Tightening Environmental Standards: The Benefit-Cost or the No-Cost Paradigm?

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Michael Porter and Claas van der Linde have written a paper that is interesting and, to us at least, somewhat astonishing. It is a defense of environmental regulation—indeed, an invitation to more stringent regulation—that makes essentially no reference to the *social* benefits of such regulation. This approach contrasts starkly with the methods that economists and other policy analysts have traditionally used when assessing environmental or other regulatory programs.

The traditional approach consists of comparing the beneficial effects of regulation with the costs that must be borne to secure these benefits. For environmental regulation, the social benefits include the reductions in morbidity or premature mortality that can accompany cleaner air, the enhanced recreational opportunities that can result from water-quality improvements, the increased land values that might attend the cleanup of a hazardous waste site, the enhanced vitality of aquatic ecosystems that might follow reductions in agricultural pesticide use or any of the other potentially significant benefits associated with tighter standards. From this benefit-cost approach emerges the standard tradeoff discussed in virtually every economics textbook.

Porter and van der Linde deny the validity of this approach to the analysis of environmental regulation, claiming it to be an artifact of what they see as a "static mindset." In their view, economists have failed to appreciate the capacity of

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stringent environmental regulations to induce innovation, and this failure has led them to a fundamental misrepresentation of the problem of environmental regulation. There is no tradeoff, Porter and van der Linde suggest; instead, environmental protection, properly pursued, often presents a free or even a paid lunch. As they put it, there are lots of $10 bills lying around waiting to be picked up.

We take strong issue with their view. If this were simply a matter of intellectual sparring, it would be inconsequential outside academe. But their view has found a ready audience in some parts of the policymaking community. For example, Vice President Gore (1992, p. 342) writes that "3M, in its Pollution Prevention Pays program, has reported significant profit improvement as a direct result of its increased attention to shutting off all the causes of pollution it could find." If environmental regulations are essentially costless (or even carry a negative cost!), then it is unnecessary to justify and measure with care the presumed social benefits of environmental programs. Stringent environmental measures (of the right kind) are good for business as well as the environment; in the Washington parlance, we have ourselves a "win-win situation." Not surprisingly, this view has also been warmly received by environmentalists and by regulators eager to avoid being seen as imposing unwanted costs on businesses or lower levels of government. At a time of burgeoning interest in Congress in the economic justification for federal regulations, Porter and van der Linde suggest the cost of environmental regulation may be negligible or even nonexistent.

To clarify the points that are in dispute, we should state at the outset that we agree with Porter and van der Linde on a number of matters. First, we share their enthusiasm for a heavier reliance on incentive-based regulation in lieu of command-and-control. Early returns suggest, for example, that tradable permits for sulfur dioxide emissions will reduce the cost of the 1990 acid rain control program by at least 50 percent when measured against the most likely command-and-control alternative (Burtraw, 1995; U.S. General Accounting Office, 1994; Rico, 1995). Second, we agree that early estimates of regulatory compliance costs are likely to be biased upward because of unforeseen technological advances in pollution control or prevention. Third, we accept that providing information, such as in EPA's "Green Lights" program (through which the agency provides technical assistance concerning energy-efficient lighting), may well help disseminate new technologies. Fourth, we acknowledge that regulations have sometimes led to the discovery of cost-saving or quality-improving innovation; in other words, we do *not* believe that firms are ever-vigilantly perched on their efficiency frontiers.

On this last point, however, we do not find Porter and van der Linde at all convincing concerning the pervasiveness of inefficiencies. The major empirical evidence that they advance in support of their position is a series of case studies. With literally hundreds of thousands of firms subject to environmental regulation in the United States alone, it would be hard *not* to find instances where regulation has seemingly worked to a polluting firm's advantage. But collecting cases where this has happened in no way establishes a general presumption in favor of this outcome. It would be an easy matter for us to assemble a matching list where firms have found

their costs increased and profits reduced as a result of (even enlightened) environ-
mental regulations, not to mention cases where regulation has pushed firms over
the brink into bankruptcy.

What is needed, we believe, is a more systematic approach to the issue. Follow-
ing a general observation to put things in context, we begin with a model in which
increasing the stringency of incentive-based environmental regulations *must* result
in reduced profits for the firm. This model is incomplete in various ways, but it
provides a useful baseline for the succeeding discussion. From this baseline, we can
then explore the sorts of changes in the model that could produce the result that
regulation leads to higher profits—the outcome that Porter and van der Linde
seem to suggest is the norm. We are then in a better position to assess the evidence
and the weight of their case.

Innovation and Environmental Regulation: An Observation

Porter and van der Linde accuse mainstream environmental economics, with
its "static mindset," of having neglected innovation. This charge is puzzling. For
several decades now, environmental economists have made their case for incentive-
based policy instruments (such as effluent charges or tradable emission permits)
precisely by emphasizing the incentives that these measures provide for innovation
in abatement technology (Kneese and Bower, 1968, p. 139). Virtually every standard
textbook in environmental economics makes the point that incentive-based ap-
proaches are perhaps more attractive for reasons of dynamic efficiency than for
their ability to minimize the costs of attaining environmental standards at any par-
ticular point in time. A substantial literature has developed in recent years that
explores the effects of various policy instruments on research and development
decisions concerning abatement technology, a literature on which we shall draw in
this discussion.[1]

What distinguishes the Porter and van der Linde perspective from neoclassical
environmental economics is *not* the "static mindset" of the latter. It is two other
presumptions. First, they see a private sector that systematically overlooks profitable
opportunities for innovation.[2] Second, and equally important, they envision a reg-
ulatory authority that is in a position to correct this "market failure."[3] With properly
designed measures, regulators can set in motion innovative activities through which

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[1] The reader interested in exploring this literature might begin with Magat (1978), Downing and White
(1986), Malueg (1989), Milliman and Prince (1989), Parry (1992), Biglaiser and Horowitz (1995) and
Simpson (1995).

[2] This, incidentally, seems a rather odd and sad commentary on the private sector to be coming from
one of the country's eminent business professors and consultants.

[3] This "market failure," incidentally, is quite different in character from the usual public goods argument
that private firms underinvest in research and development because they will have difficulty appropri-
ating enough of the social benefits. What Porter and van der Linde have in mind is a failure of private
decision makers to respond to *private* profit opportunities.

firms can realize these overlooked opportunities. Their vision thus suggests a new role for regulatory activity in bringing about dynamic efficiency: enlightened regulators provide the needed incentives for cost-saving and quality-improving innovations that competition apparently fails to provide. Regulators can, as Porter and van der Linde put it, help firms "to overcome organizational inertia and to foster creative thinking," thereby increasing their profits.[4] We find this view hard to swallow, and suspect that most regulated firms would share our difficulty.

Environmental Regulation and Competitiveness: A Proposition

Drawing on some of the early literature on innovation in abatement technology, we now present a model in which even incentive-based environmental regulation results in reduced profits for the regulated firm. The model essentially formalizes the basic point that the addition (or tightening) of constraints on a firm's set of choices cannot be expected to result in an increased level of profits. Readers uninterested in the analytics may wish to skip to the next section.

We emphasize that this model is static in character and fails to address the inherent uncertainty in research and development (R&D) decisions. In this sense, it is subject to precisely the sort of criticism that Porter and van der Linde level in their paper. However, for the same reason, it provides a useful point of entry into the issue. The model is premised on the assumption that the polluting firm maximizes profits and operates in a perfectly competitive market; the firm takes competitors' outputs and R&D expenditures as given and also takes any regulations as exogenously determined. Given these assumptions, the model does not allow for any sort of strategic interaction. The possible effects of relaxing these assumptions and allowing game-theoretic strategic interactions among firms, or between the polluting firm and the regulator, will be discussed in the next section of this paper.

Figure 1 depicts the polluting firm's options. The horizontal axis shows the "abatement level," so that the reduction in pollution increases as one moves from left to right. The vertical axis is measured in dollars, which means that one can graph both the firm's cost of various levels of pollution abatement and compare those costs with market-oriented effluent charges imposed by environmental regulators. The MAC curve (without a star) is the firm's present "marginal abatement cost" function; it indicates the marginal cost incurred by the firm to reduce pollution by an additional unit. The upward slope of the curve implies that the marginal cost of reducing pollution is rising.

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[4] It is unclear whether Porter and van der Linde view this expanded role for regulation as a general proposition, or whether it is limited to environmental regulation. They appear to suggest the latter when they contend that as waste emissions into the environment, "[Pollution] is a manifestation of economic waste and involves unnecessary, inefficient or incomplete utilization of resources. . . ." This we also find puzzling. Whether it is efficient to recycle wastes, to discharge them into the environment or to adopt an entirely new technology that employs fewer polluting inputs depends on the costs (meaning, of course, the full social costs) of the various alternatives.

Figure 1
The Incentive to Innovate under an Emission Fee
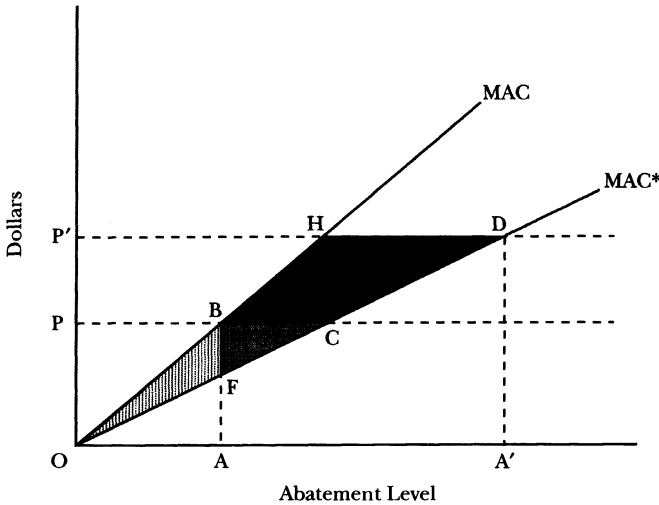
Let us now assume that the firm could, if it chooses, reduce its marginal abatement cost function from the curve MAC to MAC*. Notice that with MAC*, a given marginal expenditure has a greater effect on pollution abatement than it would have with MAC. However, to move from MAC to MAC*, the firm must spend money to research and develop new pollution abatement technology. To simplify the problem, we will assume that the R&D expenditure necessary to move from MAC to MAC* is known completely—there is no risk or uncertainty.

This model will presume market-oriented regulators who use effluent charges to encourage pollution abatement. As long as a profit-maximizing firm can abate pollution itself for less than the effluent charge, it will choose to do so. However, after the point where the cost of abating pollution exceeds the effluent charge, the firm will prefer to pay the charge. Let us assume that the firm is initially confronted by an effluent charge of P. It chooses its profit-maximizing level of abatement activity, A, corresponding to the point B, where marginal abatement cost equals the effluent charge.

If the firm has been operating at abatement level A, an implication is that the (annualized) cost of the R&D effort to reduce MAC to MAC* must exceed the gains to the firm. The R&D investment in additional pollution-abatement technology won't pay off; thus outcome B must produce more profits for the firm than does the attainable point C. Figure 1 also depicts the gains to the polluting firm from undertaking the R&D effort, which can be divided into two parts. The source of the first part is that the earlier level of abatement activity becomes cheaper; the amount of gain here is given by the triangle *OFB*. The second part comes from the new technology. The company will choose to abate a greater amount of pollution

and thus avoid paying the pollution charge on that additional pollution; the gain here is the triangle *BCF*.

The total gains to the polluting firm from innovation would thus be the area bounded by *OFCB*. Since the firm has not chosen this option, it must be that the cost of the R&D program that would move the firm from MAC to MAC* exceeds the area of the profit that would be gained, *OFCB*.

Now, assume that the environmental authority introduces a new, more strin-gent market-oriented environmental standard, taking the form of an increase in the effluent fee to *P'*. Without further assumptions, one cannot say whether the firm will respond to the higher effluent charge by sticking with the old technology and ending up at *H* or by investing in the new one and ending up at *D*.[5] But we will prove that both *H* and *D* generate lower profits than *B*. Therefore, it will be unambiguously true in this model that the higher effluent standard reduces profits for the firm.

It is straightforward to show that if the firm sticks with its old technology, the higher effluent charge must reduce its profits. In this case, the firm moves from *B* to *H*, and while this higher level of pollution abatement may be better for society, the firm is unambiguously worse off. It is paying the same amount to abate pollution up to *B* as it was before. Between *B* and *H*, it is paying more to abate pollution than under the previous, lower effluent charge. And above *H*, it is paying the higher effluent charge rather than the previously lower one.[6]

It is only a bit trickier to demonstrate that profits at *D*, where the firm faces a higher effluent charge with the new technology, must be lower than profits at *B*, where the firm chose to face the lower effluent charge with its existing technology. Notice first that along the MAC* frontier, profits at choice *D* (given the higher effluent charge) must be lower than profits at point *C*, given the lower previous effluent charge. As already explained, if technology is constant, the higher effluent charge unambiguously reduces profits. But the basis of this model was that at the

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[5] What are some of the factors determining whether the firm chooses to respond to a higher effluent charge by investing in new technology? Overall, of course, the question is whether the cost-savings from the new technology exceed the R&D expenditures. Recent work offers some further insights. Ulph (1994) shows that an increase in an emission tax rate may increase a firm's incentive to engage in environmental R&D, but is likely to decrease its incentive to engage in R&D of a general unit-cost-reducing nature, leading to an ambiguous effect on overall R&D expenditures and on the firm's costs. Simpson (1995) suggests that when R&D is both cost reducing and emission reducing, the incentive effects of an increase in the emissions tax for R&D are lower the more R&D reduces marginal cost and the more competitive are rival firms.

[6] This is an application of a more general principle that for a given technology, profit is decreasing in input prices. In the environmental economics literature, waste emissions are typically treated as an input (along with labor, capital and so on) in the production function. This is reasonable, since attempts to cut back on waste emissions will involve the diversion of other inputs to abatement activities, thereby reducing the availability of these other inputs for the production of goods. Reductions in emissions, in short, result in reduced output. Moreover, given the reasonable assumption of rising marginal abatement costs, it makes sense to assume the usual curvature properties so that we can legitimately construct isoquants in emissions and another input and treat them in the usual way. In this framework, the emis-sions fee becomes simply the price of an input called "waste emissions."

lower effluent charge, the firm didn't find it worthwhile to invest in the new technology; that is, profits were lower at *C* than at *B*. By transitivity, if profits at *B* exceed *C*, and profits at *C* exceed *D*, then it must be true that the higher effluent charge reduces profits for the firm, even if it adopts a new technology.

Thus, in this model of innovation in abatement technology, an increase in the stringency of environmental regulations unambiguously makes the polluting firm worse off. Even if the firm can invest and adopt a new, more efficient abatement technology, if that technology wasn't worth investing in before, its benefits won't be enough to raise the company's profits after the environmental standards are raised, either.

This leads us naturally to ask how one might amend the simple model to alter this basic result. We point out that simply making the model dynamic and/or introducing uncertainty will not overturn this result. It is straightforward to show that our basic proposition likewise applies to a firm that maximizes the expected present value of future profits. What elements, then, are missing from this simplified model that could give rise to an *increase* in profits following the imposition of tighter standards?

We can identify two such elements of potential importance. One possibility is strategic behavior, perhaps involving interactions between polluting firms, or between these firms and the regulating agency, or between regulatory agencies in different countries. The second possibility (the one emphasized by Porter and van der Linde) is the existence of opportunities for profitable innovation in the production of the firm's output that for some reason have been overlooked and that would be realized in the wake of new and tougher environmental regulations. The next two sections take up these extensions to the basic model and present some of the relevant empirical evidence.

Strategic Interaction Among Polluters and Regulators

In the basic model, the polluting firm was operating in a competitive environment, taking as given both the behavior of competing firms and the standards set by the regulator. One important line of extension of the analysis is the introduction of strategic interaction among the various participants. There is some recent and ongoing work along these lines. For example, Barrett (1994) has explored a series of models in which regulators and polluting firms behave strategically. He finds that, in the spirit of the Porter–van der Linde thesis, there are indeed cases in which the government can actually improve the international competitive position of domestic exporters by imposing environmental standards upon them. One such case occurs if each firm takes the price of its competitor as fixed and then competes by setting its own profit-maximizing price. If the government sets a strong emission standard—by which Barrett means a standard beyond the point where the marginal benefits of pollution control equal marginal abatement costs—the domestic firm's marginal cost, and therefore its price, will rise. Recognizing that the domestic firm

must charge a higher price to comply with the new standard, foreign competitors raise their prices without fear of retaliation. However, an increase in the foreign price raises demand for the output of the domestic firm with a resulting increase in its profits. This result holds when the domestic industry is an oligopoly as well as when it is a monopoly competing in an oligopolistic international market. It *may* also hold under Cournot competition—where each firm takes the quantity produced by its competitors as given and competes by altering the quantity it produces—if the domestic industry is an oligopoly, although this need not be the case.

In general, however, this result is not robust to other changes in the nature of the strategic behavior. For instance, if the domestic firm is a monopolist in its home country and the domestic and foreign firm are Cournot competitors, then the home government can improve the domestic firm's competitive position by reducing its environmental standards below the efficient level. Kennedy (1994) obtains a similar finding in a model with Cournot competition.

In another treatment of the issue, Simpson and Bradford (1996) develop a strategic trade model that explicitly includes R&D expenditures by firms. In this model, firms behave strategically both in setting levels of spending on R&D and in selecting output levels. The government regulates pollution through an emission fee. Simpson and Bradford find that for certain specifications of the cost and demand functions, increasing the emission fee can increase domestic R&D investment, reduce foreign R&D spending and increase domestic welfare (composed of domestic profits plus pollution fee revenues). However, they note that slight variations in the form of the cost function can reverse these results. Ulph (1994) surveys a number of recent papers that explicitly incorporate strategic R&D investment behavior by firms. This body of work indicates that the effect of environmental regulation on R&D is ambiguous and that even in the cases where higher emissions standards lead to higher domestic R&D spending, governments may still be better off selecting a lower-than-social-cost emission tax rate to shift profits from foreign firms to domestic firms.

Overall, this literature suggests that while it is possible to get results like those that Porter and van der Linde suggest are the norm from models that incorporate strategic behavior, such results are special cases. In many instances, these same strategic trade models suggest that the domestic authority should employ *weak* environmental regulations to promote international competitiveness. Moreover, as Barrett (1994) and Simpson and Bradford (1996) suggest, there are typically other sorts of measures that are more effective at improving international competitiveness than strategic environmental regulatory policy. This bottom line does not deny the Porter–van der Linde argument entirely; certain kinds of strategic models can produce outcomes of the type they describe. But it does seem to us that strategic models are unlikely to establish anything close to a general presumption that stringent environmental measures will enhance competitiveness. In addition, such strategic behavior is not what Porter and van der Linde have in mind. We turn to their basic contention now.

Regulation and "Offsets"

Their claim is that technologies exist of which the firm is unaware until prodded into discovering them by stringent environmental regulations. They go on to contend that such regulation will spur firms to innovate and that the newly discovered technologies will generally offset, or more than offset, the costs of pollution abatement or prevention. Our response takes two very different tacks.

First, we spoke with the vice presidents or corporate directors for environmental protection at Dow, 3M, Ciba-Geigy and Monsanto—all firms mentioned by Porter and van der Linde in their discussion of innovation or process offsets. While each manager acknowledged that in certain instances a particular regulatory requirement may have cost less than had been expected, or perhaps even paid for itself, each also said quite emphatically that, on the whole, environmental regulation amounted to a significant *net* cost to his company.

We have little doubt about the general applicability of this conclusion. Fortunately, we need not confine ourselves to speculation and anecdotes about the pervasiveness or the significance of pollution or innovation offsets. There are data available on this matter, and they indicate that such offsets pale in comparison to expenditures for pollution abatement and control.

Each year the Environmental Economics Division of the Commerce Department's Bureau of Economic Analysis (BEA) makes estimates of pollution abatement and control expenditures in the United States. One source for these estimates are Bureau of the Census surveys of manufacturing establishments, state and local governments, electric utilities, petroleum refiners and mining operations. Other information is gathered on federal government expenditures on pollution control, the cost of solid waste disposal, individual spending for motor vehicle pollution control equipment and operating costs and other environmental spending, as well. In 1992, according to BEA, pollution abatement and control expenditures in the United States came to $102 billion (Rutledge and Vogan, 1994, p. 47).

In addition to estimates of environmental spending, BEA also estimates the magnitude of the "offsets" that Porter and van der Linde claim are so pervasive. In fact, the Census Bureau survey of manufacturers (upon which BEA relies for most of its information about offsets) specifically asks respondents to report "cost offsets," which are defined in such a way as seemingly to encompass both the "product" and "process" offsets that Porter and van der Linde describe (U.S. Commerce Department, 1994).[7] For 1992, BEA estimates that cost offsets for the

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[7] It is worth including one of the examples from the Census Bureau survey to illustrate how closely the survey conforms to the Porter and van der Linde vision of offsets. The survey (U.S. Commerce Department, 1994, p. A-11) contains the following wording: "A manufacturer installs a closed loop recovery system in the production process so as to prevent the dumping of the chemicals into the water system. Since the closed loop recovery system recaptures and reuses the chemicals in the production process, it reduces expenses for chemicals. The pollution abatement portion of the capital expenditure pertaining to the closed loop recovery system is reported in Item 7 [the section of the survey where new capital

U.S. amounted to $1.7 billion, less than 2 percent of estimated environmental expenditures. This implies *net* spending for environmental protection in excess of $100 billion in 1992.

Net spending on protecting the environment may be greater than that, however, because there is reason to believe that the BEA estimates of environmental costs are on the low side. According to the Environmental Protection Agency (1990), the total cost associated with federal environmental regulation in the United States in 1992 was $135 billion.[8] EPA's estimates differ from those of BEA for a variety of reasons, some of which are difficult to discern. But some of the difference is due to the fact that EPA counts certain expenditures that BEA ignores (like those associated with measures to improve indoor air quality); because EPA apparently includes some opportunity costs in addition to out-of-pocket expenditures; and because the two agencies use different approaches occasionally even when focusing on the same category of pollution control. Some of the additional costs the EPA includes may give rise to their own offsets, but it is unlikely they will increase in proportion to these added costs. This is especially true where the difference between EPA's estimates and BEA's estimates involve imputed or opportunity costs.

One possible criticism of these estimates of offsets is that certain kinds of offsets in response to more stringent environmental regulation are not easily reportable on the Census Bureau survey form, and hence do not find their way into the Census or BEA estimates. For instance, a manufacturing firm that dropped a product line altogether because it wished to avoid environmental regulations, and entered what instead turned out to be a more profitable product line, would be hard-pressed to report this as an "offset" according to the definition provided in the Census Bureau survey. But even if one doubled or tripled or even quadrupled the estimated offsets that are reported by Census and included in BEA's estimates, the total offsets would be less than $10 billion per year, leaving net annual environmental compliance costs in the range of $100 billion or more.

It is impossible to escape the conclusion that the U.S. devotes significant resources, *net of cost savings,* to environmental protection each year. Moreover, we reach this conclusion without making reference to the work of either Jorgenson and Wilcoxen (1990) or Hazilla and Kopp (1990), both of whom showed that the social costs of environmental regulation are *greater* when viewed in a dynamic general equilibrium context than in a static, partial equilibrium setting, because of the manner in which environmental regulations depress "productive" investment and

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expenditures are reported]. The operating expenses to maintain the system are reported in Item 3 [the analogous section for operating costs]. The value of recovered chemicals is reported as a cost offset." This example matches perfectly the example of the Robbins Company given by Porter and van der Linde, hence suggesting a close connection between the "offsets" described by Porter and van der Linde and the BEA estimates of offsets based on the Census Bureau survey.

[8] To this must be added the costs of additional control measures introduced by states (like California) that have, in some instances, gone beyond the federal statutes. We know of no estimates of these additional costs, but they may be substantial.

the consequent reduction in the rate of economic growth. Porter and van der Linde deny the validity of this work on the grounds that it fails to factor offsets into account. Since these offsets appear to be quite small—based on both the reports of those who make environmental investments, as well as on hard data—this is hardly a liability of the general equilibrium approach.

One more word about offsets. Suppose that every single dollar a firm spent on pollution control or prevention was matched by a dollar of savings in the form of product or process offsets described by Porter and van der Linde. Would it then be the case that environmental regulation is free? Of course not. The sacrifice would be measured by other opportunities foregone. Firms can and do invest in changing the size and skill mix of their labor force, in their capital base, in the sources and term structure of their financing, their research and development strategies and other things, as well. Each of these investments is expected to do more than return one dollar for each dollar spent—typically firms must project returns that exceed a "hurdle rate" of 20 percent or more before undertaking an investment. Thus, even if environmental compliance produced offsets on a dollar-for-dollar basis— rather than one dollar for every 50 spent, as the data suggest—the foregone return on invested capital would still be a significant cost of regulation.

The International Setting

The original question prompting this debate concerned the impact of environmental regulations on the competitiveness of U.S. industry in the international arena. In a much shorter essay that appeared several years ago in *Scientific American,* Porter (1991) argued that the perverse command-and-control character of most U.S. regulation has seriously handicapped American firms in competition with foreign rivals. Making the case (with which we enthusiastically agree) for incentive-based policy measures, Porter argued that U.S. firms were losing out to competition from German and Japanese companies, which benefit from more enlightened regulatory regimes.[9]

However, we believe the truth of the matter is rather different. It is not the case that other countries, including Germany or Japan, have made better use of incentive-based approaches than the United States. While other countries appear to have put in place regulatory programs that are less adversarial (and therefore less time consuming) than certain U.S. programs, most environmental regulation in Europe looks every bit as proscriptive as does the U.S. version. In fact, visitors from OECD and developing countries pour through Washington on a regular basis, trying to learn about the sulfur dioxide trading program put in place here five years ago.

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[9] For a more detailed treatment of these particular issues, see our response (Oates et al., 1993) to the Porter (1991) paper.

Moreover, it is not clear that environmental regulation is harming the competitiveness of U.S. firms. In fact, Porter and van der Linde acknowledge as much, citing Jaffe et al. (1995, p. 157), who conclude in their survey paper that "overall, there is relatively little evidence to support the hypothesis that environmental regulations have had a large adverse effect on competitiveness, however that elusive term is defined."

This finding is important, but it has little to do with innovation offsets. As Jaffe et al. (1995) point out, there are several reasons why the relative stringency of U.S. environmental regulation to date has not been found to have adverse effects on competitiveness. First, for all but the most heavily polluting industries, the cost of complying with federal environmental regulations is a small fraction of total costs, sufficiently small (in most instances) to be swamped by international differentials in labor and material costs, capital costs, swings in exchange rates and so on. Second, although U.S. environmental regulations are arguably the most stringent in the world, the *differentials* between U.S. standards and those of our major industrialized trading partners are not very great, especially for air and water pollution control. Third, U.S. firms (as well as other multinationals) appear inclined to build modern, state-of-the-art facilities abroad, irrespective of the stringency of environmental statutes in the host country. Thus, even a significant difference in environmental standards between, say, the United States and a developing country will mean little to firms not willing to take advantage of lax standards.[10]

This is not to say that cost differentials stemming from international variations in environmental regulations are nonexistent. But as Jaffe et al. (1995, p. 159) conclude, these differentials "pose insufficient threats to U.S. industrial competitiveness to justify substantial cutbacks in domestic environmental regulations." More basically, the case for redesigning environmental programs to make more effective use of market incentives has little to do with international competitiveness; it's a much more straightforward issue of getting environmental value for the expenditures of social resources.

Conclusion

The underlying message from Porter and van der Linde about environmental regulation is not to worry, because it really won't be all that expensive. But it will. Annual U.S. expenditures for environmental protection, net of any offsets, cur-

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[10] The rationale for this behavior appears to be two-fold. First, there is a widespread perception that tighter environmental regulations in the developing countries are inevitable, and that it is less expensive to invest initially in state-of-the-art abatement technology than it will be to retrofit later. Second, the aftermath of certain disasters, notably the Union Carbide catastrophe in Bhopal, India, has made management aware of the dangers inherent in the adoption of less than state-of-the-art control technologies in developing countries.

rently are at least $100 billion, and probably considerably more. From *society's* standpoint, with the benefits of a cleaner environment figured into the balance, every dime of this money may be well spent; the literature is replete with examples of environmental programs that pass a benefit-cost test. But a comparison of the benefits and costs is exactly how one should determine the economic attractiveness of specific programs—not on the false premise of cost-free controls.

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