "point" in a graph summarizes the association between environmental and market performance across many different establishments within an industrial sector. The number of establishments included in each industry ranges from a minimum of 10 to a maximum of 429, as reported in the Appendix tables. For reasons of confidentiality, data on individual establishments are not divulged, so reported findings combine data on each establishment in the sample into an aggregate correlation coefficient. However, readers should be aware that the analysis covered thousands of manufacturing plants. Data on toxic releases and profitability were combined for 1,936 individual establishments, for example.

If the data from the individual plants are samples of the establishments in their industries, could the correlation coefficients have arisen by chance if the true correlation between environmental and economic performance were actually zero? Because the number of establishments for which data were matched differed in the various industries, significance tests were calculated for each industry's correlation coefficients. The results are depicted graphically by using a square to indicate a pair of correlations of which at least *one* was highly unlikely to have arisen solely by chance[a] and a circle to de-

[a] Formally, a "significant" correlation was defined as one that would not have arisen by chance more than one time in twenty if the true correlation with environmental performance were zero.

Figure 1.A. Simple Correlations: Toxic Emissions

Simple Correlation Coefficients between Total Toxic Releases per Dollar of Shipments and (a) Gross Operating Margin and (b) Net Return on Book Value of Invested Capital



Notes: Toxic emissions = total TRI releases per dollar of shipments
NOM/BVC = Net Operating Margin as a proportion of the Book Value of Capital
GOM/TVS = Gross Operating Margin as a proportion of the Total Value of Shipments
■ Significantly different from zero with 5 percent probability
● Not significantly different from zero

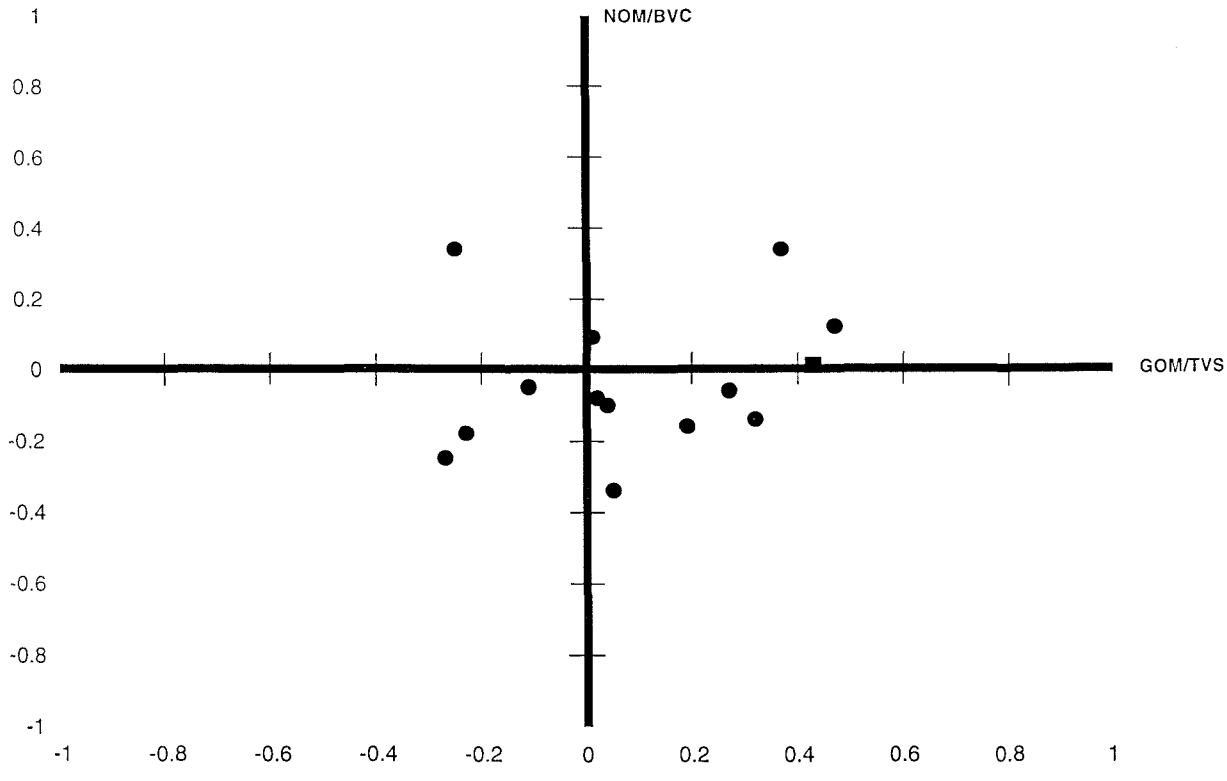
pict a pair of correlations neither of which differed significantly from zero.

Looking first at the correlations between manufacturing plants' profitability and their toxic emissions (relative to shipments)—which draw on the largest database for making comparisons—one finds that points are not clustered in the upper right: there is no tendency for higher toxic emissions to be associated with higher profitability. For all but one of the industries in which such an association exists, the correlation is weak and could have arisen by chance. There are twice as many industries for which the correlation between profitability and toxic emissions is negative, implying that plants in those industries with

> ***Across the entire range of industries, correlations between profitability and the intensity of toxic releases are weak.***

Figure 1.B. Simple Correlations: Water-borne Emissions

Simple Correlation Coefficients between Water Pollution per Dollar of Sales and (a) Gross Operating Margin and (b) Net Return on Book Value of Invested Capital



Notes: Water-borne emissions = BOD plus total suspended solids per dollar of shipments
NOM/BVC = Net Operating Margin as a proportion of the Book Value of Capital
GOM/TVS = Gross Operating Margin as a proportion of the Total Value of Shipments
■ Significantly different from zero with 5 percent probability
● Not significantly different from zero

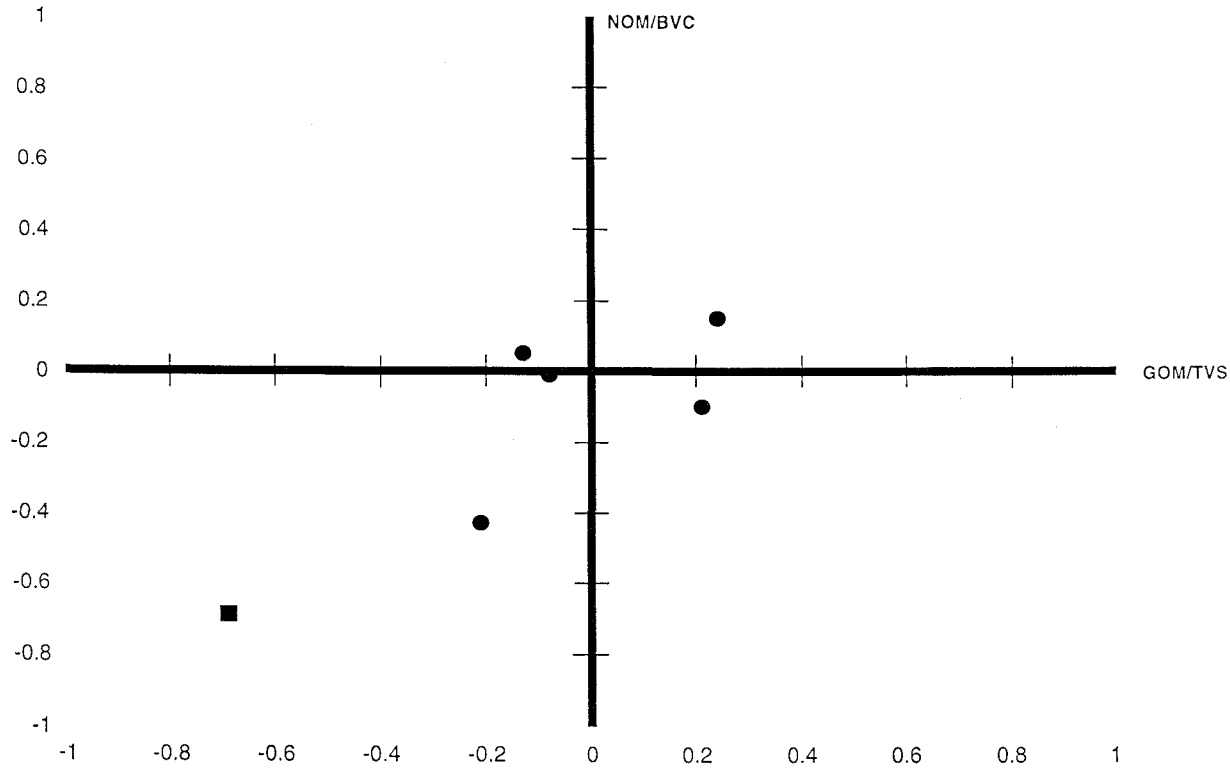
superior environmental performance (low toxic emissions relative to shipments) are more profitable. In several of these industries, including sectors such as metalplating and industrial detergents that have significant environmental control problems, the association is strong. However, across the entire range of industries, correlations between profitability and the intensity of toxic releases are weak.

The same general conclusions are borne out by correlations between waterborne emissions and airborne particulate emissions, respectively, and measures of profitability. Figures 1B and 1C reveal no tendency for profitability to be positively correlated with emissions-intensity for either conventional water pollutants, such as BOD and total suspended solids, or for airborne particulate emissions. It is at least equally likely for plants with superior environmental performance to be more profitable. Overall, the associations are weak: other factors are determining the economic performance of individual manufacturing establishments.

"Yes," skeptics will say, "and it is precisely these other factors that mask the true effects of environmental control costs on profits. That's why simple

Figure 1.C. Simple Correlations: Air Particulate Emissions

Simple Correlation Coefficients between Air Particulate Emissions per Dollar of Sales and (a) Gross Operating Margin and (b) Net Return on Book Value of Invested Capital



Notes: Air particulate emissions = particulate emissions per dollar of shipments
NOM/BVC = Net Operating Margin as a proportion of the Book Value of Capital
GOM/TVS = Gross Operating Margin as a proportion of the Total Value of Shipments
■ Significantly different from zero with 5 percent probability
● Not significantly different from zero

correlations don't reveal much." Older plants, for example, are probably both dirtier and have higher production costs, because they embody outmoded process technologies, because they are hard to retrofit with efficient pollution control equipment, and because they require a lot of maintenance to prevent leaks and emissions. Larger plants probably achieve economies of scale, both in producing their primary outputs and in treating or controlling effluents. Differences like these, which may affect both profitability and pollution-intensity among plants in an industry, could create spurious correlations between economic and environmental performance or mask whatever true associations may exist.

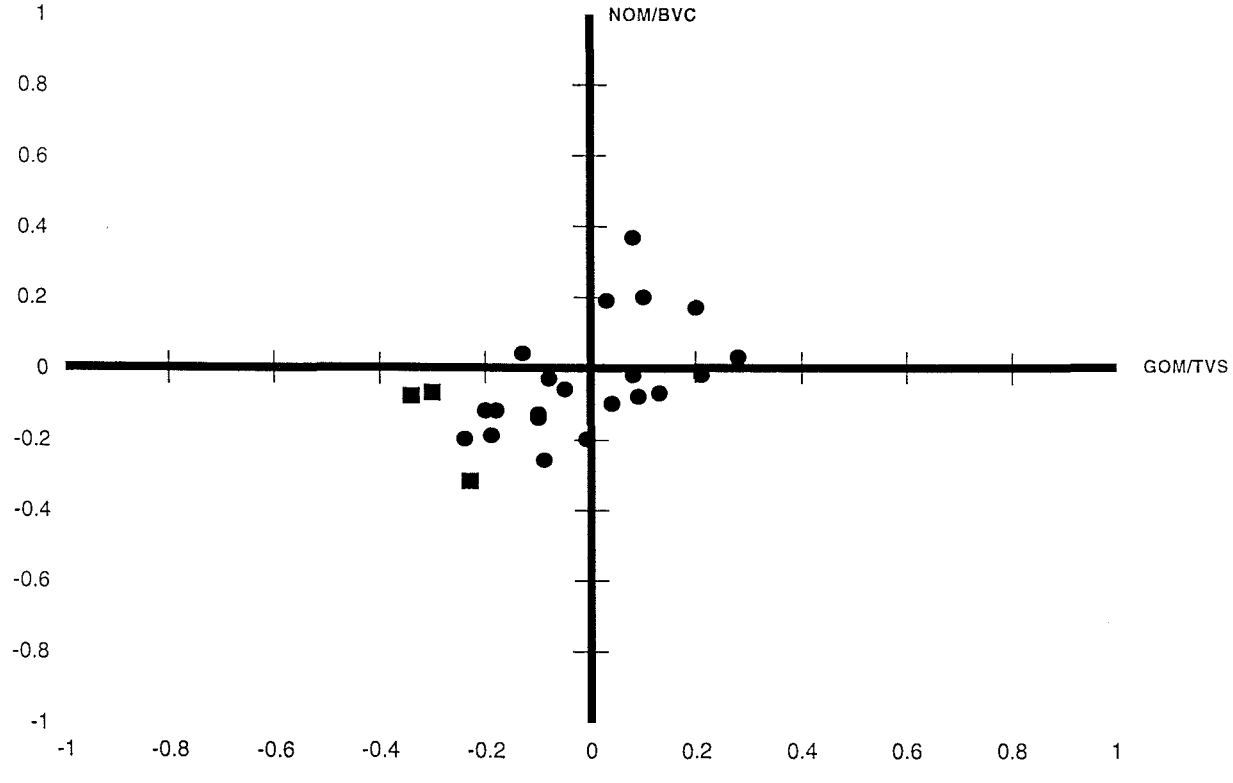
To guard against this possibility, the analysis was repeated using *partial* correlation analysis instead of simple correlations. Partial correlation analysis is a technique for exploring the association between two variables while removing the influence of extraneous variables that influence both. In effect, it is a way of controlling statistically for the effects of extraneous variables, or "holding them constant." Partial correlation coefficients were calculated for the same industries and establishments as before, controlling for a)

the age of the plant, b) the scale of production, measured by the total value of shipments, and c) the amount of recent investment in plant and equipment, as a fraction of book value of capital.

The results are presented graphically in Figures 2A–2C and in Appendix Tables IA-1C. What is striking is how small the overall differences are between the simple and partial correlations. Even when the age and scale of a plant and the amount of recent investment in plant and equipment are taken into account, there is no overall tendency for plants with superior environmental performance to be less profitable.

Even when the age and scale of a plant and the amount of recent investment in plant and equipment are taken into account, there is no overall tendency for plants with superior environmental performance to be less profitable.

Figure 2.A. Partial Correlations: Toxic Emissions
Partial Correlation Coefficient Controllings for (a) Scale, (b) Age of Plant, and (c) Amount of Recent Equipment Investment



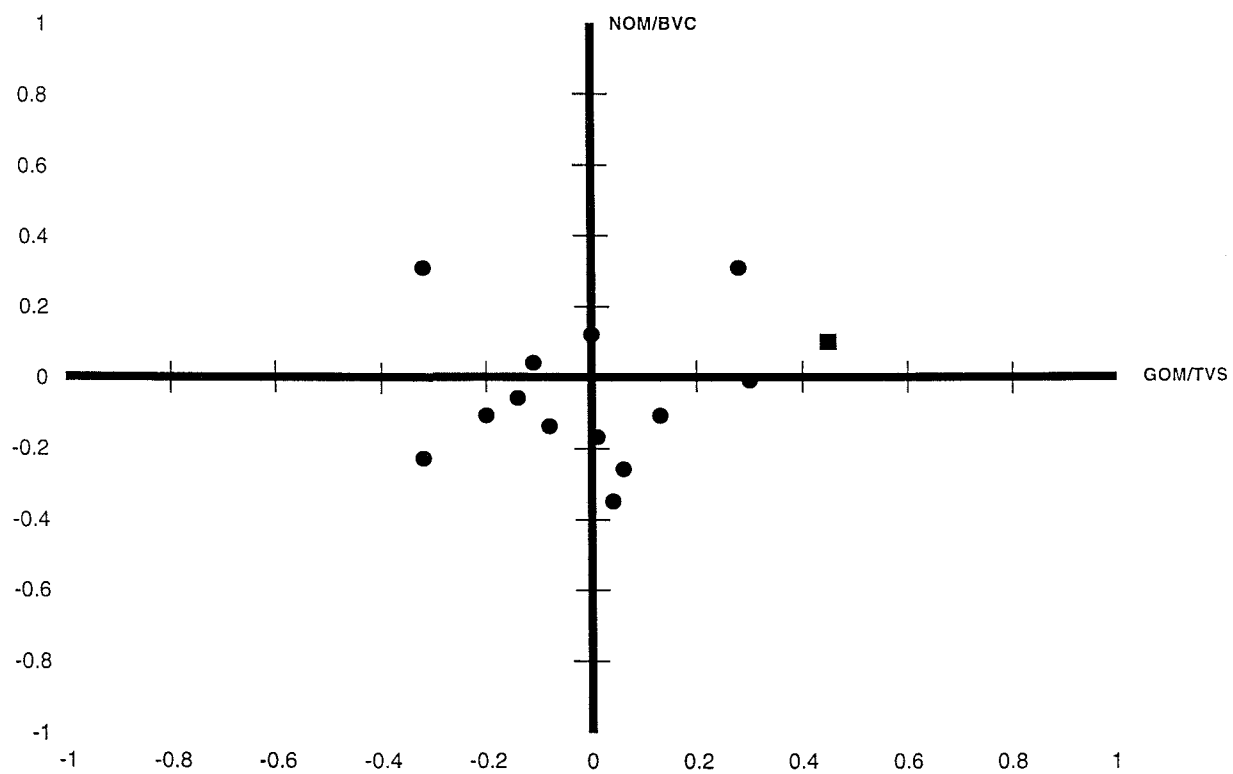
Notes: Toxic emissions = total TRI releases per dollar of shipments
NOM/BVC = Net Operating Margin as a proportion of the Book Value of Capital
GOM/TVS = Gross Operating Margin as a proportion of the Total Value of Shipments
■ Significantly different from zero with 5 percent probability
● Not significantly different from zero

Across the thousands of plants in the sample, it is at least equally likely, and perhaps somewhat more likely, for plants with lower emissions—relative to production—to achieve higher operating margins and returns on invested capital. By and large, however, the associations are weak. In the last analysis, other factors influence profitability more strongly.

This body of evidence bears directly on the relationship between environmental performance and competitiveness. The results fully support earlier findings based on international trade and investment flows. There is simply no evidence that superior environmental performance puts firms at a market disadvantage or adversely affects market performance. The implications are important for both public and private policy. Some important ramifications are highlighted below:

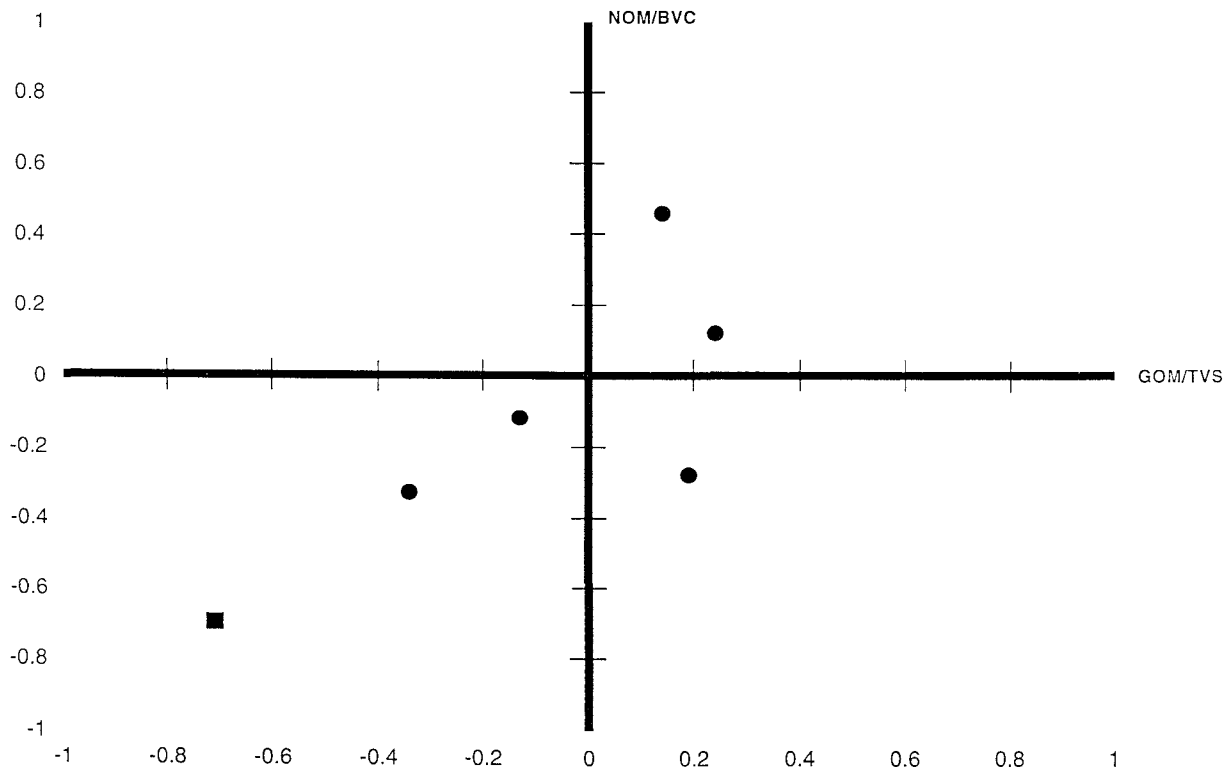
- Environmental regulations need not and should not be weakened or relaxed so as to undermine their environmental objectives out of fear of adverse effects on industries' market performance.
- In the international arena, there is no need for countervailing tariffs, anti-dumping duties or

Figure 2.B. Partial Correlations: Water-borne Emissions
Partial Correlation Coefficient Controllings for (a) Scale, (b) Age of Plant, and (c) Amount of Recent Equipment Investment



Notes: Water-borne emissions = BOD plus total suspended solids per dollar of shipments
NOM/BVC = Net Operating Margin as a proportion of the Book Value of Capital
GOM/TVS = Gross Operating Margin as a proportion of the Total Value of Shipments
■ Significantly different from zero with 5 percent probability
● Not significantly different from zero

Figure 2.C. Partial Correlations: Air Particulate Emissions
Partial Correlation Control Settings for (a) Scale, (b) Age of Plant, and (c) Amount of Recent Equipment Investment



Notes: Air particulate emissions = particulate emissions per dollar of shipments
NOM/BVC = Net Operating Margin as a proportion of the Book Value of Capital
GOM/TVS = Gross Operating Margin as a proportion of the Total Value of Shipments
■ Significantly different from zero with 5 percent probability
● Not significantly different from zero

other trade penalties directed at imports from countries with weaker environmental standards than our own, at least when the resulting environmental impacts are confined within their own borders. Nor must environmental standards necessarily be "harmonized" to prevent competitive dislocations.

- Within the United States, since superior environmental performance makes firms no less profitable, institutional and fiduciary investors should not expect to earn lower portfolio returns if they invest in the stocks of firms with superior environmental performance within each industry. Similarly, environmentally screened stock portfolios that avoid the worst performing firms within each industry should not expect to achieve lower average returns as a result.

IV. JOBS AND THE ENVIRONMENT

Similar conceptual confusion and factual misunderstandings derail the debate over the effects of environmental regulations on employment. Some maintain that regulations destroy jobs in the regulated industries; others retort that regulations increase employment in environmentally benign industries.[40] Of course, both groups are correct, narrowly speaking. Virtually *any* expenditure, however foolish or unproductive, will generate employment. That's why the last line of defense for the most egregious pork-barrel spending is that it creates a certain number of jobs. The Corps of Engineers generated employment when draining our nation's wetlands; it will create jobs again when restoring stream flows and undoing the damage its previous projects have done. That's close to digging holes in the ground and filling them in again, but it creates jobs.

Shifting resources from producing chemicals to cleaning up waste sites costs some jobs in chemicals industries and creates some jobs in remediation firms. The important question is not whether employment increases or decreases on balance, but whether cleaning up waste sites is worth the costs. The relevant costs are all the resources, not just the labor input, that could be used to generate other needed goods and services.

To focus this more sharply, think about the expenditures people make privately to improve their own environments. If people buy home water filters to improve the quality of their drinking water, nobody worries about destroying jobs. Instead, it is assumed that jobs will be created in the water filter industry. Of course, the people who buy water filters must spend less of their incomes on other things—movie tickets, for example—so employment will also go down in the movie industry. Who knows (or cares) whether employment per dollar of sales is greater in the water filter industry or in the movie industry? People assume that they can buy the goods and services they prefer and markets—including labor markets—will adjust to this allocation of resources.

"

The important question is not whether employment increases or decreases on balance, but whether cleaning up waste sites is worth the costs.

"

Now suppose that people sensibly conclude it would be much cheaper if one giant water filter were purchased for the whole community, instead of each household buying a mini-filter for itself, and the town votes to tax itself to pay for a water treatment plant. Again, employment rises in the giant water filter industry. But, since people have to cut down on other spending to pay the additional taxes, employment goes down in industries producing the other goods and services that people had been spending their money on.[a] How it balances out is anybody's guess, but that's not the relevant question. What's uppermost is whether the community thinks clean water is worth the cost.

But suppose the government requires the town's factory to install the water filter on its exhaust pipe before it dumps its wastewater in the community's water supply. Won't factory workers lose their jobs? Quite possibly. When the factory raises its prices to cover the costs of the filter, employment is likely to suffer. But, as before, employment goes up in the water filter industry. On balance, industrial employment might rise or fall, but the real issue is whether the voters think that protecting the water supply is worth the cost.

[a] Of course, if the community chooses to raise taxes on payrolls and incomes, thereby discouraging some of its citizens from working as hard, employment will go down more than it would if the community taxed other activities—downtown parking or trash disposal, for example. More on that later.

> ***Petroleum refining, chemicals manufacturing, pulp and paper, and primary metals—the environmentally sensitive industries in which pollution abatement costs represent a relatively large fraction of output value—are all among the industries with the* fewest *employees per million dollars in shipments.***

In fact, pollution-control expenditures purchase goods and services from a broad cross-section of American industry: energy, construction, chemicals, machinery and transport equipment, rubber, stone and glass, instruments, engineering and other services industries, and more.[41] These expenditures also pay the salaries of a wide range of skilled and semi-skilled workers. Consequently, the direct employment generated per dollar of expenditure on pollution control is quite similar to the average employment generated by a dollar of sales across all of American industry. A recent EPA study calculated that pollution-control expenditures in 1991 directly generated about 744,000 jobs.[42] Compared to the $107.9 billion dollars spent on pollution control in that year, this implies a direct employment content of 6.9 jobs per million dollars of expenditure (in 1986 dollars).[43] This estimate is in the same range as others: the OECD estimated 10 jobs per $1,000,000 in expenditures in 1990; the Environmental Business Journal estimated 7.6 jobs per $1,000,000.[44] Numbers vary slightly depending on how environmental expenditures were defined and how estimates were made. The main point is that the pollution-control industry, however defined, is about as labor-intensive as U.S. industry as a whole. In 1991, 18.45 million employees in manufacturing industries produced $2.82 trillion in total shipments, for a ratio of 6.5 jobs per million dollars in sales. Consequently, one would not expect that a shift in expenditures toward pollution control, even at the expense of manufacturing output, would have a significant direct impact on employment. Gains and losses would roughly balance out.

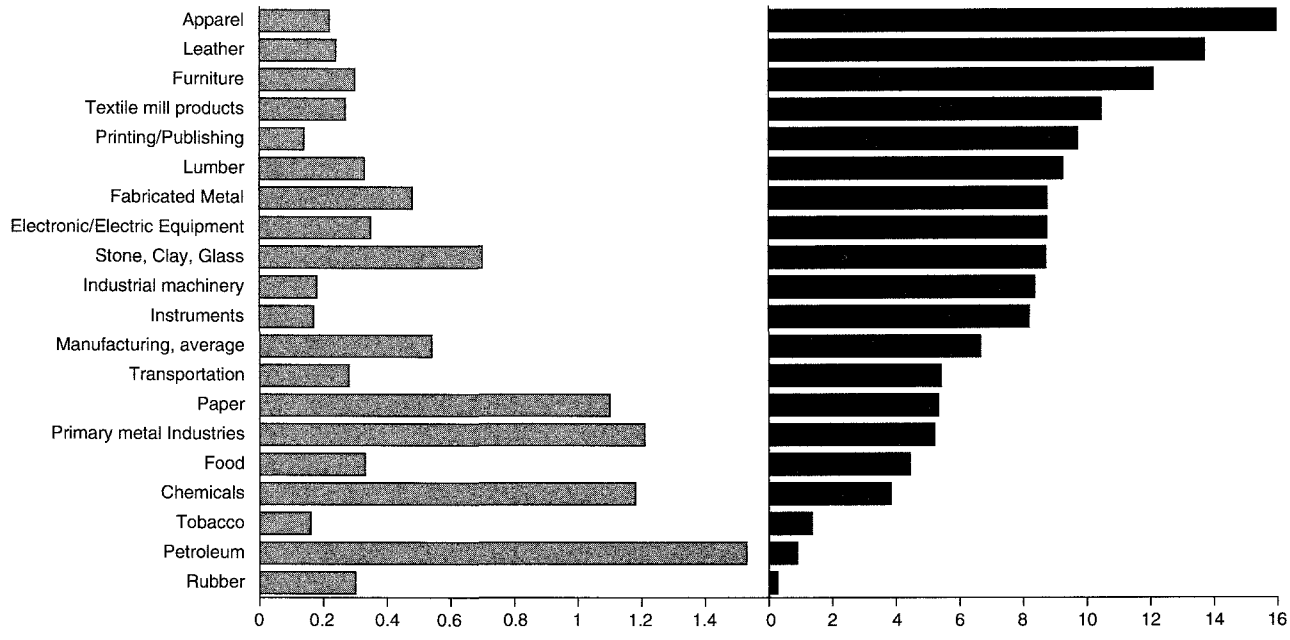
In fact, this conclusion is probably unduly pessimistic. The industries that generate the most pollution and incur the highest pollution-control expenditures are by no means the most labor-intensive. Figure 3 demonstrates just the opposite: petroleum refining, chemicals manufacturing, pulp and paper, and primary metals—the environmentally sensitive industries in which pollution abatement costs represent a relatively large fraction of output value—are all among the industries with the *fewest* employees per million dollars in shipments. These sectors are not only less labor-intensive than manufacturing in general, they are also less labor-intensive than the pollution-control industry. It follows that increasing expenditures on pollution control is unlikely to reduce overall employment in the short run. In the longer term, any second-order effects would almost certainly be undetectable among the more powerful macroeconomic secular and cyclical forces that drive unemployment up and down.

The real issue is not the environment vs. jobs. The issue is what we want our economy to produce. If we want it to produce a clean environment along with other goods and services, the industries that contribute to a clean environment will have higher output and employment; those that do damage to the environment will have less. While jobs in particular industries may rise or fall, total employment will not be systematically affected.

What we want the economy to produce is continually changing, and industries expand and contract as a result. As sales of personal computers have risen, sales of portable typewriters have declined. Jobs for typewriter repairmen have disappeared while opportunities for computer programmers have multiplied. No doubt this shift has created hardships for some households, but no politician or lobbyist has said, "The U.S. economy can't afford to have personal computers because it will destroy jobs in the typewriter industry." Yet, they routinely claim that we can't afford clean air because it will destroy jobs in the coalmining or some other industry.

Those who complain about the effect of environmental controls on employment are usually thinking about *particular* jobs, in their own firms, industries

Figure 3. Employment and Pollution-Control Expenditures by Major Industrial Sector



or communities—and well they should. Losing a job hurts the individuals affected and their families and, if clustered in particular localities, those communities as well.[45] The role of public policy, however, is not to guarantee particular jobs but to ease the transition from declining to expanding industries—through unemployment compensation and retraining programs, by giving people opportunities to acquire the skills and resources they need for greater occupational mobility, by macroeconomic policies that maintain high aggregate employment, and through measures that moderate abrupt economic shocks.

In a market economy, people don't have entitlements to particular jobs. This is obvious in the private sector: each year many companies downsize their workforces in response to declining demand or technological changes; other companies expand. Shifts like these in annual employment dwarf those remotely attributable to environmental policy. If the private sector does not give workers entitlements to particular jobs, neither can the public sector. However, workers can expect government to maintain high aggregate employment and to help them find other jobs. Americans overwhelmingly agree that the economy should produce a clean environment, even if it means producing a little less of something else. A spurious fear that a clean environment means higher unemployment should not stand in the way.

V. THE REAL ISSUE

The real issue with environmental spending, as with all spending, is not jobs or "competitiveness," but whether we're getting good value for our money. Are the resources devoted to environmental protection buying significant improvements in environmental quality, or are they being frittered away with little to show? People want unpolluted air and water, safe and healthy neighborhoods and workplaces, and undegraded natural resources. They've demonstrated over and over again that they're willing to pay for them. Two decades ago, for example, the automakers claimed vehemently that if buyers were forced to pay the two or three hundred dollars it would cost to put catalytic converters on new cars, consumers would balk and the industry would collapse. Since then, have buyers been heard complaining about the cost of catalytic converters? In fact, after improving the quality of its manufacturing systems and its cars, which are now far cleaner and more fuel-efficient than they were 20 years ago, Detroit just had its most profitable year in postwar history.

"The real issue with environmental spending, as with all spending, is not jobs or "competitiveness," but whether we're getting good value for our money."

Where people can buy environmental quality for themselves, they're doing so in increasing numbers. The agricultural chemicals industries has claimed that if the use of pesticides and chemical fertilizers are regulated more strictly, food prices will rise beyond the means of middle-class American families. Yet, the organic foods industry is getting premium prices and expanding at 25 to 30 percent per year as consumers flock to buy chemical-free foods that they perceive to be less risky. As a result, mainstream supermarkets are now stocking organic foods, and more and more farmers are finding that they can reduce their chemical use and increase their profits.

Although such market trends as these demonstrate that people value a clean, safe environment, their willingness to pay is more often masked by the need to decide collectively on the quality of the environment they share. Not everybody can afford a family estate on the coast of Maine as an escape from urban summer smog. Most of us have to breathe the air in the cities and suburbs where we live, and it's more or less the same quality air for the entire urban population. It's virtually useless for one person to spend the extra money for a cleaner car unless others do the same. Without that assurance, people tend to underspend on environmental quality. That's the main reason why governments have to get involved in the collective decision-making process.

For similar reasons, not all the benefits from a cleaner environment show up in the record of market transactions. Sure, one of the reasons that summer places on the Maine seacoast are too expensive for most of us is that people put a very high value on unspoiled natural resources and a clean environment. However, the discomfort people feel breathing polluted air in the city all summer doesn't necessarily result in any market transaction, and so doesn't generate income for anybody. Of course, if things get bad enough, people get sick and miss work, expenditures on healthcare increase, and perhaps a few people die prematurely. Ironically, some of these effects, such as increased healthcare expenditures, are counted as *increases* in income and output. A good part of the apparent economic cost of environmental protection stems from the incomplete and misleading accounting methods used to measure income and productivity. If we're getting good value from expenditures on environmental protection then (properly measured) income and productivity will rise as a result.

The nub of the issue is that we're not getting as much as we should for our expenditures on environmental protection, now exceeding two percent of

A good part of the apparent economic cost of environmental protection stems from the incomplete and misleading accounting methods used to measure income and productivity.

total GDP. This is not news. The inefficiencies in environmental, health, and safety regulations have been amply documented and analyzed over the past two decades or more.[46] The problems have been extensively studied and are well-known.

Regulations aimed at reducing illness and death, whether in the environment or in the workplace, often require expenditures that buy very little incremental risk reduction. How much society should spend to reduce such risks is a difficult question,[47] but there's clearly something wrong when one regulation buys a reduction in the same risk at a cost several orders of magnitude greater than another regulation does. This anomaly has been documented time and again.[48] Why not concentrate efforts more heavily on the actions that reduce risks at lower cost and, in that way, achieve much greater overall improvements in health and safety for the same total expenditure?

For several reasons, inefficiencies of this kind persist. Many environmental statutes prescribe that regulated firms install the best available control technology or achieve the maximum achievable emissions reduction within the bounds of economic feasibility, irrespective of the risk reductions that result. Among other things, this often implies that all emissions sources are required to install the same kind of pollution control equipment, regardless of the numbers of people exposed or the extent of their exposure. It sometimes implies that industries with "deep pockets" or in a better position to pass the costs along to consumers are made to adopt tighter controls, whether or not this extra expenditure is justified by additional improvements in health and safety.

Moreover, regulatory decisions are not based consistently on an assessment of risks or on a comparison of the incremental risk reduction tighter standards would achieve and their costs. Some statutes and regulations require such a comparison; others are based on the goal of eliminating risks completely, whatever the cost. Even when risk assessment is part of the regulatory decision-making process, methods and assumptions vary widely. To err on the side of conservatism, regulators sometimes make wildly unrealistic assumptions about people's likely behavior and exposure (children living near hazardous waste sites eating a steady diet of dirt day-in and day-out, for example). Sometimes the risk assessment is carried out to support a pre-determined regulatory decision, rather than the reverse.[49] Because these problems persist, some environmental regulations buy relatively little improvement in health and safety, certainly much less than could be achieved for the same expenditure.

Some environmental regulations buy relatively little improvement in health and safety, certainly much less than could be achieved for the same expenditure.

Pollution control efforts also require much greater expenditures than necessary to improve environmental quality. Environmental regulations grew up piecemeal, and often imply that waste streams are shunted among air, land and water: to keep pollutants out of the atmosphere, exhaust gases are "scrubbed" and the resulting sludges are dumped on land; to avoid putting wastes into landfills, they're incinerated, and the exhaust gases go up the chimney; and so on. Industry and regulators are still trying to establish the integrated, cross-media approach to residuals management and waste reduction that engineers and economists advocated decades ago.[50] Such an approach could substantially reduce the costs and environmental impacts of waste management.

One-size-fits-all regulations that necessitate uniform technological solutions to pollution problems

within an industry drastically raise the costs of compliance. They're usually end-of-pipe solutions that discourage innovative product redesign and process changes that could save money in the long run. They ignore important differences among firms in the scale, remaining lifetime, location, and design of facilities, though such differences often make other pollution-control options more cost-effective. As a result, the same amount of expenditure buys drastically varying reductions in emissions in different industries, among emissions sources within industries, and even within the same facilities. Instead of starting with the least expensive ways of reducing emissions and moving gradually up the cost curve until the emission reduction target is achieved, this regulatory approach sometimes requires a great deal of expenditure for relatively meager results. A recent Resources for the Future report summarized numerous studies of the cost-effectiveness of regulation under the Clean Air Act: most studies show that actual expenditures are several times those that would be required to achieve the same goals under a least-cost approach.[51]

These findings were recently borne out by a detailed study of a single facility, the Yorktown refinery. EPA and the refinery's owner, AMOCO, jointly inventoried all sources of volatile hydrocarbon emissions and estimated the costs of controlling them. The striking conclusion they reached was that 90 percent of the emissions reductions achievable by the applicable technology-based regulations could be obtained at about 25 percent of the cost by putting tighter controls on emission points that could be eliminated cheaply, while foregoing some controls that were very expensive and accomplished little.[52] Except that it was studied carefully, there's nothing peculiar about the Yorktown refinery; the same potential savings are very likely available at other large industrial facilities as well. Add to them the potential savings from eliminating large cost discrepancies between one facility and another and it's easy to understand the findings reported in the RFF study.

An important example of the inefficiency that drives up the costs of controlling emissions is the "new source bias" of regulations—the tendency to apply much more stringent requirements to new cars, factories, and powerplants than to those already in use. To make progress with such a strategy, new investments must be held to high (and often costly) standards, while the much larger universe of operating vehicles or factories are allowed to continue emitting at much greater rates, even though in many cases their performance could be improved cheaply. Old cars that need a tune-up are responsible for a disproportionately large share of automobile emissions, for example, but federal regulations have largely ignored them while tightening standards on new model cars, which are much cleaner to start with. This "new source bias" has a second pernicious effect: by making new models or plants more expensive relative to the cost of continuing to operate older equipment, it discourages investment, slows down the replacement rate and keeps the older, dirtier and less efficient equipment in use longer.[53] This is counter-productive economically as well as environmentally.

Not only are the legal and transactional costs of our adversarial approach high, the delays and uncertainties have serious business and financial repercussions.

The regulatory process in the United States is also exceptionally adversarial and litigious, and therefore cumbersome and time-consuming. Typically, in order to be able to defend whatever rule they decide on, EPA must compile an elaborate public record of evidence, comment, and reaction to comments from all interested parties. Nonetheless, whatever decision this process leads them to, EPA is likely to be sued by whichever party feels that its interests have been sacrificed. Quite naturally, this sometimes creates a reluctance within the Agency to act, but hesitation is also likely to generate a lawsuit. Negotiated decisions and consensus-building on environmental policy are rare in the U.S. compared to other industrial countries.[54] Not only are the legal and transactional costs of our adversarial approach high, the delays and uncertainties have serious business and financial reper-

cussions. Most notorious are the problems that have arisen under the Superfund program, intended to clean up dangerous hazardous waste sites. Almost a quarter of all the billions of dollars in expenditures so far have been to pay lawyers' bills, as the companies involved, their bankers, and insurers have brawled to avoid picking up the tab for past dumping. Meanwhile, few sites have actually been restored.[55]

Problems like these should be the focus of concern about environmental regulation. The issue is not that protecting the environment has been creating unemployment or trade deficits; such claims are erroneous and won't stand scrutiny. Rather, the issue is that the United States could be getting much more for the large sums of money we spend to protect the environment, much more real progress in reducing risks and preventing natural resource degradation.

VI. GETTING BETTER RESULTS FROM ENVIRONMENTAL SPENDING

How to get better results from spending on environmental protection is a question that has been studied almost to death.[56] The ratio of research to practical results is probably as high as in any area of public policy. It is a question that has a sensible answer. The accumulated knowledge of good ways to improve the efficiency of environmental regulations has been synthesized, summarized, and presented time after time—by academic experts, agency reviews, and high-level commissions. The resulting agenda is bi-partisan and establishes common ground among business and environmental groups. It was embraced in the report of the National Performance Review led by Vice-President Gore,[57] and also in the privately organized report of the National Commission on the Environment, which included former EPA administrators from one Democratic and three Republican administrations.[58] Many parts of the agenda are supported by leading business groups[59] and by prominent environmental groups.[60] Politicians have heard the prescriptions repeatedly from credible sources on all sides of environmental issues.[61]

There is no need to take a wrecking ball to the environmental protection system that has been constructed by Democratic and Republican administrations over the past twenty-five years. The American people don't want that; an overwhelming majority of voters think that environmental protection should be maintained or strengthened. Efforts to undermine environmental protection will just provoke the kind of bitter political and legal fights that disfigured public policy in the early 1980s. There's a better way.

If Congress and the Clinton Administration wish to work together to improve environmental quality and reduce the economic cost of doing so, the path is clear. The potential economic dividends add up to scores of billions of dollars in annual savings to consumers, businesses, and taxpayers—resources that can be used to generate new investments and higher living standards. At the same time, environmental quality can be improved. However, this is not a free lunch. The price is political—challenging some entrenched interests in the private sector and some established administrative routines in the public sector.

For starters, the confusion over the effect of environmental protection on the economy could be greatly reduced if we corrected the way we keep score. In a basketball game, if a player scored a goal but the scorekeeper sometimes decided not to count it and at other times added it to the other team's total, how would anybody know who was winning? That's exactly how our current measures of income and productivity growth deal with environmental improvements and damages.[62] Modest efforts have begun in the Department of Commerce and EPA to revise these accounting methodologies. These are worthy of support, because they promise a great deal of illumination at a very modest cost.

"Those who believe that markets work better than bureaucracies should fully support the use of environmental policy instruments that build the cost of environmental degradation into the price structure."

The most important change, however, is to make wider and more effective use of market incentives in environmental policy. Those who believe that markets work better than bureaucracies should fully support the use of environmental policy instruments that build the cost of environmental degradation into the price structure. Doing so instead of relying predominantly on command-and-control regulatory approaches raises productivity in at least three ways. First, firms can adopt the environmental controls that are cost-effective for them, rather than following the prescribed technological solutions imbedded in regu-

lations. Second, the economic burdens of environmental controls can be redistributed among firms in ways that induce those who can clean up relatively inexpensively to do more. Third, since in a market economy one firm's cost is another firm's opportunity, the profit motive can be enlisted more forcefully to develop new and better methods to deal with environmental problems.

One of the best ways to make an existing regulatory system more flexible and cost-effective is to promote trading in emissions permits or other kinds of entitlements to the use of natural resources.

A wide range of market incentive-based policies has been studied and tried.[63] Each works better under certain circumstances than others; no one instrument is best for all purposes. However, one of the best ways to make an *existing* regulatory system more flexible and cost-effective is to promote trading in emissions permits or other kinds of entitlements to the use of natural resources.[64] This approach allows the regulatory authorities to maintain or tighten the limits on overall emissions, while giving regulated parties a chance to negotiate arrangements whereby cheap emissions reductions substitute for expensive ones. Such substitutions can typically reduce aggregate pollution control costs by thirty percent or more. The flexibility that trading options provides for pollution sources with high compliance costs also reduces pressures on the government to weaken standards or issue exemptions.

The Environmental Defense Fund has pioneered in promoting the use of trading approaches, showing that they can be useful not only in controlling emissions but also in reallocating water supplies from irrigation to higher-valued municipal and industrial uses, in relocating real estate development from ecologically sensitive lands to more appropriate sites, and in a variety of other situations. Transferable catch quotas, for example, have proven themselves far more effective in preventing overfishing and over-investment in fishing gear than the disastrously ineffectual approaches to fisheries management the United States has been pursuing.

Some progress has been made in adopting tradable permits as a policy instrument. One accomplishment of the 1990 Clean Air Act Amendments was to allow sources required to reduce sulphur emissions by 10 million tons in all to trade the reduction requirements among themselves, an approach that already had been used successfully to lower the costs of eliminating lead from gasoline. Sulphur trading is expected to cut several *billion* dollars off the cost of that regulation.

However, progress has been far too slow and limited.[65] Congress and EPA adopted the so-called "bubble" policy decades ago, which allows firms to trade off tighter controls on some emissions sources for laxer controls on others within the same facility, subject to adequate monitoring, verification, and progress toward emissions reduction.[66] The bubble policy was designed precisely to deal with situations like the Yorktown refinery's. Yet, more than fifteen years later, state and federal administrators are leery of this approach and hesitate to make use of it, sacrificing huge potential savings. New approaches to emissions trading have overcome some of the design flaws in the early systems—by requiring sellers to implement and document their emissions reductions below the regulatory requirements in advance, for example.[67] Businessmen, environmental groups, politicians, and administrators can work together to design and implement workable trading systems that promote environmental improvement at significant savings.

In some environmental protection programs, however, trading systems are likely to work less well than other approaches, such as charging fees to deter environmentally damaging activities. For example, when the number of people and firms involved in creating the problem is very large and heterogeneous, creating a parallel market for permit trading may be less feasible than using the price mechanism directly. In such circumstances, most of the pollution comes from sources without regulatory permits. For

When the number of people and firms involved in creating the problem is very large and heterogeneous, creating a parallel market for permit trading may be less feasible than using the price mechanism directly.

example, automobiles are the source of increasingly severe environmental problems as the number of vehicles on the road and the average number of miles they travel both increase. It is unlikely that drivers can negotiate trade-offs among themselves even with cellular phones in their cars. Various price mechanisms are available to manage these problems. Raising parking charges and eliminating favorable tax treatment of employer-provided parking can discourage the solo drive to work. Varying annual vehicle registration fees according to tested emissions can help get the "clunkers" that account for a disproportionately large fraction of emissions off the road. "Road pricing," which implies charging tolls that are higher during rush hours than in off-peak periods, can reduce urban congestion. Raising gas taxes can encourage people to purchase more energy-efficient vehicles and to drive less.

Using fees instead of command-and-control regulations to control environmentally damaging behavior allows the price mechanism to provide incentives for efficiency. Everybody who faces the same fee, for example, finds it worthwhile to incur more-or-less the same incremental environmental control cost. Those unable to clean up at reasonable cost can temporarily pay the fee instead of spending inordinate amounts to comply with a command-and-control regulation (or taking the matter to court as the less expensive option). Fees provide incentives for continual environmental quality improvement, in contrast to regulations, which create a *status quo* once compliance is achieved.

In the relatively few instances in which the federal government has enacted specific environmental charges, such as the excise tax on ozone-depleting chlorofluorocarbons, they have promoted the adoption of less damaging alternatives, some of which proved remarkably cost-effective, as the Porter hypothesis predicted. For example, the electronics industry, when prodded, found that it could dispense with CFCs altogether in cleaning its printed circuit boards, substituting aqueous cleaners or fluxless solders that eliminated the need for cleaning. When applied to products that generate environmental problems when used—such as fuels or water—fees or environmental surtaxes stimulate consumers to seek out substitutes or find ways to conserve.

The main impediment to the wider use of environmental charges has been that they collect revenue, which generally annoys the industries that have to pay. Even though the Polluter Pays Principle is accepted in all OECD countries as the basis for environmental policy because it is economically sound and widely regarded as fair, the U.S. Congress in drafting legislation usually gives away the right to pollute and hide the costs of environmental control in technology-based standards. This regulatory approach is so much more costly that even some industries have come out in favor of having environmental charges instead. For example, General Motors has argued for promoting fuel efficiency with a gasoline tax, which applies to all vehicles, rather than with CAFE standards, which only hits new car sales. However, what's good for General Motors is apparently not good for the politicians.

One would think that the Congress would be delighted to find a way to help pay for its promised middle-class and upper-class tax cuts that would improve environmental quality, reduce regulatory burdens, and make markets work better. Environmental charges, unlike virtually all other revenue sources, can actually make the economy *more* productive.[68] At the same time, they offer households and firms the opportunity to reduce their tax bills by behaving in environmentally sound ways that are in line with their values and ideals. Commuters can avoid paying gasoline taxes by taking the metro, carpooling, or riding their bicycles, for examples. Enacting fees on environmentally damaging products and activities to help pay for cuts in more burdensome and distorting taxes is a "win-win" opportunity too good to pass up.

> ***Environmental charges, unlike virtually all other revenue sources, can actually make the economy more productive. At the same time, they offer households and firms the opportunity to reduce their tax bills by behaving in environmentally sound ways that are in line with their values and ideals.***

Unfortunately, that is what Republicans in the House of Representatives apparently wish to do. In their "Contract with America," they embrace a radically different fiscal approach, proposing that the *victims* pay the costs of environmental cleanup and businesses be granted a legal right to pollute. This inequitable and injudicious change is imbedded in draft legislation requiring the federal government to compensate property owners when environmental regulations reduce the value of investments significantly. Since the only money the federal government has to spend is collected from taxpayers, the effect is to shift the costs of compliance from polluting firms (and ultimately their customers) to the general public. Suppose that risk assessments establish that some chemical in commercial use poses a severe health threat, and consequently EPA bans or restricts its production and distribution. Companies that have invested in factories to produce this risky chemical would have to be compensated by the government for the reduction in the value of their investments, an arrangement that does nothing to encourage firms to be more responsible. Ultimately, the taxpayer would pay the compensation through higher income and payroll taxes, an outcome that conservative politicians supposedly decry because it weakens people's incentives to succeed. This is a misuse of the fiscal mechanism. Compensating businesses that pollute is not the way to improve environmental regulation.

Better use of market incentives is one important way to get better results from environmental spending, but there are others. Both Carol Browner, the EPA's current Administrator and her predecessor, Bill Reilly, have pursued initiatives to deal with the air, water, and solid effluents of individual facilities in an integrated way, to look at the environmental problems of entire industries or regions, and to cooperate with businesses, environmental groups, and local governments in devising sensible solutions. These initiatives are attempts to get away from rigid statute-by-statute, media-by-media regulation and introduce some overall coherence and rationality into the process. Environmental groups, corporations, and other stakeholders have shown their willingness to enter into dialogues and partnerships to find better solutions to environmental problems.[69] These promising initiatives should be pursued vigorously.

Another important avenue is to use risk assessment more effectively in establishing environmental policy and strategy. At present, there is little concordance between the resources spent on various environmental problems and the risks they represent.[70] Some of the reasons why this situation persists have been discussed above. Risk assessment is fraught with difficulties and uncertainties that simple-minded appeals to "sound science" as the basis for regulation cannot sweep away.[71] Considerations of fairness, caution, and responsiveness to popular concerns have a legitimate place in environmental policy. Nonetheless, systematic efforts to compare various environmental risks and set priorities accordingly can help reduce the extreme misallocations of resources that regularly occur.[72] It doesn't make sense to use risk assessment requirements as a procedural barrier to any regulatory action, but, at a minimum, environmental statutes that seem to preclude efforts to take risk reduction into account should be amended.

By and large, these opportunities to get more for the money spent on environmental protection depend on changing the approach to environmental regulation. But such change is just the tip of the iceberg. Most of our environmental problems are exacerbated by policy-induced inefficiencies in important sectors of the economy: agriculture, transportation, industry, and energy. Reducing these inefficiencies would reduce the need for environmental regulations and raise productivity throughout the economy.

Most of our environmental problems are exacerbated by policy-induced inefficiencies in important sectors of the economy: agriculture, transportation, industry, and energy. Reducing these inefficiencies would reduce the need for environmental regulations.

One would think that to fulfill their promises to reduce the deficit and cut taxes, the Administration and Congress would quickly agree to eliminate a whole range of fiscal subsidies that are inefficient, inequitable, and environmentally damaging. Take the transportation industry, for example. Instead of letting market forces determine which freight travels by which method, government in its wisdom subsidizes the trucking industry, which pays far less than its share of highway costs,[73] but then also subsidizes the railroads, inland waterways, and the merchant marine, all the competing transport modes. The net result is a total hash, a good deal of needless environmental damage, and a substantial burden on the taxpayer.

Such is the deference Congress pays to special interests that these subsidies persist while programs that help the genuinely needy are cut. The public lands belong to the American people—all the people. Instead of collecting fair market value on behalf of the citizens from businesses that make use of the public lands, Congress defends subsidies to powerful mining, logging, and agribusiness companies. Although crocodile tears are shed for the small rancher or farmer, the fact is that these subsidies go overwhelmingly to big companies and multi-millionaire operators. As a result, our public lands are overgrazed, deforested, and scarred with abandoned mines still leaching into Western rivers. One way to protect our natural resources and give the middle-class taxpayer a break would be to put a halt to these giveaway deals.

The most important of these opportunities facing the next Congress will be to restructure our agricultural support programs, which have cost the taxpayer an average of 13 billion dollars per year over the past decade. Let alone that throughout this entire period and long before, the average income of farmers exceeded that of non-farmers. Ignore the fact that the richest 5 percent of all farmers received more than half of the payments. Such inequities aside, the agricultural support programs badly distort agricultural markets and the use of resources in agriculture. Commodity support programs induce farmers to plant the same crops over and over again, maintaining soil fertility and suppressing pests through heavy chemical applications. The highest payments support the crops and cropping practices with the worst environmental costs of soil erosion and chemical run-off.[74]

Instead of paying farmers in proportion to the acreage of corn, soybeans, and other program crops they plant, and then paying them again to take part of their land out of production, the government should reward farmers for protecting streambanks from erosion, for providing habitat for wild species, for restoring wetland, and for protecting the land against wind and water erosion.

Just cutting back on farm subsidies and allowing farmers more flexibility in their production decisions would reduce government spending and environmental damages substantially, with relatively little impact on farm income. If the government continues to support farmers' incomes, whether they need help or not, there are far better ways to do it. Instead of paying farmers in proportion to the acreage of corn, soybeans, and other program crops they plant, and then paying them again to take part of their land out of

production, the government should reward farmers for protecting streambanks from erosion, for providing habitat for wild species, for restoring wetland, and for protecting the land against wind and water erosion. When farmers undertake such activities, society benefits, not just the farmers themselves. These "green payments" create the incentives farmers need to provide these social benefits. At the same time, with the government out of commodity markets, farmers would be free to plant the crops that are really the most profitable, agricultural productivity would rise, and the environmental damages from agricultural run-off would decline.

In the international arena, there are "win-win" opportunities of comparable importance. Rather than threatening our trading partners with trade *barriers* unless they raise their environmental standards, the United States should be offering to *reduce* trade barriers and improve their access to U.S. markets if they do raise their environmental standards. The United States gains from trade expansion and loses from trade restrictions—our own as well as other countries' restrictions. The negative approach hurts us along with our trading partners. The more positive approach worked well in the NAFTA negotiations. Mexico agreed to strengthen its own environmental protection policies significantly and to cooperate with the United States in cleaning up our common border region and in protecting dolphins from accidental entrapment. The carrot of expanded trade worked more effectively than the stick of sanctions. The same approach would work well as discussions begin on extending the free trade area in the Americas and creating a vast Pacific free trade area. It could give an important and positive direction to the new World Trade Organization.

These are all opportunities that a Republican Congress and a Democratic administration should be able to agree on. They would improve environmental quality, strengthen the economy, reduce regulatory burdens, cut the deficit, and help finance popular tax cuts.

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APPENDIX

Appendix Table IA. Correlations between Profitability and Airborne Emissions[a]

SIC Code	Name of Industry	Number of Establishments	Gross Operating Margin[b] Simple Correlation	Gross Operating Margin[b] Partial[d] Correlation	Net Return on Capital[c] Simple Correlation	Net Return on Capital[c] Partial[d] Correlation
26214	Uncoated free sheet	10	−.21	−.31	−.43	−.12
29111	Gasoline	15	+.21	+.19	−.10	−.28
29510	Paving mixtures and blocks	37	+.24	+.24	+.15	+.12
32510	Brick and structural clay tile	14	−.08	−.34	−.01	−.33
32730	Ready-mix concrete	13	−.13	+.14	+.05	+.46
33219	Other grey iron castings	15	−.69*[e]	−.71*[e]	−.69*[e]	−.70*[e]

a. Airborne emissions are measured as particulate emissions per dollar of shipments.
b. Gross Operating Margin is defined as the total value of shipments *minus* current operating costs, expressed as a fraction of total shipments.
c. Net Return on Capital is defined as the total value of shipments minus current operating costs and depreciation, divided by the book value of capital invested in structures and equipment.
d. Partial Correlations control for age of plant, scale of production, and the ratio of investment in plant and equipment in current year to book value of investment.
e. Correlations marked with an asterisk are significantly different from zero at the 5 percent probability level.

Appendix Table IB. Correlations between Profitability and Water-borne Emissions[a]

SIC Code	Name of Industry	Number of Establishments	Gross Operating Margin[b] Simple Correlation	Gross Operating Margin[b] Partial[d] Correlation	Net Return on Capital[c] Simple Correlation	Net Return on Capital[c] Partial[d] Correlation
20223	Natural cheese	19	+.37	+.28	+.34	+.31
20332	Canned vegetables	22	−.25	−.32	+.34	+.34
26214	Uncoated free sheet	19	+.01	+.00	+.09	+.12
26314	Recycled paperboard	11	+.32	+.04	−.14	−.35
28199	Inorganic chemicals	23	+.43*[e]	+.45*[e]	+.01	+.10
28213	Thermoplastic resins and plastics	35	−.27	−.32	−.25	−.23
28214	Thermosetting resins and plastics	14	+.27	+.13	−.06	−.11
28220	Synthetic rubber	12	+.19	−.11	−.16	+.04
28651	Cyclic intermediates	12	+.05	+.06	−.34	−.26
28697	Misc. cyclic and acyclic chemicals	34	+.02	−.08	−.08	−.14
29111	Gasoline	55	−.11	−.14	−.05	−.06
33123	Hot rolled sheet and strip	20	+.04	+.01	−.10	−.17
33541	Extruded aluminum rod	12	+.47	+.30	+.12	−.01
34710	Electroplating, plating and polish	28	−.23	−.20	−.18	−.11

a. Water-borne Emissions are measured as BOD plus Total Suspended Solids (TSS) per dollar of total shipments.

b. Gross Operating Margin is defined as the total value of shipments *minus* current operating costs, expressed as a fraction of total shipments.

c. Net Return on Capital is defined as the total value of shipments minus current operating costs and depreciation, divided by the book value of capital invested in structures and equipment.

d. Partial Correlations control for age of plant, scale of production, and the ratio of investment in plant and equipment in current year to book value of investment.

e. Correlations marked with an asterisk are significantly different from zero at the 5 percent probability level.

Appendix Table IC. Correlations between Profitability and Toxic Releases[a]

SIC Code	Name of Industry	Number of Establishments	Gross Operating Margin[b] Simple Correlation	Gross Operating Margin[b] Partial[d] Correlation	Net Return on Capital[c] Simple Correlation	Net Return on Capital[c] Partial[d] Correlation
20223	Natural cheese	54	+.04	+.08	+.28	+.37
20863	Bottled carb. soft drinks	62	−.14	−.10	−.20	−.14
20864	Canned carb. soft drinks	35	+.22	+.20	+.04	+.17
24212	Softwood lumber, rough and dressed	32	+.04	+.03	+.11	+.19
24341	Wood kitchen cabinets	38	−.05	+.10	−.21	+.20
25115	Wood bedroom furniture	51	+.00	−.01	−.05	−.20
26214	Uncoated free sheet	47	+.33*[e]	+.28	+.07	+.03
26314	Recycled paperboard	34	−.42*[e]	−.34*[e]	−.16	−.08
26570	Paperboard packaging	44	+.17	+.21	+.03	−.02
28213	Thermoplastic resins, plastics	116	+.13	+.09	−.08	−.06
28214	Thermosetting resins, plastics	79	+.13	+.13	−.08	−.07
28411	Soaps and detergents, non household	65	−.30*[e]	−.30*[e]	−.15	−.07
28511	Architectural coatings	113	−.08	−.05	−.08	−.06
29111	Gasoline	100	+.10	+.08	−.04	−.02

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Appendix Table IC. (Continued)

SIC Code	Name of Industry	Number of Establishments	Gross Operating Margin[b] Simple Correlation	Gross Operating Margin[b] Partial[d] Correlation	Net Return on Capital[c] Simple Correlation	Net Return on Capital[c] Partial[d] Correlation
30864	Plastic furnishings and furniture	61	+.06	−.09	+.05	−.26
32210	Glass containers	37	−.15	−.19	−.20	−.19
33124	Hot rolled ferrous bars, shapes and plates	42	−.23	−.20	−.13	−.12
33541	Extruded aluminum rods and bars	59	−.11	−.13	−.03	+.04
34111	Steel cans and tinware	51	−.21	−.24	−.18	−.20
34112	Aluminum cans	62	−.13	−.10	−.17	−.13
34710	Electroplating, plating and polishings	429	−.34*[e]	−.34*[e]	−.07	−.08
34790	Etching, engraving and coating	126	−.08	−.08	−.05	−.03
36720	Printed circuit boards	79	−.17	−.18	−.10	−.12
36741	Integrated microcircuits	68	−.26*[e]	−.23	+.02	−.32*[e]
36913	Lead acid storage batteries	52	+.06	+.04	−.08	−.10

a. Toxic releases are measured as emissions to all media plus transfers for *off*-site treatment, per dollar of total shipments.

b. Gross Operating Margin is defined as the total value of shipments *minus* current operating costs, expressed as a fraction of total shipments.

c. Net Return on Capital is defined as the total value of shipments *minus* current operating costs and depreciation, divided by the book value of capital invested in structures and equipment.

d. Partial Correlations control for age of plant, scale of production, and the ratio of investment in plant and equipment in current year to book value of investment.

e. Correlations marked with an asterisk are significantly different from zero at the 5 percent probability level.

NOTES

1. Richard Schmalensee, "The Costs of Environmental Protection," *Balancing Economic Growth and Environmental Goals*, (Washington, D.C.: American Council for Capital Formation, 1994).
2. Richard B. Stewart, "Environmental Regulation and International Competitiveness," *Yale Law Journal*, June 1993, vol. 102, no. 8, pp.2039–2106.
3. *Toward Smarter Regulation*, The Business Roundtable, Washington, D.C., 1994.
4. S.984, 102nd Congress, defined weaker pollution controls as a countervailable subsidy. S.1965, 102nd Congress, would have required the Secretary of Commerce to levy import fees on products manufactured by processes not meeting the standards of the Clean Water Act.
5. S.59, 102nd Congress authorized actions under section 301 of the Trade Act against policies and practices of foreign countries that diminish the effectiveness of international conservation agreements. HR1445, 103rd Congress, would require adoption in any trade agreement of the principle that denial or negation of environmental standards constitute an actionable unfair trade practice. HR4710, 103rd Congress would require future trade agreements to treat as an actionable unfair trade practice the "denial" of internationally recognized environmental standards in the exporting country.
6. *North American Agreement on Environmental Cooperation*, Government Printing Office, Washington, D.C., September, 1993; Steve Charnovitz, "NAFTA: An Analysis of its Environmental Provisions," *Environmental Law Reporter*, February, vol. 23, 1993.
7. Heraldo Munoz, ed., *Environment and Diplomacy in the Americas*, (Boulder, Colorado: Lynne Riener Publishers, 1992).
8. Michael E. Porter, "The Competitive Advantage of Nations," *Harvard Business Review*, March–April, 1990, pp.74, 87.
9. *Development Assistance, Export Promotion, and Environmental Technology*, U.S. Congress, Office of Technology Assessment, Washington, D.C., August, 1993.
10. Dale Jorgenson and Peter Wilcoxen, "Impact of Environmental Legislation on U.S. Economic Growth, Investment and Capital Costs." *U.S. Environmental Policy and Economic Growth: How Do We Fare?*, (Washington, D.C.: American Council for Capital Formation, 1992); Michael Hazilla and Raymond J. Kopp, "Social Costs of Environmental Quality Regulations: A General Equilibrium Analysis," *Journal of Political Economy*, 1990, vol. 98, pp.853–873.
11. This is not necessarily true in decreasing returns or oligopolistic industries. Paul Krugman, ed., *Strategic Trade Policy and the New International Economics*, (Cambridge: MIT Press, 1986). However, it is true of most actual trade barriers. *Costs and Benefits of Protection*, (Paris: OECD, 1985).
12. D. Phantumvanit and Theodore Panayotou, *Industrialization and Environmental Quality: Paying the Price*, (Bangkok: Thailand Development Research Institute, 1990); World Bank, *China Environmental Strategy Paper*, Washington, D.C., 1982; World Bank, *Indonesia Environment and Development: Challenges for the Future*, Washington, D.C., 1993; Werner Baer and Charles Mueller, "Environmental Aspects of Brazil's Economic Development," *Brazilian Review*, forthcoming.
13. Robert Repetto *et al.*, *Wasting Assets: Natural Resources in the National Income Accounts*, (Washington, D.C.: World Resources Institute, 1989); World Resources Institute and Tropical Sciences Center (Costa Rica), *Accounts Overdue: Natural Resource Depreciation in Costa Rica*, (Washington, D.C.: World Resources Institute, 1991).
14. Graciela Chichilinsky, "North-South Trade and the Global Environment," *American Economic Review*, vol.84, no.4, September, 1994, pp.851–874; Kym Anderson and Richard Blackhurst, eds., *The Greening of World Trade Issues*, New York, 1992.
15. Hazilla and Kopp, *op.cit.*

16. The analysis of carbon taxes to combat global warming is an important case in point. *See* U.S. Congress, Congressional Budget Office, *Carbon Charges as a Response to Global Warming: The Effects of Taxing Fossil Fuels*, Washington, D.C., 1990; Dale Jorgenson and Peter Wilcoxen, "Reducing U.S. Carbon Emissions: The Cost of Different Goals," *Energy, Growth and the Environment*, vol.7, 1992. For a more balanced treatment, William R. Cline, *Global Warming: The Economic Stakes*, (Washington, D.C.: Institute for International Economics, 1992); Roy Boyd and Kerry Krutilla, "Energy Taxation as a Policy Instrument to Reduce CO_2 Emissions: A Net Benefit Analysis," *Journal of Environmental Economics and Management*, forthcoming.
17. A.J. Barbera and V.D. McConnell, "The Impact of Environmental Regulations on Industry Productivity: The Direct and Indirect Effects," *Journal of Environmental Economics and Management*, vol.18, 1990, pp.50–65; F.M. Gollop and M.J. Roberts, "Environmental Regulations and Productivity Growth: The Case of the Electric Power Industry," *Journal of Political Economy*, vol.91, 1983, pp.654–674; W. Gray, "The Cost of Regulation: OSHA, EPA, and the Productivity Slowdown," *American Economic Review*, vol.77, 1987, pp.998–1006; W. Gray and R.J. Shadbegian, "Environmental Regulation and Manufacturing Productivity at the Plant Level," Center for Economic Studies Discussion Paper 93–6, (Washington, D.C.: U.S. Bureau of the Census, 1993).
18. Robert Repetto, "Environmental Productivity and Why It is So Important," *Challenge*, vol.33, 1990, pp.33–38.
19. Adam B. Jaffe, Steven R. Peterson, Paul R. Portney, and Robert N. Stavins, "Environmental Regulation and International Competitiveness: What Does the Evidence Tell Us?," (Washington, D.C.: Resources for the Future Discussion Paper, December, 1993).
20. Patrick Low and Alexander Yeats, "Do Dirty Industries Migrate?," Patrick Low, ed., *International Trade and the Environment*, (Washington, D.C.: World Bank, 1992).
21. Piritti Sorsa, *Competitiveness and Environmental Standards*, (Washington, D.C.: World Bank Policy Research Working Paper 1249, 1994); p.i.
22. *Ibid*, Table 6, p. 11.
23 Kopp, Portney, and DeWitt, "International Comparisons of Environmental Standards," (Washington, D.C.: Resources for the Future Discussion Paper, 1990).
24. United Nations, Department of Economic and Social Development, *World Investment Report, 1992*, New York, 1992, Annex Table 12, p.346.
25. Patrick Low & Alexander Yeats, *op.cit.*
26. R. Vernon, "International Investment and International Trade in the Product Cycle," *Quarterly Journal of Economics*, vol.80, May, 1966, pp.190–207.
27. Judith Dean, "Trade and the Environment: A Survey of the Literature," Patrick Low, *op.cit.*, pp.15–28.
28. Candice Stevens, "Synthesis Report," *Environmental Policies and Industrial Competitiveness*, (Paris: OECD, 1993), p.7.
29. Adam Jaffe, Steven Peterson, Paul Portney, and Robert Stavins, "Environmental Regulation and International Competitiveness: What Does the Evidence Tell Us?," (Washington, D.C.: Resources for the Future Working Paper, December, 1993); p.i.
30. Richard B. Stewart, "Environmental Regulation and International Competitiveness," *Yale Law Review*, Vol.102, No.8, June 1993; pp.2039–2106.
31. Timothy Bartik, "The Effects of Environmental Regulation on Business Location in the United States," *Growth and Change*, Vol. 19, 1988; pp.22–44; Jaffe et.al. p. 14; Arik Levinson, "Environmental Regulations and Manufacturers' Location Choices," (New York: Columbia University, Dept. of Economics Working Paper, November, 1992).
32. Robert U. Ayres, "Industrial Metabolism: Theory and Policy," Braden R. Allenby and Deanna J. Richards, *The Greening of Industrial Ecosystems*, (Washington, D.C.: National Academy Press, 1994).
33. Wallace Oates, Karen Palmer, and Paul Portney, "Thinking About the Porter Hypothesis," (Washington, D.C.: Resources for the Future Discussion Paper, 1993).
34. "The Car Makers' Recovery Stakes," *The Economist*, Oct. 29, 1994, p.73.

35. Paul Milgrom and John Roberts, *Economics, Organization and Management*, (New Jersey: Prentice-Hall, 1992).
36. Stephen de Canio, "Agency and Control Problems in U.S. Corporations: The Case of Energy-Efficient Projects," *Journal of the Economics of Business*, Vol.I, No.1, 1994, pp.105–123.
37. Robert H. McGuckin and George A. Pascoe Jr., "The Longitudinal Research Database: Status and Research Possibilities," *Survey of Current Business*, U.S. Department of Commerce, Bureau of Economic Analysis, Vol. 68, no.11, November 1988; pp.30–36.
38. U.S. EPA, Office of Pollution Prevention and Toxics, *1992 Toxics Release Inventory*, Washington, D.C., 1994 and previous years.
39. Gary L. Rutledge and Christine R. Vogan, "Pollution Abatement and Control Expenditure," 1972–1992, *Survey of Current Business*, vol.74, no.5, 1994; pp.36–49.
40. Roger H. Bezdek, "Environment and Economy: What's the Bottom Line?," *Environment*, vol.35, no.7, 1993; pp.7–11.
41. Kusum Ketkar, "Pollution Control and Inputs to Production," *Journal of Environmental Economics and Management*, Vol.1, no.1, 1983; pp.50–59.
42. Deborah Vaughn Nestor and Carl A. Pasurka, Jr., "The U.S. Environmental Protection Industry," (Washington, D.C.: U.S. EPA, Office of Policy, Planning and Evaluation, July, 1994).
43. The comparable figure is 6 jobs per $1,000,000 in 1991 prices. Alan Carlin, Paul F. Scodari, and Don H. Garner, "Environmental Investments: The Costs of Cleaning Up," *Environment*, vol.34, no.2, March, 1992; pp.12–44.
44. "Redefining the Environmental Industry," *Environmental Business Journal*, vol.6, no.4, April, 1991; (Paris: OECD, *The OECD Environment Industry: Situation, Prospects and Government Policies*, 1992).
45. Louis S. Jacobsone, Robert J. LaLonde and Daniel G. Sullivan, "Earnings Losses of Displaced Workers," *American Economic Review*, vol.83, no.4, 1993; pp.685–709.
46 Stephen Breyer, *Regulation and its Reform*, (Cambridge, MA.: Harvard University Press, 1982); Stephen Breyer, *Breaking the Vicious Circle: Toward Effective Risk Regulation*, (Cambridge, MA.: Harvard University Press, 1993); Wesley A. Magat, ed., *Reform of Environmental Regulation*, (Cambridge, MA.: Ballinger, 1982); Robert Crandall, "Why is the Cost of Environmental Regulation So High?" Center for the Study of American Business, Policy Study 110, Washington University of St. Louis, February, 1992; Paul Portney, ed., *Public Policies for Environmental Protection*, (Baltimore: Resources for the Future, Johns Hopkins Press, 1990).
47. Richard Wilson and Edmund Crouch, *Risk/Benefit Analysis*, Ballinger, 1982; William Lowrance, *Of Acceptable Risk;* W. Kip Viscusi, *Fatal Tradeoffs*, 1992.
48. Albert Nichols, "The Regulation of Airborne Benzene," Thomas Schelling, ed., *Incentives for Environmental Protection*, (Boston: MIT Press, 1983); A. Myrick Freeman III, "Risk Evaluation in Environmental Regulation," W.A. Magat, *op.cit.*; Tammy O. Tangs, "Five Hundred Life-Saving Interventions and their Cost-Effectiveness," *Risk Analysis*, forthcoming.
49. Lester Lave, ed., *Quantitative Risk Assessment in Regulation*, (Washington, D.C.: Brookings Institution, 1982), Ch. 1.
50. Allen V. Kneese and Blair T. Bower, *Environmental Quality and Residuals Management*, (Baltimore: Resources for the Future, Johns Hopkins Press, 1979); EPA's current Common Sense Initiative attempts to work out integrated cross-media approaches to residuals management within particular industries.
51. Paul R. Portney, ed., *Public Policies for Environmental Protection*, (Washington, D.C.: Resources for the Future, 1990), p. 72.
52. *AMOCO - U.S. EPA Pollution Prevention Project, Yorktown, Virginia*, (Washington, D.C.: Amoco, EPA, June, 1992).
53. Howard Gruenspecht, "Differentiated Regulation: The Case of Auto Emissions Standards," *American Economic Review*, vol. 72, no.2, 1990, 328–331; Randy A. Nelson, Michael R. Donihue and Thomas Teitenberg, "Differential Environmental Regulation: Effects on Electric Utility Capital Turnover and Emissions," (Waterville, Maine: Colby College, Dept. of Economics Working Paper, 1990).

54. Rob Coppock, *Regulating Chemicals Hazards in Japan, W. Germany, UK, France, and the EC: A Comparative Examination,* (Washington, D.C.: National Research Council, National Academy Press, 1986).
55. Robert E. Litan, "Superfund: Assessing the Program and Options for Reform," *Enhancing Environmental Quality Through Economic Growth,* (Washington, D.C.: American Council for Capital Formation, Center for Policy Research, 1993); Roger E. Dower, "Hazardous Wastes," Paul R. Portney, ed., *Public Policies for Environmental Protection,* (Washington, D.C.: Resources for the Future, 1990).
56. Lester Lave & Howard Gruenspecht, "Increasing the Effectiveness and Efficiency of Environmental Decisions: Benefit-Cost Analysis and Effluent Fees: A Critical Review," *Journal of the Air and Waste Management Association,* vol.41, no.5, May, 1991, pp.680–693; Maureen L. Cropper and Wallace E. Oates, "Environmental Economics: A Survey," *Journal of Economic Literature,* vol.XXX, No.2, June, 1992, pp.675–740.
57. Vice President Al Gore, *Creating a Government That Works Better and Costs Less,* Washington, D.C., 1993.
58. *Choosing a Sustainable Future,* The Report of the National Commission on the Environment, (Washington, D.C.: Island Press, 1993).
59. *Toward Smarter Regulation,* The Business Roundtable, Washington, D.C., 1994; Stephan Schmidheiny with the Business Council for Sustainable Development, *Changing Course,* (Cambridge, MA.: MIT Press, 1992).
60. *A New Generation of Environmental Leadership: Action for the Environment and the Economy,* (Washington, D.C.: World Resources Institute, 1993).
61. *Project 88: Harnessing Market Forces to Protect our Environment,* Washington, D.C., 1988; *Project 88—Round II: Incentives for Action: Designing Market-Based Environmental Strategies,* Washington, D.C., 1991.
62. Robert Repetto, "Environmental Productivity and Why it is So Important," *Challenge,* 1990; Robert Repetto *et al.*, *Wasting Assets,* (Washington, D.C.: World Resources Institute, 1989).
63. U.S. EPA, Office of Policy and Program Evaluation, *Economic Incentives: Options for Environmental Protection,* Washington, D.C., 1991; OECD, *Managing the Environment: The Role of Economic Instruments,* (Paris: OECD, 1994).
64. Thomas H. Teitenberg, *Emissions Trading: An Exercise in Reforming Pollution Policy,* (Washington, D.C.: Resources for the Future, 1985); James T.B. Tripp and Daniel J. Dudek, "Institutional Guidelines for Designing Successful Transferable Rights," *Yale Journal of Regulation,* vol.6, 1986; pp.369–391.
65. Robert W. Hahn and Gordon L. Hester, "Where Did All the Markets Go? An Analysis of EPA's Emissions Trading Program," *Yale Journal of Regulation,* vol.6, no.1, 1989; pp.109–153.
66. *Federal Register,* December 11, 1979, 71780; *Federal Register,* December 4, 1983, 43814; *Federal Register,* February 23, 1993, 11110.
67. Richard E. Ayres, "Developing a Market in Emissions Credits Incrementally: An 'Open Market' Paradigm for Market-Based Pollution Control," *Environmental Reporter,* vol.25, no.31, December 2, (Washington, D.C.: Bureau of National Affairs, 1994).
68. Robert Repetto, Roger C. Dower, Robin Jenkins and Jacqueline Geoghegan, *Green Fees: How a Tax Shift Can Work for the Environment and the Economy,* (Washington, D.C.: World Resources Institute, 1992).
69. *Partnerships to Progress: The Report of the President's Commission on Environmental Quality,* (Washington, D.C., 1993).
70. U.S. EPA, Office of Policy and Program Evaluation, *Unfinished Business: A Comparative Assessment of Environmental Problems,* (Washington, D.C.: EPA, 1987); U.S. EPA, Science Advisory Board, *Reducing Risk: Setting Priorities and Strategies for Environmental Protection,* (Washington D.C.: EPA, 1990).
71. Lester B. Lave, ed., *Quantitative Risk Assessment in Regulation,* (Washington, D.C.: Brookings, 1982); The Carnegie Commission on Science, Technology, and Government, *Risk and the Environment: Improving Environmental Decision-Making,* (New York: Carnegie Corporation, 1993).

72. John D. Graham, "Making Sense of Risk: An Agenda for the Congress," (Boston, Mass.: Center for Risk Analysis, Harvard School of Public Health, October, 1994).
73. Kenneth Small, C. Winston, and C. Evans, *Road Work: New Highway Pricing and Investment Policy*, (Washington, D.C.: Brookings Institution, 1989).
74. Paul Faeth et al., *Paying the Farm Bill: U.S. Agricultural Policy and the Transition to Sustainable Agriculture*, (Washington, D.C.: World Resources Institute, 1991).

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